27 Drydock Avenue, 8th Floor
Boston, MA 02201 USA
877.HACK.DNA or 877.422.5362

www.ginkgobioworks.com

Dear Shareholders,

Ginkgo Bioworks made good progress in 2023.

Our mission at Ginkgo is to make biology easier to engineer

Biology is an incredibly powerful substrate for developing new applications – ranging across animal-free milk, new RNA medicines, fertilizer-producing soil bacteria, new fire-proof materials, natural dyes, fragrances from extinct flowers, and glowing petunias, to name just a few of the hundreds of cell engineering programs that customers have asked us to help them with at Ginkgo.

The limitation of new applications today in biotechnology is not the imagination of product developers and scientists – it is the cost of the laboratory work needed to design, build, and evaluate DNA designs and the quality of those designs. We expect our customers will have an endless appetite for tools that allow them to design DNA better, faster, and cheaper.

Services-based lab work is the future of bioengineering, and Ginkgo has pioneered this approach

If you haven't worked in biotechnology, you would be surprised that the way that DNA code is programmed today is by a PhD-trained scientist working by-hand like a fine chef at the lab bench – conducting complicated experiments to build DNA, insert it into the genome of an organism, then grow and test that organism. They do this work by buying expensive "kits" and reagents as inputs and are only able to generate a small amount of new data every day.

Ginkgo replaces this approach with a services-based approach where a Ginkgo scientist doesn't do the lab work themselves at the bench, but rather orders the work from a collection of robotically-automated services in Ginkgo's foundry. This allows for more data per research dollar and removes the need for careful, time-consuming by-hand work. We have validated that this approach works for cell engineering across industrial, agricultural, and pharmaceutical biotechnology industries by successfully delivering commercial cell programs to our customers. This achievement seemed impossible when we started Ginkgo!

We had a breakout year in 2023 in pharma and biotech ("biopharma"), a sector with high expectations for cell engineering services

We had a breakout year in the biopharma sector, signing major deals with Pfizer, Merck, Novo Nordisk and Boehringer Ingelheim. Biopharma has the most well-funded research labs and thus the highest expectations for outsourcing work to a company like Ginkgo, so we were pleased to see strong growth in biopharma revenue and active programs in 2023. There are many mid/large-sized companies in biopharma that could make use of our services and we hope to continue to expand here.

As we increase the number of programs on our platform the economics of our platform are improving

The advantage of using an automated foundry rather than by-hand lab work to conduct cell engineering is that costs reduce with scale, much like in a traditional factory. In 2023 we saw a ~50% drop in our cost per campaign. This scale economic is core to our belief that in the long run, the laboratory work of cell engineering will transition from scientists working at the bench to automated foundries like ours.

We continue to make it easier and easier to access our foundry capacity

We grew cell engineering services revenue by 31% in 2023 from $106 million to $139 million and see continued growth opportunities there; however, many companies are hesitant to outsource their cell engineering, in particular the scientific direction of their work, to Ginkgo scientists ordering services from our foundries. To address this gap, we recently announced Lab Data as a Service ("LDaaS"). This is the first time that our customers' scientists can directly access Ginkgo's automated foundries without a Ginkgo scientist in between, while also not having to negotiate IP rights or downstream value with Ginkgo. In the tech world this business model is akin to companies like Amazon offering their Amazon Web Services microservices directly to their customers' software developers.

Customers of LDaaS will not generate the long-term milestones and royalties that Ginkgo is eligible to receive from our cell engineering solutions business customers; however, we believe they will deliver near-term cash revenue in fees and help us continue to scale our foundries. LDaaS also allows us to access a larger customer base that may in the future take advantage of Ginkgo's other offerings. In particular, we are seeing interest from companies developing AI models in biotechnology for LDaaS to generate their training data sets.

To make biology easier to engineer with care, the world needs biosecurity

We're proud to be building a growing recurring business in biosecurity. Currently, the global gaps in biothreat data are massive as governments mainly focus on the reaction to biothreats rather than the prevention and detection of these threats. According to our original research,

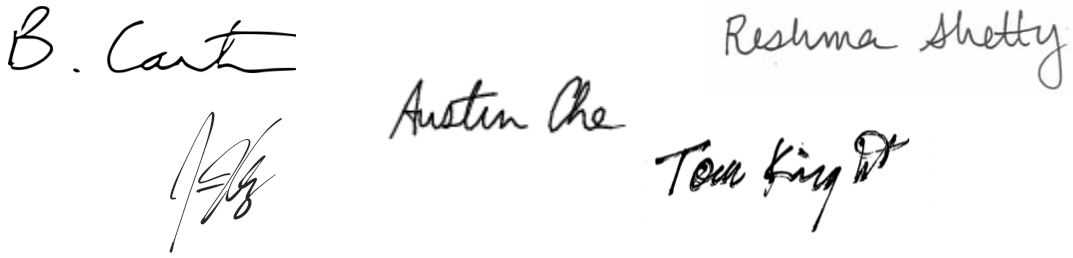
published with the Center for Global Development, there is roughly a 50-50 chance of another COVID-scale pandemic in the next 25 years. At Ginkgo, we're already well on our way to building the necessary infrastructure that could detect the spread of future biothreats through our biosecurity products, Ginkgo Canopy and Ginkgo Horizon.

Ginkgo Canopy is our end-to-end system to monitor key nodes across the world for biothreats. Our customers are countries that work with us to collect wastewater and other biological samples and use DNA sequencing to monitor pathogens and variants. Today, we run Ginkgo Canopy in 12 major international airports, receiving data from over 108 countries of origin of flights sampled. We have an active international partner pipeline with programs, pilots, or MOUs in 14 countries. In addition to Ginkgo Canopy, Ginkgo Horizon enables global situational awareness and informs critical decisions through AI-powered, multi-source data integration, analysis and forecasting. With Horizon, we're allowing customers to access biosecurity data feeds on a subscription basis, and we are building a true common operating picture for biothreats. We believe this updated biosecurity business model will not only drive valuable insights for our customers, but can also generate strong recurring revenue for Ginkgo.

Capital markets remain challenging in biotechnology, and we are focused on preserving our cash while driving efficiency

Finally, we ended 2023 with nearly $950M in cash and no bank debt, and our top priority in a difficult capital market environment is to manage cash expenses while adding additional customer demand. While we are well positioned in 2024 starting from such a strong cash position, expect us to continue to be aggressive in tightening our cash burn so that we have the runway to drive towards profitability and see the benefits of our foundry scale economics.

Sincerely,



UNITED STATES
SECURITIES AND EXCHANGE COMMISSION

Washington, D.C. 20549

FORM 10-K

(Mark One)

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2023

OR

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**
FOR THE TRANSITION PERIOD FROM TO

Commission File Number 001-40097

GINKGO BIOWORKS HOLDINGS, INC.

(Exact name of Registrant as specified in its Charter)

Delaware	**87-2652913**
(State or other jurisdiction of incorporation or organization)	**(I.R.S. Employer Identification No.)**
27 Drydock Avenue **8th Floor** **Boston, MA**	**02210**
(Address of principal executive offices)	**(Zip Code)**

Registrant's telephone number, including area code: (877) 422-5362

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Class A common stock, par value $0.0001 per share	DNA	NYSE
Warrants to purchase one share of Class A common stock, each at an exercise price of $11.50 per share	DNA.WS	NYSE

Securities registered pursuant to Section 12(g) of the Act: **None**

Indicate by check mark if the Registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☐ No ☒

Indicate by check mark if the Registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act. Yes ☐ No ☒

Indicate by check mark whether the Registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the Registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the Registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the Registrant was required to submit such files). Yes ☒ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	☒	Accelerated filer	☐
Non-accelerated filer	☐	Smaller reporting company	☐
		Emerging growth company	☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act (15 U.S.C. 7262(b)) by the registered public accounting firm that prepared or issued its audit report. ☒

If securities are registered pursuant to Section 12(b) of the Act, indicate by check mark whether the financial statements of the registrant included in the filing reflect the correction of an error to previously issued financial statements. ☐

Indicate by check mark whether any of those error corrections are restatements that required a recovery analysis of incentive-based compensation received by any of the registrant's executive officers during the relevant recovery period pursuant to §240.10D-1(b). ☐

Indicate by check mark whether the Registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No ☒

As of June 30, 2023, the last business day of the registrant's most recently completed second fiscal quarter, the aggregate market value of the voting and non-voting common equity held by our non-affiliates was approximately $2,433 million based upon the closing price reported for such date on the New York Stock Exchange.

As of February 22, 2024, there were 1,650,909,109 shares of Class A common stock, 381,486,677 shares of Class B common stock, and 120,000,000 shares of non-voting Class C common stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

The information required by Part III of this report is incorporated by reference from the registrant's definitive proxy statement relating to its annual meeting of stockholders to be held in 2024, which definitive proxy statement will be filed with the Securities and Exchange Commission within 120 days after the end of the fiscal year to which this report relates.

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Cautionary Note Regarding Forward Looking Statements

This annual report on Form 10-K and our annual report to shareholders (the "Annual Report") include forward-looking statements regarding, among other things, the plans, strategies and prospects, both business and financial, of Ginkgo Bioworks Holdings, Inc. ("Ginkgo"). These statements are based on the beliefs and assumptions of the management of Ginkgo. Although Ginkgo believes that its plans, intentions and expectations reflected in or suggested by these forward-looking statements are reasonable, Ginkgo cannot assure you that it will achieve or realize these plans, intentions or expectations. Forward-looking statements are inherently subject to risks, uncertainties and assumptions. Generally, statements that are not historical facts, including statements concerning possible or assumed future actions, business strategies, events or results of operations, are forward-looking statements. These statements may be preceded by, followed by or include the words "believes", "estimates", "expects", "projects", "forecasts", "may", "will", "should", "seeks", "plans", "scheduled", "anticipates" or "intends" or similar expressions. Forward-looking statements contained in the Annual Report include, but are not limited to, statements about:

- Ginkgo's ability to raise financing in the future and to comply with restrictive covenants related to long-term indebtedness;
- Ginkgo's ability to retain or recruit, or adapt to changes required in, its founders, senior executives, key personnel or directors;
- factors relating to the business, operations and financial performance of Ginkgo, including:
    - the performance and output of Ginkgo's cell engineering and biosecurity platforms;
    - Ginkgo's ability to effectively manage its growth, including its anticipated approach to inorganic growth and related impacts on Ginkgo's financial performance;
    - Ginkgo's exposure to the volatility and liquidity risks inherent in holding equity interests in certain of its customers;
    - rapidly changing technology and extensive competition in the synthetic biology industry that could make the products and processes Ginkgo is developing obsolete or non-competitive unless it continues to collaborate on the development of new and improved products and processes and pursue new market opportunities;
    - Ginkgo's ability to convert potential customers from "on prem" research and development ("R&D") to outsourced services, Ginkgo's reliance on its customers to develop, produce and manufacture products using the engineered cells and/or biomanufacturing processes that Ginkgo develops and Ginkgo's ability to accurately predict customer demand, including with respect to the data we access and hold;
    - the anticipated growth of Ginkgo's biomonitoring and bioinformatic support services, including its bioradar and biological intelligence offerings, its expanding epidemiology capabilities and potential impact on the ability to predict pathogen emergence and evolution, its international expansion and the relative value of the services on Ginkgo's future Biosecurity revenue;
    - Ginkgo's development of and investment in artificial intelligence ("AI") tools and achievement of certain milestones under its agreement with Google LLC ("Google Cloud");
    - Ginkgo's ability to comply with laws and regulations applicable to its business; and
    - market conditions and global and economic factors beyond Ginkgo's control, including initiatives undertaken by the U.S. government in the biotechnology sector, the frequency and scale of biological risks and threats, and the future potential and commercial applications of AI and the biotechnology sector.

Each forward-looking statement is subject to risks and uncertainties that could cause actual results to differ materially from those expressed or implied by such forward-looking statements. Applicable risks and uncertainties include, among others:

- intense competition and competitive pressures from other companies worldwide in the industries in which Ginkgo operates;
- litigation, including securities or shareholder litigation, and the ability to adequately protect Ginkgo's intellectual property rights;
- the success of Ginkgo's programs, including the growing efficiency and cost-advantage of Foundry cell engineering services, and their potential to contribute revenue, and the relative contribution of Ginkgo's programs to its future revenue, including the potential for future revenue related to downstream value to be in the form of potential future milestone payments, royalties, and/or equity consideration; and
- other factors detailed under the section entitled "Risk Factors."

These and other factors that could cause actual results to differ from those implied by the forward-looking statements in this Annual Report are more fully described under the heading "Risk Factors" and elsewhere in this report. The risks described under the heading "Risk Factors" are not exhaustive. Other sections of this Annual Report describe additional factors that could adversely affect the business, financial condition or results of Ginkgo. New risk factors emerge from time to time and it is not possible to predict all such risk factors, nor can Ginkgo assess the impact of all such risk factors on the business of Ginkgo, or the extent to which any factor or combination of factors may cause actual results to differ materially from those contained in any forward-looking statements. Forward-looking statements are not guarantees of performance. You should not put undue reliance on these statements, which speak only as of the date hereof. All forward-looking statements attributable to Ginkgo or persons acting on its behalf are expressly qualified in their entirety by the foregoing cautionary statements. Ginkgo undertakes no obligation to update or revise publicly any forward-looking statements, whether as a result of new information, future events or otherwise, except as required by law.

Risk Factors Summary

Investing in our securities involves risks. You should carefully consider the risks described in "Risk Factors" beginning on page 37 before making a decision to invest in our Class A common stock. If any of these risks actually occur, our business, financial condition and results of operations would likely be materially adversely affected. Some of the risks related to Ginkgo's business and industry are summarized below. References in the summary below to "we," "us," "our" and "the Company" generally refer to Ginkgo.

- We have a history of net losses. We expect to continue to incur losses for the foreseeable future, and we may never achieve or maintain profitability.
- Only our employees and directors are entitled to hold shares of Class B common stock (including shares of Class B common stock issued in the future), which have ten votes per share. This limits or precludes other stockholders' ability to influence the outcome of matters submitted to stockholders for approval, including the election of directors, the approval of certain employee compensation plans, the adoption of certain amendments to our organizational documents and the approval of any merger, consolidation, sale of all or substantially all of our assets, or other major corporate transactions requiring stockholder approval.
- We may need substantial additional capital in the future in order to fund our business.
- We have experienced rapid growth and expect our growth to continue, and if we fail to effectively manage our growth, then our business, results of operations, and financial condition could be adversely affected.
- Our limited operating history makes it difficult to evaluate our current business and future prospects.
- We currently own and may in the future own equity interests in other operating companies, including certain of our customers and we may receive non-cash consideration which involves estimations of fair market value. The initial fair market value of the non-cash consideration may decrease after contract inception and the amount of cash proceeds eventually realized may be less than the revenue recognized. Consequently, we have exposure to the volatility and liquidity risks inherent in holding their equity and overall operational and financial performance of these businesses.
- We have in the past, and in the future may continue to pursue strategic acquisitions and investments that are dilutive to our stockholders and that could have an adverse impact on our business if they are unsuccessful.
- We must continue to secure and maintain sufficient and stable supplies of laboratory reagents, consumables, equipment, and laboratory services. We depend on a limited number of suppliers, some of which are single-source suppliers, and contract manufacturers for critical supplies, equipment, and services for research, development, and manufacturing of our products and processes. Our reliance on these third parties exposes us to risks relating to costs, contractual terms, supply, and logistics, and the loss of any one or more of these suppliers or contract manufacturers or their failure to supply us with the necessary supplies, equipment, or services on a timely basis, could cause delays in our research, development, or production capacity and adversely affect our business.
- We use biological, hazardous, flammable and/or regulated materials that require considerable training, expertise and expense for handling, storage and disposal and may result in claims against us.
- Third parties may use our engineered cells, materials, and organisms and accompanying production processes in ways that could damage our reputation.
- If our customers discontinue their development, production and manufacturing efforts using our engineered cells and/or biomanufacturing processes, our future financial position may be adversely impacted.

- Further, because our revenue is concentrated in a limited number of customers, some of which are related parties, our revenue, results of operations, cash flows and reputation in the marketplace may suffer upon the loss of a significant customer.
- We are or could become involved in securities or shareholder litigation and other related matters, which could be expensive and time-consuming. Such litigation and related matters could harm our business.
- In certain cases, our business partners may have discretion in determining when and whether to make announcements about the status of our collaborations, including about developments and timelines for advancing programs, and the price of our common stock may decline as a result of announcements of unexpected results or developments.
- Uncertainty regarding the demand for passive monitoring programs and biosecurity services could materially adversely affect our business.
- Rapidly changing technology and emerging competition in the synthetic biology industry could make the platform, programs, and products we and our customers are developing obsolete or non-competitive unless we continue to develop our platform and pursue new market opportunities.
- Our investments in and use of AI may result in reputational harm, liability, or other adverse consequences to our business operations.
- Ethical, legal and social concerns about genetically modified organisms ("GMOs") and genetically modified plant or animal cells and genetically modified proteins and biomaterials (collectively, "Genetically Modified Materials") and their resulting products could limit or prevent the use of products or processes using our technologies, limit public acceptance of such products or processes and limit our revenues.
- If we are unable to obtain, maintain and defend patents protecting our intellectual property, our competitive position will be harmed. If we are unable to protect the confidentiality of our trade secrets, our business and competitive position will be harmed. We may become involved in lawsuits or other enforcement proceedings to protect or enforce our patents or other intellectual property, which could be expensive, time consuming and potentially unsuccessful.
- We rely on our customers, joint venturers, equity investees and other third parties to deliver timely and accurate information in order to accurately report our financial results in the time frame and manner required by law.
- We identified a material weakness in our internal controls over financial reporting and may identify additional material weaknesses in the future. A failure to maintain an effective system of internal control over financial reporting may result in a failure to accurately report our financial results or prevent fraud, which could harm our business and the trading price of our common stock.
- Failure to comply with federal, state, local and international laws and regulations could expose us to significant liabilities or penalties and adversely affect our business, our financial condition and results of operations and we may incur significant costs complying with such laws and regulations
- We and our laboratory partners are subject to a variety of laboratory testing standards, compliance with which is an expensive and time-consuming process, and any failure to comply could result in substantial penalties and disruptions to our business.
- Significant disruptions to our and our service providers' information technology systems or data security incidents could result in significant financial, legal, regulatory, business and reputational harm to us.

PART I

Item 1. Business.

Unless the context otherwise requires, all references in this section to the "Company," "Ginkgo," "we," "us," or "our" refer to the business of Ginkgo Bioworks Holdings, Inc. and our subsidiaries.

Overview: Our Mission is to Make Biology Easier to Engineer

Our mission is to make biology easier to engineer. That has never changed. Every choice we've made with respect to our business model, our platform, our people, and our culture is grounded in whether it will advance our mission.

Why? Because:

1. **Biology is programmable.** All living things run on the same DNA code.
2. **Biology matters.** The ability to engineer biology has had and will have a profound impact on how we develop new medicines and vaccines, grow our food, and manufacture many of the things we use every day.
3. **Biology is hard.** Today, it is still too difficult and too costly to engineer biology, preventing critical innovations from reaching the market.

Making biology easier to engineer is a systems challenge. No single technology offers a solution. In a way, Ginkgo acts as a systems integrator, bringing together many different technologies–whether built internally, acquired, or through partners–to offer our customers a more integrated and complete solution to a multi-dimensional challenge. We offer these integrated solutions in two domains: cell engineering, where we work to solve biological R&D challenges for our customers across a range of industries, and biosecurity, where we seek to build solutions to identify, respond to, and ultimately prevent, biological threats. An overview of these two business lines is provided below.

Cell engineering

Our cell engineering customers work with biology to do incredible things, with transformative potential across industries:

- in medicine, developing innovative new therapeutics and vaccines;
- in agriculture, advancing the sustainability and security of our food systems; and
- in industrial biotechnology, advancing the way we manufacture a wide range of products for better performance and lower environmental impact.

We are inspired by the incredible diversity of innovations our customers are enabling. Our mission is to make it easier for them to do their critical work.

Because engineering biology is incredibly hard, biotech R&D is traditionally performed by in-house labs filled with highly trained scientists running lab experiments by hand over several years in the hope of ultimately developing a working product. Many attempted cell engineering projects fail in development due to scientific challenges, and many are terminated because they are taking too long or are over budget. How many innovative new medicines or climate solutions are stuck for lack of the right tool?

Ginkgo does not make products; we build enabling platform services so that our customers can bring products to market. Ginkgo provides flexible, end-to-end biotech R&D services that can offer customers better results on the dimension of cost, speed, or probability of success – and ideally on all three. In exchange for these services, Ginkgo's customers generally pay us through a blend of fees during the development of their product and downstream value share in the form of milestones, royalties, or equity, which allows us to align our economics with the success of the products enabled by our platform.

The fundamental advantage of our platform over traditional cell engineering done by hand at our customers' labs is that our platform improves with scale while in-house cell engineering in our customers' labs largely does not. Compounding and mutually reinforcing improvements of our laboratory automation and software infrastructure—our Foundry—and our reusable data assets—our Codebase—enable us to improve our services while also enabling the flexibility to apply high throughput automation to the diversity of challenges across biological systems encountered by our customers.

- Our Foundry is a highly automated, yet flexible, lab powered by proprietary automation and software to enable flexibility and scale. The Foundry automates lab workflows at high levels of abstraction, enabling users to generate potentially valuable datasets labeling broad genetic sequence design space with a wide range of

functional data through modular design-build-test-learn cycles or campaigns. Our scale economic means that the Foundry's capacity to perform more and more diverse campaigns grows while the cost per campaign decreases. We call this scaling factor Knight's Law.

- Our Codebase is a data asset which accumulates as we operate our Foundry in service of customer projects. Our Codebase includes vast amounts of data at different levels of characterization and usability in engineering projects, including: proprietary libraries of genetic sequence data that can be used for pretraining large language models via unsupervised learning, experimental data for fine tuning task-specific generative AI models, as well as best practices for cell engineering, sequences and host cells that have been honed through dozens of programs and can be directly reusable for different applications of cell engineering.

This flexible capability for large scale data generation and broad, growing data asset empowers generative AI and machine learning ("ML") tools that enable more predictive design of cell programs and higher probability of success for our customers. As the platform scales, we have observed a virtuous cycle between our Foundry, our Codebase, and the value we deliver to customers. We believe this creates a powerful "flywheel," where new cell programs drive improvements in our platform which in turn drives customers to outsource even more new cell programs.

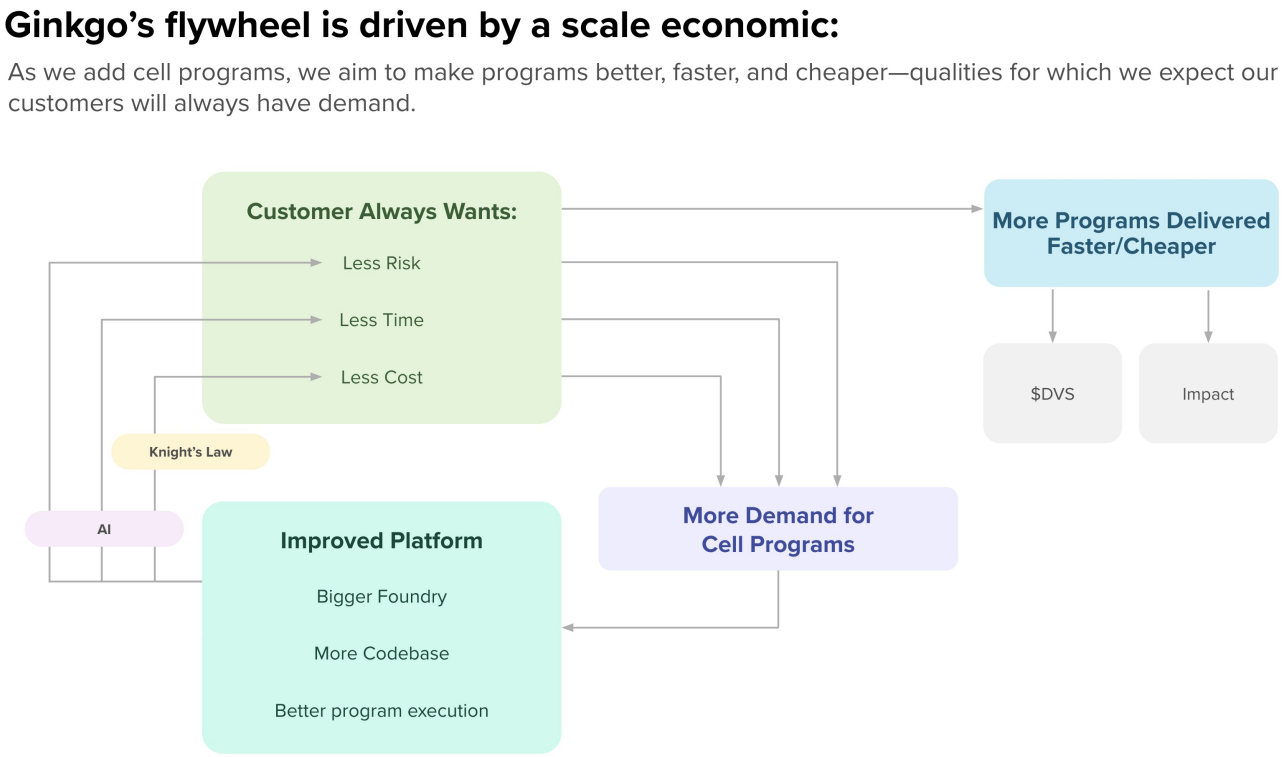


Figure 1: Ginkgo's flywheel is driven by a scale economic: as we add cell programs, we aim to make programs better, faster, and cheaper – qualities of which we expect our customers will always have demand.

We believe that cell programming has the potential to be as ubiquitous in the physical world as computer programming has become in the digital world and that products in the future will be grown rather than made. To enable that vision, we are building a horizontal platform to make biology easier to engineer. Our business model is aligned with this strategy and with the success of our customers, setting us on what we believe is a path towards sustainable innovation for years to come.

Biosecurity

As with every technological revolution, reaping its benefits to the economy and society also requires us to grapple with its risks. A critical part of making biology easier to engineer is creating biosecurity infrastructure with the goal of managing the many accelerating and diversifying sources of biological risk, whether natural or engineered, accidental or malicious. And many of the same biotechnological capabilities that we're applying to industry can also be applied to safeguarding lives and livelihoods.

In the digital world, we've learned that we need to build comprehensive infrastructure to protect our personal computers and digital systems of all kinds—from financial markets to power grids—from harmful code. The modern cybersecurity industry offers tools to constantly monitor for cyberthreats, assess the damage and ongoing risk of cyber incidents in near-real-time, recover system integrity, track the sources of threats, and rapidly deploy pieces of software that reduce vulnerabilities in our systems. This is happening constantly, all around us. A physical world grown with cell programming demands the same type of widespread biosecurity infrastructure to detect, characterize, respond to, attribute, and prevent biological threats.

This is a hard problem, and one we've been working towards for a long time. But the COVID-19 pandemic showed us—and the world—just how urgent it is to address. Our healthcare infrastructure, biomedical technology industry, and communities across the world mobilized in valiant and unprecedented ways, but still left us with losses of millions of lives and trillions of dollars. Our current systems are reactive: designed to pick up on patterns of illness, then figure out the nature of the threat, then try to quickly mobilize diagnostics, therapeutics, and vaccines.

We need a fundamentally different approach to securing biology—one that starts with data. The DNA and RNA code that underlies the biological world is what allows us to program it like computers, but it's also what allows us to understand it at a molecular level and learn to predict how it's going to behave in the world. Ginkgo's Biosecurity platform is built on the premise that genetic code is a high-fidelity data asset that will form the foundation for next-generation biosecurity—making step changes in our ability to rapidly and reliably respond to, prevent, and attribute biological threats.

Because biosecurity is a matter of national and global security, our primary biosecurity customers are national governments. We offer them end-to-end tools and services for:

- persistent and pervasive collecting of environmental samples at critical nodes—like airports and borders, agricultural settings, cities and communities;
- testing and sequencing the samples' non-human DNA and RNA and analyzing the genetic code for signatures of natural or engineered biological threats; and
- putting that information in global context with insights from our network and other data sources to provide critical, early information on what's coming and what to do about it.

Like our cell engineering platform, our biosecurity platform gets better with scale. We are observing a network effect: as we partner with more countries to stand up detection nodes and build underlying local biosurveillance capacity, we have been able to achieve earlier detection and deeper insights on a global scale. We also prioritize reinvestment in our platform with the goal of serving new types of nodes and samples, detecting new targets, integrating additional sources of data, building better predictive capabilities, and eventually plugging directly back into countermeasure development, in near-real-time. We believe that with scale we can substantially strengthen the value of our platform, with global data providing insights far beyond what any one country's data could yield alone.

An introduction to synthetic biology: designing biological sequences

Synthetic biology was founded on a deceptively simple question: could we program cells as easily as we program computers?

Biology runs on a digital code. It's just A, T, C, and G rather than 0 and 1. There are sequences that code for programming logic—turning genes on when certain conditions are met—and there are sequences that encode functions and behaviors—the physical structures of proteins and enzymes that create biological structures and materials or catalyze chemical reactions. Synthetic biologists build cell programs by writing new sequences combining regulatory and functional elements into a synthesized strand of DNA and booting them up in cells to perform useful tasks, usually producing a particular bioproduct such as a protein, enzyme, or chemical.

Biological code programs the world of atoms, not bits. This is what makes the potential impact of synthetic biology so great, and inspires us to work to make biology easier to engineer and secure. But it also poses incredible challenges that make cell programming so hard today. Our code is a physical object with chemical properties. It folds and binds and interacts in many complex ways. It produces proteins that catalyze chemical reactions that interact in a complex web of connections. Even the simplest cell programs encounter incredible complexity within, emerging from all of the interactions of chemicals, DNA, RNA, and proteins inside of a cell.

Consider a relatively straightforward program that makes a single protein product in a microbial cell, such as a biologic drug like insulin or a protein ingredient for alternative dairy:

- Different DNA sequences encode the same protein sequence, and the sequence of the DNA itself is adapted to the conditions inside of the cell it evolved in and has to be recoded to work optimally in a new host.
- The DNA doesn't do anything by itself, but must be "turned on" and transcribed into RNA by the cell's machinery, which is in turn translated into protein by other cellular systems. Different regulatory elements impact the timing, strength, and logic with which genes are turned on and off and the amount of protein produced from the RNA.
- The RNA can fold in on itself and produce structures that impact how much of the protein is produced.
- The protein likely needs to be secreted or otherwise purified from the cell, and different types of cells and proteins are secreted at different levels.
- The protein may need to be altered to improve its solubility, shelf stability, and how it behaves in a final formulation of a drug or food.
- The protein may need to be modified in different ways by the cell in order to improve its ultimate function or prevent it from causing an immune reaction in the body.
- The cell needs to be convinced to make a lot of this protein, likely shifting its metabolism from producing things more useful to its own survival.
- The cell needs to be grown at large scale to manufacture the final product, which requires precise optimization of the conditions in well regulated facilities designed for the safe production of food or medicines.
- Moreover, these elements interact with each other, and changing one aspect of the sequence, structure, modifications, gene regulation, host cell background, or production process will likely impact other parameters.

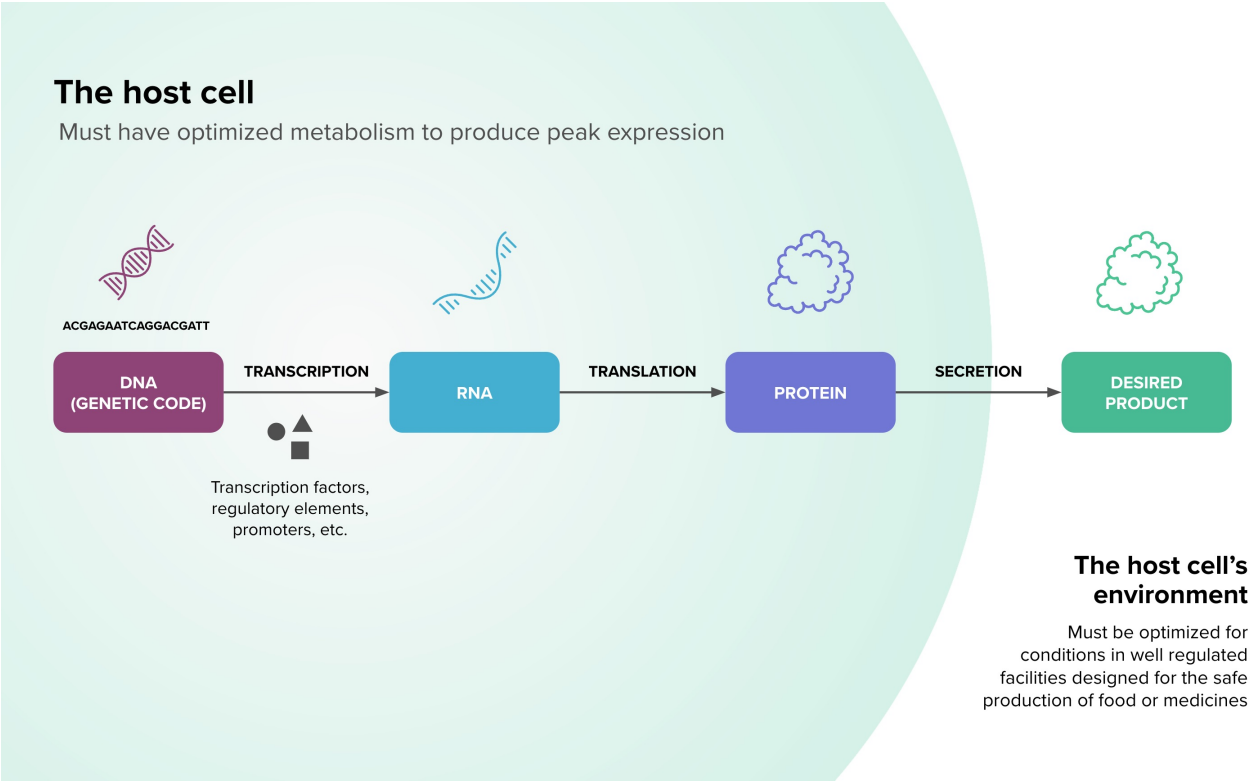


Figure 2: The process of producing even a "simple" product of synthetic biology has many steps and contexts that impact technical and commercial feasibility.

This is all for simply expressing known sequences, after the function of the protein was well characterized; designing new protein structures and functions adds many more layers of complexity based on how the protein sequence folds and functions inside of the cell. And for more complex cells and more complex programs with more parts and enzymes, the number of interactions and possibilities grows exponentially, making programming larger genetic pathways and behaviors incredibly challenging. Every single product of biotechnology that goes out into the market – a new plant trait, a new enzyme, and new therapeutic protein or new gene therapy, every chemical produced by a microbe via fermentation, required R&D teams to solve each of those layered interdependent challenges to find the right sequence, cell, and the production method that was used to manufacture it.

These sequence design and optimization problems are increasingly able to be addressed with generative AI models trained on biological data. AI models can learn to "speak" the language of DNA, RNA, and protein codes, trained on the "grammar" of sequences that have evolved over billions of years.

But context and function matter. Large libraries of natural sequence data are critical for pretraining large language models, but it is labeled data mapping sequences to function in biological contexts that is critical for the task-specific models that can predict sequences that will meet particular specifications. For most applications of synthetic biology, there is simply not enough data publicly available to generate such models.

Therefore, to develop new products in synthetic biology requires actually building large libraries of possible sequences and testing their function in order to:

1. identify the "hits" with better performance; and
2. iteratively train task specific models that aid in the design of improved libraries to further optimize sequences for the conditions required for commercial success of a synthetic biology product.

This type of R&D requires capabilities in large scale design and synthesis of DNA libraries, high throughput screening and collection of functional data for each sequence design, and machine learning to iteratively learn from the data generated by these campaigns.

We invest in this infrastructure for data generation and AI modeling so that our customers can access it as a service.

Our cell programming services enable discovery, functional optimization, and efficient manufacturing of biotech products

Because all organisms run on the same DNA code, general-purpose cell programming can be applied across many different markets to enable the design of new innovative products as well as improve manufacturing cost and sustainability of existing ones. Given the breadth of application areas and the potential of biology, we believe that the end markets for bioengineered products will be enormous. As we develop a greater ability to program biology and direct it towards novel and more challenging applications, the spectrum of possibilities will undoubtedly grow.

Traditional biotech R&D requires large up-front investment of time and fixed capital expense in order to build laboratory infrastructure to generate data needed for the particular product application. Because of this large fixed cost, it is slow to start, difficult for companies to explore new product areas, and difficult to scale to meet the need for data required to adequately optimize to meet commercial scale requirements for functionality and manufacturability.

Our services give R&D teams flexible access to automated laboratory infrastructure that provides more data per dollar without having to invest in costly capital expenditures, as well as data and AI resources that enable more predictive design for their applications, designed to help our partners better meet the needs of their markets.

Today, our services cross markets and modalities to enable a wide range of biotech products, including, but not limited to, the discovery, optimization, and manufacturing systems for:

- **DNA** sequences delivered as vaccines and gene therapies
- **RNA** sequences for vaccines, therapeutics, and novel approaches to crop protection, including mRNA, circular RNA, and other approaches
- **Proteins** used in food and alternative meat and dairy, protein-based materials such as silk and structural proteins such as collagen or keratin, biologic medicines and antibodies, plant traits for crop protection, AAV capsids and other delivery methods for gene therapies and vaccines
- **Enzymes** used in industrial processing, food production and brewing, bioremediation and biomining, chemical manufacturing and biocatalysis, diagnostics, therapeutics, or RNA vaccine production
- **Small molecules** and natural products that can be produced via pathways of multiple enzymes in engineered cells for cosmetics and food ingredients, specialty or commodity chemicals, materials, agricultural inputs, or pharmaceutical ingredients and adjuvants
- **Microbial cells** that can provide crop nutrition or protection in agriculture, impact soil carbon sequestration to help address climate change, offer probiotic nutritional benefits, or microbiome therapeutics
- **Mammalian cells** for manufacturing of biologics, genomic medicines, and cell therapies

A common platform across markets enables economies of scale to accrue in unexpected and powerful ways—an enzyme library generated for production of a fragrance might generate negative data that trains an AI model which in turn could empower design of an enzyme used to produce a treatment for a rare disease; models of RNA structure enable improved expression of both food proteins and novel therapeutics. A flexible platform to generate functionally relevant data from libraries of DNA sequences can be applied to an existing product and to new products and modalities developed by innovators from any market.

As a horizontal platform for cell programming, we focus on developing platform services and invest in technologies that we believe will have cross-cutting impact across markets. Our customers bring incredible depth and expertise in their unique technical domains and market areas, from the underlying disease biology or plant physiology, to the performance of regulatory trials in animal studies, in the clinic, or in the field, to product formulation and functional testing, and so much more to manufacture, distribute, and market a product. We provide these innovators with services that help them access more genetic design space in order to discover and optimize functionality and develop efficient manufacturing methods for their products.

Enabling customer success across markets

Partners come to us with business challenges, from the need to innovate in a new product area and quickly explore different potential opportunities, to needing optimization of product functional performance, to improving COGS, sustainability, or supply chain stability. Our teams work hand in hand with our partners to understand the critical parameters for commercial success and to build programs that meet their business objectives.

Pharma & Biotech

There is urgent, critical need for new therapeutics and vaccines for currently intractable health conditions across the globe. There is also widespread realization within the pharmaceutical industry that research productivity must be enhanced in order to meet this need. With billions of dollars spent annually on R&D in pharma, the cost to bring a new drug to market is only increasing.

At the same time, there is great promise in how AI tools may help uncover new disease biology and targets for therapeutics, as well as enable the programming of new medicines, in particular biologics and genomic medicines that are encoded in DNA and RNA sequences. Pharma R&D teams are looking for ways to generate and federate data to train these models, design and test more technical approaches and candidates at the preclinical stage to “fail fast” before costly clinical trials, and develop better leads simultaneously optimizing along multiple dimensions important for therapeutic index as well as manufacturability and cost.

The pharmaceutical industry today relies heavily on outsourced R&D, both to specialized, innovative small biotech, as well as to CROs that can automate and scale specific common workflows at different stages of the R&D process for enhanced efficiency. These approaches enable access to both innovation and efficiency, but suffer from high switching costs both organizationally as well as technically.

With flexible automation to drive economies of scale for data generation campaigns across modalities as well as a business model centered on innovation partnership, we work to provide our biopharma partners with the integrated platform services that can move the needle on R&D goals from discovery all the way through manufacturing. Our customers are using our platform to develop new manufacturing methods for gene therapies, biologics, and small molecule therapeutics and APIs, and to discover new natural products, RNA therapeutics, and much more.

Agriculture

Agriculture likewise faces urgent need for innovation to address growing pressure on growers and food systems, and similar to progress in biopharma, agricultural innovation also struggles due to long timelines, complex regulatory paths, and siloed data and capabilities.

Innovators in agricultural technology need to tap into biological diversity to develop new crop protection strategies to combat resistance and provide safer, low residue options for growers that meet consumer expectations and regulatory guidelines. They need to understand mode of action and improve the performance and stability of innovative biologicals for crop nutrition and crop protection. And increasingly, they are also innovating in soil carbon sequestration and climate strategies.

Our customers in agriculture are using our platform to improve the performance and manufacturability of existing agricultural biologics, develop revolutionary new products for crop nutrition in nitrogen fixation, phosphate solubilization, or carbon sequestration, and design new insect control proteins and other crop protection products to protect food security.

Industrial biotechnology

Many chemicals that make up the products of our material world are accessible via biology. Living organisms can be engineered to manufacture specialty and commodity chemicals or break down pollutants and create closed loop systems. There is an enormous breadth of products—chemicals, enzymes, and proteins—already produced via biotechnology today or being actively developed by companies across markets, across food and nutritional ingredients, wellness, cosmetics, and personal care, industrial processes and chemicals, and materials innovation.

Our customers leverage our services to improve the manufacturing efficiency and COGS of their existing biotechnological products, develop new production processes to replace existing extraction methods for ingredients derived from plant or animal sources to enable more sustainable and stable supply chains, replace petrochemical inputs, innovate materials with enhanced performance, develop enzymes for breaking down harmful pollutants or cells and proteins optimized for capturing rare earth elements, or valorize waste streams into feedstocks for more valuable products.

An introduction to biosecurity: scaling biological intelligence for securing lives and livelihoods

Addressing biosecurity starts with being clear-eyed about biological risks and threats. We hold at our core the tremendous positive potential of biology, and we know that we're facing a biological landscape with more frequent, more severe, and more varied threats through time.

Our world is increasingly interconnected through travel and trade, giving pathogens and biological agents new opportunities to spread across the globe, impacting people's health along with the complex global supply chains that our societies depend on to function. Climate change and habitat disruption are creating the conditions for pathogens to emerge and spill over between animal populations and into humans more often and with more severe consequences. A global boom in investments into bio-laboratory capacity, designed to improve our tools to combat such pathogens, also comes with heightened risk of lab accidents—in spite of substantial efforts to improve biosafety. And unfortunately, there are those who seek to use biology for nefarious purposes, misusing its incredible potential to cause harm.

These trends are intertwined with geopolitical competition and destabilization, eroding buy-in and trust in institutions, and emerging technologies in both biotechnology and AI/ML, presenting a core security challenge for nations and the world. Ginkgo Biosecurity is designed to help national and global leaders answer the dizzying questions about biological threats that keep them up at night:

- **What threats and outbreaks are on the horizon?**
- **What is this new threat and how bad is it?** How might it spread and evolve? Who (or what infrastructure) will be affected?
- **Where did it emerge and how?** Is there evidence of misuse and if so, what can we learn about the perpetrators?
- **What can I do about it?** How effective will existing countermeasures be? Should we develop new countermeasures, and if so, what should they look like? What are my ideal response options given resource constraints and mitigation goals?
- **How will technology change the landscape?** What and how severe are the risks of biological research activities globally (including the development of AI tools like Large Language Models and Biological Design Tools)? How can we ensure the evolving technology landscape maximizes the benefits of innovations while preventing harms?

These are technically difficult questions—and we've too often settled for flimsy answers or none at all. Having the tools to actually make these questions tractable is what will empower leaders to mount substantially earlier and more effective responses, and develop the infrastructure to prevent future threats from taking hold. While there is very important work happening in the world to coordinate global policy and strengthen existing public health infrastructure against known threats, our focus is on building the cutting-edge technology stack that countries will need to face the evolving biothreat landscape and ultimately determine how best to answer these questions.

National governments are our primary customer as they seek to protect their citizens, economies, and critical infrastructures, but these technologies also have a wide variety of other applications. For instance, they can help companies predict and mitigate disruptions to their global workforces and supply chains, help health systems prepare for shocks, and help local leaders manage community health.

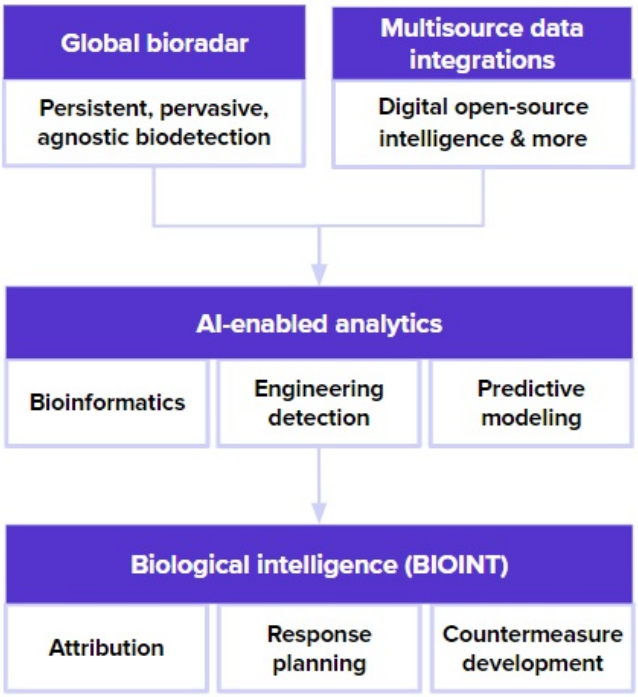


Figure 3: The Ginkgo Biosecurity technology stack leverages data and AI to generate actionable intelligence on biological threats.

The Ginkgo Biosecurity technology stack starts with persistent, pervasive, locally-operated collection of environmental samples from strategic high-risk nodes—designed to help establish baselines across a growing array of collection and sample types. The samples are analyzed through genomic sequencing of non-human DNA to turn the environment into data. Today, we are looking for a large and growing set of known threats, and we plan to use methods that are threat-agnostic and able to pick up on totally novel genetic signatures. This is what we call bioradar.

The next step is to convert that bioradar data into actionable insights that our customers can use to make more effective and timely decisions—we call this biological intelligence, or BIOINT. The bioradar data from given programs or jurisdictions are integrated with other global data sources—from our monitoring network, open-source intelligence capability, and other sources—and analyzed using a suite of AI/ML-enabled tools to help customers gain a more comprehensive picture of the threats they're facing.

Our evolving data feeds and analytics tools are bringing us closer to being able to answer the questions above, and supporting key activities like threat attribution, as well as response planning and implementation. Ginkgo's leadership in AI/ML development, in particular, will be critical to enabling BIOINT. AI/ML already helps us do everything from detecting signatures of engineered biology, to rapidly identifying anomalies in environmental samples and digital surveillance that could signal novel threats, to forecasting how a pathogen will spread. As we advance the state of the art in AI/ML, we plan to find new ways to enhance these capabilities and build new applications for BIOINT. For instance, BIOINT can feed back into the development and optimization of vaccines, therapeutics, diagnostics, and other response tools, using data and AI/ML to help us understand how effective different countermeasures will be against novel threats or disease variants.

Our commitment to caring about how our platform is developed and used

Biotechnologies already touch nearly every part of society, and they will only grow in importance to our collective security and livelihoods in the future. Because of their far-reaching impacts on the world and because we are biological beings who are both dependent on and vulnerable to the capabilities we enable, we must take great care in the ways these technologies are developed and used.

We are cognizant that making biology easier to engineer won't make the world better by default, but we believe these capabilities are essential to creating a better future where we can contend with both existing and emerging threats. To succeed in our long-term mission we must avoid multiple failure modes. We must avoid creating capabilities that cause harm in ways that aren't or can't be mitigated. We must avoid reinforcing inequities in the uses of technologies and to

whom their benefits accrue—thereby claiming to change the world but changing not much at all. We must avoid a loss in trust in biotechnologies and the motivations of their developers that limits our ability to bring solutions to global challenges from protecting against pandemics to feeding the planet. And so we must chase, everyday, the development of capabilities and partnerships that can lead to value generation undergirded by sustained attention to the values they reflect.

As our platform grows, so too does our power to enable and shape many impacts we care about. While we are proud of our direct impacts on making biology easier to engineer, most of the world cares about the impacts on the world that we indirectly enable through helping our customers with the products and services they deliver. We grow as a platform precisely because we help create more value for our customers and the world than we capture. Our position serving customers across many industries provides strategic insights into what issues need collective attention to ensure future products can deliver meaningful solutions. But as a platform we cannot anticipate and control all future uses of our technologies by our customers and those they work with.

Far from abdicating responsibility, as a platform company we realize our power is to inspire and help enable others to carefully steward technologies with attention to their impacts over time. This is directly in line with our long-term value proposition, as we need our customers and the ecosystem to succeed in avoiding the failure models outlined above and build the collective biotechnology-enabled future we all can wish for. We believe that stewardship starts with our platform and the people within it. Just as we must build and inspire trust in our partners to steward our technologies with care, we build and inspire trust in all of our bioworker-owners to build our platform with care.

To begin, we are investing in systems to help everyone in our company to better understand and shape its impacts. Last year in our environmental, social, and governance (“ESG”) report, Caring at Ginkgo, we described updates to our overarching philosophy as well as an internal governance experiment in ownership through a committee of elected bioworkers entrusted with helping to facilitate our caring commitments. The committee reviewed nearly every project last year in order to develop refined posture and processes.

As our platform grows we are now shifting attention from case-by-case reviews to strategies that can scale and address issues and opportunities in a more upstream and integrated way. This includes better understanding where the platform has the biggest impacts for our customers along key dimensions such as sustainability. We are also assessing areas of impact and gaps in governance around impacts that we wish to avoid, and developing new ways to practically extend positive impacts and mitigate potential harms that leverage our position and capabilities.

We must also pay special attention to the governance of leading capabilities for we have outsized ability to shape.

At a macroscopic level building biosecurity capabilities is an example of where we assessed the need for complementary efforts that could safeguard future biotechnologies–including those developed on our platform. But this same philosophy applies across our platform including as we work to harness powerful new capabilities in AI. We believe that our platform design is a foundation for architecting security and access that can both enable positive uses while better understanding and protecting against scenarios of misuse.

We see caring about how our platform is developed and used not as a net cost but as an enabler at multiple scales of impact aligned with long-term value. It builds trust and credibility not only in our capabilities but those of our customers. It motivates and enables our employee-owners to drive the platform towards the many diverse uses they co-envision with our platform (our social and motivational flywheel!). It also advances a framework to go beyond a reactive historical frame for ESG that has often positioned genetic engineering as a risk to the environment rather than a value.

We recognize that platforms across other industries have lessons—many negative—on how to steward their development and use. Our high-level commitment to care also comes with the expectation of needing to regularly revisit the approaches to realizing that commitment.

Our platform

Ginkgo’s platform brings together the technology, data, biological assets, subject matter experts, flexible business terms, and a broader ecosystem of resources that enable our partners’ commercial success:

- best in class, proprietary automation technologies that enable flexibility and scale
- in house software, machine learning, and generative AI models for cell programming
- massive databases of DNA sequences and labeled data on functional performance of engineered cells
- reusable assets that enable faster and more predictable cell programming
- flexible partnership models to meet R&D teams wherever they are in the development process

- expert scientists that leverage platform tools and data to enable partners to achieve their desired results
- an ecosystem of partners with capital, assets, expertise, and capabilities beyond cell programming that enable the launch and success of synthetic biology products

Our Foundry brings economies of scale to cell programming

Cell programming projects involve a conceptually similar process regardless of the specific product or market. Based on customer specifications, Ginkgo's program team develops designs of proteins, pathways and gene networks that might meet the specification, leveraging public and proprietary biological knowledge bases (see "—Our Codebase—organizing the world's biological code"). Those conceptual designs are refined and specified into particular DNA sequences using computer-aided design tools. Those DNA sequences are then chemically synthesized and inserted into a cell to execute the new DNA code. These prototype cells are then studied and the output or performance of each is measured and compared to the customer's desired specification. Learnings using data analytics and data science tools can inform a new round of prototypes, if needed. We refer to this engineering cycle from design to learning as a campaign and we perform campaigns both in parallel and serially until either the specification has been met or the customer decides to end the program.

The likelihood of technical success increases with each iterative campaign and with the number of prototypes that are explored per campaign. However, with traditional tools for genetic engineering, each campaign can be slow, expensive and error prone. Many projects across the industry run out of budget or time. Conventional R&D teams often look to stay within budget by running rapid campaigns using largely manual tools and small numbers of prototypes per campaign. However, the inability to broadly explore the potential design space (there are more possible sequences of a 200 amino acid protein encoded in 600 DNA letters than there are stars in the observable universe) and the reliance on manual tools is a difficult handicap to overcome. Since people can only work so hard and since campaigns can't be shortened beyond the duration of the physical steps, this approach has limited potential to improve in the future.

At Ginkgo, we invest in improving the tools and technology for programming cells in order to maximize program success within the constraints of our partners' R&D timelines and budgets. We do so by scaling the number of prototypes that can be evaluated in each campaign in an effort to reduce the number of campaigns required to meet the customer's specification and ultimately shorten project timelines. A typical campaign for one enzyme step in a program might evaluate 1,000 to 2,000 prototypes to optimize function, of which the top 10 to 100 might be short-listed for further study. A relatively basic program for the production of a small molecule might have three to five enzymes working in concert, and so in the process of optimizing the entire pathway, thousands or tens of thousands of enzymes and pathway combinations might be designed, built, and tested in the Foundry. The methods we use to increase scale also tend to reduce the average cost per prototype, which means that more prototypes can be evaluated for a given program budget.

Because diverse cell programs share similarities in process and code, many programs can be run simultaneously in a carefully designed centralized facility. This facility, where we use our investments in advanced cell programming technologies to manage diverse programs, is what we call our Foundry.

We make it possible to centralize many cell programming projects in our Foundry by deconstructing programs into a set of common steps and then standardizing those steps. For each step, we have built a specialized functional team that performs that step for all programs. Those teams define a set of standardized services that can be used in concert to execute an end-to-end cell programming process. Each team has access to scientific, software, and robotic engineering resources to replace manual ad hoc operations with standardized, automated, and optimized services. In addition to enabling scale, this approach ensures standard operating procedures, know-how, and human skill become encoded in software that can be more effectively debugged, monitored, controlled, and optimized.

Figure 4: A non-exhaustive summary of the functions performed throughout the lifecycle of a program in the Foundry. At each stage, learnings are generated, driving improved designs and functional optimizations.

While the engineering strategies described above have historically been relatively uncommon in the life sciences, they are obviously not our invention. Rather, we are inspired by the lessons from other engineering disciplines and seek to apply those to biology. Automotive manufacturing, semiconductor fabrication, and data centers, among many other industries, demonstrate how automation, data, economies of scale, and continuous improvement can produce compounding gains in scale, costs, and quality. Critically, routine performance of these strategies across dozens of projects gives us the data and experience needed to drive continuous improvement.

As described above, a key strategy in our Foundry is to increase the scale of our operations so that we can run larger campaigns, a greater number of campaigns, and hence run more programs. This approach benefits from operational efficiencies and economies of scale across many dimensions:

- *Fixed Cost Amortization:* Our Foundry is an inherently physical facility and as we scale and improve utilization, we are able to amortize this fixed cost across more work.
- *Continuous Learning and Improvement:* The cumulative amount of work done as we scale leads to a better understanding about how to program cells. Much of this is then encoded in our Codebase, described below.
- *Purchasing Economies:* By partnering with Ginkgo, our technology partners and suppliers can generate more value from a single account than they could from multiple smaller accounts, and that extra value is shared with Ginkgo.
- *Technology Specialization:* Certain technologies that we leverage in the Foundry (such as acoustic liquid handling, automated bioreactors, and advanced mass spectrometry systems) are not easily leveraged or practical for smaller organizations. But for an engineering organization of our size, those investments can drive material improvements in cost efficiency.

These efficiencies and economies of scale can be observed empirically from a relationship we refer to as "Knight's Law," named after Tom Knight, one of our co-founders, and loosely inspired by Moore's Law for semiconductors. We have seen a significant increase in the output of the Foundry over time alongside a significant decline in the average cost per unit of output except during temporary lab shutdowns during the COVID-19 pandemic and reduced capacity due to social distancing. Historically, we have measured the output of the Foundry in terms of the number of strain tests. In 2023, we switched to a higher level metric of Foundry output called a campaign, which is a design-build-test-learn cycle for a given biological engineering objective. We believe campaigns are a better measure than strain tests because campaigns are a more representative and integrated "unit" of biological engineering. In 2023, we continued to see significant improvements in Foundry output and cost per unit of diverse campaigns run by the Foundry.

Knight's Law does not provide the full story on our development, but it is a useful tool that allows us to continue to build efficiencies of scale. We believe we can continue to drive significant capacity growth in the foreseeable future, though it is dependent on the development of new technologies, which inherently carries risk, and, like Moore's Law, we will likely hit a limit over time. This feature compares to a conventional facility, where scaling is driven predominantly by the addition of employees, an exponential increase in work would be infeasible and the cost per unit of work would decline little, if at all.

We are frequently asked, and spend much time thinking about, whether it will be possible for compounding gains in output and productivity to continue for many years in the future. It is important to note that given significantly advanced tools, most steps in cell programming could be miniaturized to a point where single molecules of DNA and single cells are being manipulated and monitored. At that ultimate degree of miniaturization, the costs and timelines of cell programming could be reduced orders of magnitude from where they are today. Microfluidic and encapsulation technologies point to the reality of this future of cell programming at the single-cell level. Additionally, because many of the enabling tools of cell programming are biological in nature (e.g., polymerases and CRISPR), we are able to point the platform at itself, developing new biological tools to reduce the number of steps or the complexity of a certain operation. For example, we could develop better gene editing enzymes or novel ways to screen cells in a multiplexed format using biological sensors. It is easy to theorize about these types of developments, however they are hard to execute, we will undoubtedly run into roadblocks along the way and we will have to invest significantly in developing new technologies in order to enable the types of improvements we seek to achieve.

Recent advances in machine learning, molecular simulation, and other computational techniques also hold great promise to improve our ability to program cells. We believe our Foundry is well-positioned to build the kind of large, well-structured datasets that such computational approaches need to succeed. In time, we believe computational approaches will reduce the need for certain kinds of experiments (for example, we already use machine learning to make protein and enzyme design projects more efficient). If computational approaches can replace certain sets of experiments, we expect to use the recovered Foundry capacity to work on ever-more complex cell programming challenges. The reality is that the cells that we program today accomplish relatively simple functions, such as: "produce as much of molecule X as possible." Programming cells for complex functions, such as live-cell therapeutics, responsive building materials, multicellular organisms, etc., will require sophisticated sub-systems for environmental sensing, intracellular information processing and feedback, and a multidimensional program that responds to such environmental stimuli. Only when we can deliver such sophisticated programmed cells will we have truly unlocked the potential of biology, and we see the Foundry as being an integral part of the platform for doing so.

Our Codebase—organizing the world's biological code

Codebase is a familiar term to software developers but is a new concept in biology. Modern software firms develop their own (typically proprietary) codebase of source code and code libraries that can be leveraged by their software developers to more easily create new applications than they could starting from scratch. Additionally, vast repositories of debugged code are shared publicly so that programmers across application areas can leverage prior art in order to innovate faster. This allows software developers to focus their time and effort on developing new features rather than recreating existing logic.

Engineering biology is complex (see "Introduction to synthetic biology")—one of the reasons that Foundry scale is important is that it remains highly difficult to predict the performance of a biological "part" in a given context from a DNA sequence alone. The genomics revolution has outpaced biologists' ability to test the functionality of each DNA sequence as it was discovered, particularly because most of the community is still performing biological experiments by hand without the benefit of automation. Each program performed at Ginkgo involves testing thousands to millions of DNA sequences; with a small fraction of those ending up in our final engineered cells.

This reflects the advancement of Ginkgo's Codebase and the three levels of biological assets and data that it indexes and organizes:

1. Sequence data from public databases and proprietary gene sequences from a range of unique sources. Our proprietary data asset of metagenomic gene sequences contains over 2.7 billion unique protein sequences that we leverage in the training of large language models and the design of sequence libraries for many campaigns.
2. Vast datasets mapping genotype to phenotype from every strain test within a campaign (approximately 513 campaign starts in 2023). These datasets, including all the sequences of "losing" designs and "negative" data are incredibly valuable for fine tuning task-specific AI models for generative design of RNA, DNA, or protein to particular functional performance specifications.
3. High performance, reusable sequences that can be thought of as a "parts catalog" that can be drawn from in the design of a new program. For example, we developed novel synthetic promoters (DNA sequences that can turn on

the expression of a gene of interest) that allowed us to increase production of proteins in yeast. Initially, we tested tens of thousands of designs to arrive at a select number of promoters with high performance. Now those high-performing promoters can be reused in any program that involves producing a protein in yeast; they are a modular piece of genetic code.

Ginkgo's Codebase allows our customers to draw from a broader set of biological assets than any single company would develop for a given application, as well as diverse host organisms that are optimized for the production of a range of different bioproducts. The scale and diversity of our programs have allowed us to develop a large Codebase that grows with the addition of each new program and can be opened to the broad swath of partners and cell programmers using our platform. The combination of well characterized, reusable parts, host organisms, foundry workflows, and design tools for the production of classes of products is referred to as a Cell Development Kit (CDK), inspired by the Software Development Kits (SDKs) used in the software industry to enable rapid development of complex applications.

Our Foundry and Codebase are inextricably linked. Our Foundry scale allows us to generate unparalleled Codebase assets. These Codebase assets help us improve our designs and provide reusable parts and chassis strains that improve the efficiency and probability of success of our cell programming efforts in the Foundry. As the capabilities of the platform improve, it drives further demand, which increases the rate of learning in our Codebase. The continuous learning and improvements inherent in this relationship is one of the key features of our platform.

We continue to invest in both the efficiency and reusability of our platform services and assets in areas where we have significant codebase and expertise, as well as expand into new domains and modalities. As we execute more programs, generate more data, and validate more CDK parts and hosts, we aim to get better and deliver value to our customers in less time, for less budget, and with lower technical risk.

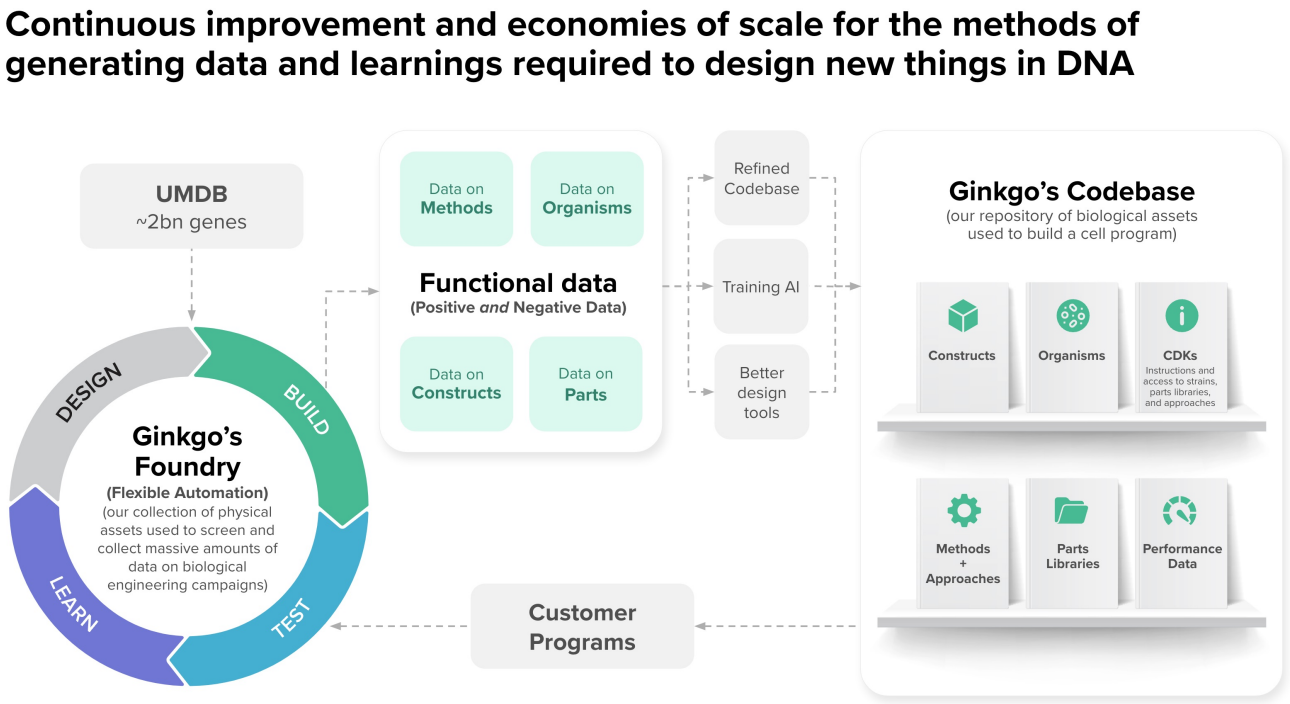


Figure 5: Our Codebase incorporates both biological assets from nature as well as engineered assets and data from our Foundry experiments. Because the Foundry enables us to test many thousands of prototype enzymes, pathways, and strains in individual engineering cycles, we are able to quickly expand the range of characterized biological assets in our Codebase.

An ecosystem to support cell programmers

Ginkgo has long recognized that it is critical to build a true ecosystem around our technical platform. We have been inspired by the leading horizontal platforms in information technology, such as Microsoft Windows and Amazon Web Services ("AWS"), which built real developer communities and provided a range of value-added services on top of their core technology. Like these pathbreakers, who set the stage for a generation of computer developers, we too are trying to

ensure that the cell programmers who build applications on our platform have the tools they need to succeed beyond the lab.

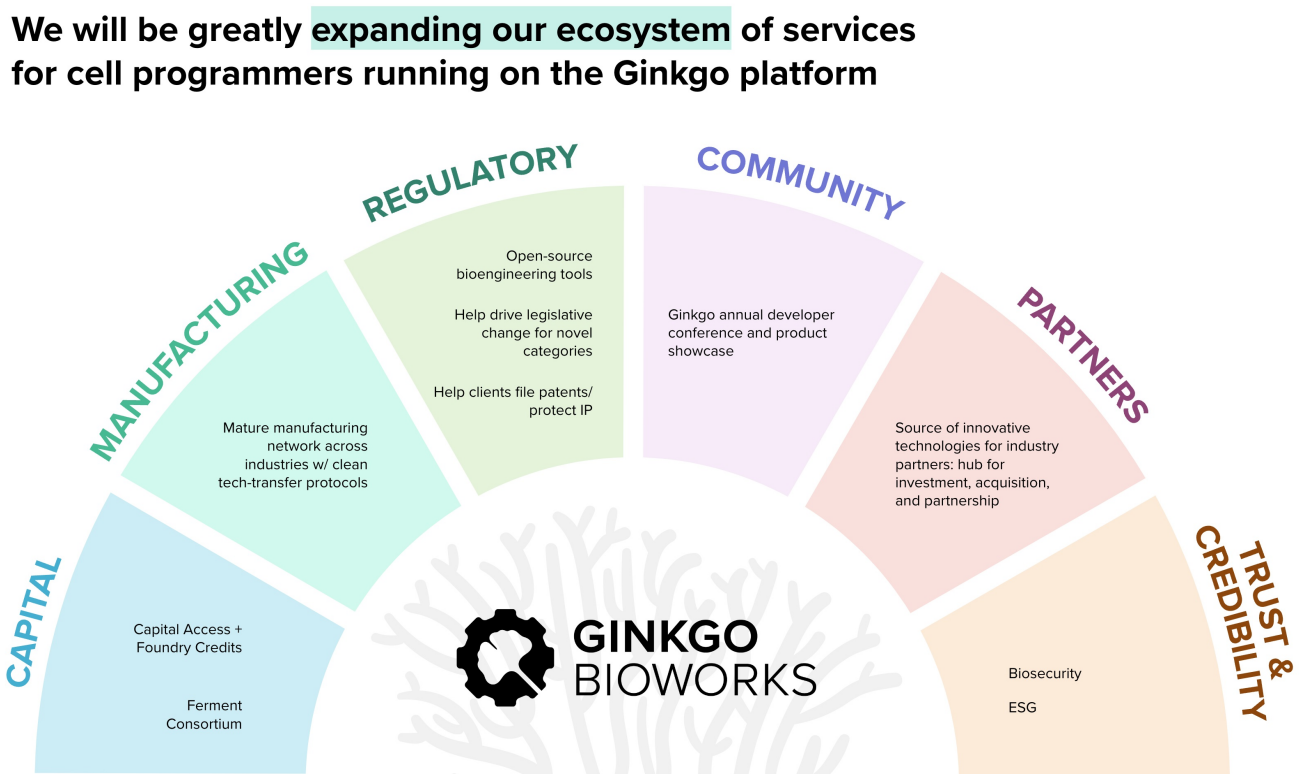


Figure 6: Ginkgo strives to create an ecosystem to ensure that cell programmers have the tools they need to succeed

Access to capital

As in the early days of computer programming, it is still extremely expensive to program biology. For that reason, it can be easier for larger companies to make investments in innovation around this space. But Ginkgo's platform gives small companies and innovators access to the same horsepower as larger players and obviates the need to invest in fixed laboratory assets, providing an even greater strategic benefit. To help address this discrepancy, Ginkgo has assisted in launching new companies (such as Motif and Arcaea) by bringing together strategic and financial investors to secure funding for these early stage companies. While we maintain a conservative approach to cash management, we are able to leverage our capacity and partner with investors to enable companies at all stages to benefit from our platform. We believe that, as Ginkgo's customers demonstrate increasing success, there will be an explosion of capital for cell programming applications and a recognition of Ginkgo's platform as setting the industry standard and providing the backbone for these development efforts. In a challenging capital markets environment, access to capital becomes an even bigger challenge for emerging companies. While we remain thoughtful around ensuring a healthy mix of large and small customers, our value proposition to emerging companies has continued to expand significantly.

Manufacturing support

Our job is to ensure that our cell programs can be executed at scale and we support our customers to ensure successful commercial scale manufacturing. We have built relationships with a number of leading contract manufacturing organizations and have demonstrated that we can transfer our lab-developed protocols to commercial scale (e.g., 50,000+ L fermentation tanks) with predictable performance. We have an in-house deployment team dedicated to supporting our customers' scale-up and downstream processing needs. We have even helped certain customers, such as Cronos acquire and build out their own in-house manufacturing capabilities and certain programs, such as our work with Moderna, focus on manufacturing process optimization.

In 2022, we acquired Bayer's West Sacramento agricultural biologicals R&D facility, which included robust pilot manufacturing infrastructure for microbial strains, with room to grow. We plan to continue to invest in this capability, helping bridge the gap for our customers between R&D and commercial production.

Intellectual property protection and regulatory support

Ginkgo takes responsibility for the cell engineering intellectual property generated through customer collaborations. Our scientific team collaborates with our customers and with Ginkgo's intellectual property team to file patent applications and monitor collaboration deliverables for freedom to operate. We are also active in the evolving regulatory landscape for biological engineering. While our customers are responsible for handling their own regulatory procedures on a product-by-product basis, our broader view can help build understanding of and support for novel product classes.

Building a community of cell programmers

We launched Ferment, our annual conference, in 2018. The conference highlights developments and thought leadership in the field and brings together scientists, entrepreneurs, investors, and suppliers, and we look forward to hosting our next Ferment in April 2024. Even prior to launching Ginkgo, our founders focused on building community within the emerging field of cell programming. Tom Knight, one of our founders, was among the professors who launched the iGEM Competition in 2004, which has now had over 70,000 participants from over 40 countries take part in the competition (including dozens of Ginkgo employees and all five founders!).

Facilitating partnerships within our community

Because Ginkgo serves both large market incumbents and smaller startups, our community also serves to facilitate introductions between innovators and those looking to invest in innovation. We believe that investors and large strategic companies have come to recognize Ginkgo's platform as a key enabler of innovation and are keen to get to know the companies that are building with us. Those relationships can be the source of funding and go-to-market support for the earlier stage companies building on the platform, increasing the odds that they develop successful products.

We invest in building trust and credibility for the entire industry

The most powerful technologies require the most care. Biology is too powerful for us to not care about how our platform is used. We have and will continue to invest heavily to build and maintain trust in bioengineering as a technology platform across all layers of the industry. At the platform layer, we have focused on building robust biosecurity measures. At the application layer, we are proud to enable a diverse set of programs that drive towards environmental sustainability. We are committed to ESG practices and broad stakeholder engagement at a corporate level. We are also engaged in deep conversations around the implications and ethics of biotechnologies through many forums, helping shape our platform and our ecosystem to promote sustainability in our global community.

Our Biosecurity platform—building the end-to-end infrastructure for countering biological threats

Our biosecurity platform is designed to provide end-to-end support for gathering, organizing, analyzing, and sharing data and insights on biological threats to inform decision-making. We combine:

- the technologies and logistics required for collection of physical samples,
- continually advancing biodetection capabilities, leveraging the expertise of our Foundry and external partners,
- state-of-the-art tools and infrastructure for data and analytics, increasingly enabled by AI,
- a team of scientific experts who work directly with customers to shed light on trends in biological risk, and
- a long-term partnership mindset focused on meeting our partners' sustained biosecurity needs.

We lead with care across our platform. Our bioradar approach places privacy at the center, using anonymized and aggregated samples to glean insights on pathogens without requiring the collection of any personally identifiable information. As developers of AI/ML tools and biosecurity experts, we are actively helping policymakers to understand potential risks at the nexus of AI and biotechnology and develop guardrails and tools to manage them.

We're building a global bioradar network

We believe that every person—and therefore every country—on the planet should have access to biosecurity tools. Biology doesn't respect borders, so we can't achieve local biosecurity goals without plugging in gaps in global biosecurity, and vice versa.

We are working to establish long-term partnerships with national governments, taking a comprehensive approach to empowering their biosecurity goals. We partner with local operators on the ground to equip and train them to conduct sample collection, in order to be minimally disruptive to ongoing operations in airports, municipalities, and beyond. We

work with in-country laboratories and public health institutions—for instance, the Rwanda Biomedical Centre—to build local capacity for sample testing and sequencing through training, supplies and equipment, quality assurance, and ongoing technical support. This year, we joined forces with Illumina, Inc., a global leader in sequencing and array-based technologies, to further expand biosecurity capabilities, particularly next-generation sequencing tools, across the international market.

Taken together, these aspects of our model allow us to rapidly scale to new bioradar nodes in our partner countries, where we establish persistent monitoring programs for biological threats. Many of these nodes are international airports, which multiply the reach of our network by tracking incoming pathogens from over 100 countries of origin. These programs add immediate local value by providing early warning for pathogens entering or emerging within a country, while also contributing to a unified data asset that gives our partners access to broader and deeper global insights than what any country alone is collecting.

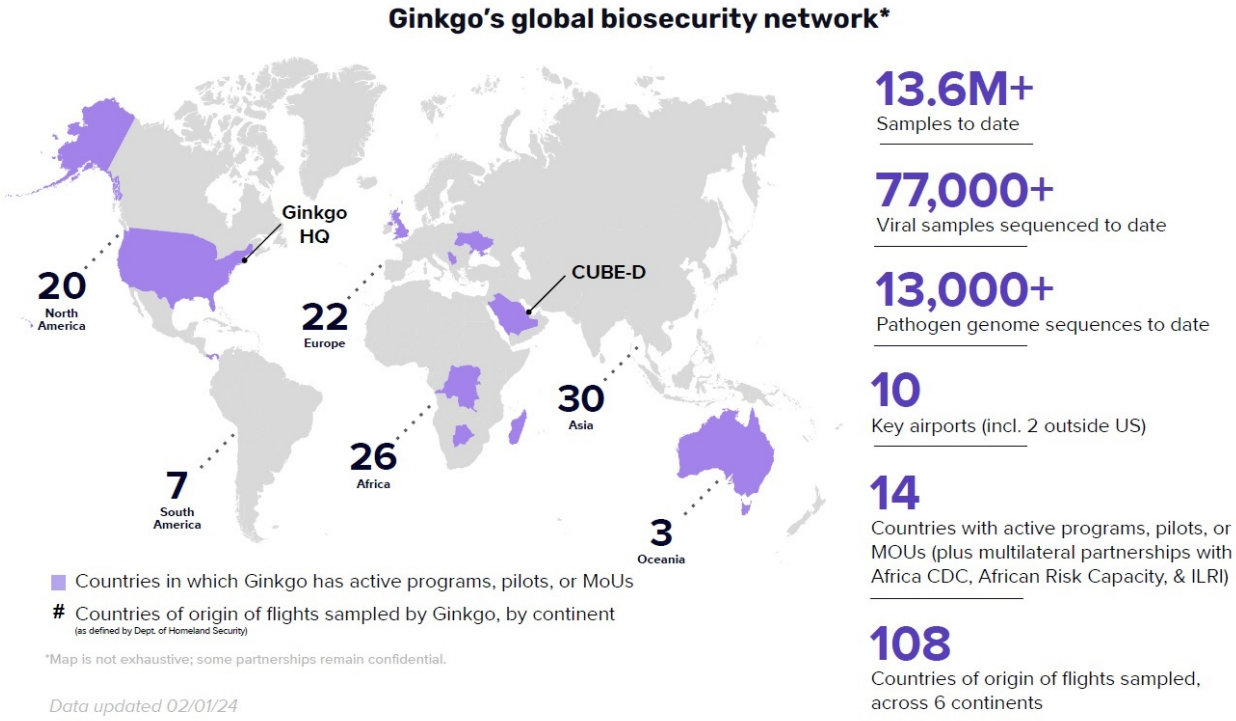


Figure 7: Our global network now includes 14 countries and several multilateral organizations who are actively building biosecurity infrastructure on our platform, with 10 international airports running active pathogen monitoring programs.

As we've stood up distributed nodes, Ginkgo's headquarters in Boston has served as a hub for analyzing data from our global network throughout the development of our Biosecurity business. In the future, our network will increasingly be bolstered by regional hubs, known as Centers for Unified Biosecurity Excellence (CUBEs). We recently announced the establishment of CUBE-D, a first-of-its-kind international biosecurity analytics center in Doha, Qatar. When completed, this facility will support analysis of data from bioradar nodes across the region to generate valuable insights.

We push the frontiers of biodetection to new nodes, modalities, and targets

We are developing our tools and techniques to collect new types of samples from new varieties of nodes, partnering with public, private, and academic institutions for research and development. Early in our development, we were focused on collecting nasal swab and saliva samples in schools, senior living communities, correctional facilities, and other congregate settings. As we have established airport-based monitoring in partnership with CDC, we have innovated new methods to collect wastewater from aircraft, lavatory trucks, and the airports themselves. We plan to continue evaluating new sampling approaches for addition to our platform, such as air monitoring.

We are also expanding to differentiated nodes. While airports and aircraft represent the largest share of our network, we've also expanded our model to diverse settings, from municipal conflict areas in Ukraine, to a dairy farm in Australia, to the deer populations of Texas. In the future, these development efforts can help us to strategically place nodes in settings where

we think pathogens are most likely to emerge or spread, with the aim of enhancing our capabilities to provide early warning.

Figure 8: Our collection technologies are expanding, and we aim to eventually be able to sample from a wide variety of nodes where pathogens emerge or spread, such as those pictured above. (Note: nodes are illustrative and not necessarily indicative of past programs.)

In the past year, we've rapidly expanded the capabilities across our network to mature from the SARS-CoV-2 monitoring programs of the emergency pandemic response to over 30 new viruses, bacteria, and antimicrobial resistance targets. Where today our sequencing platform identifies and characterizes pre-determined sets of targets that are amplified or enriched within samples, we look forward to incorporating customized detection tools and metagenomic (or fully agnostic) sequencing technologies that can afford us greater flexibility to detect a wider variety of known and as-yet unknown threats.

Generating a new form of intelligence

The goal of collecting genetic sequencing data on pathogens and biological threats is ultimately to generate actionable biological intelligence that can help decision makers plan timely, effective, and resource-efficient responses, guide the development and deployment of novel countermeasures (such as vaccines and therapeutics), and attribute the origins of a given threat. We are building towards this goal with state-of-the-art data integration, analysis, and reporting capabilities that are increasingly enabled by AI/ML and develop symbiotically with Ginkgo's Foundry and Codebase.

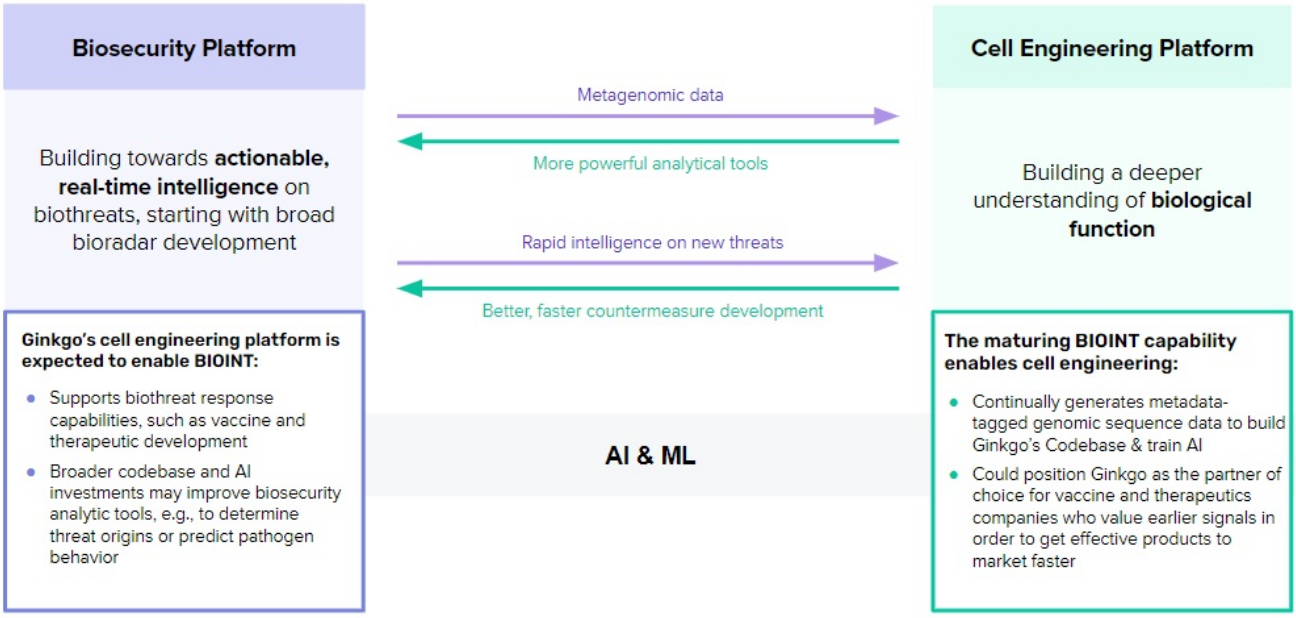


Figure 9: Ginkgo's biosecurity and cell engineering platforms accelerate each other's development through feedback loops of data, analytics, and intelligence on Ginkgo's AI/ML platform

Our bioinformaticians ingest bioradar data and assemble biothreat genomes to rapidly detect anomalies (threats emerging or surging in unexpected ways) and identify new variants of pathogens that could have a negative impact. These pathogen genomic insights have provided early warning, such as in the case of SARS-CoV-2 Omicron sub-variants BA.2 and BA.3, which were identified through our traveler-based program with CDC 7 and 43 days, respectively, before clinical detection in the U.S., and fill in gaps in genomic surveillance of pathogens with little to no data available globally. We plan to continue developing our capabilities in genomic epidemiology to better understand pathogens' evolution through time and space and help predict the emergence of new variants.

Pathogen genetic data also forms the basis for our novel engineering detection system, known as ENDAR (Engineered Nucleotide Detection and Ranking). ENDAR is a computational platform that uses a series of algorithms, reference databases of genomic data, and expert analysis to identify and characterize genetic engineering in a sample of interest. The platform is designed to be compatible with a variety of real-world applications and samples—ranging from clinical specimens to complex, multispecies samples such as those collected from wastewater or the environment. By systematically identifying known or novel strains and various signatures of engineering in a given sample, ENDAR can help us determine not only whether a sample was engineered, but where in the genome, how, and potentially why it was engineered.

We supplement the pathogen genetic data from bioradar programs with a collection of open-source intelligence through digital surveillance. We track hundreds of different open-source epidemiological data feeds—ranging from official public health reports to unofficial sources like media and social media—on an ongoing basis. We use natural language processing and machine learning techniques, along with careful expert review, to aggregate, structure, and validate these insights into a unified data feed that identifies and tracks the progress of infectious disease outbreaks all around the world for early warning and situational awareness. In addition to this near-real-time monitoring, we have curated a database with information on thousands of outbreaks from the past 60 years.

We use all of this information to model how diseases spread and estimate the risk that they pose. For instance, we:

- advance global experts' understanding of the likelihood and distribution of future epidemics and pandemics to inform policy conversations,
- help regional leaders understand the risk profile of their jurisdiction to inform preparedness investments, and
- iteratively design our bioradar sampling strategies for more efficient capture of high-risk targets.

We're currently working with a consortium of partners funded by the CDC Center for Forecasting and Analytics, known as EPISTORM, to advance capabilities for forecasting and predictive analytics, such as finding new ways to tell when a disease is about to spike and what measures should be taken against it. Taken together, these efforts are bringing us closer to generating a novel form of intelligence on biological threats.

Our Business Model

The key input into our unit economics is a cell program. For each of these cell programs, we generate economic value in two primary ways. First, we charge service fees for Foundry services, in much the same way that cloud computing companies charge usage fees for utilization of computing capacity or CROs charge for services. Additionally, we negotiate a value share with our customers (typically in the form of royalties, milestones, and/or equity interests) in order to align our economics with the success of the programs enabled by our platform. As we add new programs, our portfolio of programs with this "downstream" value potential grows. Because we typically do not incur material downstream costs (e.g., manufacturing or product development, which our customers manage), these value share payments flow through with approximately 100% contribution margin. This flexible business model allows for more predictable near-term revenue in up-front research fees and technical milestones without sacrificing our ability to create long-term value with asymmetric upside through downstream value share (typically in the form of a royalty stream, milestone, and/or equity share).

Foundry (or Cell Engineering) Revenue

Illustrative Program Economics

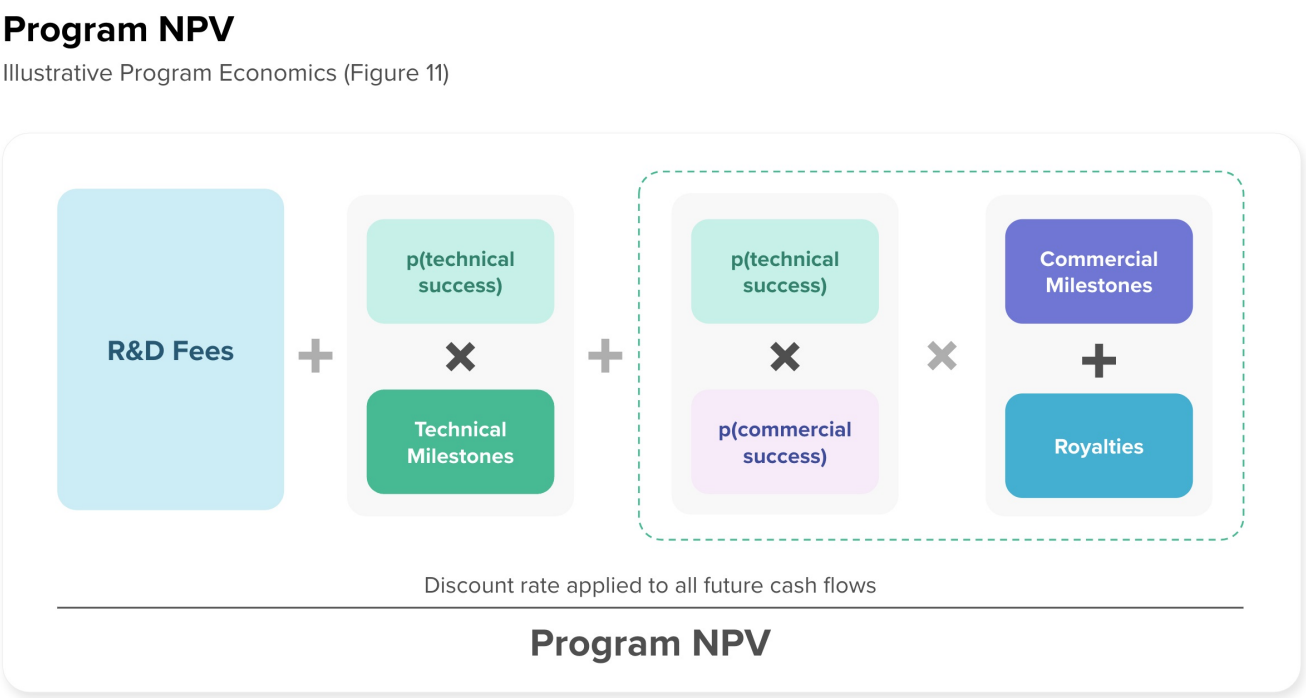


Figure 10: Ginkgo generates economics from programs in multiple ways that help calculate a program's NPV. First, customers generally pay upfront fees to cover initial R&D costs for a program. Ginkgo also receives revenue from the technical milestones that the program achieves throughout the R&D process. Ginkgo also shares in the downstream value of a given program, typically in the form of commercial milestones and royalties generated by a given program.

Cell Engineering Service Fees

The first stage of a cell program consists of R&D work being performed on Ginkgo's platform, leveraging our Foundry and Codebase. R&D is inherently risky and our customers recognize that this is a cost they will incur regardless of success and whether they are working on the program in-house or with a partner. Ginkgo can provide a much more efficient platform to conduct this R&D work, encouraging companies to build on or adopt our platform.

We estimate that the unit costs of our Foundry cell engineering services are several times less expensive on average than the status quo (a customer doing equivalent R&D in-house, by-hand) and we expect that cost advantage to grow over time. We typically earn service fees tied to the units of work that we perform on behalf of our customers' programs and as our platform matures, we would expect our growing cost advantage to enable us to fully cover our direct costs, eventually enabling us to earn a modest margin. Service fees provide a strong foundation of predictable revenue that is independent of any commercialization efforts by our partners.

As we continue to scale the Foundry and build Codebase, we expect to drive further efficiencies and decrease our average unit costs. This presents us with a strategic choice going forward. We could retain these efficiencies and increase our margins or we could pass these efficiencies on to our customers, increasing the number of shots on goal and, therefore, the likelihood of program success given a fixed budget. We believe the right choice for long-term value creation is to pass the savings to our customers, reducing the barriers to adoption and driving increased demand for our platform. Our service fees are thus impacted by a number of drivers:

- Number of active programs: We hope to dramatically increase the number of programs working on our platform over time, and if we are successful, we believe this will drive increasing service fees.
- Units of work per program per year: If our Foundry becomes more efficient as we scale, we have the opportunity to run more experiments with the same budget. At the same time, technical advancements, such as our investments in AI, may allow us to achieve program goals with less work.
- Average price per unit of work: If we bring on innovative technologies or step change improvements in existing Foundry services, we plan to pass capability and cost improvements on to our customers. If these new technologies or services are adopted across programs, we believe the average price per unit of work will fall over time.
- Number of years per program: If our platform improves, we expect program duration to decrease over time. Some programs may still be charting new territories and take several years, but programs that are able to leverage substantial pre-existing Codebase (e.g., our Nth program in bulk protein production) should have shorter duration and, in general, greater Foundry capabilities should shorten program durations.

The multi-year nature of an average cell programming project means that our service fees are recurring in nature. Additionally, given the lead times inherent in developing technical plans as part of a sales process, we have visibility into new service fee bookings. This provides a strong foundation for the business and allows us to be patient while we wait for downstream economics.

Downstream Value Share

As the key enabling technology for our customers' products, we are able to earn a share of the value of the products that are created using our platform, an important component of the financial potential of most cell programs. We are quite flexible and have structured a variety of value sharing mechanisms, including royalties, lump-sum milestones, and equity payments. As Ginkgo has matured, we have seen a shift in our downstream value towards milestone payments and commercial royalties rather than equity.

Because Ginkgo typically will have completed the program (and received associated service fees) prior to realizing downstream value, cash flows from the downstream value capture component generally fall straight to the bottom line as we incur minimal to no ongoing support or delivery costs once the strain is commercialized. This dynamic creates opportunities for outsized returns as our clients successfully commercialize products built on our platform. As we add more programs to the platform over time, we expect downstream value share to contribute income, and therefore we believe our overall margins and cash flow profile will grow significantly. The realization of potential revenue related to downstream value in the form of potential future milestone payments and royalties and/or equity consideration is dependent upon a number of factors, including our ability to successfully develop engineered cells, bioprocesses, data packages, or other deliverables, and the product development and commercialization success of our customers.

Biosecurity Revenue

Since the end of the COVID-19 public health emergency in May 2023, Ginkgo has transitioned its Biosecurity business to focus its efforts on building out scalable biosecurity infrastructure. As of February 2024, Ginkgo has partnered with 14 countries to form memorandums of understanding, active or pilot programs. Through these partnerships, Ginkgo works to operate programs for collections, testing, sequencing, and insights delivery on pathogen samples in different countries. Ginkgo is also investing in building our BIOINT offering and wraparound technical assistance services in 2024, in consultation with our existing network and additional public and private partners, as we think it has the potential to significantly drive revenue in the future. Our revenue flows are expected to become more recurring as we increasingly incorporate longer-term contracts with recurring monthly fee models for data, analytics, and services.

Our Sustainable Advantage

We have defined a unique business model over the past 16 years. The biotechnology industry has been product-centric for decades, with early horizontal platforms in life sciences frequently vertically integrating upon the development of the first

successful product on their platform. As Ginkgo has embarked on this journey, we have studied and learned from innovators and established platform companies in other industries as we built our platform and business. We now benefit from significant historical investments, a virtuous cycle that grows with scale, and a strong business model that is aligned with our customers' outcomes. These establish a strong sustainable advantage that we believe will help establish Ginkgo as a true industry standard.

Decade-plus head start in creating an industry standard platform

Hardware, software and biological tools need to be tightly integrated to replicate our platform. We have spent over 15 years building the software, automation and data science to best support a high throughput, generalized platform and expect to continue investing in this area. Our software, automation and data infrastructure cannot be easily replicated without bringing together a number of rare, specialized skill sets. In addition, without the scale and demand to stress test a high throughput platform, we expect any newly developed platform would be suboptimal. We estimate that it took us over eight years of investment and iteration to reach cost parity with "by hand" cell programming. We believe competitors will find it difficult to justify the investment in the software, automation and data science needed for high throughput operations before they acquire matching high demand.

Scale economics provide a structural cost advantage

As the only scaled horizontal platform in this space, we have the broadest number of programs that can be run on our platform, providing the highest potential for scale economics. Other companies choose to target specific markets and vertically integrate into products with high expected value. This has a tendency to overfit the capabilities of their R&D team to their targets. As discussed above, our continued scaling and investment in flexible tools that can apply to a broad range of end markets helps us drive efficiencies in the Foundry and Codebase across our diverse programs. Furthermore, as we scale, we are able to leverage advanced technologies that are only practical at scale and also may obtain preferred pricing with a number of suppliers. Competitors may be unable to source equivalent technology or negotiate similar pricing without first achieving scale, a feat that is difficult to do with a narrowly focused R&D platform.

Strong network and learning effects

In addition to a raw scale economic, we also accumulate knowledge and reusable Codebase from each program that runs on the platform. Every program benefits from the programs that came before and generates benefits for other current and future programs. These learnings and reusable assets are cumulative, extremely hard to replicate, and increasingly valuable to our customers. Because our learnings are generated by the work we execute in our Foundry, the scaling in our Foundry drives a scaling in our rate of learning. Thus, there is a recursive element to our platform: as the platform gets better, it also improves faster—we are excited to make this advantage of our platform available to our ecosystem of cell programmers.

As Ginkgo drives scalability through our models, we have heavily invested in the use and creation of AI foundational and fine-tuned models. Efficient use of AI is only possible with the use of massive amounts of data. Because of our access to large amounts of data, Ginkgo has the ability to build superior foundational models and from there, build fine-tuned models designed to cater to our customer needs. We believe this is and will continue to be a major asset to our current and future customers.

Ginkgo's value creation is aligned closely with customer success

Our platform drives value for customers along two dimensions: reducing the cost of laboratory work via automation and increasing the probability of technical success due to cumulative data and learnings. Our financial model is aligned with those factors. As we gain efficiency, we drive further demand for cell programming, which drives our Cell Engineering revenue up. As both demand and probability of success increase, our risk-adjusted value share also increases. Our model only requires we share in a small fraction of the downstream value created by our programs, providing our customers the opportunity to generate and retain significant value. Ultimately, this encourages broader adoption of our platform across industries.

Furthermore, we seek to maintain close relationships with our customers, supporting their work, and earning their loyalty and satisfaction. The breadth and highly integrated nature of our platform makes it inefficient for a customer to simultaneously work with Ginkgo and any theoretical competitor. As there is not yet a standard interface for cell programming, it requires an upfront investment to learn how to choose and design programs to make the best use of our platform. These substantial switching costs are expected to be a long-term driver of customer retention.

We are uniquely positioned to attract the top cell programmers

Just as the top software programmers want to work with the latest technologies, we believe the top cell programmers will be attracted to our industry leading platform and access to its unique capabilities. Our ability to hire and retain the best cell programmers as internal users and developers of our platform pushes us to continually improve and also builds a base of Ginkgo-trained experts. If these Ginkgo trained cell programmers move on to roles and opportunities in product-specific companies, we expect they will become ambassadors for the Ginkgo approach in their next role, expanding our reach into potential customers.

History of investing in credibility and trust

Let's face it, GMOs have an image problem. This image problem has led to activities by the first generation of genetic engineering companies that backfired: lobbying against transparency in labeling laws, trying to "rebrand" GMOs with different terminology, and other efforts that have failed to build trust and engagement with stakeholders. We have taken a different approach. Rather than avoid the term, we've championed transparent labeling, sought to engage and build trust through open dialog, and enthusiastically embraced the potential for GMOs to do great things. We don't seek to make GMOs acceptable through branding; we aim to make GMOs that people love.

Figure 11: Ginkgo seeks to make GMOs that people love.

Doing so requires care and attention to both the technical and social aspects of our platform and its impacts. This means investing in biosecurity and embedding it into our platform and how we operate (see below). This also means engaging with the social complexities of science and technology with a diverse group of people. We strive for a company culture based on a foundation of Diversity, Equity and Inclusion (see also the sections titled "—The Impact of Cell Programming —ESG is in our DNA" and "—Our People & Culture"), and aim to engage different perspectives through our creative residency and through our magazine, Grow. Through both our internal and external efforts, we seek to engage with the realities of what has made genetic engineering an ESG risk historically, and work towards equitable and positive impact.

Early investments in biosecurity

Too often, security infrastructure is built long after a new technological area has been built and commercialized, after security implications have already reared their heads and governments and corporations alike are left scrambling. We take a different approach—proactively acknowledging the risks inherent in biotechnological advances and addressing potential vulnerabilities. We aim to build biosecurity in tandem with biotechnology and the bioeconomy, through strong, early collaborations across the public and private sectors.

For instance, we started working on technology to screen DNA sequences for potential threats through an Intelligence Advanced Research Projects Activity (IARPA) program in 2017—a security need that became a critical global policy priority with the emergence of AI chatbots in 2023. We've built on that work with IARPA through additional projects to

identify whether a DNA sequence is engineered (yielding our ENDAR platform, see above) and create a cellular "flight recorder" to support attribution. For years, we have also contributed to and continue to learn from committed stakeholders and communities, including, for example, within the International Gene Synthesis Consortium and at the National Academies of Sciences, Engineering, and Medicine.

The COVID-19 pandemic drove our Biosecurity ambitions even higher, to formally establish a business unit that actually builds the global infrastructure needed to predict, detect, investigate, neutralize, and attribute biological threats, whether from Mother Nature, bioerror, or bioterror (see above). We choose to take a systemic approach—scoping biosecurity along the lines of modern cybersecurity infrastructure for protecting the digital economy—because it will be a critical piece of enabling the bioeconomy to grow to a similar scale.

We're working with national governments, scientists, and other partners around the world to move the needle on biosecurity vulnerabilities, from the ground up. We're also routinely helping policymakers to understand the evolving threat surface, shedding light on everything from the increasing trends in likelihood and severity of pandemics of natural origin to the biorisk of new generative AI models. We believe that advancing biosecurity across the whole ecosystem and leading its development will allow the bioeconomy to advance, and our platform and customers to lead within it.

Our Growth Strategy

We are seeking to usher in a new paradigm for cell programming. It took us over eight years of basic research and investment in software, automation, data science and scale to reach parity with the status quo of individual scientists conducting experiments by hand at a lab bench. It took us several more years to demonstrate business model maturity: delivering a platform with enough value-add to customers that we could cover the cost of cell engineering R&D programs while building Codebase and sharing in the downstream value of our programs. We believe that we are now at an inflection point where we have the opportunity to become the industry standard. We see several drivers of this evolution and growth.

Scale our platform and continue to drive efficiencies and improvements

As discussed above, our platform improves with scale and to date we have observed a positive feedback loop between our Foundry and Codebase. As we scale capacity and demand on the Foundry, we expect our average unit costs to fall, creating a better value proposition for our customers as their program budgets stretch further and drive more demand. Similarly, Foundry output also grows our Codebase, which supports better program execution and helps with building out our AI models, creating a better value proposition for our customers as well.

We occupy over 325,000 square feet at our headquarters and maintain state-of-the-art machinery and laboratory equipment. We have built more than 50 custom integrated work cells, consisting of robotic automation systems, mass spectrometry, fermenters, sequencers, and more. We have the capabilities to engineer dozens of species of organisms from bacteria to fungi to mammalian cells. We have worked on enabling products as varied as polymers, bacterial therapeutics, bulk protein production, novel antibiotics, fine chemicals, and more.

We have been able to work on a diversity of programs while consistently driving efficiencies in the Foundry with scale. We expect to accelerate growth in capacity by integrating new technologies across our existing footprint, building new Foundry space, and investing in software, automation and data to increase utilization.

Leverage our proof points to grow within all industries

We have now established proof points of success in a diverse set of end markets, in several cases far exceeding our customers' specifications. When engaging with existing customers or potential new customers in similar or adjacent industry verticals, we can point to these case studies of success to demonstrate the value of our platform. This reduces the barriers to adoption, helps us grow our customer base, and increases the number of new programs under contract. Importantly, the reusable Codebase we generate from these new programs enables us to stay ahead of vertically focused competitors.

Grow with existing customers

Once we establish a relationship with a customer, there is significant room to expand the scope of our program engagements. We are able to grow with our customers and/or expand into other existing pockets of R&D spending. We have seen customers expand from one early program to five or ten programs a few years later and each new logo we add has the potential to become a true platform partner.

When we work with companies from their inception (or at least from the inception of their biotech investments), we enable them to avoid significant fixed cost investments and benefit from our economies of scale. Our relationship with these customers is extremely strong, as we are the core technology powering their R&D efforts. As a result, when these customers scale, their usage of our platform typically scales commensurately. For companies with existing, established biological capabilities, as we demonstrate the value of our flexible platform, we are able to grow our relationships to complement their core capabilities and increase the probability of success.

Reduce barriers to adoption by integrating with external R&D teams

It can be easy to fall into the trap of assuming that new disruptive technologies must subsume existing ways of working. When hosted servers and SaaS started rising in prominence, corporate IT teams had to wrestle with changing integrations and demands. Some information technology departments were resistant to moving "off-prem" because they felt they were effectively outsourcing their jobs. In response, the leaders in this field, such as Dell, would sometimes hire their customers' information technology departments and find them jobs within Dell simply to get past this internal resistance. The reality was that these technologies were ushering in a much more substantial era for information technology, which dramatically increased the demand for this type of talent. This centralization of the model (from every company having large information technology departments building customized code to a broader array of specialized software vendors) didn't come at the expense of information technology and digital technologies, but enabled its flourishing across all industries. We see something similar happening in biotechnology today. Internal R&D teams are typically both very excited to learn about the power of our platform but are also understandably nervous about what "outsourcing" work to Ginkgo might mean for the future of their teams. We have the opportunity to help them see the benefit in a true partnership with Ginkgo.

The vast majority of programs being run on the platform today are being run and managed by Ginkgo program teams—in-house scientists and engineers who are managing the R&D project to meet a customer's specifications. Over time, we would like to build in enough standardized interfaces that a distributed network of scientists could access the platform directly through a well-defined integration and self-service layer. This transition will allow our program teams to devote more of their efforts to developing Codebase assets, enabling more rapid scaling, and reducing the barriers to adoption by our customers. There are significant technical hurdles for us to overcome in developing this technology, but it is on our roadmap and we are constantly thinking about how to "productize" individual workflows on the platform. As an example, we are developing CDKs that standardize common cell engineering workflows and assets, capturing best practices that we've identified.

Building long-term global partnerships for advanced infrastructure in biosecurity

In Biosecurity, we apply this mindset to our relationships with national governments. We work to build capacity in local and regional biosecurity institutions and integrate them into our operations as a means to add local value in each node while also strengthening the global network as a whole. We seek out partnerships that will allow us to have immediate local impact, grow our centralized Biosecurity data asset by providing unique insights, and further enable us to bring more countries and customers onto our platform. We often start our partnerships with well-established, off-the-shelf offerings, like our airport-based bioradar product, to lay the foundation for broader and longer-term engagements focused on growing and securing national bioeconomies. And we work with partners who enable us to accelerate our growth, such as Illumina: we co-market their next-generation sequencing technologies with our detection and analysis service offerings to expand our international reach.

Our People & Culture

A company is made of people. We have sought to bring together a diverse and multidisciplinary group of people who share our mission to make biology easier to engineer. Today, our extensive cross-functional team is collaborating to build our ecosystem, from organism designers to automation engineers, software developers the people team, business development to facilities management, finance to molecular biology.

A culture built on care

We've strived to grow a culture based on care. As engineers, it is easy to fall into the trap of thinking of ourselves simply as tool builders. Tools can be used in many different ways, both good and bad, and engineers often discuss their tools as value neutral. But tools reflect the social beliefs and biases of the people who make them: today this is becoming increasingly apparent, with more and more evidence of algorithmic bias being built into AI systems, facial recognition, and much more.

As designers of the largest horizontal platform for cell programming, we are keenly aware of the need to care about how our platform is used. More significant than the impacts we have seen from digital platforms on our social world, biology is

our health, our bodies, our food, and our environment. As we build the tools for programming biology, we must also care how those tools are used, and ensure that the risks and benefits are transparently and equitably shared.

A diverse, world-class team

As of December 31, 2023 we had 1,218 employees. Building a horizontal platform for cell engineering and a biosecurity and public health unit requires collaboration between diverse skills and functions. It also requires deep technical expertise. Our employees are dedicated to the following functions:

- Platform functions including organism engineering, design, DNA synthesis and assembly, genome engineering, protein engineering and characterization, transformation and transfection, next generation sequencing, assay development, ultra high throughput screening, analytical chemistry, synthetic chemistry, directed evolution, and fermentation.
- Platform infrastructure functions including automation, software, development operations ("DevOps"), product management, data engineering, data analysis, and data science.
- Deployment functions including upstream and downstream process engineering, project engineering, quality assurance and quality control.
- Commercial functions including marketing, business development, alliance management, and corporate development.
- Operational functions including bioinformatics, lab network management, delivery logistics and customer support.
- Shared enabling functions including legal, people, operations, finance, information technology, information security, facilities, environmental health and safety, procurement, shipping and receiving, inventory management, laboratory operations, media preparation, and transformations.

In addition to our employees, our success would not be possible without the collaboration and support of the broad network of partners, contractors, contingent workers and temporary staff who make up the Ginkgo team.

Technologies reflect the values of the people who build them. Diversity, Equity, and Inclusion are valuable and necessary in their own right, but we believe that it is essential to build a diverse team where people from different backgrounds are included and empowered to speak up and shape the growth of this technology. We are committed to growing a diverse team and continuing to empower an inclusive culture with strong employee ownership and engagement.

The full breadth of Ginkgo's diversity and inclusion cannot be captured in demographic statistics, just as demographic categories cannot capture the full spectrum of diversity of human experience; however, we collect and report these numbers for transparency and as a lagging indicator of our efforts. As of December 31, 2023, 42.1% of our U.S. employees self-identify as an underrepresented gender (not cis male) and 14.1% self-identify as coming from an underrepresented racial or ethnic group in science and engineering (Black or African American, Hispanic or Latino, American Indian or Alaska Native, and Native Hawaiian and other Pacific Islander). We are not yet satisfied with these numbers and all teams have objectives around increasing diversity and building a culture of inclusion to ensure that diverse perspectives thrive.

Laying the groundwork for strong employee engagement in the future

As a founder-led company we have been able to infuse the organization with long-term strategic thinking from the start. The long-term engagement and mentality of our employees can be seen in our turnover: voluntary attrition is well below the industry average.

The individuals who work at Ginkgo and build our platform care deeply about how that platform is used and the impact our company will have in the world. We hope to maintain the long-term mentality we have benefited from as a founder-led public company. We believe a workforce with strong equity ownership will make the wise decisions needed to build long-term value for our company and build a company whose long-term impacts make them proud. That is why we have implemented a multi-class stock structure that permits all employees (current and future), not just founders, to hold high-vote (10 votes per share) common stock. We believe that our multi-class stock structure will help maintain this long-term mentality and encourage long-term equity ownership by our employees, thereby resulting in increasing employee ownership over time. For more information, see *"Risk Factors—Risks Related to Ginkgo's Business—Risks Related to Our Organizational Structure and Governance—Only our employees and directors are entitled to hold shares of Class B common stock (including shares of Class B common stock granted or otherwise issued to our employees and directors in the future), which shares have ten votes per share. This limits or precludes other stockholders' ability to influence the outcome of matters submitted to stockholders for approval, including the election of directors, the approval of certain employee compensation plans, the adoption of certain amendments to our organizational documents and the approval of*

any merger, consolidation, sale of all or substantially all of our assets, or other major corporate transaction requiring stockholder approval."

Competition

To our knowledge, there are currently no other cell engineering companies that serve all industries covered by our horizontal cell programming platform. The solutions and applications offered by potential competitors vary in size, breadth, and scope, and given our broad set of application areas, we could face competition in many different forms. We face competition from customers' internal R&D departments and other research solution providers that largely conduct genetic engineering by-hand. We also compete against companies that seek to utilize synthetic biology technologies to develop specific products or target certain end markets. Additionally, competing platforms may emerge from various sources, including from joint ventures and partnerships between well-capitalized technology and life sciences companies. We identify the following three groups as our principal set of competitors:

The Status Quo: "on prem" cell programming efforts

The main source of competition we encounter is from potential customers choosing to build or maintain in-house cell engineering teams and capabilities. This status quo includes building out laboratory space and then hiring a team of highly trained scientists to conduct research, largely "by-hand" and with limited scale efficiencies. Some internal R&D operations maintain a full suite of capabilities and can design, build and test relatively complex pathways while others may have certain internal capabilities and need to outsource other elements to CROs. We believe this is far less efficient for the customer and likely to yield worse outcomes as customers get fewer shots on goal for a given program budget.

That said, it can still be very difficult for companies to choose to trust Ginkgo with their R&D efforts versus building more traditional "on prem" labs. Smaller companies may feel like they're "betting the farm" on Ginkgo, while larger companies may be sensitive to displacing existing R&D teams. As such, a key focus area for us is reducing the barriers to adoption for the platform by de-risking the upfront investment for earlier-stage companies and by helping larger companies integrate their scientists closely into our workflows and empower their scientists to manage requests directly so we feel more like a resource and partner than a fully outsourced provider. Investing in these areas is a key focus area for us going forward.

Examples of traditional "synthetic biology" companies that have been vertically integrated from their founding with a focus on building products using synthetic biology include Amyris, Inc. ("Amyris"), Genomatica, Novozymes, DuPont, and DSM. Additionally, the vast majority of therapeutics companies that are leveraging genetic engineering have in-house capabilities, including Biogen, Novo Nordisk, Vertex, Regeneron, Bayer, and many others. These companies may be viewed as competitors to Ginkgo because they are creating products, using cell programming, that may compete with the products Ginkgo is enabling for our customers. However, as a horizontal platform, we view these companies not as competitors but as potential customers and focus not on "beating" them but rather on demonstrating our value proposition.

Verticalized cell engineering platforms

Within certain end markets, Ginkgo may compete against vertically-focused biotechnology companies providing cell engineering R&D capabilities to customers within a narrow set of end markets. While we believe the siloed nature of these companies limits their long-term potential, in the near-term, we may have a harder time penetrating those end markets given the incumbent vertical specialists in that space. The vast majority of these companies exist within therapeutic end markets given the history of cell engineering in that field. In theory, the expertise and learnings they develop from work in one field could be leveraged into neighboring end markets if these companies decided to adopt (and invest in) a more horizontal strategy. Examples of these vertically-focused platforms include AbCellera (antibody discovery), Codexis (enzymes), Senti Bio (cell therapy for oncology applications) and WuXi biologics (therapeutics).

Other possible entrants

We may also face competition from new entrants in the market, including well-capitalized technology companies with possible strategic interests in synthetic biology and its capabilities. Such companies may emerge as competitors given their access to capital, capacity to create multi-disciplinary teams across biology, chemistry, computer science and engineering, and flexibility to enter strategic ventures with life sciences companies.

Biosecurity competition

We're unique in the global biosecurity market because our approach is global and comprehensively covers end-to-end biosecurity needs. We face competition from a small number of companies who operate in single biosecurity verticals, such as wastewater monitoring (e.g., Verily and Biobot, both primarily in the US) and digital biosurveillance and modeling (e.g.,

BlueDot, Airfinity, and the Public Health Company), as well as internationally from BGI, China's national champion for sequencing and diagnostics. As we partner with national governments, we also face competition from homegrown public solutions to particular vertical challenges, especially among high-income countries and large multilaterals with little history of engagement with the private sector.

We have several important attributes that contribute to our competitive advantage:

- Ginkgo's cell engineering platform, which allows countries to partner with us across biosecurity and bioeconomy needs (e.g., in Serbia), sets us up for future biosecurity partnerships with medical countermeasure developers across the biopharma industry who work with the Foundry already, and accelerates our technical development through access to proprietary Codebase and AI;
- unique technological tools, like our ENDAR platform for engineering detection, that to our knowledge has no equivalent capabilities in the world;
- a comprehensive offering that allows customers to come to a single platform for multimodal physical and digital surveillance and integrated global insights, rather than fragmented approaches;
- a foundation of partnerships with 14 countries and key multilaterals such as Africa CDC, African Risk Capacity, and the International Livestock Research Institute; and
- global leadership in the airport-based pathogen monitoring space.

Intellectual Property

Overview: Foundry and Codebase

As discussed above, Ginkgo's two core platform assets include:

- Ginkgo's Foundry, which enables high-throughput cell programming; and
- Ginkgo's Codebase, which includes reusable biological assets that can be used to accelerate cell programs.

Ginkgo protects each of these core assets—the Foundry and the Codebase—through a combination of patents and trade secret protections.

Patents

Our general policy has been to seek patent protection for those inventions likely to be incorporated into our offerings. Many of our collaboration agreements also provide a limited exclusive patent license to our collaboration partners relating to new technology developed in the collaboration. We typically retain the right to outlicense patents developed in connection with collaborations to third parties outside the scope of the exclusive license granted to our collaboration partner.

Our worldwide patent portfolio includes patents acquired in transactions over time, including, most significantly, our acquisitions of Gen9 in 2017; Novogy in 2020; and Zymergen Inc. ("Zymergen") in October 2022. Because these acquisitions more than doubled the size of our patent portfolio, and because the strategic priorities of the companies we acquired often differed from Ginkgo's priorities, we may decide that it is in our interest to abandon, sell, or otherwise dispose of certain patents or patent applications from these acquisitions or that we determine are no longer relevant to our business.

Patents generally have a term of twenty years from the date they are filed. As our patent portfolio has been built over time, the remaining terms of the individual patents across our patent portfolio vary. No single patent or patent family is essential to Ginkgo as a whole or to any of Ginkgo's subsidiaries. In addition to developing our patent portfolio, we license patents from third parties.

We intend to pursue additional patent protection to the extent that we believe that it would be beneficial and cost-effective. We cannot provide any assurance that any of our current or future patent applications will result in the issuance of patents. We also cannot assure the scope of any of our future issued patents or warrant that any of our patents will prevent others from commercializing infringing products or technology.

Trade secrets

Ginkgo's technology-related intellectual property that is not patent-protected is maintained as trade secrets. We employ a variety of safeguards to protect our information and trade secrets, including contractual arrangements with our employees, consultants, contractors and other advisors that impose obligations of confidentiality, assignment of inventions, and security; digital security measures; and physical security precautions.

We require confidentiality and material transfer agreements from third parties that receive our confidential data or materials, and we also incorporate confidentiality and material transfer precautions into our collaboration agreements. For example, in the course of a cell program, we might transfer samples of intermediate strains to the customer for testing and scale-up work and then transfer a final commercial strain upon completion of our work. To protect both intermediate and final strains, we use strain transfer agreements that document the contractual restrictions and controls we have put into place, typically including, in the case of intermediate strains, covenants requiring the customer to return or destroy all strain samples after testing.

Trademarks and domain names

Although our business is directed at sophisticated corporate customers rather than end consumers, we have trademark rights and registrations in our name, logo, and other brand indicia in the United States and other jurisdictions around the world. We also have registered domain names for websites that we use in our business, such as www.ginkgobioworks.com.

Intellectual property transaction structure

We earn revenue from collaboration agreements with customers under which we perform cell programming activities. Through our cell programs, we develop cells that produce or are products for our customers, which they market in their verticals.

With respect to intellectual property, we have relatively standard transaction structures that apply to cell programs for a customer. In this situation, our collaboration agreements typically provide that Ginkgo will own all collaboration-related intellectual property ("Foreground IP") concerning cell programming. To protect our collaboration partners' investment in the collaboration and to provide them with a competitive advantage from working with Ginkgo, Ginkgo provides a limited exclusive license to patents within the Foreground IP that cover the product, usually within a specified field. However, our terms may vary.

We typically do not provide exclusive licenses to unpatented Foreground IP (i.e., trade secrets and other know-how) that results from a collaboration. In our typical deal structure, we also do not provide exclusive licenses to our "background" intellectual property—i.e., the intellectual property, whether patented or unpatented, that we developed before entering into a collaboration or develop independently from our work in the collaboration. We believe that our transaction structures allow us to maximize the reuse of Codebase across programs and ensure that technology we develop does not lie fallow.

In-License Agreements

In addition to our proprietary methods and technologies, we also non-exclusively in-license certain intellectual property assets from third parties.

Amyris Partnership Agreement

On October 20, 2017, we entered into a partnership agreement (the "Partnership Agreement") with Amyris, which, as amended from time to time, terminated all prior agreements between Ginkgo and Amyris. In the Partnership Agreement, Amyris, among other things, granted us a non-exclusive license effective as of June 28, 2016 (the date of an earlier agreement between the parties) under all of Amyris's rights in and to certain specified microbial strains, and under all patents and applications associated with such microbial strains, to make, have made, use, sell, offer to sell and import any products other than farnesene and/or farnesene derivatives that are chemically produced from farnesene. The license is subject to any previous exclusive licenses provided to third parties and is royalty-free, fully paid-up, sublicensable, non-exclusive and perpetual (i.e., it survives termination or expiration of the Partnership Agreement except in the case of our insolvency).

Strateos Collaboration Agreement

On October 2, 2017, we entered into a collaboration agreement with Strateos, Inc. f/k/a Transcriptic, Inc. ("Strateos"), which was amended and restated on April 20, 2021 (the "Strateos Collaboration Agreement"). Under the Strateos Collaboration Agreement, Strateos granted us a non-exclusive, perpetual, irrevocable, fully paid-up, royalty-free license under certain intellectual property rights to use its software platform in a range of activities relating to our business, including, among other things, developing and commercializing cell lines, developing data packages, providing foundry and analytical services and performing diagnostic testing. The Strateos Collaboration Agreement expired in 2022 and we retain a license to use Strateos' software.

Suppliers

Ginkgo's suppliers for cell programming operations comprise primarily manufacturers and distributors of life science tools, consumables and equipment as well as certain specific providers of contract research, development and manufacturing services. We will sometimes enter into long-term, strategic partnerships with innovative suppliers. Because of the significant scale of our Foundry's operations, we believe we are often an early adopter and the largest customer at scale of certain new life science tools and technologies. We will also occasionally acquire technology or Codebase assets for strategic reasons and because we can integrate the technology effectively into our platform — Zymergen, Altar, and Circularis Biotechnologies, Inc., ("Circularis") are recent examples.

Our software, automation, data, information technology, DevOps and information security functions utilize various third party software and information technology service providers, including AWS, for data storage and processing. We also routinely engage a variety of third parties for professional services, contract employment services and consulting services.

Government Contracts

We have entered into agreements with governmental entities and contractors in the past to serve as a U.S. government contractor or subcontractor and may do so again in the future. See "*Risk Factors—Risks Related to Governmental Regulation and Litigation—We have pursued in the past and may pursue additional U.S. Government contracting and subcontracting opportunities in the future and as a U.S. Government prime contractor and subcontractor, we are subject to a number of procurement rules and regulations.*"

Government Regulations

Our business, or the business of our customers, may be regulated by the FDA and other federal authorities in the United States, including the U.S. Federal Trade Commission ("FTC"), U.S. Department of Agriculture ("USDA"), U.S. Drug Enforcement Administration ("DEA") and U.S. Environmental Protection Agency ("EPA"), as well as comparable authorities in foreign jurisdictions and various state and local authorities in the United States. Failure to comply with applicable regulations may result in enforcement actions, civil or criminal sanctions, and adverse publicity.

FDA regulation

We provide cell engineering and product discovery services to customers engaged in the manufacture of foods, cosmetics and pharmaceutical products. The FDA regulates the research, development, testing, quality control, import, export, safety, effectiveness, storage, recordkeeping, premarket review, approval or licensure, processing, formulation, manufacturing, packaging, labeling, advertising, promotion, marketing, distribution, sale, post-market monitoring and reporting of our customers' pharmaceuticals, cosmetics and food products, and the FTC also regulates the advertising and promotion of these products.

We have acted as a systems integrator and authorized distributor of certain COVID-19 over-the counter diagnostic tests manufactured by independent third parties. We worked with laboratory partners that provide surveillance testing services as part of the COVID-19 and other pathogen surveillance testing services we offer, and these tests and test kits may be subject to regulation by the FDA. In particular, the tests and test kits used in our testing services may be subject to regulation by the FDA as medical devices, and may be required to comply with the requirement that such products have obtained clearance, approval, or other marketing authorizations, before they can be commercialized, as well as post-market requirements such as adverse event reporting and restrictions on labeling, marketing, and distribution.

Laboratories must seek FDA marketing authorization and otherwise comply with FDA device regulations when marketing COVID-19 Laboratory Developed Tests ("LDTs"). An LDT is an in vitro diagnostic test that is intended for clinical use and is designed, manufactured, and used within a single laboratory. LDTs are classified as medical devices, but the FDA has historically exercised enforcement discretion and has generally not enforced FDA requirements, including premarket review, with respect to laboratories that offer LDTs. However, FDA intends to phase out its enforcement discretion for LDTs. While HHS and FDA have announced their intention to require premarket review of COVID-19 LDTs, either agency may change its position in the future.

Medical products, including COVID-19 tests, that are granted a clearance, Emergency Use Authorization ("EUA"), or other marketing authorization must comply fully with the terms and conditions provided in the clearance, EUA, or other marketing authorization. For example, EUAs for COVID-19 tests may include conditions of authorization applicable to the EUA holder, authorized distributors and authorized laboratories. Noncompliance with applicable requirements could result in negative consequences, including adverse publicity, judicial or administrative enforcement, warning letters or untitled letters from the FDA, mandated corrective promotional materials, advertising or communications with doctors, and civil or criminal penalties, among others. The FDA can also withdraw marketing authorization for the applicable product, and in

the case of a product subject to an EUA, the FDA may require EUA holders to transition to permanent marketing authorization which could impact some of the tests in our supply chain.

DEA regulation

We are engaged in the research, development, and export of certain products that may be regulated as controlled substances, including microbes designed to generate precursors to cannabinoids or other chemical intermediates. The Controlled Substances Act of 1970, as amended from time to time, establishes registration, security, recordkeeping, reporting, storage, distribution and other requirements administered by the DEA. The DEA is concerned with the control of handlers of controlled substances, and with the equipment and raw materials used in their manufacture and packaging, in order to prevent loss and diversion into illicit channels of commerce. The DEA regulates controlled substances as Schedule I, II, III, IV or V substances. Schedule I substances by definition have no established medicinal use, and may not be marketed or sold in the United States. Schedule I substances are considered to present the highest risk of abuse, and Schedule V substances the lowest relative risk of abuse among controlled substances. Marijuana is classified as a Schedule I controlled substance. However, the term does not include "hemp," which means the cannabis plant and any part of that plant, including the seeds and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 THC concentration of not more than 0.3% on a dry weight basis.

Annual registration is required for any facility that manufactures, distributes, dispenses, imports or exports any controlled substance. The registration is specific to the particular location, business activity and controlled substance schedule. For example, separate registrations are needed for import and manufacturing, and each registration will specify which controlled substance schedule is authorized for that activity.

The DEA typically inspects a facility to review its security measures prior to issuing a registration. The DEA requires "effective controls and procedures" to guard against theft and diversion of controlled substances. Security requirements vary by controlled substance schedule (with the most stringent requirements applying to Schedule I and Schedule II substances), type of business activity conducted, quantity of substances handled, and a variety of other factors. Required security measures include background checks on employees and physical control of inventory. While the specific means by which effective controls and procedures are achieved may vary, security practices may include use of cages, surveillance cameras and inventory reconciliations. Records must be maintained for the handling of all controlled substances, and, in certain scenarios, periodic reports made to the DEA. Reports must also be made for thefts or losses of any controlled substance, and disposal of controlled substances must adhere to various methods authorized by the regulations. In addition, special authorization and notification requirements apply to imports and exports.

Failure by registered establishments to maintain compliance with applicable requirements, particularly as manifested in loss or diversion, can result in enforcement action. The DEA may seek civil penalties, refuse to renew necessary registrations, or initiate proceedings to revoke those registrations. In certain circumstances, violations could eventuate in criminal proceedings. Individual states also regulate controlled substances.

Laboratory Licensing and Certification Requirements

The clinical laboratories we partnered with for our COVID-19 testing program are subject to federal oversight under the Clinical Laboratory Improvement Amendment of 1988 ("CLIA"), which requires all clinical laboratories to meet certain quality assurance, quality control and personnel standards. Laboratories also must undergo proficiency testing and are subject to inspections. Standards for testing under CLIA are based on the complexity of the tests performed by the laboratory, with tests classified as "high complexity," "moderate complexity," or "waived." Laboratories performing high complexity testing are required to meet more stringent requirements than moderate complexity laboratories. Certain of our partner laboratories must undergo on-site surveys at least every two years, which may be conducted by the Centers for Medicare and Medicaid Services ("CMS") under the CLIA program or by a private CMS-approved accrediting agency. In addition, we hold CLIA Certificates of Waiver and may perform certain CLIA-waived tests on behalf of our clients, which subjects us to certain CLIA requirements. The sanction for failure to comply with CLIA requirements may be suspension, revocation or limitation of a laboratory's CLIA certificate, which is necessary to conduct business, as well as significant fines and criminal penalties.

The operations of our partner laboratories and our laboratories holding CLIA Certificates of Waiver are also subject to state and local laboratory regulation. CLIA provides that a state may adopt laboratory regulations different from or more stringent than those under federal law, and a number of states have implemented their own laboratory regulatory requirements. State laws may require that laboratory personnel meet certain qualifications, specify certain quality controls, or require maintenance of certain records. No assurances can be given that we or our partner laboratories will pass all future licensure or certification inspections.

Our facilities and laboratories hold local, state and federal permits, licenses and registrations necessary for compliance in specific work and operations, including from the Massachusetts Water Resource Authority, Boston Fire Department, Massachusetts Department of Environmental Protection, Boston Public Health Commission, Cambridge Biosafety Committee, Massachusetts Department of Public Health, USDA and DEA.

Federal Select Agent Regulations

Our research facilities that synthesize DNA sequences or perform other activities could become subject to the FSAP, which involves rules administered by the CDC and the USDA Animal and Plant Health Inspection Service ("APHIS"). The FSAP regulates the possession, use, and transfer of biological select agents and toxins that have the potential to pose a severe threat to public health, animal or plant health, or animal or plant products. FSAP regulatory requirements include: (i) registration with the CDC and/or APHIS for research facilities that deal with the select agents and toxins; (ii) submission to periodic biosafety and security inspections; and (iii) reporting of theft, loss or release of select agents. Federal agency enforcement actions for violations of FSAP regulations can include the initiation of corrective actions, complete or partial suspension or revocation of select agent registrations or civil or criminal liability.

Genetically Modified Materials Regulations

Our technologies and the technologies of our customers involve the use of genetically modified cells, organisms and biomaterials, including, without limitation, GMOs and genetically modified microorganisms ("GMMs"), and their respective products. In the United States, the FDA, the USDA through its APHIS, and the EPA are the primary agencies that regulate the use of GMOs, GMMs and potential products derived from GMOs or GMMs or Genetically Modified Materials, pursuant to the Coordinated Framework for the Regulation of Biotechnology.

The FDA reviews the safety of food consumed by humans and of feed consumed by animals under the Federal Food, Drug and Cosmetic Act ("FDCA"). Under the FDCA, food and feed manufacturers are responsible for ensuring that the products they market, including those developed through genetic engineering, are safe and properly labeled. In addition, the FDA must approve the use of any food additives, including GMOs, before marketing.

USDA's APHIS examines whether a plant itself presents a "plant pest" risk under the Plant Protection Act ("PPA"). Specifically, APHIS is responsible for regulating the introduction (i.e., importation, interstate movement or release into the environment) of certain GMOs and plants under the plant pest provisions in the PPA to ensure that they do not pose a plant pest risk. APHIS finalized changes to the PPA's implementing regulations with respect to certain GMOs in May 2020. A person or organization may request a regulatory status review from APHIS to determine whether a GMO is unlikely to pose a plant pest risk and, therefore, is not regulated under the plant pest provisions of the PPA or the regulations codified at 7 C.F.R. Part 340; requesting a regulatory status review tends to assume the GMO at issue does not otherwise fall within a regulatory exemption. If the GMO does not qualify for an exemption or if the APHIS regulatory status review process finds that the plant poses a plausible plant pest risk, then the GMO may require an APHIS permit, i.e., be a regulated article under Part 340. A regulated article may be subject to APHIS for the environmental release, importation, or interstate movement of the GMO or its progeny.

EPA regulates, under the Federal Insecticide, Fungicide and Rodenticide Act ("FIFRA"), the pesticides (including plant incorporated protectants) that are used with crops, including GMO herbicide-tolerant crops. FIFRA generally requires all pesticides to be registered before distribution or sale, unless they are exempted. Under FIFRA, a pesticide registrant must demonstrate that the pesticide at issue, when used pursuant to its specifications, "will not generally cause unreasonable adverse effects on the environment" to secure a registration. EPA must approve each distinct pesticide product, each distinct use pattern, and each distinct use site. In addition to EPA's FIFRA authority, EPA also regulates potential human health impacts from pesticides under the FDCA. EPA does so by establishing "tolerance levels" (i.e., "the amount of pesticide that may remain on food products") under the FDCA.

Certain genetically modified microorganisms that are not otherwise regulated under FIFRA and FDCA may be subject to EPA regulation under the Toxic Substances Control Act ("TSCA"). New microorganisms that are formed by combining genetic material from organisms in different genera (known as intergeneric microorganisms) may be subject to reporting requirements prior to production or distribution in commerce (Microbial Activity Commercial Activity Notice), or use in research and development (TSCA Experimental Release Application), unless the entity can meet all required criteria to obtain an exemption under TSCA.

Federal and state data privacy and security regulations

Numerous state, federal and foreign laws, including consumer protection laws and regulations, govern the collection, dissemination, use, access to, confidentiality and security of personal information, including health-related information. In the United States, numerous federal and state laws and regulations, including data breach notification laws, health

information privacy and security laws, including HIPAA, and federal and state consumer protection laws and regulations (e.g., Section 5 of the FTC Act), that govern the collection, use, disclosure, and protection of health-related and other personal information could apply to our operations or the operations of our partners. HIPAA, and its respective implementing regulations, imposes obligations on "covered entities," including certain health care providers, health plans, and health care clearinghouses, and their respective "business associates" that create, receive, maintain or transmit individually identifiable health information for or on behalf of a covered entity, as well as their covered subcontractors with respect to safeguarding the privacy, security and transmission of individually identifiable health information. Violations of the HIPAA privacy and security regulations may result in civil and criminal penalties. HHS is required to conduct periodic compliance audits of covered entities and their business associates. HIPAA also authorizes state attorneys general to bring civil actions seeking either an injunction or damages in response to violations of HIPAA privacy and security regulations.

In addition, certain state laws, such as the California Confidentiality of Medical Information Act, govern the privacy and security of health-related information in certain circumstances, some of which are more stringent than HIPAA and many of which differ from each other in significant ways and may not have the same effect, thus complicating compliance efforts. States including California, Virginia, Colorado, Connecticut and Utah have also enacted comprehensive privacy laws that are currently in effect, and similar laws have been passed or are being considered in several other states, as well as at the federal and local levels. Failure to comply with these laws, where applicable, can result in the imposition of significant civil and/or criminal penalties and private litigation. Privacy and security laws, regulations, and other obligations are constantly evolving, may conflict with each other (thus complicating compliance efforts), and can result in investigations, proceedings, or actions that lead to significant civil or criminal penalties and restrictions on data processing.

Ginkgo Corporate Information

Ginkgo's principal executive office is located at 27 Drydock Avenue, Boston, Massachusetts 02210, and Ginkgo's telephone number is (877) 422-5362. Ginkgo's corporate website address is www.ginkgobioworks.com. We make available on the Investor Relations section of our website, free of charge, our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K, proxy statements, and Forms 3, 4 and 5, and amendments to those reports as soon as reasonably practicable after filing such documents with, or furnishing such documents to, the U.S. Securities and Exchange Commission (the "SEC"). The SEC maintains a website (*www.sec.gov*) that contains reports, proxy and information statements and other information regarding issuers that file electronically with the SEC.

The information contained on, or accessible through, our corporate website is not incorporated into this Annual Report and should not be considered part of this Annual Report. The inclusion of the corporate website address is an inactive textual reference only.

Item 1A. Risk Factors.

An investment in our securities involves a high degree of risk. You should carefully consider the following risk factors, together with all of the other information included in this Annual Report, before making an investment decision. Our business, prospects, financial condition or operating results could decline due to any of these risks and, as a result, you may lose all or part of your investment.

Unless the context otherwise requires, all references in this section to the "Company," "we," "us" or "our" refer to the business of Ginkgo and its subsidiaries.

Risks Related to Ginkgo's Business

We have a history of net losses. We expect to continue to incur losses for the foreseeable future, and we may never achieve or maintain profitability.

We have incurred significant operating losses since our inception. Our net loss attributable to our stockholders was approximately $892.9 million, $2.1 billion and $1.8 billion for the fiscal years ended December 31, 2023, 2022 and 2021, respectively.

As of December 31, 2023, we had an accumulated deficit of approximately $5.3 billion. We may incur losses and negative cash flow from operating activities for the foreseeable future as we continue to invest significant additional funds toward further developing our platform, the cell programs we perform on behalf of our customers and otherwise growing our business, including our Biosecurity unit. Our operating expenses have increased as a result of becoming a public company, and we expect that our operating expenses will either remain consistent or decline in 2024 as compared to 2023, reflecting a stabilization in our operational overhead. We have derived a significant portion of our revenues from fees and milestone

payments from technical development services provided to customers to advance programs, as well as a significant portion of our revenues from Biosecurity. Historically, these fees have not been sufficient to cover the full cost of our operations. Additionally, if our customers terminate their agreements or development plans with us, our near-term revenues could be adversely affected. In addition, certain of our customer agreements provide for milestone payments, future royalties and other forms of contingent consideration, the payment of which are uncertain, as they are dependent on our ability to successfully develop engineered cells, bioprocesses, or other deliverables and our customers' ability and willingness to successfully develop and commercialize products and processes.

Our expenses may exceed revenues in the foreseeable future and we may not achieve profitability. If we fail to achieve profitability, or if the time required to achieve profitability is longer than we anticipate, we may not be able to expand or continue our business, and the value of our common stock could be negatively impacted. Our ability to achieve or sustain profitability is based on numerous factors, many of which are beyond our control, including the development of our platform, the initiation of new programs with new and existing customers, the commercial terms of our programs, the realization of any potential downstream value from our programs, our ability to advance cell engineering programs in a timely and cost-effective manner, our ability to extend new offerings to customers, our customers' ability to scale up bioprocesses, the ability of our customers to produce and sell products, the impact of market acceptance of our customers' products, and our customers' market penetration and margins. Even if we do achieve profitability, we may not be able to sustain or increase profitability on a quarterly or annual basis.

We may need substantial additional capital in the future in order to fund our business.

We have consumed considerable amounts of capital to date, and we expect to incur continued net losses over the next several years as we continue to develop our business, advance our programs, expand and enhance our platform, and make the capital investments necessary to scale up our Foundry operations and Codebase assets. We have used, and may continue to use, additional capital for Biosecurity, strategic investments and acquisitions. We believe that our cash and cash equivalents, short-term investments, and interest earned on investments will be sufficient to meet our projected operating requirements for several years and until we reach profitability. However, these assumptions may prove to be incorrect and we could exhaust our available capital resources sooner than we currently expect. Because of the numerous risks and uncertainties associated with our programs, including risks and uncertainties that could impact the rate of progress of our programs, we are unable to estimate with certainty the amounts of capital outlays and operating expenditures associated with these activities.

We do not currently have any commitments for future funding. We may receive fees, milestones, and royalty payments under our customer agreements, but these are not guaranteed, and we may receive non-cash consideration which involves estimations of fair market value. The initial fair market value of the non-cash consideration may decrease after contract inception and the amount of cash proceeds eventually realized may be less than the revenue recognized. Additionally, we may sell our equity interests in certain subsidiaries or collaborations but most of these equity stakes are in private companies and we may not be able to find a buyer due to contractual restrictions or otherwise, or may incur significant impairment if we sell these positions for liquidity. We may not receive any further funds under those agreements, the funds we receive may be lower than projected and/or disclosed as potential downstream value, or our program costs may be higher than projected. In addition, we may not be able to sign new customer agreements or enter into new development plans with existing customers with adequate funds to cover program development expenses. As a result of these and other factors, we do not know whether additional financing will be available when needed, or, if available, whether such financing would be on terms favorable to our stockholders or us.

If future financings involve the issuance of equity securities, our existing stockholders would suffer dilution. If we raise debt financing in the future, we may be subject to restrictive covenants that limit our ability to conduct our business. Our ability to raise funds may be adversely impacted by current or future economic conditions. If we fail to raise sufficient funds and continue to incur losses, our ability to fund our operations, take advantage of strategic opportunities, or otherwise respond to competitive pressures could be significantly limited. If adequate funds are not available, we may not be able to successfully execute our business plan or continue our business.

We have experienced rapid growth and expect our growth to continue, and if we fail to effectively manage our growth, then our business, results of operations, and financial condition could be adversely affected.

We have experienced substantial growth in our business since inception, including as a result of our recent acquisitions, which has placed and may continue to place significant demands on our company culture, operational infrastructure, and management. We believe that our culture has been a critical component of our success. We have invested substantial time

and resources in building our team and nurturing a culture of empowerment of, and active engagement by, our employees. As we expand our business, integrate employees and technology from our recent acquisitions, and mature as a public company, we may find it difficult to maintain our culture while managing this growth. Any failure to manage our anticipated growth and organizational changes in a manner that preserves the key aspects of our culture could be detrimental to future success, including our ability to recruit and retain personnel, and effectively focus on and pursue our objectives. This, in turn, could adversely affect our business, results of operations, and financial condition.

In addition, in order to successfully manage our rapid growth, our organizational structure has become more complex and is likely to continue to become more complex. In order to manage these increasing complexities, we will need to continue to scale and adapt our operational, financial, and management controls, as well as our reporting systems and procedures. The expansion of our systems and infrastructure will require us to commit substantial financial, operational, and management resources before our revenue increases and without any assurances that our revenue will increase.

Finally, continued growth could strain our ability to maintain reliable service levels and offerings for our customers. If we fail to achieve the necessary level of capacity, quality and efficiency in performing services and other development activities, or the necessary level of efficiency in our organizational structure as we grow, then our business, results of operations, and financial condition could be adversely affected.

Our limited operating history makes it difficult to evaluate our current business and future prospects.

We have a portfolio of cell engineering programs which vary in start date, duration, complexity, and revenue potential. Additionally, our downstream economics in the form of equity interests, milestone payments, or royalty streams add an additional level of uncertainty to our possible future performance. Consequently, predictions about our future success or viability are highly uncertain and may not be as accurate as they could be if we had a longer company history of successfully developing, commercializing and generating revenue from our programs and/or downstream economic participation. With respect to Biosecurity, now that the White House and World Health Organization have each announced the end of the public health emergency effective May 2023, the revenue stream of our COVID-19 school testing services ended in the third quarter of 2023.

Our long-term objective is to generate free cash flow from the commercialization of programs by customers across a variety of industries, as well as from our biosecurity-focused offerings. Our estimated costs and timelines for the completion of programs are based on our experiences to date and our expectations for each stage of the program in development. Given the variety of types of programs we support and the continued growth of our platform, there is variability in timelines and costs for launching and executing programs, and completion dates can change over the course of a customer engagement. Our costs and timelines may be greater or subject to variability where regulatory requirements lead to longer timelines, such as in agriculture, food, and therapeutics. In addition, we have equity interests in certain companies and there is and will continue to be variability in the financial performance of these other companies or future companies in which we may have equity interests.

As a business with a limited operating history, we may encounter unforeseen expenses, difficulties, complications, delays, and other known and unknown obstacles. We have encountered in the past, and will encounter in the future, risks and uncertainties frequently experienced by growing companies with limited operating histories in emerging and rapidly changing industries. If our assumptions regarding these risks and uncertainties, which we use to plan and operate our business, are incorrect or change, or if we do not address these risks successfully, our results of operations could differ materially from our expectations, and our business, financial condition, and results of operations could be adversely affected.

Uncertainty regarding the demand for biosecurity services could materially adversely affect our business.

Our Biosecurity offering consists of pathogen testing, sequencing, and insights delivery which are subject to inherent risks of commercial viability, such as demand for services and price or market share erosion due to competition. For example, the White House and World Health Organization have each announced the end of the public health emergency effective May 2023; therefore, the revenue stream of our COVID-19 school testing services ended in the third quarter of 2023.

As a result, our Biosecurity business is now focusing on global surveillance programs and analytic services. However, creating the commercial and technical infrastructure to provide biosecurity services globally is expensive. We may also be limited in our ability to scale up based on expense or unavailability of the required materials, equipment, personnel and infrastructure necessary to deliver biosecurity on a large, international scale. We may not be able to recover our investment expenses with sufficient revenue generated by our biosecurity efforts.

Our ability to commercialize our biosecurity programs is also subject to available government, private, and multilateral funding. If governments decide that the biosecurity offerings are not necessary or that they do not have the funds to support them, we may experience difficulty in expanding and growing the biosecurity business.

We are or could become involved in securities or shareholder litigation and other related matters, which could be expensive and time-consuming. Such litigation and related matters could harm our business.

We have been and may in the future be a target for securities and shareholder lawsuits. The outcome of such pending and potential litigation is uncertain. Such disputes, including any related governmental or regulatory investigations and the cost of defending such, could result in an adverse effect on our business, results of operations, financial condition, reputation and cash flows, and could adversely impact the market price of our common stock. Although the results of lawsuits and claims cannot be predicted with certainty, defending against such claims could be costly and could impose a significant burden on management and employees. Any litigation to which we become a party may result in an onerous or unfavorable judgment, or may be resolved with a monetary payment.

If we cannot maintain and expand current customer partnerships and enter into new customer partnerships, our cell engineering business could be adversely affected.

We do not generate substantial revenue from our own products, and instead generate revenue from customer collaborations in which we provide cell engineering services, and also typically receive downstream value in the form of royalties, equity, or milestone payments. As a result, our success depends on our ability to expand the number, size and scope of our customer collaborations. Our ability to win new business depends on many factors, including our reputation in the market, the quality of our service offerings relative to alternatives, the pricing and efficiency of our services relative to alternatives, our technical and operational capabilities, our sales team effectiveness, and the customer's ability to fund new work. If we fail to maintain a position of strength in any of these factors, our ability to deliver on customer programs, sign new customer collaborations, and/or launch new programs with existing customers may suffer and this could adversely affect our prospects. Additionally, in the process of developing programs, we generate Foundry know-how and accumulate meaningful biological and data assets, including optimized proteins and organisms, characterized genetic parts, enhanced understanding of metabolic pathways, biological, chemical, and genetic libraries, and other elements of biological data. Data and know-how generated from our programs provide the basis for expanded capabilities that we believe further supports our customer collaborations. As a result, in addition to reducing our revenue or delaying the development of our programs, the loss of one or more of our customer relationships or the failure to add new customers or programs may hinder our accumulation of such information, thus hindering our efforts to advance our technological differentiation and improve our platform.

We engage in conversations with companies regarding potential customer collaborations on an ongoing basis. We may spend considerable time and money engaging in these conversations and feasibility assessments, including understanding the technical approach to a program, customer concerns and limitations, and legal or regulatory landscape of a potential program or offering, which may not result in a commercial agreement. Even if an agreement is reached, the resulting relationship is not always successful, which may be for many reasons, including our inability to complete a program to our customers' specifications or within our customers' time frames, or unsuccessful development or commercialization of products or processes by our customers. In such circumstances, our revenues and downstream value potential from such a collaboration has been and might in the future be meaningfully reduced.

We currently own and may in the future own equity interests in other operating companies, including with respect to certain of our customers and we may receive non-cash consideration which involves estimations of fair market value. The initial fair market value of the non-cash consideration may decrease after contract inception and the amount of cash proceeds eventually realized may be less than the revenue recognized. Consequently, we have exposure to the volatility and liquidity risks inherent in holding their equity and overall operational and financial performance of these businesses.

We currently own equity interests in several of our customers, and we may receive non-cash consideration for our services, which involves estimations of fair market value. The initial fair market value of the non-cash consideration may decrease after contract inception and the amount of cash proceeds eventually realized may be less than the revenue recognized. In the future, we may also own equity interests in other companies. The process by which we receive equity interests and the factors we consider in deciding whether to accept, hold or dispose of these equity positions may differ significantly from those that an independent investor would evaluate when considering equity interests in a company. Owning equity increases our exposure to the risks of the other company and, in the case of customers, beyond the products of our collaborations. Our equity ownership positions expose us to market volatility and the potential for negative returns. We may have restrictions on resale or limited markets to sell our equity ownership. In many cases, our equity position is a

minority position which exposes us to further risk, as we are not able to exert control over the companies in which we hold securities.

In connection with future collaborations or joint ventures, we may, from time to time, receive warrants or options, all of which involve special risks. To the extent we receive warrants or options in connection with future collaborations or joint ventures, we would be exposed to risks involving pricing differences between the market value of underlying securities and our exercise price for the warrants or options, a possible lack of liquidity, and the related inability to close a warrant or option position, all of which could ultimately have an adverse effect on our financial position.

We leverage our own resources and partner with strategic and financial investors in order to help early stage companies and innovators secure funding and benefit from our platform, which exposes us to a number of risks.

Since our founding, we have helped to launch new companies (such as BiomEdit, LLC ("BiomEdit"), Motif FoodWorks, Inc. ("Motif"), Allonnia LLC ("Allonnia"), Arcaea, LLC ("Arcaea"), Ayana Bio, LLC ("Ayana") and Verb Biotics, LLC ("Verb")) by bringing together strategic and financial investors to secure funding for these early stage and small companies. Going forward, we intend to continue to leverage our own balance sheet and partner with investors to enable companies at all stages to benefit from our platform.

Partnering with and investing in early stage and small companies may expose us to a number of risks, including that early stage and small companies may have:

- shorter operating histories, narrower product lines and smaller market shares than larger businesses, which tend to render small companies more vulnerable to competitors' actions and market conditions, as well as general economic downturns;
- more limited access to capital and higher funding costs, may be in a weaker financial position and may need more capital than originally anticipated to expand, compete and operate their business;
- the inability to obtain financing from the public capital markets or other traditional sources, such as commercial banks, in part because loans made to these types of companies entail higher risks than loans made to companies that have larger businesses, greater financial resources or are otherwise able to access traditional credit sources on more attractive terms;
- a higher likelihood of holding cash deposits or maintaining lines of credit with banks focused on providing banking services to early stage or venture-backed companies, such as Silicon Valley Bank ("SVB"), which failed in March 2023;
- a higher likelihood of depending on the management talents and efforts of a small group of persons; therefore, the death, disability, resignation or termination of one or more of these persons could have a material adverse impact on such company and, in turn, on us;
- less predictable operating results, may be engaged in rapidly changing businesses with products subject to a substantial risk of obsolescence, and may require substantial additional capital to support their operations, finance expansion or maintain their competitive position;
- particular vulnerabilities to changes in customer preferences and market conditions, depend on a limited number of customers, and face intense competition, including from companies with greater financial, technical, managerial and marketing resources; and
- fewer administrative resources, which can lead to greater uncertainty in their ability to generate accurate and reliable financial data, including their ability to deliver audited financial statements.

Any of these factors or changes thereto could impair an early stage or small company's financial condition, results of operation, cash flow or result in other adverse events, such as bankruptcy. This, in turn, could result in losses in our investments and a change in our income (loss) on investments.

We may be unable to complete future strategic acquisitions or successfully integrate strategic acquisitions which could adversely affect our business and financial condition.

Our inability to complete any future strategic acquisitions or to successfully integrate any new or previous strategic acquisitions could have a material adverse effect on our business. Our business strategy includes the acquisition of technologies and businesses that complement or augment our existing products and services. We may continue to seek attractive opportunities to acquire technologies or businesses, enter into joint ventures and make other investments that are complementary to our existing strengths. There are no assurances, however, that any strategic acquisition opportunities will arise or, if they do, that they will be consummated. Certain acquisitions may be difficult to complete for a number of

reasons, including the need to satisfy customary closing conditions, the need for antitrust and/or other regulatory approvals, as well as disputes or litigation. In addition, any strategic acquisition we may complete may be made at a substantial premium over the fair value of the net identifiable assets in the acquisition and thus our realization of this value relies on successful integration and continued operations. We may not be able to integrate acquired technologies, assets, products, operations or businesses successfully, make any acquired businesses profitable, retain key employees (or integrate employees) or realize anticipated revenues, cost savings, or synergies, if any, from these acquisitions, or do so in an effective, timely and non-disruptive manner, which could adversely affect our business and financial condition. Further, our ongoing business may be disrupted, and our management's attention may be diverted by acquisitions, investments, transition and/or integration activities.

We have in the past, and in the future may continue to pursue strategic acquisitions and investments that are dilutive to our stockholders, and such strategic acquisitions or investments could have an adverse impact on our business if they are unsuccessful.

We have made acquisitions in the past and, as appropriate opportunities become available, we may acquire additional businesses, assets, technologies, or products to enhance our business in the future, but our ability to do so successfully cannot be ensured. We have also made investments in companies that we view as synergistic with our business. Although we conduct due diligence on these acquisitions and investments, such processes may underestimate or fail to reveal significant liabilities and we could incur losses resulting from liabilities of the acquired business that are not covered by indemnification we may obtain from the seller. Even if we identify suitable opportunities, including pending transactions, we may not be able to complete such acquisitions on favorable terms or at all, which could damage our business.

Additionally, pursuing acquisitions, whether successful or unsuccessful, could result in civil litigation and regulatory penalties. Any acquisitions we make may not strengthen our competitive position, and these transactions may be viewed negatively by customers or investors. We may decide to incur debt or spend cash in connection with a strategic acquisition, which may cause us to face liquidity concerns or be subject to restrictive covenants in the future. We have issued, and in the future may issue, common stock or other equity securities to the stockholders of the acquired company, which, if such issuances were unregistered, we may be contractually required to register on Form S-3 and may be subject to piggyback registration rights. Such issuances could constitute a material portion of our then-outstanding shares of common stock and may reduce the percentage ownership of our existing stockholders.

Acquisitions may also increase our expenses and reduce our cash available for operations and other uses. In addition, we may not be able to fully recover the costs of such acquisitions or be successful in leveraging any such strategic transactions into increased business, revenue, or profitability. We also cannot predict the number, timing, or size of any future acquisitions or the effect that any such transactions might have on our operating results.

Accordingly, although there can be no assurance that we will undertake or successfully complete any future acquisitions, any transactions that we have completed or in the future do complete may not yield the anticipated benefits and may be subject to the foregoing or other risks and have a material and adverse effect on our business, financial condition, results of operations, and prospects. Conversely, any failure to pursue or delay in completing any acquisition or other strategic transaction that would be beneficial to us, including those caused by competing parties, could impact our ability to sign new programs, delay the development of our platform, or slow the advancement of our programs and, thus, potential commercialization of our customer’s products.

Our programs may not achieve milestones, earn royalties or complete other anticipated key events on the expected timelines or at all, which could have an adverse impact on our business and could cause the price of our common stock to decline.

We may adopt various technical, manufacturing, regulatory, commercial, and other objectives for our programs. These milestones may include our or our customers’ expectations regarding the commencement or completion of technical development, the achievement of manufacturing targets, the submission of regulatory filings, or the realization of other development, regulatory, or commercialization objectives by us or our customers. The achievement of many of these milestones may be outside of our control. All of these milestones are based on a variety of assumptions, including assumptions regarding capital resources, constraints, and priorities, progress of and results from research and development (“R&D”) activities, and other factors, any of which may cause the timing of achievement of the milestones to vary considerably. If we, our collaborators, or our customers fail to achieve milestones in the expected timeframes, the commercialization of our programs may be delayed, our credibility may be undermined, our expectations with respect to potential future downstream value may be inaccurate, our ability to earn royalties may be impacted, our business and results of operations may be harmed, and the trading price of our common stock may decline.

We must continue to secure and maintain sufficient and stable supplies of laboratory reagents, consumables, equipment, and laboratory services. We depend on a limited number of suppliers, some of which are single-source

suppliers, and contract manufacturers for critical supplies, equipment, and services for research, development, and manufacturing of our products and processes. Our reliance on these third parties exposes us to risks relating to costs, contractual terms, supply, and logistics, and the loss of any one or more of these suppliers or contract manufacturers or their failure to supply us with the necessary supplies, equipment, or services on a timely basis, could cause delays in our research, development, or production capacity and adversely affect our business.

Widespread inflationary pressures exist across global economies, resulting in disruptions or higher costs for disposable lab equipment, raw materials and synthetic biology materials and services, and significant increases in the future could adversely affect our results of operations. We have experienced shortages in some of our key equipment and supplies, including those required in our labs, as well as disruptions in services provided by third parties, and may do so in the future as a result of supply chain issues tied to global pandemics, conflicts, or otherwise. We may also experience price increases, quality issues and longer lead times due to unexpected material shortages, service disruptions, and other unanticipated events, which may adversely affect our supply of lab equipment, lab supplies, chemicals, reagents, supplies, and lab services. For some suppliers, we do not enter into long-term agreements and instead secure our materials and services on a purchase order basis. Our suppliers may reduce or cease their supply of materials or services to us at any time in the future. If the supply of materials or services is interrupted, our programs may be delayed.

We depend on a limited number of suppliers for critical items, including lab consumables and equipment, for the development of our programs. Some of these suppliers are single-source suppliers. We do not currently have the infrastructure or capability internally to manufacture these items at the necessary scale or at all. Although we have a reserve of supplies and although alternative suppliers exist for some of these critical products, services, and equipment, our existing processes used in our Foundry have been designed based on the functions, limitations, features, and specifications of the products, services, and equipment that we currently utilize. While we work with a variety of domestic and international suppliers, our suppliers may not be obligated to supply products or services or our arrangements may be terminated with relatively short notice periods. Additionally, we do not have any control over the process or timing of the acquisition or manufacture of materials by our manufacturers and cannot ensure that they will deliver to us the items we order on time, or at all.

In particular, we rely on Twist for custom DNA synthesis and Thermo Fisher Scientific Inc. and others for certain instruments and consumables. The price and availability of DNA, chemicals, reagents, equipment, consumables, and instruments have a material impact on our ability to provide Cell Engineering services.

The loss of the products, services, and equipment provided by one or more of our suppliers could require us to change the design of our research, development, and manufacturing processes based on the functions, limitations, features, and specifications of the replacement items or seek out a new supplier to provide these items. Additionally, as we grow, our existing suppliers may not be able to meet our increasing demand, and we may need to find additional suppliers. We may not be able to secure suppliers who provide lab supplies at, or equipment and services to, the specification, quantity, and quality levels that we demand (or at all) or be able to negotiate acceptable fees and terms of services with any such suppliers.

As described above, some lab equipment, lab consumables, and other services and materials that we purchase are purchased from single-source or preferred suppliers, which limits our negotiating leverage and our ability to rely on additional or alternative suppliers for these items. Our dependence on these single-source and preferred suppliers exposes us to certain risks, including the following:

- our suppliers may cease or reduce production or deliveries, raise prices, or renegotiate terms;
- we may be unable to locate a suitable replacement on acceptable terms or on a timely basis, if at all;
- if there is a disruption to our single-source or preferred suppliers' operations, and if we are unable to enter into arrangements with alternative suppliers, we will have no other means of continuing the relevant research, development, or manufacturing operations until they restore the affected facilities or we or they procure alternative sources of supply;
- delays caused by supply issues may harm our reputation, frustrate our customers, and cause them to turn to our competitors for future programs; and
- our ability to progress the development of existing programs and the expansion of our capacity to begin future programs could be materially and adversely impacted if the single-source or preferred suppliers upon which we rely were to experience a significant business challenge, disruption, or failure due to issues such as financial difficulties or bankruptcy, issues relating to other customers such as regulatory or quality compliance issues, or other financial, legal, regulatory, or reputational issues.

Moreover, to meet anticipated market demand, our suppliers may need to increase manufacturing capacity, which could involve significant challenges. This may require us and our suppliers to invest substantial additional funds and hire and retain the technical personnel who have the necessary experience. Neither we nor our suppliers may successfully complete any required increase to existing research, development, or manufacturing capacity in a timely manner, or at all.

For the year ended December 31, 2023, our cost of lab equipment, lab supplies, and lab services accounted for a significant portion of our total R&D expenses. In the event of price increases by suppliers, whether as a result of inflationary pressures or otherwise, we may attempt to pass the increased costs to our customers. However, we may not be able to raise the prices of our Cell Engineering services sufficiently to cover increased costs resulting from increases in the cost of our materials and services, or the interruption of a sufficient supply of materials or services. As a result, materials and services costs, including any price increase for our materials and services, may negatively impact our business, financial condition, and results of operations.

Some of our suppliers and contract manufacturers are foreign entities. We may face disruptions due to the inability to obtain customs clearances in a timely manner or restrictions on shipping or international travel. As a result of ongoing global supply chain challenges resulting in very long lead times for certain products and equipment, we may order in larger volumes in order to secure the supplies we require for our future operations, which may negatively impact our financial conditions, especially if we are unable to use the supplies ordered.

We use biological, hazardous, flammable and/or regulated materials that require considerable training, expertise and expense for handling, storage and disposal and may result in claims against us.

We work with biological and chemical materials that could be hazardous to human, animal, or plant health and safety or the environment. Our operations produce hazardous and biological waste products, and we largely contract with third parties for the disposal of these products. Federal, state, and local laws and regulations govern the use, generation, manufacture, storage, handling, and disposal of these materials and wastes. Compliance with applicable laws and regulations is expensive, and current or future laws and regulations may restrict our operations. If we do not comply with applicable laws and regulations, we may be subject to fines and penalties.

In addition, we cannot eliminate the risk of (a) accidental or intentional injury or (b) release, or contamination from these materials or wastes, which could expose us to liability. Furthermore, laws and regulations are complex, change frequently, and have tended to become more stringent. We cannot predict the impact of such changes and cannot be certain of our future compliance. Accordingly, in the event of release, contamination, or injury, we could be liable for the resulting harm or penalized with fines in an amount exceeding our resources and our operations could be suspended or otherwise adversely affected. These liabilities could also include regulatory actions, litigation, investigations, remediation obligations, damage to our reputation and brand, supplemental disclosure obligations, loss of customer, consumer, and partner confidence in the safety of our laboratory operations, impairment to our business, and corresponding fees, costs, expenses, loss of revenues, and other potential liabilities, as well as increased costs or loss of revenue or other harm to our business.

The release of GMOs or Genetically Modified Materials, whether inadvertent or purposeful, into uncontrolled environments could have unintended consequences, which may result in increased regulatory scrutiny and otherwise harm our business and financial condition.

The genetically engineered organisms and materials that we develop may have significantly altered characteristics compared to those found in the wild, and the full effects of deployment or release of our genetically engineered organisms and materials into uncontrolled environments may be unknown. In particular, such deployment or release, including an unauthorized release, could impact the environment or community generally or the health and safety of our employees, our customers' employees, and the consumers of our customers' products.

In addition, if a high profile biosecurity breach or unauthorized release of a biological agent occurs within our industry, our customers and potential customers may lose trust in the security of the laboratory environments in which we produce GMOs, Genetically Modified Microorganisms ("GMMs") and Genetically Modified Materials, even if we are not directly affected. Any adverse effect resulting from such a release, by us or others, could have a material adverse effect on the public acceptance of products from engineered cells and our business and financial condition. Such a release could result in increased regulatory scrutiny of our facilities, platform, and programs, and could require us to implement additional costly measures to maintain our regulatory permits, licenses, authorizations and approvals. To the extent such regulatory scrutiny or changes impact our ability to execute on existing or new programs for our customers, or make doing so more costly or difficult, our business, financial condition, or results of operations may be adversely affected. In addition, we could have

exposure to liability for any resulting harm, as well as to regulatory actions, litigation, investigations, remediation obligations, damage to our reputation and brand, supplemental disclosure obligations, loss of customer, consumer, and partner confidence in the safety of engineered cells materials and organisms, impairment to our business, and corresponding fees, costs, expenses, loss of revenues, and other potential liabilities, as well as increased costs or loss of revenue or other harm to our business.

We could synthesize DNA sequences or engage in other activity that inadvertently contravenes biosecurity requirements, or regulatory authorities could promulgate more far-reaching biosecurity requirements that our standard business practices cannot accommodate, which could give rise to substantial legal liability, impede our business, and damage our reputation.

The Federal Select Agent Program ("FSAP") involves rules administered by the Centers for Disease Control and Prevention and the USDA's APHIS that regulate possession, use, and transfer of biological select agents and toxins that have the potential to pose a severe threat to public, animal, or plant health or to animal or plant products. In accordance with the International Gene Synthesis Consortium's ("IGSC") Harmonized Screening Protocol for screening of synthetic DNA sequence orders, we follow biosafety and biosecurity industry practices and avoid DNA synthesis activities that implicate FSAP rules by screening synthetic DNA sequence orders against the IGSC's Regulated Pathogen Database; however, we could err in our observance of compliance program requirements in a manner that leaves us in noncompliance with FSAP or other biosecurity rules. In addition, authorities could promulgate new biosecurity requirements that restrict our operations. One or more resulting legal penalties, restraints on our business or reputational damage could have material adverse effects on our business, financial condition, or results of operations.

Third parties may use our engineered cells, materials, and organisms and accompanying production processes in ways that could damage our reputation.

After our customers have received our engineered cells, materials, and organisms and accompanying production processes, we do not have any control over their use and our customers may use them in ways that are harmful to our reputation. In addition, while we have established biosecurity offerings designed to comply with biosafety and biosecurity requirements and export control requirements in an effort to ensure that third parties do not obtain our engineered cells or other biomaterials for malevolent purposes, we cannot guarantee that these preventative measures will eliminate or reduce the risk of the domestic and global opportunities for the misuse or negligent use of our engineered cells materials, organisms and production processes. Accordingly, in the event of such misuse or negligent use, our reputation, future revenue, and operating results may suffer.

International expansion of our business exposes us to business, regulatory, political, operational, financial, and economic risks associated with doing business outside of the United States.

We currently market our services and deliver our programs, materials, and processes outside of the United States and may market future offerings outside of the United States. We, and our suppliers, collaborators, and customers, currently conduct business outside of the United States. From time to time, our services may include the hiring or secondment of our employees outside the United States at third party facilities or require the hiring or secondment of foreign persons within our facilities, including as a result of foreign acquisitions. Accordingly, we are subject to a variety of risks inherent in doing business internationally, and our exposure to these risks will increase as we continue to expand our operations and customer base. These risks include:

- political, social and economic instability;
- higher levels of credit risk, corruption, and payment fraud;
- enhanced difficulties of integrating any foreign acquisitions;
- increased expenses and diversion of our management's attention from advancing programs;
- regulations that might add difficulties in repatriating cash earned outside the United States and otherwise prevent us from freely moving cash;
- import and export controls and restrictions and changes in trade regulations;
- compliance with the U.S. Foreign Corrupt Practices Act, the U.K. Bribery Act, and similar laws in other jurisdictions;
- multiple, conflicting and changing laws and regulations such as privacy, security and data use regulations, tax laws, tariffs, trade regulations, economic sanctions and embargoes, employment laws, anti-corruption laws, regulatory requirements, reimbursement or payor regimes and other governmental approvals, permits and licenses;

- failure by us, our collaborators or our customers to obtain regulatory clearance, authorization or approval for the use of our services in various countries;
- additional potentially relevant third-party patent rights;
- complexities and difficulties in obtaining intellectual property protection and enforcing our intellectual property;
- difficulties in staffing and managing foreign operations, including difficulties related to the increased operations, travel, infrastructure and legal compliance costs associated with international locations;
- logistics and regulations associated with shipping chemicals, biomaterials and product samples, including infrastructure conditions and transportation delays;
- financial risks, such as longer payment cycles, difficulty collecting accounts receivable, widespread inflationary pressure, the impact of local and regional financial crises, on demand and payment for our products and exposure to foreign currency exchange rate fluctuations;
- natural disasters, political and economic instability, including wars, terrorism and political unrest, the outbreak of disease, or public health epidemics/pandemics, such as COVID-19, which could have an adverse impact on our employees, contractors, customers, partners, travel and the global economy;
- breakdowns in infrastructure, utilities and other services;
- boycotts, curtailment of trade and other business restrictions; and
- the other risks and uncertainties described in this Annual Report.

Additionally, as part of our growth strategy, we will continue to evaluate potential opportunities for international expansion. Operating in international markets requires significant resources and management attention and will subject us to regulatory, economic and political risks in addition to those we face in the United States. However, our international expansion efforts may not be successful, which could limit the size of our market or the ability to provide services or programs internationally.

In addition, due to potential costs from any international expansion efforts and potentially higher supplier costs outside of the United States, our international operations may operate with a lower margin profile. As a result, our margins may fluctuate as we expand our operations and customer base internationally.

Any of these factors could significantly harm our future international expansion and operations and, consequently, our revenue and results of operations.

Our investments in and use of AI may result in reputational harm, liabilities, or other adverse consequences to our business operations.

In August 2023, we entered into a strategic partnership with Google Cloud to develop and deploy AI tools for biology and biosecurity. Under the strategic partnership, Ginkgo will work to develop new, state-of-the-art large language models (LLMs) running on Google Cloud's Vertex AI platform across genomics, protein function, and synthetic biology, helping Ginkgo's customers accelerate innovation and discovery in fields as diverse as drug discovery, agriculture, industrial manufacturing, and biosecurity.

Our development and use of AI technology in our products and operations remains in the early phases. While we aim to develop and use AI responsibly and attempt to mitigate ethical and legal issues presented by its use, we may ultimately be unsuccessful in identifying or resolving issues before they arise. There is no guarantee that Ginkgo will be successful in developing AI tools and as with many innovations, the use of AI presents many risks and challenges, including misuse, flawed algorithms, and insufficient and/or biased datasets. Additionally, AI technologies are complex and rapidly evolving. Uncertainty around new and emerging AI technologies may require additional investment to remain commercially relevant and/or to develop appropriate protections and safeguards. These investments may be costly and could increase our expenses as we contemplate expanding the use of AI in our platform and services. In addition, perceived or actual technical, legal, compliance, privacy, security, ethical or other issues relating to the use of AI may cause public confidence in AI to be undermined, which could slow our customers' adoption of our products and services that use AI. We may also face significant potential disruption as a result of rapidly evolving domestic and international laws and regulations, which could impose significant costs and obligations on the company. For example, in 2023 the Biden Administration issued a new, executive order on safe, secure and trustworthy AI and the EU introduced the AI Act to establish rules for providers and users. Emerging regulations may pertain to data privacy, data protection, and the ethical use of AI, as well as clarifying intellectual property considerations. Challenges inherent to the use of AI or specific to Google's AI systems could adversely impact the reliability of our data and subject us to delays and competitive harm, result in new or enhanced

governmental or regulatory scrutiny, pose confidentiality or security risks, ethical concerns, or legal liability, as well as brand or reputational harm, and our business and results of operations may suffer.

Risks Related to Our Customers

We rely on our customers to develop, produce and manufacture products using the engineered cells, other biological assets and/or biomanufacturing processes that we develop. If these initiatives by our customers are not successful or do not achieve commercial success, or if our customers discontinue their development, production and manufacturing efforts using our engineered cells, other biological assets and/or biomanufacturing processes, our future financial position may be adversely impacted.

We operate as a platform company. As such, we rely on our customers to commercialize products that may be enabled by our engineered cells, other biological assets(e.g., enzyme DNA sequences) and/or biomanufacturing processes. A portion of the value in our customer collaborations is typically earned through downstream value sharing in the form of equity, royalty streams, or milestone payments. If our customers are not successful in bringing these products to market, or if these products are not successful once on the market, the downstream portion of our value will be adversely impacted. Because we do not directly control manufacturing, product or downstream process development or commercialization, we have limited ability to impact the quality of our partners' production processes and ultimate commercial success.

In addition, our customers have chosen, and may in the future choose, not to develop or commercialize a product we have enabled in which we are entitled to downstream value sharing. In our current relationships, we would have limited or no recourse to find alternative methods to monetize these products without the original customer. Because this industry is still nascent and the regulatory environment is evolving, we have limited historical information on the probability of commercial success for bioengineered products or biomanufacturing processes in the market and have limited ability to underwrite the likelihood that our customers will be able to create valuable products or processes in their market using the results of their programs with us. If we overestimate the probability or scale of commercial success, the price of our common stock may be adversely impacted as a result of lower expectations for future cash flows from customer collaborations.

Our revenue is concentrated in a limited number of customers, some of which are related parties, and our revenue, results of operations, cash flows and reputation may suffer upon the loss of a significant customer.

We have derived, and may continue to derive, a significant portion of our revenue from a limited number of large customers. During the year ended December 31, 2023, two customers each represented more than 10% of our total revenue and cumulatively represented 23% of our total revenue. Due to the significant time required to acquire new customers, to plan and develop new programs for customers, and to satisfactorily execute on existing programs, the loss of any of these customers, or the loss of any other significant customer or a significant reduction in the amount of demand from a significant customer would adversely affect our revenue, results of operations, cash flows and reputation in the marketplace. There is always a risk that existing customers will not elect to do business with us in the future or will experience financial difficulties. If our customers experience financial difficulties or business reversals which reduce or eliminate the need for our services, they may be unable or unwilling to fulfill their contracts with us. There is also the risk that our customers will attempt to impose new or additional requirements on us that reduce the profitability of the services performed by us. Our customer concentration also increases the concentration of our accounts receivable and our exposure to payment defaults by key customers, which could expose us to substantial and potentially unrecoverable costs if we do not receive payment from key customers. Additionally, the loss of any significant customer could pose reputational harm to us and make it more challenging to acquire new customers.

In addition, while our customer collaborations are typically multi-year, we generally do not require our customers to generate a minimum amount of annual demand and without such contracts, our customers are not obligated to use our services beyond the amounts they choose to incur. Our customers may choose to use fewer of our services depending on program progress, their own technological capabilities, market demand for their products and/or their own internal budget cycles. As a result, we cannot accurately predict our customers' decisions to reduce or cease utilizing our services. Even where we enter into long-term contracts with our customers, there is no guarantee that such agreements will be negotiated on terms that are commercially favorable to us in the long-term. In addition, existing customers may choose to perform some or all of the services they expect from us internally, with another third-party partner or by using capabilities from acquisitions of assets.

In certain cases, our business partners may have discretion in determining when and whether to make announcements about the status of our collaborations, including about developments and timelines for advancing programs, and the price of our common stock may decline as a result of announcements of unexpected results or developments.

Generally, we and our customers must mutually agree on determining when and whether to make announcements about the status of our collaborations, including developments in our programs and timelines for commercialization of or improvements to products using engineered cells developed using our platform. However, in some cases our customers may report or otherwise may be obligated to disclose certain matters without our consent. Our partners may also wish to report such information more or less frequently than we intend to or may not wish to report such information at all. We or our partners may announce a collaboration or partnership even if there is no guarantee that we will recognize program fees. The price of our common stock may decline as a result of a public announcement of unexpected results or developments in our partnerships, or as a result of our partners not consenting to an announcement or withholding information.

Risks Related to the COVID-19 Pandemic

We may be subject to tort liability if the COVID-19 tests we utilized in our testing programs provided inaccurate results.

The Public Readiness and Emergency Preparedness Act (the "PREP Act") provides immunity for manufacturers, distributors, program planners, qualified persons, and their officials, agents, and employees from certain claims under state or federal law for a "loss" arising out of the administration or use of a "covered countermeasure" in the United States. Distributors are certain persons or entities engaged in the distribution of drugs, biologics, or devices. Program planners include persons who supervise or administer a program with respect to the administration, distribution, provision, or use of a Covered Countermeasure (as defined in the PREP Act). Covered Countermeasures include security countermeasures and "qualified pandemic or epidemic products," including products intended to diagnose or treat pandemic or epidemic disease, such as COVID-19 diagnostic tests, as well as treatments intended to address conditions caused by such products. Covered Countermeasures must also be approved, cleared, or authorized for emergency use, or otherwise authorized for investigational use, by the FDA in order to be considered Covered Countermeasures under the PREP Act.

For these immunities to apply, the Secretary of HHS must issue a declaration in cases of public health emergency or "credible risk" of a future public health emergency. On March 10, 2020, the Secretary of HHS issued a declaration under the PREP Act and has issued subsequent amendments thereto to provide liability immunity for activities related to certain countermeasures against the COVID-19 pandemic.

We have acted as the authorized distributor of certain third-party COVID-19 tests and collection kits that received an EUA and supervised testing programs for COVID-19 testing customers. There can be no assurance that our test distribution and program planning activities regarding these programs would be covered under the provisions of the PREP Act. Also, there can be no assurance that the U.S. Congress will not act in the future to reduce coverage under the PREP Act or to repeal it altogether.

Furthermore, some of the third-party tests that were used as part of our pooled testing program were not covered by an EUA and, at this time, we do not believe that such testing services, administration, or program planning related to our pooled testing program will qualify for PREP Act immunity. If product liability lawsuits are brought against us in connection with allegations of harm connected to our prior COVID-19 testing services, we may incur substantial liabilities. The PREP Act is a complex law with limited judicial precedent, and thus even for the third-party COVID-19 tests and collection kits used in our testing services that were subject to EUAs, we may have to expend significant time and legal resources to obtain dismissal of a lawsuit on the basis of PREP Act immunity.

If we cannot successfully defend ourselves against claims that our COVID-19 testing services caused injuries and if we are not entitled to immunity under the PREP Act, or the U.S. Congress limits or eliminates coverage under the PREP Act, or if the liability protections under the PREP Act are not adequate to cover all claims, we may incur substantial liabilities. Regardless of merit or eventual outcome, product liability claims may result in decreased demand for our services, injury to our reputation, costs to defend litigation, loss of revenue, and substantial money awards to customers.

Risks Related to the Synthetic Biology Industry

Rapidly changing technology and emerging competition in the synthetic biology industry could make the platform, programs, and products we and our customers are developing obsolete or non-competitive unless we continue to develop our platform and pursue new market opportunities.

The synthetic biology industry is still emerging and is characterized by rapid and significant technological changes, frequent new product introductions and enhancements, and evolving industry demands and standards. Our future success will depend on our ability to sign and initiate new programs that address the evolving needs of our customers on a timely and cost-effective basis, to advance existing programs and to pursue new market opportunities that develop as a result of technological and scientific advances. Additionally, our customers may face significant competition or other risks which may adversely impact our business and results of operations.

There are a number of companies in the broader synthetic biology industry, and our future success will depend on our ability to maintain a competitive position with respect to technological advances. Technological developments, including emerging AI technologies**,** may result in our platform becoming obsolete. Our ability to compete successfully will depend on our ability to develop proprietary technologies that enable our customers to develop products using our platform in a manner that is either less expensive, faster, superior or otherwise differentiated from what a competitor's technologies and products might enable. If we are unable to continue to successfully advance our platform or the services it provides at scale, or if our customers are unable to commercialize the products or processes made or improved upon by using our platform, our business and results of operations will be adversely impacted.

Due to the significant lead time involved in launching a new program or developing a new product or process using our platform, our customers are required to make a number of assumptions and estimates regarding the commercial feasibility of a new product, including assumptions and estimates regarding the size of an emerging product category and demand for those end-products and processes which will use our technology, the ability to scale-up manufacturing processes to produce a product on a commercial scale, the ability to penetrate that emerging product category, customer adoption of a downstream product, the existence or non-existence of products being simultaneously developed by competitors, potential market penetration and obsolescence, planned or unplanned. As a result, it is possible that we may commence a new program with a customer who wishes to develop a product or process that has been displaced by the time of launch, addresses a market that no longer exists or is smaller than previously thought, that end-consumers do not like or otherwise is not competitive at the time of launch, in each case, after the incurrence of significant opportunity costs on our part to develop such product. The ultimate success of the products developed by our customers using our services may be dependent on the success of other markets in which we or our customers do not operate in or have knowledge or expertise or which, in each case, may not reach the size anticipated by us or our customers or may be replaced by another emerging product category or eliminated entirely.

The market, including customers and potential investors, may be skeptical of our ability to deliver on programs because they are based on a relatively novel and complex technology.

The market, including customers and potential investors, may be skeptical of the viability and benefits of bioengineered products as well as our enabling abilities, including our platform and programs, because they are based on a relatively novel approach and the adoption of complex technology and because we are still demonstrating to the market the value of our platform. There can be no assurance that our platform and programs will be understood, approved, or accepted by customers, regulators and potential investors or that we will be able to sell our services profitably at competitive prices and with features sufficient to establish demand.

In addition, in order for novel products from our programs to be successfully commercialized, support from the entire relevant supply chain is needed. Relationships with all parts of the supply chain are important in order to gain visibility into market trends and feature and specification requirements and in order to ensure customers are able to successfully manufacture their products, obtain regulatory approval and gain access to key distribution channels. If we are unable to convince these potential customers, their suppliers, or the consumers who purchase products containing or made or developed using engineered cells and/or biomanufacturing processes, of the utility and value of such products or that such products are superior to the products they currently use, we will not be successful in entering these markets and our business and results of operations will be adversely affected. If potential investors are skeptical of the success of our platform or cell programs, our ability to raise capital and the value of our common stock may be adversely affected.

Ethical, legal and social concerns about GMOs and Genetically Modified Materials and their resulting products could limit or prevent the use of products or processes using our technologies, limit public acceptance of such products or processes and limit our revenues.

Our technologies and the technologies of our customers involve the use of genetically modified cells, organisms and biomaterials, including, without limitation, GMOs, GMMs, Genetically Modified Materials and their respective products. The use, production and marketing of Genetically Modified Materials are subject to laws and regulations in many countries, some of which are new and some of which are still evolving. In the United States, the FDA, the EPA and the USDA are the primary agencies that regulate the use of GMOs, GMMs and potential products derived from GMOs or GMMs. If regulatory approval of the Genetically Modified Materials or resulting products is not secured, our business operations, financial condition and our ability to grow as a business could be adversely affected. We expect to encounter regulations regarding Genetically Modified Materials in most, if not all, of the countries in which our customers may seek to establish production capabilities or sell their products and the scope and nature of these regulations will likely be different from country to country. Governmental authorities could, for safety, social or other purposes, impose limits on, or implement regulation of, the use, production or marketing of Genetically Modified Materials. If our customers cannot meet the applicable requirements in other countries in which they intend to produce or sell their products, or if it takes longer than anticipated to obtain such approvals, our business could be adversely affected.

In addition, public perception regarding the safety and environmental hazards of, and ethical concerns over, Genetically Modified Materials or the processes used to create them, including gene editing or gene regulating technologies, could influence public acceptance of our and our customers' technologies, products, and processes. For instance, certain advocacy groups engage in efforts that include regulatory legal challenges and labeling campaigns for genetically modified products, as well as application of pressure to consumer retail outlets seeking a commitment not to carry genetically modified foods. These groups in the past have pressured retail food outlets and grocery store chains to publicly state that they will not carry genetically modified foods and have pressured food brands to publicly state that they will not use ingredients produced by genetically modified microbes. In addition, certain labeling-related initiatives have heightened consumer awareness of GMOs, which may make consumers less likely to purchase products containing GMO ingredients, and could have a negative impact on the commercial success of our customers' products and programs. These concerns could result in increased expenses, regulatory scrutiny, delays or other impediments to our programs. The subject of Genetically Modified Materials has received negative publicity, which has aroused public debate. This adverse publicity has led to, and could continue to lead to, greater regulation and trade restrictions on imports of Genetically Modified Materials or their resulting products. In addition, with the acquisitions of Dutch DNA Biotech B.V., FGen AG, and Altar SAS, we are expanding into the European Union market, which has increased government regulation and scrutiny over genetically modified products. There is a risk that products produced using our technologies could cause adverse health effects or other adverse events, which could also lead to negative publicity, regulatory action or private litigation. If we are unable to overcome the ethical, legal and social concerns relating to genetic engineering, our programs could face increased expenses, regulatory scrutiny, delays or other impediments to deliver our programs or the commercialization of resulting products and processes.

Risks Related to Intellectual Property

If we are unable to obtain, maintain and defend patents protecting our intellectual property, our competitive position will be harmed.

Our success depends in part on our ability to obtain and maintain intellectual property protection for our proprietary technologies. We protect our proprietary technologies through patents and trade secrets, both of which entail risk. If we are unable to obtain, maintain or protect intellectual property rights related to our technology, or if our intellectual property rights are inadequate, our competitive position, business, financial conditions, results of operations and prospects may be harmed.

Because of the volume and nature of our inventions, patent protection may not be practicable, available, or appropriate for some aspects of our proprietary technologies. While we own patents and pending patent applications in the United States and in foreign jurisdictions, these applications do not ensure the protection of our intellectual property. There may be prior art of which we are not aware. Additionally, obtaining, maintaining, defending and enforcing patents is costly, time consuming and complex, and we may not be able to file and prosecute all necessary or desirable patent applications, or maintain and enforce any patents that may issue from such patent applications at a reasonable cost or in a timely manner. It is also possible that we will fail to identify patentable aspects of our technologies before it is too late to obtain patent protection. Although we enter into confidentiality agreements with parties who have access to confidential or patentable aspects of our R&D output, such as our employees, collaborators, consultants, advisors and other third parties, any of these

parties may breach the agreements and disclose such output before a patent application is filed, thereby jeopardizing our ability to seek patent protection.

Further, pending applications may not be issued or may be issued with claims significantly narrower than we currently seek. Patents for which claims have been allowed may be successfully challenged and invalidated. Unless and until our pending applications issue, their protective scope is impossible to determine and, even after issuance, their protective scope may be limited.

Recent changes in patent law have made patents covering life science inventions more difficult to obtain and enforce. Further legislative changes or changes in the interpretation of existing patent law could increase the uncertainty and cost surrounding the prosecution of our owned patent applications and the maintenance, enforcement or defense of our owned patents. The Leahy-Smith America Invents Act ("the Leahy-Smith Act") included changes that affect the way patent applications are prosecuted; redefine prior art; enable third-party submission of prior art to the United States Patent and Trademark Office ("USPTO") during patent prosecution; and provide cost-effective avenues for competitors and other third parties to challenge the validity of patents at USPTO-administered post-grant proceedings, including post-grant review, inter partes review, and derivation proceedings. Thus, the Leahy-Smith Act and its continued implementation could increase the uncertainties and costs surrounding the prosecution of our patent applications and the enforcement or defense of our issued patents, all of which could have a material adverse effect on our business, financial condition, results of operations, and prospects.

Other changes in the law may further detract from the value of life science patents and facilitate challenges to our patents. In some cases, we develop inventions with the assistance of machine learning and other computational tools that may be considered to be AI, and we expect to use such tools, and to use generative AI, in future development. The U.S. Court of Appeals for the Federal Circuit (the "Federal Circuit") has ruled that inventions created entirely by AI are not patentable, while the USPTO has sought public comment about how it could encourage the use of AI in developing inventions. Because the law is in flux with respect to AI-assisted inventions, there is uncertainty and risk associated with patenting such inventions. Depending on future actions by the U.S. Congress, the federal courts and the USPTO, the laws and regulations governing patents could change in unpredictable ways that could have a further material adverse effect on our patent rights and our ability to protect, defend and enforce our patent rights in the future. It is also possible that disclosure requirements with respect to use of AI tools may be imposed by the patent office, which could increase the cost of patent prosecution and cause uncertainty and delay in the enforcement of patent rights.

In some cases, we use genetic sequence information from naturally occurring organisms. U.S. Supreme Court rulings have narrowed the scope of patent protection for naturally occurring sequences and for inventions based on the observation and exploitation of natural phenomena. These decisions have weakened the rights of patent owners in certain situations. The Federal Circuit and the Supreme Court have also issued a series of rulings that create obstacles to the patenting of groups of genetic sequences that share functional characteristics, making it more difficult to obtain claims to certain genetic constructs, particularly antibodies. These changes in the law have created uncertainty with respect to the validity and enforceability of patents covering natural and engineered sequences.

Further, the issuance of a patent is not conclusive as to its inventorship, scope, validity or enforceability, and our patents may be challenged in the courts or patent offices in the United States and abroad. An adverse determination in any such challenge could result in loss of exclusivity, or patent claims being narrowed, invalidated or held unenforceable, in whole or in part. Any of these results could limit our ability to stop others from using or commercializing similar or identical technology to compete directly with us. In addition, if the breadth or strength of protection provided by our patents or patent applications is threatened, regardless of the outcome, it could dissuade companies from collaborating with us. Such proceedings also may result in substantial cost and require significant time from our scientists and management, even if the eventual outcome is favorable to us.

The laws of some foreign countries do not protect intellectual property rights to the same extent as do the laws of the United States or may apply different rules concerning the assignment of intellectual property rights. Many companies have encountered significant problems in protecting and defending intellectual property rights in certain foreign jurisdictions. We may encounter similar difficulties, particularly as we expand to work with foreign employees and contractors and expand our collaboration activities into foreign markets. The legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents by foreign holders and, in some cases, do not favor the enforcement of patents at all, particularly patents in the life sciences. This could make it difficult for us to stop the infringement of our patents. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business and could be unsuccessful.

Reductions in the scope or enforceability of our patent protection may adversely affect our customers' ability to commercialize their products and may thus reduce our downstream value from royalties, equity, or commercial milestone payments.

If we are unable to protect the confidentiality of our trade secrets, our business and competitive position will be harmed.

Because patent protection may not be available or appropriate for significant aspects of the technology we are developing, our success may depend in large part on our proprietary information, including genetic and other chemical and biological data, processes, know-how, and other trade secrets developed over years of R&D, some of which are embodied in proprietary software. We rely heavily on trade secret protections, especially in cases where we believe patents or other forms of registered intellectual property protection may not be appropriate or obtainable. However, trade secrets are difficult to protect. The secrecy of the Company's trade secrets must be maintained for them to retain their status and protection as trade secrets. While we strive to protect the secrecy of our trade secrets and other proprietary information, including by requiring our employees, customers, consultants, and contractors to enter into confidentiality agreements and instituting multilayered protections covering our digital environment and biomaterials, we may not be able to adequately protect our trade secrets or other proprietary information. We cannot guarantee that we have entered into such agreements with every party that may have or has had access to our trade secrets, biomaterials or proprietary technology and processes. Further, despite these efforts, any of these parties may breach the agreements and disclose our proprietary information, including our trade secrets, and we may not be able to obtain adequate remedies for such breaches.

We seek to preserve the integrity and confidentiality of our information by maintaining physical security of our premises and physical and electronic security of our information technology systems, but it is possible that these security measures could be breached. We also rely on systems provided by third parties, which may suffer security breaches or incidents. Such security breaches may be inadvertent or may come about due to intentional misconduct or other malfeasance or by human error or technical malfunctions, including those caused by hackers, employees, contractors, or vendors. It may be difficult or impossible to recover trade secrets or other confidential information once it is hacked, and hackers may operate from jurisdictions that will not cooperate with such efforts. Enforcing any claim that a third party unlawfully obtained and is using any of our trade secrets is expensive and time consuming, and the outcome is unpredictable. In addition, courts in some jurisdictions are less willing or unwilling to protect trade secrets even when a hacker or thief can be identified.

Our competitors may lawfully obtain or independently develop knowledge that is equivalent to one or more of our trade secrets. Were they to do so, we would be unable to prevent them from using that independently developed knowledge. Such a competitor could claim that we had learned the trade secret from them and bring an action against us on that basis. If any of our trade secrets were to be disclosed to or independently developed by a competitor or other third party, our competitive position could be materially and adversely harmed. Moreover, a competitor could file for patent protection covering intellectual property that we have chosen to protect as a trade secret. In such a case, we might be restricted or excluded from using that intellectual property even if we had developed it before our competitor did.

Our facilities hold large collections of microbial strains, cell lines and other biomaterials. Failure to implement adequate controls and protections, failure to implement adequate disposal procedures, unauthorized visitors in the labs, or customers' failure to adequately protect biological materials can put us and our customers at risk of losing valuable assets through negligence or theft and enabling the use of those lost materials by our competitors. While we believe that we take reasonable measures to protect the security of biomaterials owned by us or our customers, it is possible that our security controls and practices may not prevent unauthorized or other improper access to such genetic material. Any unauthorized access, acquisition, use, destruction, or release of the GMOs we engineer could result in our having exposure to significant liability under our contracts, as well as to regulatory actions, litigation, investigations, remediation obligations, damage to our reputation and brand, supplemental disclosure obligations, loss of customer, consumer, or partner confidence in the security of our platform, impairment to our business, and corresponding fees, costs, expenses, loss of revenues, and other potential liabilities.

Our customers sometimes provide organisms, genetic material and/or data to us in connection with our collaborations. In the event that we fail to protect customer materials or data or inadvertently use such materials or data for unauthorized purposes, we could be liable to our customers under trade secret laws or contractual provisions.

We may be subject to claims challenging the inventorship or ownership of our patents, biomaterials and other intellectual property.

Certain of our employees, consultants and contractors were previously employed at universities or other software or biotechnology companies, including our competitors or potential competitors. Additionally, some of our consultants or

contractors may have ongoing relationships with universities. Although we try to ensure that our employees, consultants and contractors do not use the intellectual property of others in their work for us, we may be subject to claims that these individuals or other contractors have used or disclosed intellectual property, including trade secrets or other proprietary information, of another. Litigation may result from these claims.

While it is our policy to require that our employees, consultants and contractors who may be involved in the development of intellectual property for us execute agreements assigning such intellectual property to us, we may be unsuccessful in executing such an agreement with each party who in fact develops intellectual property that we regard as our own. Our intellectual property assignment agreements with them may not be self-executing or may be breached, and we may be forced to bring claims against third parties, or defend claims they may bring against us, to determine the ownership of what we regard as our intellectual property. Such claims could have a material adverse effect on our business, financial condition, results of operations and prospects.

If we are unsuccessful in litigating any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights or personnel, which could have a material adverse effect on our competitive business position and prospects. Such intellectual property rights could be awarded to a third party, and we could be required to obtain a license from such third party to use or commercialize our technology or products, which license might not be available on commercially reasonable terms, or at all. Even if we are successful in prosecuting or defending against such claims, litigation could result in substantial costs and be a distraction to our management and employees.

The life science academic and research community has abided by norms of free exchange of biomaterials, but norms have begun to change so that parties may assert ownership and control over biomaterials that they permitted to be freely disseminated in the past. Thus, despite our best efforts to confirm our right to use biomaterials in our possession, we may use organisms that we believe to be free of encumbrance that are, in fact, subject to claims of title by others. In such a situation, litigation may be required to clear title, if it can be cleared at all. Similarly, we may be subject to claims that we have used biomaterials obtained from licensors or repositories for unauthorized purposes, or purposes not consistent with the licensing terms of the providing organization.

We may become involved in lawsuits or other enforcement proceedings to protect or enforce our patents or other intellectual property, which could be expensive, time consuming and potentially unsuccessful.

Competitors and other third parties may infringe or otherwise violate our issued patents or other intellectual property. In addition, our patents may become involved in inventorship, ownership, or priority disputes. We may also become subject to claims by collaboration partners that intellectual property or biomaterials that we believe to be owned by us are actually owned by them. Any litigation concerning any of these issues would be expensive, time consuming and uncertain. There can be no assurances that we would prevail in any suit brought by us or against us by third parties, or successfully settle or otherwise resolve those claims. Significant litigation would have substantial costs, even if the eventual outcome were favorable to us, and would divert management's attention from our business objectives.

Under certain circumstances, we may share or lose rights to intellectual property developed under U.S. federally funded research grants and contracts.

Some of our inventions, data, or other intellectual property have been or may be developed during the course of research funded by the U.S. government. The U.S. government may have the right to take title to government-funded inventions if we fail to disclose the inventions to the government in a timely manner or fail to file a patent for the intellectual property within specified time limits. Further, in consequence of our receiving government funding, the U.S. government may have certain rights to intellectual property that we use in our platform or programs pursuant to the Bayh-Dole Act of 1980, as amended (the "Bayh-Dole Act"). Under the Bayh-Dole Act, U.S. government rights in certain "subject inventions" developed under a government-funded program may include a non-exclusive, irrevocable worldwide license to use inventions for any governmental purpose. In some circumstances, the U.S. government may acquire unlimited rights in data we generate. In addition, the U.S. government has the right to require us, or an assignee or exclusive licensee to U.S. Government-funded inventions, to grant licenses to any of these inventions to the government or a third party if the government determines that: (i) adequate steps have not been taken to commercialize the invention; (ii) government action is necessary to meet public health or safety needs; (iii) government action is necessary to meet requirements for public use under federal regulations; or (iv) the right to use or sell such inventions is exclusively licensed to an entity within the United States and substantially manufactured outside the United States without the U.S. government's prior approval. Additionally, we may be restricted from granting exclusive licenses for the right to use or sell such inventions unless the licensee agrees to comply with relevant Bayh-Dole Act restrictions (e.g., manufacturing substantially all of the invention in the United States) and reporting requirements. In addition, the U.S. government may acquire title in any country in which a

patent application is not filed. Certain technology and inventions are also subject to transfer restrictions during the term of these agreements with the U.S. government and for a period thereafter. These restrictions may limit sales of products or components, transfers to foreign subsidiaries for the purpose of the relevant agreements, and transfers to certain foreign third parties. If any of our intellectual property becomes subject to any of the rights or remedies available to the U.S. government or third parties pursuant to the Bayh-Dole Act, this could impair the value of our intellectual property and could adversely affect our business.

The use of digital genetic sequence information may be subject to the Nagoya Protocol or other treaties or local legislation concerning biodiversity, which could increase our costs and adversely affect our business.

The Nagoya Protocol is a supplemental agreement to the Convention on Biological Diversity ("CBD") that is designed to provide for equitable sharing of benefits arising from the utilization of genetic resources and traditional knowledge. There are other international treaties, as well as local legislation in many countries, with similar objectives. Under the Nagoya Protocol and many other treaties and laws, countries possessing genetic resources ("source countries") are tasked with setting up procedures and institutional infrastructure for researchers to obtain prior informed consent, both from the source country and from any relevant indigenous or traditional communities, for biological research. Many have been slow to adopt workable institutions permitting the rational negotiation of benefit-sharing agreements. Many source countries are now asserting that the use of digital genetic sequence information is subject to the constraints of the Nagoya Protocol or similar national- or local-level benefit-sharing requirements. It is unclear whether this position will ultimately be adopted or what the implications of such adoption might be. It is unclear what a source country might assert if we used genetic sequences (i) extracted by a third party from a natural resource that was removed from its source country before that source country ratified the CBD or signed the Nagoya Protocol (ii) extracted by a third party and uploaded to public sequence databases after the source country ratified the CBD; (iii) in a heterologous host organism; or (iv) as a base for further engineering, so that the sequence we use no longer conforms to the natural sequence on which it was based.

We make extensive use of public and proprietary sequence databases to support our work. While we undertake efforts to identify and comply with laws and international protocols relating to the use of genetic resources, the uncertainty surrounding the use of digital sequence information and the lack of workable institutions in many source countries for the efficient negotiation of benefit-sharing agreements may limit our use or cause uncertainty in our use of certain sequences that we obtain from public access databases or natural sources. New financial obligations may arise regarding our use of sequence information. Customers that must certify their compliance with Nagoya Protocol obligations may be reluctant to do business with us unless we engage in expensive and time-consuming benefit-sharing negotiations with source countries of publicly available genetic sequences. Moreover, the World Intellectual Property Organization is considering requiring disclosures in patents of the origin of genetic resources, which may further increase uncertainty and the cost of patent prosecution. These changes could increase our R&D costs and adversely affect our business, financial condition, and results.

Third party patents may limit our freedom to operate in certain areas, which may adversely affect our business.

There may be patents that affect our freedom to operate in certain areas, and we may as a result choose to design around or license such patents from third parties. If we must spend significant time and money designing around or licensing patents held by others, our business and financial prospects may be harmed. We may be restricted from carrying out certain operations in our Foundry, or we may be limited in our ability to design new products for our customers. We may become subject to claims by third parties alleging that we are infringing, misappropriating, or otherwise violating their intellectual property rights.

If we are sued for infringing, misappropriating, or otherwise violating intellectual property rights of third parties, such litigation could be costly and time consuming and could prevent or delay us from using our platform and technologies.

Litigation arising from disputes relating to the intellectual property of third parties is expensive, time-consuming, and uncertain. There can be no assurance that we will prevail in such disputes. Parties making claims against us might be able to obtain injunctive or other relief, which could block our or our customers' ability to develop, commercialize and sell products or use our technologies, and could result in the award of substantial damages against us, including treble damages, attorney's fees, costs and expenses if we were found to have willfully infringed. In the event of a successful claim against us, we or our customers might be required to pay damages and ongoing royalties, and obtain licenses from third parties, or be prohibited from selling certain products or using certain technologies. We may not be able to obtain these licenses on acceptable or commercially reasonable terms, if at all. In addition, we or our customers could encounter delays in product or service introductions while we attempt to develop alternative designs or redesign existing products or technologies to avoid or resolve these claims. Our loss in any lawsuit or failure to obtain a license could prevent us from using our platform and technologies. Such a loss or failure could materially affect our business and reputation. Any litigation pertaining to these issues would have substantial costs, even if the eventual outcome were favorable to us, and would divert management's attention from our business objectives.

If our trademarks and trade names are not adequately protected, then we may not be able to build name recognition in our markets of interest and our business may be adversely affected.

Our registered or unregistered trademarks or trade names may be challenged, infringed, diluted, tarnished, circumvented or declared generic or determined to be infringing on other marks. We may not be able to protect our rights to these trademarks and trade names, which we need to build name recognition among potential collaborators or customers in our markets of interest. At times, competitors may adopt trade names or trademarks similar to ours, thereby impeding our ability to build brand identity and possibly leading to market confusion. In addition, there could be potential trade name or trademark infringement, dilution or tarnishment claims brought by owners of other trademarks or trademarks that incorporate variations of our registered or unregistered trademarks or trade names. Over the long term, if we are unable to establish name recognition based on our trademarks and trade names, then we may not be able to compete effectively and our business may be adversely affected. Our efforts to enforce or protect our proprietary rights related to trademarks, trade names, trade secrets, domain names, copyrights or other intellectual property may be ineffective and could result in substantial costs and diversion of resources and could adversely affect our business, financial condition, results of operations and prospects.

Any claims or lawsuits relating to infringement of, misappropriating, or otherwise violating intellectual property rights brought by or against us will be costly and time consuming and may adversely affect our business, financial condition and results of operations.

Any of the risks identified above could result in significant litigation. In addition to the specific litigation-related risks identified above, litigation of any kind carries certain inherent risks. Because of the substantial amount of discovery required in connection with litigation in U.S. courts, there is a risk that some of our confidential information could be compromised in the discovery process. There could be public announcements of the results of hearings, motions or other interim proceedings or developments. If securities analysts or investors perceive these results to be negative, it could have a substantial adverse effect on our share price.

Further, our agreements with some of our customers, suppliers or other entities require us to defend or indemnify these parties if they become involved in infringement claims that target our products, services or technologies, or in certain other situations. If we must defend or indemnify third parties, we could incur significant costs and expenses that could adversely affect our business, operating results or financial condition.

Intellectual property rights do not necessarily address all potential threats to our business.

The degree of future protection afforded by our intellectual property rights is uncertain because intellectual property rights have limitations and may not adequately protect our business or permit us to maintain our competitive advantage. The following examples are illustrative:

- we may choose not to file a patent in order to maintain certain intellectual property as trade secrets or know-how, and a third party may subsequently file a patent covering such intellectual property;
- others may independently develop similar or alternative technologies or duplicate any of our technologies without infringing our owned or licensed intellectual property rights;
- the patents of others may harm our business;
- we might not have been the first to make the inventions covered by the issued patents or pending patent applications that we own;
- we might not have been the first to file patent applications covering certain of our inventions; and
- issued patents that we hold rights to may fail to provide us with any competitive advantage, or may be held invalid or unenforceable, including as a result of legal challenges by our competitors.

Should any of these events occur, they could harm our business, financial condition, results of operations and prospects.

Intellectual property disputes of third parties and customers could have a material adverse effect on our business, financial condition, and results.

We rely, and expect to continue to rely on, certain capital equipment, machinery, consumables, reagents, software, services and intellectual property that we purchase or license from third parties for use in our operations, platform, products, services and offerings. We cannot be certain that our vendors, suppliers, and licensors are not infringing upon the

intellectual property rights of others or that they have sufficient rights to the third-party technology used in our business in all jurisdictions in which we may operate. Disputes with any of these third parties over uses or terms could result in the payment of additional royalties or penalties by us, cancellation or non-renewal of the underlying license, termination of supplies or rights to use, or litigation. In the event that we cannot resolve issues of this kind, we may be required to discontinue or limit our use of the operations, platform, products, services or offerings that include or incorporate the licensed intellectual property. Any such discontinuation or limitation could have a material and adverse impact on our business, financial condition and results of operation.

Our customers may become involved in intellectual property disputes with third parties that are related or unrelated to any products or services we have supplied or rendered to them. Such disputes could result in a customer being unable to market its products, thus depriving us of license, milestone, or other revenues. Such deprivation could have a material adverse impact on our financial condition and results.

Our use of "open-source" software could negatively affect our ability to market or provide our services and could subject us to possible litigation.

We have used "open-source" software in connection with the development and deployment of our software platform, and we expect to continue to use open-source software in the future. Open-source software is licensed by its authors or other third parties under open-source licenses, which in some instances may subject us to certain unfavorable conditions, including requirements that we offer our products that incorporate the open-source software for no cost, that we make publicly available all or part of the source code for any modifications or derivative works we create based upon, incorporating or using the open-source software, or that we license such modifications or derivative works under the terms of the particular open-source license.

Companies that incorporate open-source software into their products have, from time to time, faced claims challenging the use of open-source software and compliance with open-source license terms. We could be subject to similar suits by parties claiming ownership of what we believe to be open-source software or claiming noncompliance with open-source licensing terms. While we monitor our use of open-source software and try to ensure that none is used in a manner that would require us to disclose our proprietary source code or that would otherwise breach the terms of an open-source agreement, we cannot guarantee that we will be successful, that all open-source software is reviewed prior to use in our platform, that our developers have not incorporated open- source software into our products that we are unaware of or that they will not do so in the future.

Furthermore, there are an increasing number of open-source software license types, almost none of which have been interpreted by U.S. or foreign courts, resulting in a dearth of guidance regarding the proper legal interpretation of such licenses. As a result, there is a risk that open-source software licenses could be construed in a manner that imposes unanticipated conditions or restrictions on our ability to market or provide our products and services. If we are held to have breached or failed to fully comply with all the terms and conditions of an open-source software license, we could face infringement claims or other liability, or be required to seek costly licenses from third parties to continue providing our offerings on terms that are not economically feasible, if at all, to re-engineer all or a portion of our platform, to discontinue or delay the provision of our offerings if re-engineering could not be accomplished on a timely basis or to make generally available, in source code form, our proprietary code. Further, in addition to risks related to license requirements, use of certain open-source software carries greater technical and legal risks than does the use of third-party commercial software. For example, open-source software is generally provided without any support or warranties or other contractual protections regarding infringement or the quality of the code, including the existence of security vulnerabilities. To the extent that our platform depends upon the successful operation of open-source software, any undetected errors or defects in open-source software that we use could prevent the deployment or impair the functionality of our systems and injure our reputation. In addition, the public availability of such software may make it easier for others to compromise our platform. Any of the foregoing risks could materially and adversely affect our business, financial condition and results of operations.

Risks Related to Personnel, IT and Physical Infrastructure

Loss of key personnel, including our founders and senior executives, and/or failure to attract, train and retain additional key personnel could delay our cell engineering programs, harm our platform development efforts, limit our biosecurity and public health offerings, and harm our ability to meet our business objectives, particularly given the substantial investment required to recruit, hire and train our employees.

Our business involves complex, global operations across a variety of markets and requires a management team and employee workforce that is knowledgeable in the many areas in which we operate. Our future success depends upon our

ability to attract, train, retain and motivate highly qualified management, scientific, engineering, information technology, operations, business development and marketing personnel, among others. In addition, the market for qualified personnel is very competitive because of (a) the limited number of people available who have the necessary technical skills and understanding of our technology and products and (b) the nature of our industry which requires certain of our technical personnel to be on-site in our facilities. We compete for qualified technical personnel with other life sciences and information technology companies, as well as academic institutions and research institutions in the markets in which we operate, including: Massachusetts, USA; California, USA; The Netherlands; France; and Switzerland. In addition, as we add international operations, we will increasingly need to recruit qualified personnel outside the United States. However, doing so may also require us to comply with laws to which we are not currently subject, which could cause us to allocate or divert capital, personnel and other resources from our organization, which could adversely affect our business, financial condition, results of operations, prospects and reputation. Establishing international operations and recruiting personnel has in the past been impacted by COVID-19 travel and operational restrictions. Our senior leadership team is critical to our vision, strategic direction, platform development, operations and commercial efforts. Our employees, including members of our leadership team, could leave our company with little or no prior notice and would be free to work for a competitor. We also do not maintain "key person" life insurance on any of our employees. The departure of one or more of our founders, senior leadership team members or other key employees could be disruptive to our business until we are able to hire qualified successors.

Our continued platform development, growth and commercial success depends, in part, on recruiting and retaining highly-trained personnel across our various target industries and markets with the necessary background and ability to develop and use our platform and to effectively identify and sell to current and new customers. New hires and employees onboarded as a result of any of our recent acquisitions may require significant training and, in most cases, take significant time before they achieve full productivity. Our failure to successfully hire and integrate these key personnel into our business could adversely affect our business. To attract top talent, we believe we will need to offer competitive compensation and benefits packages, including equity incentive programs, which may require significant investment. If we are unable to offer competitive compensation this may make it more difficult for us to attract and retain key employees. Moreover, if the perceived value of our equity awards declines, it may adversely affect our ability to attract and retain key employees. If we do not maintain the necessary personnel to accomplish our business objectives, we may experience staffing constraints that adversely affect our ability to support our programs and operations.

In addition, some of our personnel are qualified foreign nationals whose ability to live and work in the U.S. is contingent upon the continued availability of appropriate visas and whose ability to work on some of our technologies may require the procurement of appropriate export licenses. Due to the competition for qualified personnel in the key markets in which we operate, we expect to continue to utilize foreign nationals to fill part of our recruiting needs. As a result, changes to United States immigration policies have restrained, and could further restrain, the flow of technical and professional talent into the United States and adversely affect our ability to hire and retain qualified personnel.

Our business and results of operations are dependent on adequate access to laboratory and office space and suitable physical infrastructure, including electrical, plumbing, HVAC and network infrastructure, to conduct our operations. Our headquarters and certain of our laboratories are located in a flood zone in Boston's Seaport District. Other facilities are located in active earthquake and tsunami zones or in active hurricane or wildfire zones. If we are unable to access enough space or we experience failures of our physical infrastructure, including due to natural disasters affecting us or our suppliers, our business and results of operations could be adversely affected.

Our business depends on providing customers with technical services. In order to properly conduct our business, we need access to sufficient laboratory space and equipment to perform the activities necessary to advance and complete our programs. Additionally, we need to ensure that our laboratories and corporate offices remain operational at all times, which includes maintaining suitable physical infrastructure, including electrical, plumbing and HVAC, logistics and transportation systems and network infrastructure. We own certain properties in California and lease most of our laboratories and office spaces. We rely on the landlords for basic maintenance of our leased laboratories and office buildings. If one of our landlords has not maintained a leased property sufficiently, we may be forced into an early exit from the facility, which could be disruptive to our business. Furthermore, we may continue to acquire laboratories not built by us in order to sufficiently scale and expand our output capacity. If we discover that these buildings and their infrastructure assets are not in the condition we expected when they were acquired, we may be required to incur substantial additional costs to repair or upgrade the laboratories.

Problems in and around one or more of our laboratories or corporate offices, whether or not within our control, could result in service interruptions or significant infrastructure or equipment damage. These could result from numerous factors, including:

- human error;
- equipment failure;
- physical, electronic and cybersecurity breaches;
- fire, earthquake, hurricane, flood, tornado and other natural disasters;
- extreme temperatures;
- flood and/or water damage;
- fiber cuts;
- power loss;
- terrorist acts, including acts of bioterrorism;
- sabotage, vandalism and cyberattacks; and
- local epidemics or global pandemics such as the COVID-19 pandemic.

Certain of our facilities are located in an active earthquake and tsunami zone, and certain of our suppliers conduct their operations in the same region or in other locations that are susceptible to natural disasters. The occurrence of a natural or other disaster, such as an earthquake, tsunami, hurricane, drought, flood, fire, wildfire or any potential effects of climate change or localized extended outages of critical utilities or transportation systems, or any critical resource shortages affecting us or our suppliers or manufacturers could cause a significant interruption in our business, damage or destroy our facilities, production equipment or inventory or those of our suppliers and cause us to incur significant costs or result in limitations on the availability of our raw materials, any of which could harm our business, financial condition and results of operations.

We have timeline obligations to certain customers with respect to their programs. As a result, service interruptions or significant equipment damage in our laboratories could result in difficulty maintaining program timelines for these customers and potential claims related to such failures. Because the services we provide in our laboratories are critical to many of our customers' businesses, service interruptions or significant equipment damage in our laboratories could also result in lost revenue or other indirect or consequential damages to our customers. We cannot guarantee that a court would enforce any contractual limitations on our liability in the event that one of our customers brings a lawsuit against us as a result of a problem at one of our laboratories and we may decide to reach settlements with affected customers irrespective of any such contractual limitations. In addition, any loss of service, equipment damage or inability to meet our service obligations could reduce the confidence of our customers and could consequently impair our ability to obtain and retain customers, which would adversely affect both our ability to generate revenues and our operating results.

Furthermore, we are dependent upon internet service providers, telecommunications carriers and other website operators, some of which have experienced significant system failures and electrical outages in the past.

Our customers may, in the future, experience difficulties due to system failures unrelated to our systems and offerings. If, for any reason, these providers fail to provide the required services, our business, financial condition and results of operations could be materially and adversely impacted.

Risks Related to Financial Reporting

We rely on our customers, joint venturers, equity investees and other third parties to deliver timely and accurate information in order to accurately report our financial results in the time frame and manner required by law.

We need to receive timely, accurate, and complete information from a number of third parties in order to accurately report our financial results on a timely basis. If the information that we receive is not accurate or complete, or if a third party differs from us in its interpretation of accounting rules, our consolidated financial statements may be materially incorrect and may require restatement, or we may otherwise be required to correct our prior financial reporting. Although we have audit rights with third parties, performing such an audit could be expensive and time consuming and may not be adequate to reveal any discrepancies in a time frame consistent with our reporting requirements. We have had, and in the future may have, difficulty completing accurate and timely financial disclosures, which could have an adverse effect on our business. For example, we amended our 2021 Annual Report on Form 10-K to include significant investee financial statements in connection with one of our equity method investments.

We use estimates in determining the fair value of certain assets and liabilities. If our estimates prove to be incorrect, we may be required to write down the value of these assets or write up the value of these liabilities, which could adversely affect our financial position.

Our ability to measure and report our financial position and operating results is influenced by the need to estimate the fair value of an asset or liability. Fair value is estimated based on a hierarchy that maximizes the use of observable inputs and minimizes the use of unobservable inputs. Observable inputs are inputs that reflect the assumptions that market participants would use in pricing the asset or liability developed based on market data obtained from sources independent of the reporting entity. Unobservable inputs are inputs that reflect the reporting entity's own assumptions about the assumptions market participants would use in pricing the asset or liability developed based on the best information available in the circumstances. We estimate the impact or outcome of future events on the basis of information available at the time of the financial statements. An accounting estimate is considered critical if it requires that management make assumptions about matters that were highly uncertain at the time the accounting estimate was made. If actual results differ from management's judgments and assumptions, then they may have an adverse impact on our results of operations and cash flows.

Our ability to use our net operating loss carryforwards and certain other tax attributes may be limited.

We have incurred net losses since our inception and we may never achieve or sustain profitability. Generally, for U.S. federal income tax purposes, net operating losses incurred will carry forward. However, net operating loss carryforwards generated prior to January 1, 2018 are subject to expiration for U.S. federal income tax purposes. As of December 31, 2023, we had federal net operating loss carryforwards of approximately $1.0 billion, of which $139.2 million will begin to expire in 2029 and $884.1 million can be carried forward indefinitely. As of December 31, 2023, we had state net operating loss carryforwards of approximately $998.2 million, of which $869.2 million will begin to expire in 2030 and $129.0 million can be carried forward indefinitely. As of December 31, 2023, we had foreign net operating losses of approximately $1.7 million, which can be carried forward indefinitely. As of December 31, 2023, we had federal research and development tax credit carryforwards of approximately $40.4 million, which begin to expire in 2029. As of December 31, 2023, we also had state research and development and investment tax credit carryforwards of approximately $30.1 million, which begin to expire in 2030.

Under Sections 382 and 383 of the Internal Revenue Code of 1986, as amended, if a corporation undergoes an "ownership change," generally defined as a greater than 50% change by value in its equity ownership by certain stockholders over a three-year period, the corporation's ability to use its pre-ownership change net operating loss carryforwards and other pre-ownership change tax attributes, such as research tax credits, to offset its post-ownership change income or taxes may be limited. Similar provisions of state tax law may also apply to limit the use of our state net operating loss carryforwards and other state tax attributes. We have not performed an analysis to determine whether our past issuances of stock and other changes in our stock ownership may have resulted in one or more ownership changes. If it is determined that we have in the past experienced an ownership change, or if we undergo one or more ownership changes as a result of future transactions in our stock, which may be outside our control, then our ability to utilize our net operating loss carryforwards and other tax attributes may be materially limited. As a result, even if we earn taxable income, we may be unable to use a material portion of our net operating loss carryforwards and other tax attributes, which could adversely affect our future cash flows. There is also a risk that regulatory changes, such as suspensions on the use of net operating losses or other unforeseen reasons, may result in our existing net operating loss carryforwards expiring or otherwise becoming unavailable to offset future taxable income. For these reasons, we may not be able to utilize a material portion of our net operating loss carryforwards and other tax attributes even if we attain profitability.

We have identified a material weakness in our internal controls over financial reporting, and we may identify additional material weaknesses in the future. A failure to maintain an effective system of internal control over financial reporting, may result in failure to accurately report our financial results or prevent fraud. As a result, stockholders could lose confidence in our financial and other public reporting, which would harm our business and the trading price of our common stock.

SEC and New York Stock Exchange ("NYSE") rules and regulations require, among other things, that we establish and periodically evaluate procedures with respect to our internal control over financial reporting. In addition, we are required to document and test our internal control over financial reporting pursuant to Section 404 of the Sarbanes-Oxley Act of 2002 so that our management can certify as to the effectiveness of our internal control over financial reporting. Likewise, our independent registered public accounting firm is required to attest to the effectiveness of our internal control over financial reporting.

As disclosed in Part II-Item 9A, "Controls and Procedures", of this Annual Report ("Item 9A"), in connection with the audit of our financial statements for the year ended December 31, 2023, we concluded that there was a material weakness

in our internal controls over financial reporting. The material weakness identified in Item 9A did not result in any material misstatement of our financial statements.

Our remediation efforts with respect to our identified material weakness may be inadequate, and we may in the future discover other areas of our internal controls that require remediation.

We cannot provide assurances that there will not be additional material weaknesses or significant deficiencies in our internal control over financial reporting in the future. Any failure to maintain internal control over financial reporting could severely inhibit our ability to accurately report our financial condition, or results of operations. Any material weaknesses or significant deficiencies in our internal control over financial reporting could cause investors to lose confidence in the accuracy and completeness of our financial reports, the market price of shares of our common stock to decline, and result in sanctions or investigations by NYSE, the SEC or other regulatory authorities. Failure to remedy material weaknesses in our internal control over financial reporting or to implement or maintain other effective control systems could also restrict our future access to the capital markets.

Adverse developments affecting the financial services industry could adversely affect our business operations, financial condition and results of operations.

Actual or rumored events involving reduced or limited liquidity, defaults, non-performance or other adverse developments that affect financial institutions or other companies in the financial services industry or the financial services industry generally, have in the past and may in the future lead to market-wide liquidity problems. For example, the closures of SVB, Signature Bank and First Republic Bank in the spring of 2023 created bank-specific and broader financial institution liquidity risk and concerns. Future adverse developments with respect to specific financial institutions or the broader financial services industry may lead to market-wide liquidity shortages, impair the ability of companies to access working capital needs, and create additional market and economic uncertainty.

We regularly maintain cash balances at third-party financial institutions in excess of the Federal Deposit Insurance Corporation insurance limit. Immediately following SVB's receivership in 2023, we temporarily lost access to our cash and cash equivalents at SVB. While we regained access to all funds then held at SVB, any similar failure of a depository institution to return our deposits, or if a depository institution is subject to other adverse conditions in the financial or credit markets, could further impact access to our invested cash or cash equivalents and could adversely impact our operating liquidity and financial performance.

In addition, widespread investor concerns regarding the U.S. or international financial systems could result in less favorable commercial financing terms, including higher interest rates or costs and tighter financial and operating covenants, or systemic limitations on access to credit and liquidity sources, thereby making it more difficult for us to acquire financing on acceptable terms or at all. Any decline in available funding or access to our cash and liquidity resources could, among other risks, adversely impact our ability to meet our operating expenses, financial obligations or fulfill our other obligations, or result in breaches of our financial and/or contractual obligations. Any of these impacts, or any other impacts resulting from the factors described above or other related or similar factors not described above, could have material adverse impacts on our liquidity and our current and/or projected business operations and financial condition and results of operations.

Risks Related to Governmental Regulation and Litigation

Failure to comply with federal, state, local and international laws and regulations could adversely affect our business and our financial condition.

A variety of federal, state, local and international laws and regulations govern certain aspects of our business. For example, we maintain a registration from the DEA for the research of certain controlled substances and permits from the Boston Public Health Commission to conduct work with recombinant DNA. Some of our programs or products made or developed using our engineered cells and/or biomanufacturing processes are subject to regulations, including those promulgated by the FDA, DEA, EPA or USDA. In addition, we are subject to laws relating to, among other things, anti-bribery, insider trading, sourcing of biological materials and data privacy. The legal and regulatory requirements that apply to our business may be interpreted and applied in a manner that is inconsistent from one jurisdiction to another or may conflict with other rules or our practices. As a result, our practices may not comply, or may not comply in the future with all such laws, regulations, requirements and obligations. Any failure, or perceived failure, by us to comply with any federal, state, local or international laws, regulations, industry self-regulatory principles, industry standards or codes of conduct, regulatory guidance, orders to which we may be subject or other legal obligations could adversely affect our reputation, brand and business, and may result in claims, proceedings or actions against us by governmental entities or others or other liabilities

or require us to change our operations. We may also be contractually required to indemnify and hold harmless third parties from the costs or consequences of non-compliance with any laws, regulations or other legal obligations.

We may also become subject to increasing regulation in the future as we expand our business. As we continue to expand our operations and offerings domestically and globally, we will have to expend significant management and financial resources to maintain compliant practices in those locations. Non-compliance could lead to litigation, which would require substantial management and financial resources.

We may incur significant costs complying with environmental, health and safety laws and regulations, and failure to comply with these laws and regulations could expose us to significant liabilities.

We use hazardous chemical and biological materials in our business and are subject to a variety of federal, state, local and international laws and regulations governing, among other matters, the use, generation, manufacture, transportation, storage, handling, disposal of, and human exposure to these materials, including regulation by governmental regulatory agencies, such as the Occupational Safety and Health Administration and the EPA. We have incurred, and will continue to incur, capital and operating expenditures and other costs in the ordinary course of our business in complying with these laws and regulations.

Although we have implemented safety procedures for storing, handling and disposing of these materials and waste products in an effort to comply with these laws and regulations, we cannot be sure that our safety measures will be compliant or capable of eliminating the risk of injury or contamination from the generation, manufacturing, use, storage, transportation, handling, disposal of and human exposure to hazardous materials and/or flammable chemicals. Failure to comply with environmental, health and safety laws could subject us to liability and resulting damages. There can be no assurance that violations of environmental, health and safety laws will not occur as a result of human error, accident, equipment failure, contamination, intentional misconduct or other causes. Compliance with applicable environmental laws and regulations may be expensive, and the failure to comply with past, present or future laws could result in the imposition of fines, regulatory oversight costs, third party property damage, product liability and personal injury claims, investigation and remediation costs, the suspension of production or a cessation of operations, and our liability may exceed our total assets. Liability under environmental laws can be imposed for the full amount of damages without regard to comparative fault for the investigation and cleanup of contamination and impacts to human health and for damages to natural resources. Contamination at properties we may own and operate and at properties to which we send hazardous materials, may result in liability for us under environmental laws and regulations.

Our business and operations may be affected by other new environmental, health and safety laws and regulations, which may require us to change our operations, or result in greater compliance costs and increasing risks and penalties associated with violations, which could impair our research, development or production efforts and harm our business.

If we fail to comply with healthcare and other governmental regulations, we could face substantial penalties and our business, financial condition and results of operations could be adversely affected.

Our business activities may be subject to regulation and enforcement by the FDA, U.S. Department of Justice, HHS, Office of Inspector General, and other federal and state governmental authorities. Although our offerings are not currently billed to any third-party payor, including any commercial payor or government healthcare program, we may, in the future, submit claims for our services to third-party payors, including government healthcare programs. If we submit claims to third-party payors, such activity will expand the scope of federal and state healthcare laws applicable to us.

Federal and state healthcare laws and regulations that may affect our ability to conduct business include, without limitation:

- the federal Anti-Kickback Statute, which prohibits, among other things, persons or entities from knowingly and willfully soliciting, offering, receiving or paying any remuneration, directly or indirectly, overtly or covertly, in cash or in kind, to induce or reward either the referral of an individual for, or the purchase, lease, order, or arranging for or recommending the purchase, lease or order of, any item or service, for which payment may be made, in whole or in part, under federal healthcare programs such as Medicare and Medicaid. A person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation;
- the federal physician self-referral prohibition, commonly known as the Stark Law, which prohibits a physician, in the absence of an applicable exception, from making a referral for certain designated health services covered by the Medicare or Medicaid program, including clinical laboratory services, if the physician or an immediate family member of the physician has a financial relationship with the entity providing the designated health services. The

Stark Law also prohibits the entity furnishing the designated health services from billing, presenting or causing to be presented a claim for the designated health services furnished pursuant to the prohibited referral;

- the federal civil false claims laws, including without limitation the federal False Claims Act (which can be enforced through "qui tam," or whistleblower actions, by private citizens on behalf of the federal government), and civil monetary penalties laws, which prohibit, among other things, individuals or entities from knowingly presenting, or causing to be presented, false or fraudulent claims for payment of government funds, or knowingly making, using or causing to be made or used, a false record or statement material to an obligation to pay money to the government or knowingly and improperly avoiding, decreasing or concealing an obligation to pay money to the federal government. In addition, the government may assert that a claim including items and services resulting from a violation of the federal Anti-Kickback Statute or Stark Law constitutes a false or fraudulent claim for purposes of the civil False Claims Act;
- the EKRA, which created a new federal crime for knowingly and willfully: (1) soliciting or receiving any remuneration in return for referring a patient to a recovery home, clinical treatment facility, or laboratory; or (2) paying or offering any remuneration to induce such a referral or in exchange for an individual using the services of a recovery home, clinical treatment facility, or laboratory. Unlike the Anti-Kickback Statute, EKRA is not limited to services reimbursable under a government health care program, but instead extends to all services reimbursed by "health care benefit programs";
- the healthcare fraud statutes under HIPAA, which impose criminal and civil liability for, among other things, knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program, or knowingly and willfully falsifying, concealing or covering up a material fact or making any materially false statement, in connection with the delivery of, or payment for healthcare benefits, items or services by a healthcare benefit program, which includes both government and privately funded benefits programs. Similar to the federal Anti-Kickback Statute, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation;
- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act ("HITECH") enacted as part of the American Recovery and Reinvestment Act of 2009, and its implementing regulations, and as amended again by the Modifications to the HIPAA Privacy, Security, Enforcement and Breach Notification Rules Under HITECH and the Genetic Information Nondiscrimination Act; Other Modifications to the HIPAA Rules, commonly referred to as the Final HIPAA Omnibus Rule, published in January 2013, which imposes certain obligations, including mandatory contractual terms, on covered entities subject to HIPAA (i.e., health plans, healthcare clearinghouses and certain healthcare providers), as well as their business associates that perform certain services for or on their behalf involving the use or disclosure of individually identifiable health information, to safeguard the privacy, security and transmission of individually identifiable health information from any unauthorized use or disclosure;
- the U.S. Food, Drug, and Cosmetic Act ("FDCA") which imposes civil and criminal liability for engaging in any of a number of Prohibited acts, including distributing drugs, devices and foods that are adulterated or misbranded. To charge a criminal misdemeanor violation of the FDCA, no intent need be shown;
- federal consumer protection and unfair competition laws, which broadly regulate platform activities and activities that potentially harm consumers; and
- state law equivalents of each of the above federal laws, such as anti-kickback, self-referral, and fee-splitting, and false claims laws which may apply to items or services reimbursed by any third-party payor, including commercial insurers and self-pay patients.

Because of the breadth of these laws and the narrowness of available statutory and regulatory exemptions, exceptions, and safe harbors, it is possible that some of our activities could be subject to challenge under one or more of such laws. We may face claims and proceedings by private parties, and claims, investigations and other proceedings by governmental authorities, relating to allegations that our business practices do not comply with current or future laws or regulations involving applicable fraud and abuse or other healthcare laws and regulations, and it is possible that courts or governmental authorities may conclude that we or any of our partners have not complied with them, or that we may find it necessary or appropriate to settle any such claims or other proceedings. Any action brought against us for violation of these or other laws or regulations, even if we successfully defend against it, could cause us to incur significant legal expenses and divert our management's attention from the operation of our business. If our operations are found to be in violation of any federal or state laws described above or any other current or future fraud and abuse or other healthcare laws and regulations that apply to us, we may be subject to claims and proceedings by private parties, investigations and other proceedings by governmental authorities, as well as penalties, including significant criminal, civil and administrative penalties, damages and fines, disgorgement, additional reporting requirements and oversight if we become subject to a corporate integrity agreement or similar agreement to resolve allegations of noncompliance with these laws or regulations, imprisonment for

individuals and exclusion from participation in government programs, such as Medicare and Medicaid, as well as contractual damages and reputational harm. We could also be required to curtail or cease our operations. In addition, if any customers, healthcare professionals we engage, laboratory partners or other entities with whom we do business are found not to be in compliance with applicable laws, they may be subject to the same criminal, civil or administrative sanctions, including exclusion from government-funded healthcare programs. Any of the foregoing could seriously harm our business and financial results.

We and our laboratory partners are subject to a variety of laboratory testing standards, compliance with which is an expensive and time-consuming process, and any failure to comply could result in substantial penalties and disruptions to our business.

We and the third-party laboratories that we partner with are subject to the CLIA. CLIA is a federal law that regulates clinical laboratories that perform testing on specimens derived from humans for the purpose of providing information for the diagnosis, prevention or treatment of disease. CLIA requires certain clinical laboratories to be certified by the federal government and mandates compliance with various operational, personnel, facilities administration, quality and proficiency testing requirements depending on the level of complexity for which the laboratory is certified. CLIA certification is also a prerequisite to be eligible to bill state and federal healthcare programs, as well as many private third-party payors, for laboratory testing services. Our partner laboratories hold CLIA certifications for high complexity testing, which mandate compliance with various operational, personnel, facilities administration, quality and proficiency testing requirements depending on the level of complexity for which the laboratory is certified. Sanctions for failure to comply with CLIA requirements may include suspension, revocation, or limitation of a laboratory's CLIA certificate, as well as the imposition of significant fines or criminal penalties. Any sanction imposed under CLIA, its implementing regulations, or state or foreign laws or regulations governing licensure, or our partner laboratories' failure to renew a CLIA certificate, a state or foreign license, or accreditation, could have a material adverse effect on our business.
In addition, our partner laboratories and our laboratories holding CLIA Certificates of Waiver are subject to state laws and regulations governing laboratory licensure. Some states have enacted state licensure laws that are more stringent than CLIA. In certain markets such as California, New York, and Pennsylvania, we or our partner laboratories may also need to obtain and maintain additional licensure from such states. It is uncertain that our partner laboratories will be granted such licensure and, in such cases, we cannot offer testing to patients located in those states, which could limit our ability to offer testing on a wide scale.

It is possible that additional states may enact laboratory licensure requirements in the future, which could further limit our ability to expand our services.

We rely on third-party laboratories in the conduct of our biosecurity and public health business offerings. If any of our partners cease working with us, or face supply chain disruptions or other difficulties, our business could be harmed.

The testing industry is subject to complex and costly regulation and if government regulations are interpreted or enforced in a manner adverse to us, we may be subject to enforcement actions, penalties, exclusion, and other material limitations on our operations.

We have offered COVID-19 testing services by partnering with third-party laboratories, diagnostic test manufacturers and manufacturers of collection kits, which are subject to extensive and frequently changing federal, state and local laws and regulations governing various aspects of our business, including significant governmental certification and licensing regulations. New laws, regulations and judicial decisions, or new interpretations of existing laws, regulations and decisions, may also limit our potential revenues, and we may need to revise our R&D or commercialization programs. The costs of defending claims associated with violations, as well as any sanctions imposed, could significantly adversely affect our financial performance.

Our testing does not identify nor sequence any individual human DNA or RNA nor can results be tied to any individual. As a result, we do not collect informed consents from any individual participating in our programs. However, our approach could be challenged in the future based on the claims or privacy considerations and searches governed by the 4th Amendment of the U.S. Constitution. Any legal challenges could consume our management and financial resources.

Current regulations governing the testing services we offer are shifting and in some cases unclear. In addition, our laboratory partners may be unsuccessful in validating, or obtaining or maintaining authorizations for, the tests we relied on to provide our prior COVID-19 testing services. If any third-party manufacturers or laboratories offering tests that we use in our testing services are deemed by the FDA or other regulatory authorities to have violated applicable law or if the tests or test components are marketed, processed or distributed in violation of applicable law, we may be subject to enforcement

action or litigation, or we may be required to find alternative tests to support our testing services, which could increase our costs.

In addition, we are required to comply with applicable FDA regulations with respect to distribution of certain COVID-19 diagnostic test kits and collection kits, including, for certain kits, compliance with applicable terms and conditions of an EUA. Such conditions may include requirements related to collection of information on the performance of the product, reporting of adverse events, recordkeeping requirements, and labeling and promotional activities. To the extent that we market or promote third-party tests or test kits outside of the uses authorized for these products or in a false or misleading manner, the tests or collection kits could be considered misbranded or adulterated and distributing them in interstate commerce could violate the FDCA. Violations of applicable FDA requirements could result in enforcement actions, such as warning or "untitled" letters, revocation of EUAs, seizures, injunctions, civil penalties and criminal prosecutions and fines, and violation of the FTC Act could result in injunctions and other associated remedies, all of which could have a material adverse effect on our business. Most states also have similar regulatory and enforcement authority for laboratory testing and distribution of related collection kits. For example, many state laws require us to hold a specific form of license to distribute COVID-19 diagnostic test kits and collection kits into such states. These requirements vary from one state to another and frequently change. Complying with state laws and regulations may subject us to similar risks and delays as those we could experience under federal regulation.

Our surveillance testing efforts do not collect identifying individual data and do not return a diagnostic result, but some surveillance methods, such as double collection, require samples from individuals. Regulatory authorities could take issue with our characterization of such testing as surveillance and/or impose additional requirements or restrictions.

Advertising for any of the tests or collection kits we distribute or the testing services we offer is also subject to regulation by the Federal Trade Commission ("FTC"), under the Federal Trade Commission Act ("FTC Act"). The FTC may take enforcement action for advertising claims that are not adequately substantiated or that are false or misleading.

We are subject to federal and state laws and regulations governing the protection, use, and disclosure of health information and other types of personal information, and our failure to comply with those laws and regulations or to adequately secure the information we hold could result in significant liability or reputational harm.

Numerous state and federal laws, regulations, standards and other legal obligations, including consumer protection laws and regulations, which govern the collection, dissemination, use, access to, confidentiality, security and processing of personal information, including health-related information, could apply to our operations or the operations of our partners. For example, HIPAA imposes privacy, security and breach notification obligations on certain healthcare providers, health plans, and healthcare clearinghouses, known as covered entities, as well as their business associates that perform certain services that involve creating, receiving, maintaining or transmitting individually identifiable health information for or on behalf of such covered entities, and their covered subcontractors. HIPAA requires covered entities and business associates to develop and maintain policies with respect to the protection of, use and disclosure of protected health information ("PHI"), including the adoption of administrative, physical and technical safeguards to protect such information, and certain notification requirements in the event of a breach of unsecured PHI. If in the future we engage in certain types of standard electronic transactions involving payors, including billing the Medicare or Medicaid programs or commercial health plans, we will be subject to HIPAA as a "covered entity." We are currently subject to HIPAA as a "business associate" because we performed certain services involving the use or disclosure of PHI on behalf of covered entity customers with respect to our prior COVID-19 testing service offerings. Implementation of the infrastructure necessary to meet HIPAA standards requires substantial investment. Being subject to HIPAA as a covered entity or business associate exposes us to significant fines and penalties, including criminal fines and penalties.

Entities that are found to be in violation of HIPAA as the result of a breach of unsecured PHI, a complaint about privacy practices or an audit by HHS, may be subject to significant civil, criminal and administrative fines and penalties and/or additional reporting and oversight obligations if required to enter into a resolution agreement and corrective action plan with HHS to settle allegations of HIPAA non-compliance. HIPAA also authorizes state attorneys general to file suit on behalf of their residents. Courts may award damages, costs and attorneys' fees related to violations of HIPAA in such cases. While HIPAA does not create a private right of action allowing individuals to sue us in civil court for violations of HIPAA, its standards have been used as the basis for duty of care in state civil suits such as those for negligence or recklessness in the misuse or breach of PHI.

Even when HIPAA or a state law does not apply, according to the FTC, violating consumers' privacy rights or failing to take appropriate steps to keep consumers' personal information secure may constitute unfair and/or deceptive acts or

practices in violation of Section 5(a) of the FTC Act. The FTC expects a company's data security measures to be reasonable and appropriate in light of the sensitivity and volume of consumer information it holds, the size and complexity of its business, and the cost of available tools to improve security and reduce vulnerabilities.

Several states have enacted privacy laws governing the use and disclosure of health information, such as the California Confidentiality of Medical Information Act; these laws are not preempted by HIPAA to the extent they are more stringent than HIPAA. Such laws and regulations will be subject to interpretation by various courts and other governmental authorities, thus creating potentially complex compliance issues for us and our partners. Further, in recent years, there have been a number of well-publicized data breaches involving the improper dissemination of personal information of individuals both within and outside of the healthcare industry. Laws in all 50 states require businesses to provide notice to individuals whose personally identifiable information has been disclosed as a result of a data breach. The laws are not consistent, and compliance in the event of a widespread data breach is costly. States are also constantly amending existing laws, and creating new data privacy and security laws, requiring attention to frequently changing regulatory requirements. For example, the California Consumer Privacy Act of 2018 ("CCPA") went into effect on January 1, 2020. The CCPA creates new transparency requirements and grants California residents several new rights with respect to their personal information. Failure to comply with the CCPA may result in, among other things, significant civil penalties and injunctive relief, or potential statutory or actual damages. On November 3, 2020, California voters passed a ballot initiative for the California Privacy Rights Act ("CPRA"), which significantly expands the CCPA. The CPRA imposes additional data protection obligations on covered businesses, including additional consumer rights processes, limitations on data uses, new audit requirements for higher risk data, and opt outs for certain uses of sensitive data. It also creates a new California data protection agency authorized to issue substantive regulations and could result in increased privacy and information security enforcement. Additional compliance investment and potential business process changes may be required to remain compliant with similar laws that have been proposed or passed in other states. For example, Virginia, Colorado, Connecticut, and Utah have also passed comprehensive privacy laws that became effective in 2023, and similar laws have been passed or are being considered in several other states, as well as at the federal and local levels. The evolving patchwork of differing state and federal privacy and data security laws increases the cost and complexity of operating our business and increases our exposure to liability, including from third-party litigation and regulatory investigations, enforcement, fines, and penalties.

Through our wholly owned subsidiaries with established offices in the European Union, parts of our business are subject to the European Union General Data Protection Regulation ("GDPR"), which went into effect in May 2018, and imposes strict requirements for processing the personal data of individuals within the European Economic Area. Companies that must comply with the GDPR face increased compliance obligations and risk, including more robust regulatory enforcement of data protection requirements and potential fines for noncompliance of up to €20 million or 4% of the annual global revenues of the noncompliant company, whichever is greater. Among other requirements, the GDPR regulates transfers of personal data subject to the GDPR to third countries that have not been found to provide adequate protection to such personal data, including the United States. Further, from January 1, 2021, companies that process the personal information of UK residents have to comply with the United Kingdom GDPR (the "UK GDPR"), which, together with the amended UK Data Protection Act 2018, retains the GDPR in UK national law. The UK GDPR mirrors the fines under the GDPR, i.e., fines up to the greater of €20 million (£17.5 million) or 4% of global turnover. Enforcement uncertainty and the costs associated with ensuring compliance may be onerous and adversely affect our business, operating results, prospects and financial condition.

Although we work to comply with applicable laws, regulations and standards, contractual obligations and other legal obligations relating to data privacy, protection and security, these requirements are evolving and may be modified, interpreted and applied in an inconsistent manner from one jurisdiction to another, and may conflict with one another or other legal obligations with which Ginkgo must comply. Monitoring, preparing for and complying with these obligations requires us to devote significant resources (including, without limitation, financial and time-related resources). And as our operations and business grow, we may become subject to or affected by new or additional data protection laws and regulations and face increased scrutiny or attention from regulatory authorities. There is also increased public awareness of privacy issues in the wake of revelations about the data-collection activities of various government agencies and in the number of private privacy-related lawsuits filed against companies. Any failure or perceived failure by us or our employees, representatives, contractors, consultants, collaborators, or other third parties to comply with such requirements or adequately address privacy and security concerns, even if unfounded, could result in additional cost and liability to us, damage our reputation, and adversely affect our business and results of operations.

Our employees, agents, contractors, research partners, consultants or vendors may engage in misconduct or other improper activities, including noncompliance with regulatory standards and requirements.

We are exposed to the risk that our employees, agents, contractors, research partners, consultants or vendors may engage in fraudulent or other illegal activity or misconduct. Misconduct by these parties could include intentional, reckless and/or

negligent conduct or disclosure of unauthorized activities to us that causes us to breach our contracts and/or violates applicable laws and regulations, including but not limited to laws:

- applicable to the provision of health care services;
- governing the storage and handling of controlled substances;
- requiring the reporting of true, complete and accurate information to the FDA, USDA, and other government agencies;
- specifying vendor qualification standards and recordkeeping requirements;
- international, federal and state fraud and abuse laws and regulations;
- protecting the privacy and security of personally identifiable information and requiring breach notification;
- relating to anti-corruption, anti-bribery, and anti-money laundering; and
- requiring the true, complete and accurate reporting of services, financial information, or data.

Specifically, the health care industry and government contractors are subject to extensive laws and regulations intended to prevent fraud, kickbacks, self-dealing and other abusive practices. These laws and regulations may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, sales commission, and other business arrangements. Additionally, activities that involve the improper use or misrepresentation of information obtained in the course of research or creating fraudulent data could result in breach of contract, regulatory sanctions, and serious harm to our reputation. It is not always possible to identify and deter misconduct by our employees and other third parties, and the precautions we take to detect and prevent this kind of activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations, other actions, or lawsuits stemming from a failure to be in compliance with such laws or regulations. Additionally, we are subject to the risk that a person could allege such fraud or other misconduct, even if none occurred. If any such actions are instituted against us, and we are not successful in defending ourselves or asserting our rights, those actions could have a significant impact on our business, including the imposition of civil, criminal and administrative penalties, damages, monetary fines, possible exclusion from participation in Medicare, Medicaid and other federal health care programs, debarment under 21 U.S.C. § 335a or a comparable foreign law, contractual damages, reputational harm, diminished potential profits and future earnings, and curtailment of our operations, any of which could adversely affect our business, financial condition, results of operations or prospects.

Distribution and use of screening and/or diagnostic tests marketed under an EUA from the FDA are subject to certain limitations, and the continued availability of such authorizations is subject to government discretion.

Screening and/or diagnostic tests used in the testing programs and services of our Biosecurity business are subject to EUAs granted by the FDA to the manufacturers or laboratories marketing such tests. Each EUA requires compliance with certain conditions, including specific workflow requirements, and imposes other limitations on the test's marketing, distribution, and use. The FDA has signaled that, while there will be a grace period for EUA holders to transition their devices, not all of the EUA products we distribute may apply for or be approved by the FDA and may need to withdraw from the market. Sourcing and finding products that transition from EUA to FDA cleared status may increase our costs of sourcing these products and may impact our profitability.

We have pursued in the past and may pursue additional U.S. government contracting and subcontracting opportunities in the future and as a U.S. government prime contractor and subcontractor, we are subject to a number of procurement rules and regulations.

We have entered into agreements with governmental entities and contractors in the past to serve as a U.S. government prime contractor or subcontractor and may do so again in the future. U.S. government procurement contractors and subcontractors must comply with specific procurement regulations and other requirements. These requirements, although customary in U.S. government contracts, could impact our performance and compliance costs, including by limiting or delaying our ability to share information with business partners, customers and investors. The U.S. government has in the past and may in the future demand contract terms that are less favorable than standard arrangements with private sector customers and may have statutory, contractual, or other legal rights to terminate contracts with us for convenience or for other reasons. Generally, U.S. government contracts contain provisions permitting unilateral termination or modification, in whole or in part, at the government's convenience. Under general principles of government contracting law, if the government terminates a contract for convenience, the government contractor may recover only its incurred or committed costs, settlement expenses and profit on work completed prior to the termination. If the government terminates a contract for default, the government contractor is entitled to recover costs incurred and associated profits on accepted items only and may be liable for excess costs incurred by the government in procuring undelivered items from another source. Any termination for default may also adversely affect our ability to contract with other government customers and agencies, as well as our reputation, business, financial condition and results of operations. In addition, changes in U.S. government budgetary priorities could lead to changes in the procurement environment, affecting availability of U.S. government

contracting, subcontracting or funding opportunities, which could lead to modification, reduction or termination of our U.S. government contracts or subcontracts. If and to the extent such changes occur, they could impact our results and potential growth opportunities.

Furthermore, our U.S. government contracts grant the government the right to use technologies developed by us under the government contract or the right to share data related to our technologies, for or on behalf of the government. Under our government contracts, we may not be able to limit third parties, including our competitors, from accessing certain of these technology or data rights, including intellectual property, in providing products and services to the government.

In addition, failure by us, our employees, representatives, contractors, partners, agents, intermediaries, other customers or other third parties to comply with these regulations and requirements could result in reductions of the value of contracts, contract modifications or termination, claims for damages, refund obligations, the assessment of civil or criminal penalties and fines, loss of rights in our intellectual property and temporary suspension or permanent debarment from government contracting, all of which could negatively impact our results of operations and financial condition. Any such damages, penalties, disruptions or limitations in our ability to do business with the public sector could result in reduced sales of our products, reputational damage, penalties and other sanctions, any of which could harm our business, reputation and results of operations.

We are engaged in certain research activities involving controlled substances, including cannabinoids and other chemical intermediates, the making, use, sale, importation, exportation, and distribution of which may be subject to significant regulation by the DEA, FDA, and other regulatory agencies.

We are engaged in certain research activities involving the development of microbes designed to generate cannabinoids, their precursors and other chemical intermediaries, some of which may be regulated as controlled substances in the United States. Controlled substances are subject to state, federal, and foreign laws and regulations regarding their manufacture, use, sale, importation, exportation, and distribution. Among other laws, controlled substances are regulated under the federal Controlled Substances Act of 1970 and implementing regulations of the DEA. The DEA regulates controlled substances as Schedule I, II, III, IV or V substances. Schedule I substances by definition have no established medicinal use and may generally not be marketed or sold in the United States. Schedule I substances are subject to the most stringent controls and Schedule V the least controls of the five schedules, based on their relative risk of abuse.

Cannabinoids are naturally occurring compounds found in the cannabis plant. The cannabis plant and its derivatives are highly regulated by the DEA and the USDA. Specifically, marihuana, which is defined as all parts of the plant *Cannabis sativa L.*, whether growing or not, the seeds thereof, the resin extracted therefrom, and every compound, manufacture, salt, derivative, mixture, or preparation, is classified as a Schedule I controlled substance. However, the term does not include "hemp," which means the cannabis plant and any part of that plant, including the seeds and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol ("THC") concentration of not more than 0.3% on a dry weight basis. Thus, depending on the THC concentration of the product, the product may or may not be regulated as a controlled substance. The DEA has historically regulated synthetic cannabinoids similarly to naturally-derived cannabinoids. Consequently, even though our cannabinoids that could be produced from microbes may not be derived from the cannabis plant, the DEA may consider them to be controlled substances subject to stringent regulatory controls.

Regulations associated with controlled substances govern manufacturing, labeling, packaging, testing, dispensing, production and procurement quotas, recordkeeping, reporting, handling, shipment and disposal. These regulations include required security measures, such as background checks on employees and physical control of inventory and increase the personnel needs and the expense associated with development and commercialization of products or product candidates including controlled substances. Regulators conduct periodic inspections of entities involved in handling, manufacturing, or otherwise distributing controlled substances, and have broad enforcement authorities. If we are found to be non-compliant with applicable controlled substance registrations and related requirements, we may need to modify its business activities and/or stop handling or producing the products regulated as controlled substances, and could be subject to enforcement action, significant fines or penalties, and/or adverse publicity, among other consequences.

Various states also independently regulate controlled substances. Though state-controlled substances laws often mirror federal law, because the states are separate jurisdictions, they may separately schedule substances, as well. The failure to comply with applicable regulatory requirements could lead to enforcement actions and sanctions from the states in addition to those from the DEA or otherwise arising under federal law.

Changes in government regulations may materially and adversely affect our sales and results of operations.

The markets where we provide our services are heavily influenced by foreign, federal, state and local government regulations and policies. The U.S. or foreign governments may take administrative, legislative, or regulatory action that could materially interfere with our customer's ability to sell products derived from engineered cells in certain countries and/or to certain customers. The uncertainty regarding future standards and policies may also affect our ability to develop our programs or to license engineered cells to customers and to initiate new programs with our customers, which could have a material adverse effect on our business, financial condition and results of operations.

Changes in U.S. trade policy more generally could trigger retaliatory actions by affected countries, which could impose restrictions on our ability to do business in or with affected countries or prohibit, reduce or discourage purchases of our services by foreign customers, leading to increased program costs, increased costs of developing or manufacturing our customers' products and higher prices for their products in foreign markets. Changes in, and responses to, U.S. trade policy could reduce the competitiveness of our services or our customers' products, cause our services to be less in demand and our sales to decline and adversely impact our ability to compete, which could materially and adversely impact our business, financial condition and results of operations.

We are subject to certain U.S. and foreign anti-corruption, anti-bribery and anti-money laundering laws and regulations. We can face serious consequences for violations.

We are subject to the U.S. Foreign Corrupt Practices Act of 1977, as amended (the "FCPA"), the U.S. domestic bribery statute contained in 18 U.S.C. § 201, the U.S. Travel Act, the U.K. Bribery Act and possibly other anti-corruption, anti-bribery and anti-money laundering laws and regulations in the jurisdictions in which we do business, both domestic and abroad. Anti-corruption and anti-bribery laws have been enforced aggressively in recent years. The FCPA and other anti-corruption laws generally prohibit companies, their employees, agents, representatives, business partners and third-party intermediaries from corruptly promising, authorizing, offering, or providing, directly or indirectly, anything of value to government officials, political parties, or candidates for public office for the purpose of obtaining or retaining business or securing an improper business advantage. The UK Bribery Act and other anti-corruption laws also prohibit commercial bribery not involving government officials, and requesting or accepting bribes; and anti-money laundering laws prohibit engaging in certain transactions involving criminally-derived property or the proceeds of criminal activity.

We and our third-party business partners, representatives and agents may have direct or indirect interactions with officials and employees of government agencies or state-owned or -affiliated universities or other entities (for example, to obtain necessary permits, licenses, patent registrations and other regulatory approvals), which increases our risks under the FCPA and other anti-corruption laws. We also engage contractors, consultants and other third parties from time to time to conduct business development activities abroad. We may be held liable for the corrupt or other illegal activities of our employees or third parties even if we do not explicitly authorize such activities. We have increased and, in the future, expect our non-U.S. activities to increase over time, which may also increase our exposure under these laws.

The FCPA also requires that we keep accurate books and records and maintain a system of adequate internal controls. While we have controls to address compliance with such laws and will continue to review and enhance our compliance program, we cannot assure you that our employees, agents, representatives, business partners or third-party intermediaries will always comply with our policies and applicable law, for which we may be ultimately held responsible.

Any allegations or violation of the FCPA or other applicable anti-bribery, anti-corruption laws and anti-money laundering laws may result in whistleblower complaints, sanctions, settlements, investigations, prosecution, enforcement actions, substantial criminal fines and civil penalties, disgorgement of profits, imprisonment, debarment, tax reassessments, breach of contract and fraud litigation, loss of export privileges, suspension or debarment from U.S. government contracts, adverse media coverage, reputational harm and other consequences, all of which may have an adverse effect on our reputation, business, financial condition, results of operations and prospects. Responding to an investigation or action can also result in a materially significant diversion of management's attention and resources and significant defense costs and other professional fees.

Significant disruptions to our and our service providers' information technology systems or data security incidents could result in significant financial, legal, regulatory, business and reputational harm to us.

We are increasingly dependent on information technology systems and infrastructure, including services licensed, leased or purchased from third parties such as cloud computing infrastructure and operating systems, to operate our business. In the ordinary course of business, we collect, store, process and transmit large amounts of sensitive information, including

intellectual property, proprietary business information, personal information and other confidential information. It is critical that we do so in a secure manner to maintain the confidentiality, integrity and availability of such sensitive information. We have also outsourced elements of our operations (including elements of our information technology infrastructure) to third parties, and as a result, we manage a number of third-party vendors who may have access to our networks or our confidential information. While we take measures to safeguard and protect this information, threats to network and data security are constantly evolving and growing in frequency and sophistication. We may also face increased cybersecurity risks due to our reliance on internet technology and the number of our employees working remotely, which may create additional opportunities for cybercriminals to exploit vulnerabilities. We are required to expend significant resources in an effort to protect against security incidents, and may be required or choose to spend additional resources or modify our business activities, particularly where required by applicable data privacy and security laws or regulations or industry standards. Security incidents result from the actions of a wide variety of actors with a wide range of motives and expertise, such as traditional hackers, personnel or the personnel of third parties, sophisticated nation-states and nation-state-supported actors. While we have developed systems and processes designed to protect the integrity, confidentiality and security of the confidential and personal information under our control, we cannot guarantee that any security measures that we or our third-party service providers implement will be effective in preventing security breaches and incidents, cyberattacks or similar events such as viruses and worms, phishing attacks and other forms of social engineering, denial-of-service attacks, ransomware attacks, physical or electronic break-ins, third-party or employee theft or misuse, and other negligent actions, errors or malfeasance by employees or other third parties, and similar disruptions from unauthorized tampering with our servers and computer systems or those of third parties that we use in our operations. These incidents could lead to interruptions, delays, loss or corruption of critical data, and unauthorized access to or acquisition of health-related and other personal information. In addition, we may be the target of email scams and other social engineering attacks that attempt to acquire personal information or company assets or access to our systems. Additionally, future or past business transactions (such as acquisitions or integrations) could expose us to additional cybersecurity risks and vulnerabilities, as our systems could be negatively affected by vulnerabilities present in acquired or integrated entities' systems and technologies. Despite our efforts to create security barriers to such threats, we may not be able to entirely mitigate these risks. Our third-party service providers face similar risks. Any cyberattack that attempts to obtain our data or assets, including data that we maintain on behalf of our customers, disrupt our service, or otherwise access our systems, or those of third parties we use, or any other security breach or incident, could adversely affect our business, financial condition and operating results, be expensive to remedy, and damage our reputation. We and our third-party service providers may be unable to anticipate or detect attempted security incidents or face difficulties or delays in identifying or otherwise responding to any attacks or actual or potential security breaches or security incidents. We may incur significant costs and operational consequences of investigating, remediating, eliminating and putting in place additional tools and devices designed to prevent actual or perceived security breaches and other security incidents, including in response to any actual or perceived incident we may suffer, and substantial costs to comply with any notification or other legal obligations resulting from any security breaches or other security incidents. In addition, any such breaches or incidents, or the perception that they have occurred, may result in substantial remediation costs and expose us to litigation (including class claims), regulatory enforcement action (for example, investigations, fines, penalties, audits, and inspections), liability under laws that protect the privacy of personal information, additional reporting requirements and/or oversight, indemnification obligations, negative publicity, reputational harm, and interruptions in our operations (including availability of data), any of which could have a material adverse effect on our business, financial condition, and operating results.

Although we maintain insurance coverage that may cover certain liabilities in connection with security breaches and other security incidents, we cannot be certain our insurance coverage will be adequate for liabilities actually incurred, that insurance will continue to be available to us on commercially reasonable terms (if at all) or that any insurer will not deny coverage as to any future claim.

Governmental trade controls, including export and import controls, sanctions, customs requirements and related regimes, could subject us to liability or loss of contracting privileges or limit our ability to compete in certain markets.

Our programs and technologies are subject to U.S. and non-U.S. export controls. Export authorizations may be required for biotechnology products, technologies, or services to be exported outside of the United States, to a foreign person, or outside of a foreign jurisdiction. Our current or future programs or technologies are, and may in the future, be subject to the Export Administration Regulations ("EAR"). If a program, technology, or service meets certain criteria for control under the EAR, then that engineered cell, production process, resulting product, technology, or service would be exportable outside the United States or to a foreign person or from one foreign jurisdiction to another foreign jurisdiction only if we obtain the applicable export license or other applicable authorization including qualifying for a license exception, if required. Compliance with the U.S. and foreign export laws and regulations and other applicable regulatory requirements regarding the sales, shipment and use of our engineering cells, bioprocesses and other technology may affect our ability to work with foreign partners, affect the speed at which we can introduce new products into non-U.S. markets, or limit our ability to sell programs or services or license technologies into some countries.

Additionally, certain materials that we use in our programs are subject to U.S. import controls. We currently have, and may in the course of business need to procure, certain import authorizations, for example, related to plant pests, chemicals, biological agents and other controlled materials, including from the USDA, EPA and CDC. Compliance with applicable regulatory requirements regarding the import of such materials may limit our access to materials critical to our development activities or affect the speed at which we can advance new programs.

Our activities are also subject to the economic sanctions laws and regulations of the United States and other jurisdictions. Such controls prohibit certain transactions, potentially including financial transactions and the transfer of products, technologies and services, to sanctioned countries, governments and persons, without a license or other appropriate authorization. U.S. sanctions policy changes could affect our or our customers' ability to interact, directly and indirectly, with targeted companies or companies in sanctioned countries.

While we take precautions to comply with U.S. and non-U.S. export control, import control and economic sanctions laws and regulations, we cannot guarantee that such precautions will prevent violations of such laws, including transfers to unauthorized persons or destinations, and including inadvertent violations as a result of a misclassification of a product, technology or service under export control laws. Violations could result in our business being subject to government investigations, denial of export or import privileges, significant fines or penalties, denial of government contracts and reputational harm. Any limitation on our ability to export our engineered cells, production processes, resulting products, technology, or services, or import materials critical to our programs would likely adversely affect our business and financial condition.

Changes in U.S. and foreign tax laws could have a material adverse effect on our business, cash flow, results of operations or financial condition.

We are subject to income and non-income based taxes in the U.S. and foreign jurisdictions. Changes in tax laws, regulations and policies, or their interpretation and application, in the jurisdictions where we are subject to tax, could have a material adverse effect on our business, cash flow, results of operations or financial condition. The U.S. Congress frequently debates changes to U.S. corporate income tax laws and the Group of Twenty (G20), the Organization for Economic Co-operation and Development (OECD), the European Commission (EC) and individual taxing jurisdictions have published proposals covering various international tax-related issues, including country-by-country reporting, permanent establishment rules, transfer pricing and tax treaties. It is possible that any future tax legislation which may be enacted could materially impact our effective tax rate and cash tax liability as well as tax credits and incentives.

We may become subject to lawsuits or indemnity claims in the ordinary course of business, which could materially and adversely affect our business and results of operations.

From time to time, we may in the ordinary course of business be named as a defendant in lawsuits, indemnity claims and other legal proceedings. These actions may seek, among other things, compensation for alleged product liability, personal injury, employment discrimination, breach of contract, property damage and other losses or injunctive or declaratory relief.

The marketing, sale and use of our services engineered cells, production processes and resulting products could lead to the filing of product liability claims were someone to allege that our services, engineered cells, production processes or resulting products failed to perform as designed or intended or caused injury or other harms. A product liability claim could result in substantial damages and be costly and time-consuming for us to defend.

Regardless of merit or eventual outcome, product liability claims may result in:

- decreased demand for programs and resulting products;
- loss of revenue;
- substantial monetary payments;
- significant time and costs to defend related litigation;
- the inability to commercialize any products from our programs; and
- injury to our reputation and significant negative media attention.

In the event that such actions, claims or proceedings are ultimately resolved unfavorably to us at amounts exceeding our accrued liability, or at material amounts, the outcome could materially and adversely affect our business and results of operations. In addition, payments of significant amounts, even if reserved, could adversely affect our liquidity position. We maintain product liability insurance, but this insurance may not fully protect us from the financial impact of defending against product liability claims. Any product liability claim brought against us, with or without merit, could increase our

insurance rates or prevent us from securing insurance coverage in the future. Additionally, any product liability lawsuit could cause current collaborators to terminate existing agreements or potential collaborators to seek other companies, any of which could impact our business and results of operations.

Risks Related to our Common Stock, Organizational Structure and Governance

Only our employees and directors are entitled to hold shares of Class B common stock (including shares of Class B common stock granted or otherwise issued to our employees and directors in the future), which shares have ten votes per share. This limits or precludes other stockholders' ability to influence the outcome of matters submitted to stockholders for approval, including the election of directors, the approval of certain employee compensation plans, the adoption of certain amendments to our organizational documents and the approval of any merger, consolidation, sale of all or substantially all of our assets, or other major corporate transaction requiring stockholder approval.

Shares of our Class B common stock have ten votes per share, whereas shares of our Class A common stock have one vote per share and shares of our Class C common stock have no voting rights (except as otherwise expressly provided in our amended and restated certificate of incorporation (the "Charter") or required by applicable law). As of December 31, 2023, our directors and executive officers hold in the aggregate almost half of the total voting power of our outstanding capital stock, and our directors, founders and executive officers hold in the aggregate more than half of the total voting power of our outstanding capital stock. Accordingly, holders of shares of Class B common stock are able to significantly influence the outcome of matters submitted to our stockholders for approval, including the election of directors, the approval of certain employee compensation plans, the adoption of amendments to our organizational documents and the approval of any merger, consolidation, sale of all or substantially all of our assets or other major corporate transaction requiring stockholder approval. This concentrated voting power limits or precludes other stockholders' ability to influence the outcome of these matters. Holders of Class B common stock may have interests that differ from holders of Class A common stock and may vote in a way with which holders of Class A common stock disagree and which may be adverse to the interests of holders of Class A common stock. This concentrated voting power is likely to have the effect of limiting the likelihood of an unsolicited merger proposal, unsolicited tender offer or proxy contest for the removal of directors. As a result, our governance structure and Charter may have the effect of depriving our stockholders of an opportunity to sell their shares at a premium over prevailing market prices and make it more difficult to replace our directors and management. Furthermore, this concentrated voting power could discourage a potential investor from acquiring Class A common stock due to the limited voting power of such stock relative to Class B common stock, which could also adversely affect the trading price of Class A common stock.

Our multi-class stock structure is intended to preserve our existing founder-led governance structure, to promote employee retention and engagement, to facilitate continued innovation and the risk-taking that it requires, to permit us to continue to prioritize our long-term goals rather than short-term results, to enhance the likelihood of continued stability in the composition of our board of directors and its policies, and to discourage certain types of transactions that may involve an actual or threatened acquisition of the company, all of which we believe are essential to the long-term success of our company and to long-term stockholder value. We expect to maintain this concentrated voting power among our founders and employees for the foreseeable future, including by issuing additional shares of Class B common stock to our employees pursuant to our equity compensation plans and allowing our employees and directors to exchange shares of Class A common stock for shares of Class B common stock.

Future transfers of shares of Class B common stock to persons other than Ginkgo directors and employees, or trusts or legal entities through which the right to vote the shares of Class B common stock held thereby is exercised exclusively by one or more of Ginkgo's directors or employees (any such director, employee, trust or legal entity, an "Eligible Holder"), or the holder of shares of Class B common stock ceasing to be an Eligible Holder, will generally result in those shares converting to shares of Class A common stock on a one-to-one basis, subject to certain exceptions and unless a majority of the independent directors of our board of directors determine that such transfer or event will not result in such automatic conversion. Each share of Class B common stock is also convertible at any time at the option of the holder into one share of Class A common stock. The conversion of Class B common stock to Class A common stock over time will have the effect of increasing the relative voting power of those holders of Class B common stock who retain their shares of Class B common stock in the long term. As a result, the relative voting power of holders of Class A common stock is expected to remain limited for a significant period of time, and it is possible that one or more of the persons or entities holding Class B common stock could gain significant voting control as other holders of Class B common stock sell or otherwise convert their shares into Class A common stock. In addition, the conversion of Class B common stock to Class A common stock would dilute holders of Class A common stock in terms of voting power within the Class A common stock. Because holders of Class C common stock have no voting rights (except as otherwise expressly provided in the Charter or required

by applicable law), the holders of Class B common stock may be able to significantly influence the outcome of matters submitted to our stockholders for approval for a longer period of time than would be the case if we issued Class A common stock rather than Class C common stock in such transactions.

Our share price may change significantly over time, and you may not be able to resell our common stock at or above the price you paid or at all, and you could lose all or part of your investment as a result.

The trading price of our Class A common stock has been in the past and is likely to continue to be volatile. Such volatility may be, in part, attributable to:

- future sales of our common stock or other securities by us or our existing stockholders, or the perception of such future sales;
- results of operations of the company or our competitors that vary from the expectations of securities analysts and investors;
- changes in expectations as to our future financial performance and growth, including assessments of our business, prospects, financial estimates and investment recommendations by securities analysts, investors and short sellers;
- additions or departures of key management personnel or members of our board of directors;
- announcements by us or our competitors of significant contracts, new products, acquisitions, joint marketing relationships, joint ventures, other strategic relationships or capital commitments;
- announcements relating to actual or potential civil and non-civil litigation, as well as governmental or regulatory investigations or inquiries;
- guidance that we provide to the public, any changes in this guidance or our failure to meet this guidance;
- changes in the perception of our offerings or the synthetic biology industry more general including changes in regulatory conditions;
- the development and sustainability of an active trading market for our common stock;
- changes in accounting principles;
- changes in general economic or market conditions or trends in our industry or markets;
- other events or factors, including those resulting from natural disasters, pandemics, epidemics, war, acts of terrorism or responses to these events.

These factors among others may materially adversely affect the market price of our Class A common stock, regardless of our actual operating performance. In addition, price volatility may be greater if the public float and trading volume of our common stock are low.

In the past, following periods of market volatility, stockholders have instituted securities class action litigation. If we were involved in securities litigation, it could have a substantial cost and divert resources and the attention of executive management from our business regardless of the outcome of such litigation.

Future sales, or the perception of future sales, by us or our stockholders in the public market could cause the market price for our securities to decline.

The sale of our securities in the public market, including by entities to which we have issued shares in connection with transactions, or the perception that such sales could occur, could harm the prevailing market price of our securities. These sales, or the possibility that these sales may occur, also might make it more difficult for us to sell equity securities in the future at a time and at a price that we deem appropriate.

There are up to approximately 206 million shares of common stock that may be earned if the trading price is greater than or equal to certain earnout price thresholds ranging from $12.50 to $20.00 for any point in a trading day during 20 trading days in a 30 consecutive trading day period, of which approximately 51.5 million shares were earned as of December 31, 2023. The vast majority of the shares that are part of the earnout will not be subject to lock-up once the earnout conditions are met.

In connection with the SRNG Business Combination, in September 2021, Jason Kelly, Reshma Shetty, Austin Che and Bartholomew Canton were granted restricted stock units, which vested, along with certain related earnout shares that achieved the $12.50 price threshold, on October 1, 2022. Certain of such shares have been sold into the market, and any future sales could harm the prevailing market price of our securities.

We have also issued shares of our common stock in connection with certain of our acquisitions, which issuances dilute our existing shareholders. In addition, the shares of our common stock reserved for future issuance under our equity incentive plans will become eligible for sale in the public market once those shares are issued, subject to provisions relating to various vesting agreements and, in some cases, limitations on volume and manner of sale applicable to affiliates under Rule 144, as applicable. Our compensation committee of our board of directors may determine the exact number of shares to be reserved for future issuance under our equity incentive plans at its discretion. We have filed, and expect to file in the future, one or more registration statements on Form S-8 under the Securities Act to register shares of Class A common stock or securities convertible into or exchangeable for shares of Class A common stock issued pursuant to our equity incentive plans. Any such Form S-8 registration statements automatically become effective upon filing. Accordingly, shares registered under such registration statements will be available for sale in the open market.

Short sellers may engage in manipulative activity intended to drive down the market price of our Class A common stock, which could also result in related regulatory and governmental scrutiny, among other effects.

Short selling is the practice of selling securities that the seller does not own but rather has borrowed or intends to borrow from a third party with the intention of later buying lower priced identical securities to return to the lender. Accordingly, it is in the interest of a short seller of our Class A common stock for the price to decline. At any time, short sellers may publish, or arrange for the publication of, opinions or characterizations that are intended to create negative market momentum. Issuers, like us, whose securities have historically had limited trading history or volumes and/or have been susceptible to relatively high volatility levels can be vulnerable to such short seller attacks. Short selling reports can cause increased volatility in an issuer's stock price, and result in regulatory and governmental inquiries. On October 6, 2021, such a report was published about us. Shortly after, we received a preliminary and informal inquiry from the U.S. Department of Justice related to this report. Any related inquiry or formal investigation from a governmental organization or other regulatory body, including any inquiry from the SEC, is not within the control of the Company. Although we have received confirmation from the SEC that it concluded its inquiry into Ginkgo Bioworks Holdings, Inc. begun in October 2021 or soon after with no recommendation of enforcement action, any inquiry or formal investigation by any governmental organization or regulatory body could result in a material diversion of our management's time and could have a material adverse effect on our business and results of operations.

Our Charter authorizes a large number of shares of Class B common stock for issuance in the future. The future issuance of shares of Class B common stock may have the effect of further concentrating voting power with our employees and other Class B stockholders, and could have an adverse effect on the trading price of Class A common stock.

Under our Charter, we are authorized to issue 4,500.0 million shares of Class B common stock, which are entitled to ten votes per share. We currently intend to issue additional shares of Class B common stock in the future to existing and newly hired employees pursuant to our equity compensation plans. Our authorized but unissued shares of Class B common stock are available for issuance to Eligible Holders with the approval of our board of directors without stockholder approval, except as may be required by the Listing Rules of the NYSE. In addition, our authorized but unissued shares of Class B common stock are available for issuance to persons other than Eligible Holders only with the approval of a majority of our directors elected by the holders of Class B common stock, voting separately as a class. If we issue additional shares of Class B common stock in the future, holders of shares of Class A common stock, which are entitled to one vote per share, will experience disproportionate voting power dilution relative to economic dilution, and the holders of Class B common stock may be able to significantly influence the outcome of matters submitted to our stockholders for approval for a longer period of time than would be the case if we issued shares of Class A common stock.

See *"Risk Factors—Risks Related to Our Common Stock Organizational Structure and Governance—Only our employees and directors are entitled to hold shares of Class B common stock (including shares of Class B common stock granted or otherwise issued to our employees and directors in the future), which shares have ten votes per share. This limits or precludes other stockholders' ability to influence the outcome of matters submitted to stockholders for approval, including the election of directors, the approval of certain employee compensation plans, the adoption of amendments to our organizational documents and the approval of any merger, consolidation, sale of all or substantially all of our assets or other major corporate transaction requiring stockholder approval."*

Under our Charter, we are authorized to issue 800.0 million shares of Class C common stock, which have no voting rights (except as otherwise expressly provided in the Charter or required by applicable law). Outstanding Class C

common stock may have the effect of extending voting power in Class B common stock, and may discourage potential acquisitions of our business and could have an adverse effect on the trading price of Class A common stock.

Under our Charter, we are authorized to issue 800.0 million shares of Class C common stock, which have no voting rights (except as required by law). Class C common stock may be used for a variety of corporate purposes, including financings, acquisitions and investments. Our authorized but unissued shares of Class C common stock are available for issuance with the approval of our board of directors without stockholder approval, except as may be required by the Listing Rules of the NYSE. Because the Class C common stock carries no voting rights (except as otherwise expressly provided in the Charter or required by applicable law), is not convertible into any other capital stock, and is not listed for trading on an exchange or registered for sale with the SEC, shares of Class C common stock may be less liquid and less attractive to any future recipients of these shares than shares of Class A common stock, although we may seek to list the Class C common stock for trading and register shares of Class C common stock for sale in the future. In addition, because our Class C common stock has no voting rights (except as otherwise expressly provided in the Charter or required by applicable law), the holders of Class B common stock may be able to significantly influence the outcome of matters submitted to our stockholders for approval for a longer period of time than would be the case if we issued Class A common stock rather than Class C common stock in such transactions. In addition, further issuances of Class C common stock would have a dilutive effect on the economic interests of Class A common stock and Class B common stock. Any such issuance could also cause the trading price of Class A common stock to decline.

We cannot predict the effect the multi-class structure of our common stock may have on the trading price of our Class A common stock.

The holding of low-voting stock, such as Class A common stock, may not be permitted by the investment policies of certain institutional investors or may be less attractive to the portfolio managers of certain institutional investors. In addition, certain index providers have announced restrictions on including companies with multiple-class share structures in certain of their indices. Because of our multi-class stock structure, our Class A common stock will likely continue to be excluded from certain indices, and we cannot assure you that other stock indices will not take similar actions. Given the sustained flow of investment funds into passive strategies that seek to track certain indices, exclusion from stock indices would likely preclude investment by many of these funds in our Class A common stock and could make shares of our Class A common stock less attractive to other investors. As a result, the trading price of shares of our Class A common stock could be adversely affected.

Our focus on the long-term best interests of our company and our consideration of all of our stakeholders, including our stockholders, workforce, customers, suppliers, academic researchers, governments, communities and other stakeholders that we may identify from time to time, may conflict with short-term or medium-term financial interests and business performance, which may adversely impact the value of our common stock.

We believe that focusing on the long-term best interests of our company and our consideration of all of our stakeholders, including our stockholders, workforce, customers, suppliers, academic researchers, governments, communities and other stakeholders we may identify from time to time, is essential to the long-term success of our company and to long-term stockholder value. Therefore, we have made decisions, and may in the future make decisions, that we believe are in the long-term best interests of our company and our stockholders, even if such decisions may negatively impact the short- or medium-term performance of our business, results of operations, and financial condition or the short- or medium-term performance of our Class A common stock. Our commitment to pursuing long-term value for the company and its stockholders, potentially at the expense of short- or medium-term performance, may materially adversely affect the trading price of our Class A common stock, including by making owning our Class A common stock less appealing to investors who are focused on returns over a shorter time horizon. Our decisions and actions in pursuit of long-term success and long-term stockholder value, which may include our multi-class stock structure, making investments in R&D and our employees, and investing in and introducing new products and services, may not result in the long-term benefits that we expect, in which case our business, results of operations and financial condition, as well as the trading price of our Class A common stock, could be materially adversely affected.

Item 1B. Unresolved Staff Comments.

None.

Item 1C. Cybersecurity.

Cybersecurity risk management and strategy

Ginkgo integrates risk management into its overall cybersecurity strategy, and has implemented processes designed to identify, assess, prioritize and manage risks to protect Ginkgo's data, intellectual property and information assets. As part of our risk governance and management, Ginkgo has developed processes designed to: identify and assess risks, evaluate those risks against pre-defined criteria, develop and implement strategies to address identified risks, monitor and review those risks and communicate risks to relevant stakeholders. Identifying Ginkgo's cybersecurity risks involves a multifaceted approach that encompasses both internal assessments and external information sources. For example, we use security audits conducted by internal and external auditors to assess compliance with security policies and industry frameworks; vulnerability assessments to discover vulnerabilities in networks, systems and applications; penetration testing using simulated cyberattacks to test the resilience of systems and identify weaknesses; and risk assessment processes to evaluate IT infrastructure, including using a risk register to identify risks, likelihood of their occurrence, potential impact, and remediation. We also oversee third-party service providers by conducting vendor diligence upon onboarding and additional monitoring. Vendors are assessed for risk based on the nature of their services, access to data and systems and supply chain risk.

Cybersecurity risk management is overseen by Ginkgo's Chief Information Security Officer ("CISO"), who is supported by full-time information security staff. The CISO advises the executive team on the development and implementation of the information security program.

Ginkgo incorporates learning from its cybersecurity risk management process into its overall cybersecurity program. To date, Ginkgo has not experienced a cybersecurity incident that resulted in a material effect on our business strategy, results of operations, or financial condition. Despite our efforts, we cannot provide assurance that we will not be materially affected in the future by cybersecurity risks or any future material incidents. For more information, see Item 1A. Risk Factors, *"Significant disruptions to our and our service providers' information technology systems or data security incidents could result in significant financial, legal, regulatory, business and reputational harm to us."*

Cybersecurity governance

The Board provides regular oversight of the Company's cybersecurity risk management program. The CISO presents to the Board and the audit committee of our Board (the "Audit Committee") at least annually and quarterly updates via business review dashboards. The Board provides guidance to the CISO, including with respect to any changes to business priorities, risk tolerance, or security initiatives. These briefings are also augmented by ongoing and continuous interactions between the Board and the CISO, as needed.

Ginkgo's CISO has primary responsibility for assessing and managing Ginkgo's risks from cybersecurity threats. The CISO has over 20 years of pubic- and private-sector experience in information technology and has served as Ginkgo's CISO since 2018. Executive leadership provides oversight and governance through monthly business reviews of the cybersecurity program.

Ginkgo also has a Disclosure Committee, which is composed of representatives from executive leadership from various departments across Ginkgo (e.g., legal, finance, accounting). Their role is to determine materiality of a cyber incident and provide guidance with respect to any disclosure obligations resulting from a cyber incident.

Item 2. Properties.

Ginkgo's headquarters are located in the Seaport district of Boston, Massachusetts and comprise a set of non-cancellable operating leases within a facility totaling over 325,000 square feet of office and laboratory space. These lease agreements expire on dates ranging from 2030 to 2036 and each contain one option to extend the lease for a five-year period at then-market rates. We also lease approximately 184,000 square feet of office and lab space in Cambridge, Massachusetts; Emeryville, California; Basel, Switzerland; Evry, France; and Zeist, Netherlands.

In anticipation of expanding facility needs to support future growth, in April 2021, we entered into a lease, as amended, consisting of approximately 260,000 rentable square feet of new office and laboratory space being developed in Boston, Massachusetts near our headquarters. The lease commencement date is estimated to be June 1, 2024, subject to certain extensions, and expires on the fifteenth anniversary of the lease commencement date. The lease includes one option to extend the lease for ten years at then-market rates as well as an expansion option if the owner constructs an additional building on the property.

We also own approximately 193,000 square feet of real property in West Sacramento, California. We believe our facilities are adequate and suitable for our current needs and that the new lease described above provides significant expansion space. To support future organic growth or merger and acquisition activity, we may enter into new leases, assume lease obligations or acquire property both domestically and internationally and believe that, if needed, suitable or alternative space will be available.

Item 3. Legal Proceedings.

From time to time, the Company may in the ordinary course of business be named as a defendant in lawsuits, indemnity claims and other legal proceedings. The Company does not believe any pending litigation to be material, or that the outcome of any such pending litigation, in management's judgment based on information currently available, would have a material adverse effect on the Company's results of operations, cash flows or financial condition.

See Note 11, Commitments and Contingencies, to the consolidated financial statements included elsewhere in this Annual Report.

Item 4. Mine Safety Disclosures.

Not Applicable.

PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities.

Market Information

Our Class A common stock and Public Warrants began trading on the NYSE under the symbols "DNA" and "DNA.WS," respectively on September 17, 2021. Prior to that date, there was no public trading market for our Class A common stock and Public Warrants.

Holders of Record

As of December 31, 2023, there were approximately 363 stockholders of record of our Class A common stock, 357 stockholders of record of our Class B common stock and 1 stockholder of record of our Class C common stock, which does not include persons whose stock is held in nominee or "street name" accounts through brokers, banks and intermediaries.

Securities Authorized for Issuance Under Equity Compensation Plans

	Number of securities to be issued upon exercise of outstanding options and vesting of outstanding restricted stock units (#)		Weighted-average exercise price of outstanding options ($)	Number of securities remaining available for future issuance under equity compensation plans (excluding securities reflected in the first column) (#)	
Equity compensation plans approved by security holders (1)	143,688,936	(2)	$ 0.70	183,048,456	(3)
Equity compensation plans not approved by security holders (4)	16,194,690		—	8,805,310	
Total	159,883,626		$ 0.70	191,853,766	

(1) Includes the Ginkgo Bioworks Holdings, Inc. 2021 Equity Incentive Plan.

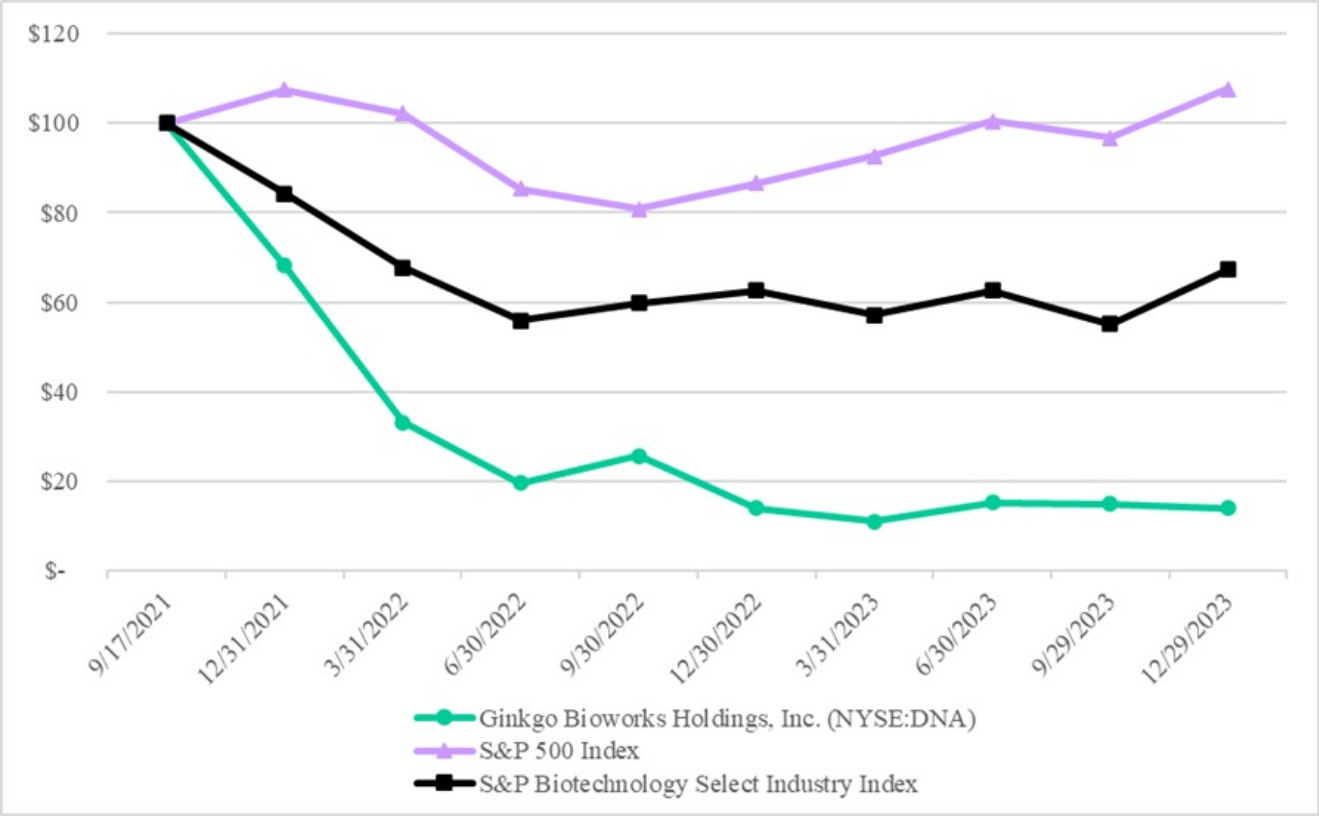
(2) Includes 7,716,048 shares of common stock issuable upon the exercise of outstanding stock options and 135,972,888 shares of common stock issuable upon settlement of outstanding restricted stock units.

(3) The Plan provides that the number of shares of common stock reserved and available for issuance under the Plan shall be cumulatively increased on January 1 of each year. The number of shares of common stock increased each year will be equal to the lesser of: (i) 4% of the number of shares of common stock issued and outstanding on the immediately preceding December 31 or (ii) such lesser amount as determined by our board of directors.

(4) Includes the Ginkgo Bioworks Holdings, Inc. 2022 Inducement Plan.

Performance Graph

The following graph compares the cumulative total stockholder return on our Class A common stock relative to the cumulative total returns of the S&P 500 Index and the S&P Biotechnology Select Industry Index between September 17, 2021 (the date our common stock began trading on the NYSE after the SRNG Business Combination) through December 31, 2023. All values assume a $100 initial investment at market close on September 17, 2021 and data for the S&P 500 and the S&P Biotechnology Select indices assume reinvestment of all dividends.



Recent Sales of Unregistered Securities

On November 13, 2023, we issued a total of 1,581,135 shares of our Class A common stock to the sellers of Circularis, valued at approximately $2.3 million, as consideration in connection with the acquisition of the outstanding equity interests of Circularis, in a private placement transaction exempt from the registration requirements of the Securities Act pursuant to Section 4(a)(2) of the Securities Act.

On December 14, 2023, we issued a total of 1,826,414 shares of our Class A common stock to the sellers of FGen, valued at approximately $2.5 million, as settlement for employee retention payments, in a private placement transaction exempt from the registration requirements of the Securities Act pursuant to Section 4(a)(2) of the Securities Act.

Issuer Purchases of Equity Securities

None.

Item 6. [Reserved]

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations.

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with the consolidated financial statements and related notes thereto included elsewhere in this Annual Report on Form 10-K. Further, this section of this Form 10-K generally discusses 2023 and 2022 items and year-to-year comparisons between 2023 and 2022. For discussion related to 2021 items and year-to-year comparisons between 2022 and 2021 that are not included in this Form 10-K, please refer to Part II, Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations in our 2022 Form 10-K, filed with the United States Securities and Exchange Commission on March 13, 2023. This discussion contains forward-looking statements that reflect our plans, estimates and beliefs that involve risks and uncertainties. Actual results may differ materially from those anticipated in these forward-looking statements as a result of many factors, including those discussed in Item 1A. "Risk Factors" and "Cautionary Note Regarding Forward-Looking Statements" elsewhere in this Annual Report on Form 10-K.

Overview

Our mission is to make biology easier to engineer.

Ginkgo is the leading horizontal platform for cell programming, providing flexible, end-to-end services that solve challenges for organizations across diverse markets, from food and agriculture to pharmaceuticals to industrial and specialty chemicals. Ginkgo's Biosecurity business is building a global infrastructure for biosecurity to empower governments, communities, and public health leaders to prevent, detect and respond to a wide variety of biological threats.

We use our platform to program cells on behalf of our customers. These "cell programs" are designed to enable biological production of products as diverse as novel therapeutics, key food ingredients, and chemicals currently derived from petroleum. Biology did not evolve by end market. All of these applications run on cells which have a common code—DNA—and a common programming platform can enable all of them. Because of this shared platform, we are able to drive scale and learning efficiencies while maintaining flexibility and diversity in our program areas. Ultimately, customers come to us because they believe we maximize the probability of successfully developing their products.

The foundation of our cell programming platform includes two core assets that execute a wide variety of cell programs for customers according to their specifications: our Foundry and our Codebase.

- Our Foundry is a highly automated, yet flexible, lab powered by proprietary automation and software to enable flexibility and scale. The Foundry automates lab workflows at high levels of abstraction, enabling users to generate potentially valuable datasets labeling broad genetic sequence design space with a wide range of functional data through modular design-build-test-learn cycles or campaigns. Our scale economic means that the Foundry's capacity to perform more and more diverse campaigns grows while the cost per campaign decreases. We call this scaling factor Knight's Law.

- Our Codebase is a data asset which accumulates as we operate our Foundry in service of customer projects. Our Codebase includes vast amounts of data at different levels of characterization and usability in engineering projects, including: proprietary libraries of genetic sequence data that can be used for pretraining large language models via unsupervised learning, experimental data for fine tuning task-specific generative artificial intelligence ("AI") models, as well as sequences and optimized host cells that can be directly reusable for different applications of cell engineering.

As the platform scales, we have observed a virtuous cycle between our Foundry, our Codebase, and the value we deliver to customers. We believe this virtuous cycle sustains Ginkgo's growth and differentiated value proposition.

- Foundry: As we take on more work in the Foundry, we benefit from scale economics, which over time may lead to lower program costs. We expect that these lower costs, in turn, will drive additional demand for our cell programming capabilities.

- Codebase: Cell programs also generate Codebase, which can drive better experimental direction and improve the odds of technical success, further increasing our customer value proposition, which we believe will result in additional demand.

Put simply: we believe that as we scale, the platform improves. We believe that this in turn yields better program execution and customer outcomes, ultimately driving more demand, which drives further investments in scale and platform improvements, and so on. We believe this positive feedback loop has the potential to drive compounding value creation in the future, as new programs typically contribute to both near-term revenues and have the potential to add significant downstream economics and more positive impact.

Our cell programming business model mirrors the structure of our platform and we are compensated in two primary ways. First, we charge usage fees for services, in much the same way that cloud computing companies charge usage fees for utilization of computing capacity or contract research organizations charge for services. Additionally, we negotiate a value share with our customers (typically in the form of royalties, milestones, and/or equity interests) in order to align our economics with the success of the programs enabled by our platform. As we add new programs, our portfolio of programs with this "downstream" value potential grows.

With a mission to make biology easier to engineer, we have always recognized the need to invest in biosecurity as a key component of our platform. We are building the future bioeconomy with our customers and partners, and we envision the future of biosecurity as a global immune system equipped with the capabilities to prevent, detect, and respond to biological threats. The first, critical step in realizing this future is to build a robust early warning system for biological threats—this is the primary focus of Ginkgo's Biosecurity business.

Our biosecurity offering includes biomonitoring and bioinformatic support services internationally as well as domestically. We are currently offering biomonitoring and bioinformatic support services domestically through our partnership with the Centers for Disease Control and Prevention ("CDC") and XpresCheck, and internationally such as through our international programs, including those in Qatar, Rwanda and Ukraine.

We operate in two reportable business segments:

- Cell Engineering: Consists of research and development ("R&D") services performed under collaboration and license agreements relating to our cell programming platform. Our cell programming platform includes two core assets: the Foundry, highly efficient biology lab facilities, enabled by investment in proprietary workflows, custom software, robotic automation, and data science and analytics, which is paired with our Codebase, a collection of biological "parts" and a database of biological data used to program cells. The Cell Engineering segment includes costs incurred for the development, operation, expansion and enhancement of the Foundry and Codebase. Cell Engineering revenue is derived from service fees and downstream value share in the form of milestone payments, royalties or equity interests.
- Biosecurity: Consists of our end-to-end biomonitoring and bioinformatic support services primarily provided to public health authorities. Biosecurity revenue is derived from fees for data, analytics, and services. Before the fourth quarter of 2023, Biosecurity revenue was also derived from sales of test kits.

Generating Economic Value Through Cell Programs

Our cell programming platform is a key enabling technology and source of intellectual property for our customers' products. We earn Cell Engineering revenue for our R&D services as well as through a share of the value of products created using our platform.

We typically structure Cell Engineering revenue to include some combination of the following:

- service fees, which may comprise cash and/or non-cash consideration, in the form of:
    - upfront payments upon consummation of an agreement or other fixed payments that are generally recognized over our period of performance;
    - reimbursement for costs incurred for R&D services;
    - milestone payments upon the achievement of specified technical criteria;

plus,

- downstream value share payments in the form of:
    - milestone payments, which may comprise cash and/or non-cash consideration, upon the achievement of specified commercial criteria;
    - royalties on sales of products from or comprising engineered organisms;
    - royalties related to cost of goods sold reductions realized by our customers;

or,

- downstream value share in the form of equity interests in our customer.
    - downstream value share in the form of equity interest appreciation is not recognized as revenue but is expected to contribute to future cash flows upon liquidation, the amount and timing of which is inherently unpredictable.

Customer arrangements which involve non-cash consideration generally fall into two categories: Platform Ventures and Structured Partnerships.

Platform Ventures

Platform Ventures enable Ginkgo to partner with leading multinationals and financial investors to form new ventures in identified market segments with potential to benefit from synthetic biology. In exchange for an equity position in the venture, we contribute license rights to our proprietary cell programming technology and intellectual property, while our partners contribute relevant industry expertise, other resources and venture funding. We also provide R&D services for which we receive cash consideration on a fixed-fee or cost-plus basis. Platform Ventures include:

Motif FoodWorks, Inc.

Founded in 2018, Motif FoodWorks, Inc. ("Motif") was formed to focus on the application of synthetic biology to reduce the reliance on animal products in the food industry. We entered into an intellectual property contribution agreement that granted Motif rights to our intellectual property, subject to mutually agreed upon technical development plans. In return for our contribution of intellectual property and access to our platform, we received shares of common stock in Motif. The initial fair value of our common stock investment in Motif was $65.1 million which has subsequently been reduced to a carrying value of zero as a result of the allocation of losses under our accounting for equity method investments. Motif was capitalized through Series A preferred stock financings that raised approximately $119 million in gross proceeds from an investor group which included certain of our investors, Louis Dreyfus Company and Fonterra Co-operative Group Limited. In June 2021, Motif raised an additional $226 million through a Series B preferred stock financing. Ginkgo also entered into a Technical Development Agreement with Motif under which we provide R&D services in return for cash consideration on a fixed-fee or cost-plus fixed margin basis.

Allonnia, LLC

Founded in 2019, Allonnia, LLC ("Allonnia") was formed to focus on the application of synthetic biology in the waste bioremediation and biorecovery industries. We entered into an intellectual property contribution agreement that granted Allonnia rights to our intellectual property, subject to mutually agreed upon technical development plans. In return for our contribution of intellectual property and access to our platform, we received common units in Allonnia with a right to additional units subject to additional closings of Allonnia's Series A preferred units. The initial fair value of our common units received in Allonnia was $24.5 million, subsequently increased by $12.7 million in 2021, all of which has been reduced to a carrying value of zero as a result of the allocation of losses under our accounting for equity method investments. Allonnia was capitalized through Series A preferred unit financings that raised approximately $52 million in gross proceeds from an investor group which included certain of our investors and Battelle Memorial Institute. In 2023, Allonnia raised an additional $30 million through a Series A extension. Ginkgo also entered into a Technical Development Agreement with Allonnia under which we provide R&D services in return for cash consideration on a fixed fee or cost-plus basis.

Arcaea, LLC

Founded in 2021, Arcaea, LLC ("Arcaea") was formed to focus on the application of synthetic biology in the beauty and personal care products industry. In March 2021, we entered into an intellectual property contribution agreement that granted Arcaea rights to our intellectual property, subject to mutually agreed upon technical development plans. In return for our contribution of intellectual property and access to our platform, we received common units in Arcaea with a right to additional units subject to additional closings of Arcaea's Series A preferred units. The initial fair value of our common units received in Arcaea was $11.9 million which has subsequently been reduced to a carrying value of zero as a result of the allocation of losses under our accounting for equity method investments. Arcaea was capitalized through a Series A preferred unit financing that raised approximately $77 million in gross proceeds from an investor group which included certain of our investors, CHANEL and Givaudan. Upon the closing of the Series A preferred unit financing in July 2021, we received an additional 5.2 million common units in Arcaea. The fair value of our Arcaea common units received in July 2021 of $35.5 million has subsequently been reduced to a carrying value of zero as a result of the allocation of losses under our accounting for equity method investments. Ginkgo also entered into a Technical Development Agreement with Arcaea under which we provide R&D services in return for cash consideration on a fixed fee or cost-plus basis.

Ayana Bio, LLC

Founded in September 2021, Ayana Bio, LLC ("Ayana") was formed to identify and design new bioactive compounds for use as complementary medicine to support human health and wellness. Ayana was capitalized through a Series A funding that raised $30 million in gross proceeds from an investor group comprising certain of our investors. We hold an interest in

9.0 million common units (representing 100% of common units at inception) of Ayana and have also provided Ayana with certain licenses to our intellectual property for use in the development or production of products that we have agreed to research and develop under technical development plans. Prior to the third quarter of 2022, we consolidated Ayana as a variable interest entity. In the third quarter of 2022, we deconsolidated Ayana and began accounting for our retained investment in Ayana as an equity method investment. The initial carrying value of the equity method investment in Ayana was equal to the fair value of our retained interest of $16.0 million as of the deconsolidation date which has been subsequently reduced to a carrying value of zero due to a basis difference associated with in-process research and development identified as part of the initial accounting for the equity method investment. Ginkgo also entered into a Technical Development Agreement with Ayana under which we provide R&D services in return for cash consideration on a fixed fee or cost-plus basis.

Verb Biotics, LLC

Founded in September 2021, Verb Biotics, LLC ("Verb") was formed to identify and design new strains of probiotic bacteria with advanced properties for human nutrition, health, and wellness. Verb was capitalized through a Series A funding that raised $30 million in gross proceeds from an investor group comprising certain of our investors. We hold an interest in 9.0 million common units (representing 100% of common units at inception) of Verb and have also provided Verb with certain licenses to our intellectual property for use in the development or production of products that we have agreed to research and develop under technical development plans. Prior to the first quarter of 2022, we consolidated Verb as a variable interest entity. In the first quarter of 2022, we deconsolidated Verb and began accounting for our retained investment in Verb as an equity method investment. The initial carrying value of the equity method investment in Verb was equal to the fair value of our retained interest of $15.9 million as of the deconsolidation date which has been subsequently reduced to a carrying value of zero due to a basis difference associated with in-process research and development identified as part of the initial accounting for the equity method investment. Ginkgo also entered into a Technical Development Agreement with Verb under which we provide R&D services in return for cash consideration on a fixed fee or cost-plus basis.

BiomEdit, LLC

Founded in April 2022, BiomEdit, LLC ("BiomEdit") was formed to discover, design and develop novel probiotics, microbiome derived bioactives and engineered microbial medicines in the animal health industry. BiomEdit was capitalized through a Series A preferred unit financing that raised approximately $32.5 million in gross proceeds from an investor group which included one of our investors. In April 2022, we entered into an intellectual property contribution agreement that granted BiomEdit rights to our intellectual property, subject to mutually agreed upon technical development plans and, in return, we received 3.9 million voting common units in BiomEdit. In addition, Elanco Animal Health also contributed intellectual property in exchange for 3.9 million non-voting common units in BiomEdit. The initial fair value of our common units received in BiomEdit was $8.9 million, subsequently increased by $1.1 million in the first quarter of 2023, all of which has been reduced to a carrying value of zero as a result of the allocation of losses under our accounting for equity method investments. Ginkgo also entered into a Technical Development Agreement with BiomEdit under which we provide R&D services in return for cash consideration on a fixed fee or cost-plus basis.

Structured Partnerships

Structured Partnerships allow Ginkgo to: (i) partner with early stage synthetic biology product companies to adopt our Foundry as their cell programming R&D platform, in which we offer flexible commercial terms on the service fees including the ability to pay a portion or all of such upfront fees in the form of non-cash consideration (convertible financial instruments and/or equity securities), in addition to downstream value share consideration ("Startup Structured Partnership"); and (ii) partner with existing entities with complementary assets for high potential synthetic biology applications in a large-scale, multi-program collaboration ("Legacy Structured Partnership"). In 2023 and 2022, we entered into 6 and 11 Startup Structured Partnerships, respectively, and received prepayments of service fees in the form of equity securities or convertible financial instruments in the amount of $18.9 million and $30.7 million, respectively, that is recognized as revenue over our period of performance. Our Legacy Structured Partnerships are described below:

Genomatica, Inc.

Genomatica, Inc. ("Genomatica") is a biotechnology company specializing in the development and manufacturing of intermediate and specialty chemicals from both sugar and alternative feedstocks. In 2016 and 2018, we acquired preferred stock in Genomatica with an aggregate investment value of $55.0 million in exchange for cash and committed R&D

services. The carrying value of the investment has been reduced to $11.9 million as of December 31, 2023, reflective of impairment losses recognized through that date.

Synlogic, Inc.

Synlogic, Inc. ("Synlogic") is a publicly traded clinical-stage biopharmaceutical company focused on advancing drug discovery and development for synthetic biology-derived medicines. In 2019, we entered into several agreements with Synlogic whereby we purchased Synlogic common stock and warrants to purchase Synlogic common stock and agreed to provide R&D services to Synlogic. At inception, the fair value of Synlogic common stock and warrants was recorded at $35.8 million and $14.4 million, respectively. As of December 31, 2023, the fair value of Synlogic common stock and warrants was $1.6 million and $0.7 million, respectively. On February 8, 2024, Synlogic announced its decision to cease operations and evaluate strategic options for the company.

See Notes 5 and 16 of our audited consolidated financial statements included elsewhere in this Annual Report on Form 10-K for further details of our investments in and the material terms of our agreements with our Platform Ventures and Structured Partnerships.

Key Business Metrics

A cell program (or "program") is the work we do for our customers to enable their product(s) of interest. Programs are defined by a technical development plan or objective. We generally exclude proof-of-concept projects and other exploratory work undertaken on a customer's behalf from the program count. In the near-term, programs typically deliver multi-year revenue from service fees. Over the long-term, program growth drives a physical infrastructure scale economic through our Foundry, a data and learning scale economic through our Codebase and accumulation of potential downstream value share. Our key business metrics comprise New Programs, Current Active Programs, and Cumulative Programs.

	Years Ended December 31,	
	2023	2022
New Programs	78	59
Current Active Programs	162	112
Cumulative Programs	242	164

New Programs

New Programs represent the number of unique programs commenced within the reporting period. As new programs typically have multi-year durations, we view this metric as an indication of future Cell Engineering revenue growth.

Current Active Programs

Current Active Programs represent the number of unique programs for which we performed R&D services in the reporting period. We view this metric as an indication of current period and future Cell Engineering revenue.

Cumulative Programs

Cumulative Programs represent the cumulative number of unique programs Ginkgo has commenced. We view this metric as an indication of our competitive advantage and as a leading indicator of the mid- to long-term potential economic value derived from downstream value share arrangements. The cumulative number of programs also contributes to Codebase, which accumulates with each additional program we conduct over time and drives better experimental direction and improves the odds of technical success in current and future programs.

We believe the preceding metrics are important to understand our current business. These metrics may change or be substituted for additional or different metrics as our business develops. For example, as our program mix changes, our data gathering abilities expand or our understanding of key business drivers develops, we anticipate updating these metrics or their definitions to reflect such changes.

Zymergen Bankruptcy and Deconsolidation

On October 3, 2023, Zymergen and certain of its subsidiaries filed voluntary petitions for relief under Chapter 11 of the U.S. Bankruptcy Code (the "Zymergen Bankruptcy") in the U.S. Bankruptcy Court for the District of Delaware (the "Bankruptcy Court"). In connection with the Zymergen Bankruptcy, we entered into an asset purchase agreement with Zymergen as the stalking horse bidder under Section 363 of the U.S. Bankruptcy Code to acquire exclusive rights to substantially all of Zymergen's intellectual property assets and certain other assets. On December 14, 2023, Zymergen concluded its auction. On December 21, 2023, the Bankruptcy Court approved the sale of substantially all of Zymergen's assets to us through certain of our affiliates. On January 18, 2024, we completed our acquisition of such assets, and on February 5, 2024, Zymergen's plan of liquidation was confirmed by the Bankruptcy Court. All of our interests in the Zymergen entities were extinguished and terminated as of February 23, 2024.

While as of December 31, 2023 Zymergen remained a wholly-owned subsidiary of ours, as a result of the Zymergen Bankruptcy, we no longer had a controlling financial interest over Zymergen and therefore deconsolidated Zymergen's financial position as of October 2, 2023. The deconsolidation included the derecognition of the carrying amounts of Zymergen's consolidated assets and liabilities that were previously included in our financial statements. Upon deconsolidation, we recorded a $42.5 million loss, representing the remaining net book value of our investment that was reduced to a fair value of zero. Zymergen's results of operations were removed from our consolidated statements of operations and comprehensive loss beginning October 3, 2023. The historical financial results for Zymergen have not been classified as a discontinued operation because it does not represent a strategic shift with a major effect on our operations and financial results.

See Note 3, Acquisitions and Divestitures, of our audited consolidated financial statements included elsewhere in this Annual Report on Form 10-K for further details.

2021 Modification of Equity Awards in Connection with SRNG Business Combination

Prior to our merger with Soaring Eagle Acquisition Corp. on September 16, 2021 (the "SRNG Business Combination"), our restricted stock units ("RSUs") were granted based on both service-based and performance-based vesting conditions. Historically, we did not recognize any stock-based compensation expense related to these awards as the achievement of the performance condition required either a change in control or an initial public offering (both as defined in the underlying award agreement), events that were deemed improbable. The SRNG Business Combination did not satisfy the performance condition required for the vesting of our RSUs.

On November 17, 2021 our board of directors modified the vesting terms of RSUs to allow 10% of the RSUs that met the service condition as of the closing of the SRNG Business Combination to vest with respect to the performance condition. The rest vested fully with respect to the performance condition by March 15, 2022. The change to the vesting terms was accounted for as a modification and the awards were remeasured using the fair value as of the modification date. RSU earnout shares were also modified as they were subject to the same performance condition as the underlying RSUs, in addition to achieving certain target stock price thresholds. The first target stock price of $12.50 per share was achieved on November 15, 2021. For the years ended December 31, 2023 and 2022, we recognized $129.7 million and $1.9 billion, respectively, of stock-based compensation expense related to the modified RSUs and RSU earnout shares.

Components of Results of Operations

Revenue

Cell Engineering Revenue

We generate Cell Engineering revenue through the execution of license and collaboration agreements whereby customers obtain license rights to our proprietary technology and intellectual property for use in the development and commercialization of engineered organisms and derived products. Under these agreements, we typically provide R&D services for cell programming with the goal of producing an engineered cell that meets a mutually agreed specification. Our customers obtain license rights to the output of our services, which are primarily the optimized strains or cell lines, in order to manufacture and commercialize products derived from that licensed strain or cell line. Generally, the terms of these agreements provide that we receive some combination of: (1) service fees in the form of (i) upfront payments upon consummation of the agreement or other fixed payments, (ii) reimbursement for costs incurred for R&D services and (iii) milestone payments upon the achievement of specified technical criteria, plus (2) downstream value share payments in the form of (i) milestone payments upon the achievement of specified commercial criteria, (ii) royalties on sales of products

from or comprising engineered organisms arising from the collaboration or licensing agreement and (iii) royalties related to cost of goods sold reductions realized by our customers. Royalties did not comprise a material amount of our revenue during any of the periods presented.

Cell Engineering revenue includes transactions with Platform Ventures and Legacy Structured Partnerships where, as part of these transactions, we received an equity interest in such entities. Specifically related to the Platform Ventures, in these transactions, we received upfront non-cash consideration in the form of common equity interests in these entities, while the Platform Ventures each received cash equity investments from strategic partners and financial investors. We view the upfront non-cash consideration as prepayments for licenses which will be granted in the future as we complete mutually agreed upon technical development plans. In these instances, we also receive cash consideration for the R&D services performed by us on a fixed fee or cost-plus basis. We are not compensated through additional milestone or royalty payments under these arrangements. Our transactions with Genomatica and Synlogic included the purchase of equity securities and the provision of R&D services. As we perform R&D services under the mutually agreed upon development plans, we recognize a reduction in the prefunded obligation on a cost-plus basis. These arrangements are further described in Notes 5, 6, 16 and 20 of our audited consolidated financial statements included elsewhere in this Annual Report on Form 10-K.

Cell Engineering revenue also includes transactions with Startup Structured Partnerships where, as part of these transactions, we received upfront non-cash consideration in the form of current equity interests or financial instruments that are convertible into equity upon a triggering event. We grant the customer a prepaid Cell Engineering services credit in exchange for the upfront non-cash consideration, which can be drawn down as payment for R&D services performed under mutually agreed upon development plans.

Downstream value share in the form of equity interest appreciation is not recognized as revenue but is expected to contribute to future cash flows upon liquidation, the amount and timing of which is inherently unpredictable. The initial fair market value of the equity interests received may also decrease after contract inception and the amount of cash proceeds eventually realized may be less than the revenue recognized. Equity investments are accounted for under the equity method, cost method or are carried at fair value.

Biosecurity Revenue

We offer biomonitoring and bioinformatic support services internationally as well as domestically. We are currently offering biomonitoring and bioinformatic support services domestically through our partnerships with the CDC and XpresCheck, and internationally through our international programs, including those in Qatar, Rwanda and Ukraine. We are also engaged in a series of smaller partnerships that generate revenues through biosecurity services and R&D.

We generate service revenue through the sale of our end-to-end biomonitoring and bioinformatic support services. These service offerings generally consist of multiple promised goods and services including, but not limited to, sample collection, sample storage and transportation, outsourced laboratory analysis, access to results reported through a web-based portal, analytical reporting of results, and overall program management. Before the fourth quarter of 2023, we generated product revenue by selling lateral flow assay (“LFA”) diagnostic test kits, polymerase chain reaction (“PCR”) sample collection kits, and pooled test kits associated with COVID-19 tests to customers on a standalone basis.

In general, these agreements stipulate that we are entitled to compensation for service revenue as services are performed and for product revenue upon delivery of diagnostic test kits. The timing of revenue recognition depends on the identified performance obligations but is generally recognized ratably over time or as results are reported to the customer.

Costs and Operating Expenses

Cost of Biosecurity Product Revenue

Before the fourth quarter of 2023, cost of Biosecurity product revenue consisted of costs associated with the sale of diagnostic and sample collection test kits, which included costs incurred to purchase test kits from third parties.

Cost of Biosecurity Service Revenue

The cost of Biosecurity service revenue consists of costs related to our end-to-end pathogen testing, sequencing, and analysis services. This includes costs incurred for sample collection equipment and materials, outsourced laboratory analysis, access to results reported through our proprietary web-based portal, and reporting of results to public authorities.

Additionally, the cost of Biosecurity service revenue includes direct labor cost associated with bioinformatics, lab network management, delivery logistics, and customer support.

Research and Development Expenses

The nature of our business, and primary focus of our activities, generates a significant amount of R&D expenses. R&D expenses represent costs incurred by us for the following:

- development, operation, expansion and enhancement of our Foundry and Codebase; and
- development of new offerings, such as Biosecurity.

The activities above incur the following expenses:

- laboratory supplies, consumables and related services provided under agreements with third parties and in-licensing arrangements;
- personnel compensation and benefits; and
- rent, facilities, depreciation, software, professional fees and other direct and allocated overhead expenses.

We expense R&D costs as incurred. As we grow our active programs and customer base and invest in our Foundry and Codebase through organic and inorganic growth initiatives, we anticipate that our R&D expenses will continue to increase. The nature, timing, and estimated costs required to support our growth will be dependent on advances in technology, our ability to attract new customers and the rate of market penetration within our existing customer industries.

In 2022, R&D expenses included a significant charge for stock-based compensation expense as a result of the modification of vesting terms of RSUs and the vesting of certain earnout shares in the fourth quarter of 2021 (as further described above in "*Modification of Equity Awards in Connection with SRNG Business Combination*"). The impact of the modification on stock-based compensation expense has significantly diminished by the end of 2023.

General and Administrative Expenses

General and administrative ("G&A") expenses consist primarily of costs for personnel in executive, business development, finance, human resources, legal and other corporate administrative functions. G&A expenses also include professional legal services fees and costs incurred relating to litigation, corporate, intellectual property and patent matters, professional fees incurred for accounting, auditing, tax and administrative consulting services, insurance costs, facility-related costs not otherwise included in R&D expenses, and asset impairments.

We anticipate that our G&A expenses attributable to organic business activities will either remain consistent or decline in 2024 as compared to 2023, reflecting a stabilization in our operational overhead. Conversely, we intend to maintain a strategic and opportunistic approach regarding inorganic G&A expenses arising from mergers, acquisitions, and other non-organic growth initiatives. We will capitalize on beneficial opportunities as they arise to enhance shareholder value and support our long-term growth objectives.

In 2022, G&A expenses included a significant charge for stock-based compensation expense as a result of the modification of vesting terms of RSUs and the vesting of certain earnout shares in the fourth quarter of 2021 (as further described above in "Modification of Equity Awards in Connection with SRNG Business Combination"). The impact of the modification on stock-based compensation expense has significantly diminished by the end of 2023.

Impairment of Lease Assets

Impairment of lease assets relates to impairment losses recognized on a right-of-use asset and the related leasehold improvements associated with a Zymergen facility that we exited in the third quarter of 2023.

Interest Income

Interest income consists primarily of interest earned on our cash and cash equivalents.

Interest Expense

Interest expense consists primarily of interest related to our financing lease obligations.

Loss on Equity Method Investments

Loss on equity method investments includes our share of losses from certain of our equity method investments under the hypothetical liquidation at book value ("HLBV") method.

Loss on Investments

Loss on investments includes the change in fair value of our marketable equity securities in publicly traded companies and impairment losses recognized on non-marketable equity securities in privately held companies.

Change in Fair Value of Warrant Liabilities

Change in fair value of warrant liabilities includes the change in fair value of private placement warrants ("Private Placement Warrants") and publicly traded warrants ("Public Warrants"), which are classified as liabilities and were assumed as part of the SRNG Business Combination. Warrant liabilities are marked to market at each balance sheet date.

(Loss) Gain on Deconsolidation of Subsidiaries

(Loss) gain on deconsolidation of subsidiaries pertains to our deconsolidation of Zymergen in 2023 and Verb and Ayana, variable interest entities, in 2022.

Other Income (Expense), Net

Other income (expense), net primarily consists of sublease rent income, changes in fair value of notes receivable that we elected to account for under the fair value option and loss on disposal of equipment.

Provision for Income Taxes

Income taxes are recorded in accordance with ASC 740*, Income Taxes* ("ASC 740"), which provides for deferred taxes using an asset and liability approach. We recognize deferred tax assets and liabilities for the expected future tax consequences of events that have been included in our audited consolidated financial statements or tax returns. Deferred tax assets and liabilities are determined based on the difference between the financial statement and tax bases of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse. A valuation allowance against deferred tax assets is recorded if, based on the weight of the available evidence, it is more likely than not that some or all the deferred tax assets will not be realized. For all periods presented, we have recorded a valuation allowance against the deferred tax assets that are not expected to be realized.

We account for uncertain tax positions using a more-likely-than-not threshold for recognizing and resolving uncertain tax positions. The evaluation of uncertain tax positions is based on factors, including, but not limited to, changes in the law, the measurement of tax positions taken or expected to be taken in tax returns, the effective settlement of matters subject to audit, new audit activity and changes in facts or circumstances related to a tax position.

As of December 31, 2023, we had federal net operating loss carryforwards of approximately $1.0 billion, of which $139.2 million will begin to expire in 2029 and $884.1 million can be carried forward indefinitely. As of December 31, 2023, we had state net operating loss carryforwards of approximately $998.2 million, of which $869.2 million will begin to expire in 2030 and $129.0 million can be carried forward indefinitely. As of December 31, 2023, we had foreign net operating losses of approximately $1.7 million, which can be carried forward indefinitely. As of December 31, 2023, we had federal research and development tax credit carryforwards of approximately $40.4 million, which will begin to expire in 2029. As of December 31, 2023, we also had state research and development and investment tax credit carryforwards of approximately $30.1 million, which will begin to expire in 2030.

Income taxes are determined at the applicable tax rates adjusted for non-deductible expenses, R&D tax credits and other permanent differences. Our income tax provision may be significantly affected by changes to our estimates.

Results of Operations

Comparison of the Years Ended December 31, 2023 and 2022

The following table presents our result of operations for the periods indicated:

	Years Ended December 31,		
(in thousands)	2023	2022	Change
Cell Engineering revenue	$ 143,531	$ 143,666	$ (135)
Biosecurity revenue:			
Product	28,949	35,455	(6,506)
Service	78,975	298,585	(219,610)
Total revenue	251,455	477,706	(226,251)
Costs and operating expenses:			
Cost of Biosecurity product revenue	7,481	20,646	(13,165)
Cost of Biosecurity service revenue	46,524	183,570	(137,046)
Research and development [(1)]	580,621	1,052,643	(472,022)
General and administrative [(1)]	385,025	1,429,799	(1,044,774)
Impairment of lease assets	96,210	—	96,210
Total operating expenses	1,115,861	2,686,658	(1,570,797)
Loss from operations	(864,406)	(2,208,952)	1,344,546
Other income (expense):			
Interest income	57,217	20,262	36,955
Interest expense	(93)	(106)	13
Loss on equity method investments	(2,635)	(43,761)	41,126
Loss on investments	(54,827)	(53,335)	(1,492)
Change in fair value of warrant liabilities	5,168	124,970	(119,802)
(Loss) gain on deconsolidation of subsidiaries	(42,502)	31,889	(74,391)
Other income (expense), net	9,138	7,634	1,504
Total other income (expense), net	(28,534)	87,553	(116,087)
Loss before income taxes	(892,940)	(2,121,399)	1,228,459
Income tax benefit	(71)	(15,027)	14,956
Net loss	(892,869)	(2,106,372)	1,213,503
Loss attributable to non-controlling interest	—	(1,443)	1,443
Net loss attributable to Ginkgo Bioworks Holdings, Inc. stockholders	$ (892,869)	$ (2,104,929)	$ 1,212,060

[(1)] R&D and G&A expenses included a significant charge for stock-based compensation expense as a result of the modification of the vesting terms of RSUs and related earnout shares (as further described above in "Modification of Equity Awards in Connection with

SRNG Business Combination"). Total stock-based compensation expense, inclusive of employer payroll taxes, was allocated as follows (in thousands):

	Year Ended December 31,	
	2023	2022
Research and development	$ 148,861	$ 738,821
General and administrative	86,047	1,202,099
Total	$ 234,908	$ 1,940,920

Cell Engineering Revenue

Cell Engineering revenue remained relatively flat in 2023 compared to 2022, decreasing by $0.1 million. The flat revenue for the year ended December 31, 2023 was primarily driven by a decrease in downstream value share from equity milestones, offset by an increase in services revenue. The increase in services revenue was primarily due to progress of Current Active Programs with existing and new customers. Additionally, services revenue increased due to the launch of New Programs and was partially offset by the completion of certain programs.

As discussed above in Components of Results of Operations, Cell Engineering revenue comprises both cash and non-cash consideration. Cell Engineering revenue recognized relating to non-cash consideration decreased from $75.8 million in 2022 to $48.5 million in 2023 primarily due to downstream value share milestone payments received in the form of equity securities in 2022.

In 2023, 78 New Programs commenced compared to 59 New Programs in 2022. The total number of Current Active Programs increased to 162 in 2023 from 112 in 2022. Cumulative Programs increased to 242 in 2023 from 164 in 2022. The number of customers increased to 91 in 2023 from 56 in 2022.

While the majority of Cell Engineering revenue today is made up of service fees, as we increase Cumulative Programs and to the extent our customers successfully commercialize products built on our platform, downstream value share is expected to comprise a larger proportion of Cell Engineering revenue. Downstream value share in the form of equity interest appreciation is not recognized as revenue but is expected to contribute to future cash flows upon liquidation, the amount and timing of which is inherently unpredictable. The initial fair market value of the equity interests received may also decrease after contract inception and the amount of cash proceeds eventually realized may be less than the revenue recognized.

Biosecurity Revenue

Biosecurity revenue decreased $226.1 million in 2023 compared to 2022 and was comprised of a decrease in product revenue of $6.5 million and a decrease in service revenue of $219.6 million.

The amount and components of Biosecurity revenue were primarily dependent on the demand for COVID-19 testing products and services. The demand for COVID-19 testing in schools significantly diminished following the end of the public health emergency in May 2023, and by the third quarter of 2023, our COVID-19 testing in schools had ceased completely. Biosecurity revenue in the fourth quarter of 2023 was comprised of our ongoing testing services. The amount and components of Biosecurity revenue in future periods are expected to be comprised of our expanded offerings of biomonitoring and bioinformatic support services provided through our domestic and international partnerships.

Cost of Biosecurity Product and Service Revenue

Cost of Biosecurity product and service revenue decreased $150.2 million in 2023 compared to 2022. The decrease was driven by decreased demand for our COVID-19 testing products and services and the end of our COVID-19 testing in schools in the third quarter of 2023.

Research and Development Expenses

Research and development expenses decreased $472.0 million in 2023 compared to 2022. The decrease was primarily attributable to a decrease in stock-based compensation expense of $590.0 million (inclusive of employer payroll taxes) due to vesting of RSUs and related earnout shares that were modified in the fourth quarter of 2021 (refer to above section "Modification of Equity Awards in Connection with SRNG Business Combination"), and decreases in professional fees of

$11.2 million and laboratory supplies of $7.3 million, partially offset by increases in personnel-related compensation and benefits expense of $59.5 million, rent and facilities expense of $20.0 million, depreciation and amortization expense of $25.8 million, impairment of lab equipment of $12.3 million, software and technology expense of $9.1 million, acquired in-process research and development costs of $5.5 million, and other expenses of $4.3 million. Increases in research and development expenses, excluding stock-based compensation expense, supported the growth of Cell Engineering revenue and the integration of prior year acquisitions.

General and Administrative Expenses

General and administrative expenses decreased $1,044.8 million in 2023 compared to 2022. The decrease was primarily attributable to a decrease in stock-based compensation expense of $1,116.1 million (inclusive of employer payroll taxes) due to vesting of RSUs and related earnout shares that were modified in the fourth quarter of 2021 (refer to above section "Modification of Equity Awards in Connection with SRNG Business Combination"), partially offset by increases in rent and facilities expense of $18.1 million, increases in personnel-related compensation and benefits expense of $14.1 million, increases in professional fees and litigation costs of $13.5 million, an impairment of lab equipment related to prior year acquisitions of $12.9 million, and increases in the fair value of contingent consideration liabilities resulting from acquisitions of $10.4 million. Increases in general and administrative expenses, excluding stock-based compensation expense, supported the growth of Cell Engineering and Biosecurity revenue and the integration of prior year acquisitions.

Impairment of Lease Assets

Impairment of lease assets increased $96.2 million in 2023 compared to 2022. In September 2023, Zymergen exited and ceased use of a leased facility which resulted in a $96.2 million impairment to reduce the carrying value of the right-of-use asset and the related leasehold improvements to their estimated fair value.

Interest Income

Interest income increased $37.0 million in 2023 compared to 2022, primarily due to increased interest rates on cash held in money market accounts.

Interest Expense

Interest expense decreased by less than $0.1 million in 2023 compared to 2022.

Loss on Equity Method Investments

Loss on equity method investments decreased $41.1 million in 2023 compared to 2022. The decrease was primarily attributable to our equity method investments in Verb, Ayana, Joyn Bio, LLC ("Joyn Bio"), and BiomEdit. Upon the deconsolidation of Verb and Ayana in 2022, we recorded an aggregate $31.9 million loss on our retained investments in Verb and Ayana due to a basis difference associated with in-process research and development identified as part of the initial accounting for the equity method investments. The loss reduced the carrying value of our equity method investments in Ayana and Verb to zero and no further losses on these investments were recognized in the periods presented. In 2022, we recorded a $3.0 million loss on our equity method investment in Joyn Bio, a joint venture which was subsequently terminated in the fourth quarter of 2022. Our share of BiomEdit's losses under the HLBV method decreased by $7.0 million in 2023 compared to 2022 and the carrying value of our equity method investment in BiomEdit has been reduced to zero.

Under the HLBV method, we absorb losses as a common unit holder prior to preferred unit holders due to a substantive profit-sharing agreement where the preferred unit holders receive preferential distribution rights. Because we have no commitment to fund the losses of our equity method investees, no further losses on these investments were recognized during the periods presented.

Loss on Investments

Loss on investments increased $1.5 million in 2023 compared to 2022. The increase was driven by a $35.4 million increase in impairment losses and downward adjustments related to our non-marketable equity securities, offset by fluctuations in the stock prices of marketable equity securities and a $12.6 million mark-to-market adjustment on equity securities received as downstream value share payments upon the achievement of a commercial milestone in 2022. Non-cash consideration from customers is initially measured at the fair value of the non-cash consideration at contract inception.

Change in Fair Value of Warrant Liabilities

The gain on the change in fair value of warrant liabilities decreased $119.8 million in 2023 compared to 2022. The change in fair value of warrant liabilities is primarily driven by changes in the value of our common stock. Increases or decreases in the value of our common stock results in a loss or gain, respectively, on the change in fair value of warrant liabilities.

(Loss) Gain on Deconsolidation of Subsidiaries

In 2023, we recorded a $42.5 million loss on our deconsolidation of Zymergen following Zymergen's bankruptcy filing in October 2023. In 2022, we recorded a $31.9 million gain on our deconsolidation of Verb and Ayana equal to the fair value of our retained interest in each entity measured as of the deconsolidation date.

Other Income (Expense), Net

Other income (expense), net increased $1.5 million in 2023 compared to 2022 primarily due to a $6.6 million unfavorable change in fair value of notes receivable offset by a $6.0 million increase in sublease rent income from Zymergen subleases prior to deconsolidation and a $2.6 million decrease in loss on disposal of equipment.

Non-GAAP Information

In addition to our results determined in accordance with GAAP, we use earnings before interest, taxes, depreciation and amortization (“EBITDA”) and Adjusted EBITDA internally to evaluate our performance and make financial and operational decisions. We believe these non-GAAP measures, when viewed with our GAAP results, may be helpful to investors in assessing our operating performance.

We define EBITDA as net loss attributable to Ginkgo Bioworks Holdings, Inc. stockholders before the impact of interest income, interest expense, provision for income taxes and depreciation and amortization.

We define Adjusted EBITDA as EBITDA adjusted for stock-based compensation expense, gain or loss on equity method investments, gain or loss on investments, change in fair value of warrant liabilities, gain or loss on deconsolidation of subsidiaries, transaction and integration costs associated with planned, completed or terminated mergers and acquisitions, including related litigation costs, acquired in-process research and development expenses, impairment charges, costs associated with the Zymergen Bankruptcy, and other income and expenses. We believe that the use of EBITDA and Adjusted EBITDA provides an additional tool for investors to use in evaluating ongoing operating results and trends because it eliminates the effect of financing activities, investing activities, and certain non-cash charges and other items that are not related to our core operating performance or affect comparability period over period.

Our non-GAAP financial measures have limitations as analytical tools and should not be considered in isolation or as a substitute for performance measures calculated in accordance with GAAP. In addition, our presentation of these measures should not be construed as an inference that our future results will be unaffected by future income or future expenses similar to those excluded when calculating these measures. Our computation of these measures, especially Adjusted EBITDA, may not be comparable to similarly titled measures of other companies because not all companies calculate these measures in the same way. We compensate for these limitations by providing a reconciliation of EBITDA and Adjusted EBITDA to their most directly comparable GAAP financial measure.

The following table reconciles net loss attributable to Ginkgo Bioworks Holdings, Inc. stockholders to EBITDA and Adjusted EBITDA for the years ended December 31, 2023 and 2022, respectively:

	Year Ended December 31,	
(in thousands)	2023	2022
Net loss attributable to Ginkgo Bioworks Holdings, Inc. stockholders	$ (892,869)	$ (2,104,929)
Interest income	(57,217)	(20,262)
Interest expense	93	106
Income tax benefit	(71)	(15,027)
Depreciation and amortization	70,507	42,552
EBITDA	(879,557)	(2,097,560)
Stock-based compensation [(1)]	234,908	1,940,920
Impairment of long-lived assets [(2)]	121,404	—
Merger and acquisition related expenses [(3)]	70,771	46,229
Loss on investments	54,827	53,335
Loss (gain) on deconsolidation of subsidiaries	42,502	(31,889)
Loss on equity method investments [(4)]	2,635	45,315
Change in fair value of warrant liabilities	(5,168)	(124,970)
Change in fair value of notes receivable	2,295	(4,153)
Adjusted EBITDA	$ (355,383)	$ (172,773)

(1) For the years ended December 31, 2023 and 2022, includes $5.0 million and $10.3 million, respectively, in related employer payroll taxes.

(2) For the year ended December 31, 2023, includes $25.2 million impairment loss on lab equipment and $96.2 million impairment loss on a right-of-use asset and the related leasehold improvements associated with an exited Zymergen leased facility.

(3) Represents transaction and integration costs directly related to mergers and acquisitions, including: (i) due diligence, legal, consulting and accounting fees associated with acquisitions, (ii) post-acquisition employee retention bonuses and severance payments, (iii) the fair value adjustments to contingent consideration liabilities resulting from acquisitions, (iv) acquired intangible assets expensed as in-process research and development, and (v) costs associated with the Zymergen Bankruptcy, as well as securities litigation costs, net of insurance recovery.

(4) Represents losses on equity method investments under the HLBV method, net of losses attributable to non-controlling interests.

Liquidity and Capital Resources

Sources of Liquidity

Upon the closing of the SRNG Business Combination in September 2021, we received net proceeds totaling approximately $1,509.6 million, inclusive of $760.0 million from investments from certain accredited investors for 76 million shares of our Class A common stock at a price of $10.00 per share. As of December 31, 2023, we had cash and cash equivalents of $944.1 million which we believe will be sufficient to enable us to fund our projected operations through at least the next 12 months from the date of filing of this Annual Report on Form 10-K.

Material Cash Requirements

We anticipate that our expenditures will exceed our revenue through at least the next 12 months from the date of filing of this Annual Report on Form 10-K, as we:

- continue our R&D, activities under existing and new programs and further invest in our Foundry and Codebase;
- hire additional personnel and secure facilities to support our expanding R&D efforts;
- develop and expand our offerings, including Biosecurity;

- upgrade and expand our operational, financial and management systems and support our operations;
- acquire and integrate companies, assets or intellectual property that advance our company objectives; and
- maintain, expand, and protect our intellectual property.

Leases

We have various noncancelable operating leases for office and laboratory space, with significant leases expiring between 2030 and 2036. As of December 31, 2023, we have minimum rental commitments under noncancellable operating leases of $43.6 million in 2024 and $387.5 million thereafter. See Note 8 to the consolidated financial statements in Part II, Item 8 of this Annual Report on Form 10-K for more information.

Purchase Obligations

In August 2023, we entered into a five-year strategic cloud and AI partnership with Google Cloud, which includes minimum annual commitments to purchase cloud hosting services. As of December 31, 2023, the remaining aggregate commitment was $286.1 million, with approximately $14.4 million payable in the next 12 months and $271.7 million thereafter.

In March 2022, we entered into a four-year noncancelable supply agreement with Twist for the purchase of diverse products including synthetic DNA. Under this agreement, we are obligated to spend a minimum of $58.0 million over the four-year term, with approximately $17.6 million payable in the next 12 months and $23.0 million thereafter.

Capital Expenditures

We anticipate our cumulative spending on capital expenditures to be in the range of $70 million over the next 12 months, subject to management's ongoing reassessment, to support our commercial plan as we strategically invest in capacity and technology to deliver new cell programs.

Cash Flows

The following table provides information regarding our cash flows for each period presented:

	Year Ended December 31,	
(in thousands)	**2023**	**2022**
Net cash (used in) provided by:		
Operating activities	$ (295,500)	$ (252,198)
Investing activities	(80,693)	(67,394)
Financing activities	(3,216)	95,337
Effect of exchange rate changes	(588)	908
Net decrease in cash, cash equivalents and restricted cash	$ (379,997)	$ (223,347)

Operating Activities

Net cash used in operating activities for the year ended December 31, 2023 consisted of net loss of $892.9 million, adjusted for net change in operating assets and liabilities of $29.8 million and non-cash charges of $567.5 million. The net change in operating assets and liabilities was primarily due to (i) a $50.1 million decrease in accounts receivable from collections of Biosecurity receivables and the end of COVID-19 testing in schools in the third quarter of 2023, (ii) a $10.5 million decrease in prepaid expenses and other current assets primarily from depletion of inventory coinciding with the reduction of Biosecurity product revenue in the third quarter plus the timing of directors and officers insurance payments in the prior year, (iii) a $9.3 million decrease in operating lease right-of-use assets from lease incentives received, (iv) a $16.9 million increase in accrued expenses and other current liabilities primarily from accrued litigation costs, partially offset by (v) a $35.9 million decrease in deferred revenue and (vi) a $22.8 million decrease in operating lease liabilities from rent payments. Non-cash adjustments primarily consisted of $70.5 million of depreciation and amortization, $229.9 million of stock-based compensation, $57.5 million loss on investments including equity method investments, $9.2 million loss on the change in fair value of contingent consideration liabilities, $28.3 million of non-cash lease expense, $121.4 million in impairments of long-lived assets, and $42.5 million loss on deconsolidation of Zymergen.

Net cash used in operating activities for the year ended December 31, 2022 consisted of net loss of $2.1 billion, adjusted for net change in operating assets and liabilities of $37.0 million and non-cash charges of $1.9 billion. The net change in operating assets and liabilities was primarily due to (i) a decrease in accounts receivable of $55.0 million from increased Biosecurity collections, partially offset by (ii) increase in prepaid expenses and other current assets of $8.5 million primarily due to prepaid insurance for directors and officers, (iii) decrease in accounts payable of $10.8 million due to timing of invoices, (iv) decrease in accrued expenses and other current liabilities of $39.6 million, (v) decrease in deferred revenue of $36.4 million, and (vi) lease incentives received of $13.2 million offset by (vii) $10.8 million decrease in operating lease liabilities from rent payments. Non-cash adjustments primarily consisted of depreciation and amortization of $42.6 million, stock-based compensation expense of $1.9 billion, loss on investments and equity method investments of $97.1 million, non-cash lease expense of $19.1 million associated with operating lease right-of-use assets, partially offset by deferred income tax benefit of $14.6 million related to acquisitions, gain on the change in fair value of warrant liabilities of $125.0 million, non-cash equity consideration of $34.3 million from commercial milestones associated with a customer collaboration arrangement, and $31.9 million gain on the deconsolidation of Verb and Ayana.

Investing Activities

Net cash used in investing activities for the year ended December 31, 2023, primarily consisted of purchases of property and equipment of $40.8 million associated with Foundry capacity and capability investments, relinquishment of $43.0 million in cash upon the deconsolidation of Zymergen, offset by $4.4 million in proceeds from the sale of equipment.

Net cash used in investing activities for the year ended December 31, 2022, primarily consisted of purchases of property and equipment of $52.3 million associated with Foundry capacity and capability investments, purchases of notes receivable and marketable equity securities of $43.7 million, relinquishment of $55.7 million in cash upon the deconsolidation of Verb and Ayana, partially offset by a $10.0 million cash redemption of a convertible note and net cash received from business and asset acquisitions of $74.7 million.

Financing Activities

Net cash used in financing activities for the year ended December 31, 2023, primarily consisted of principal payments on finance leases and payments of contingent consideration related to business acquisitions.

Net cash provided by financing activities for the year ended December 31, 2022, primarily consisted of $99.3 million in net cash proceeds from our underwritten public offering in November 2022.

Critical Accounting Estimates

Our management's discussion and analysis of our financial condition and results of operations is based on our consolidated financial statements, which have been prepared in accordance with GAAP. The preparation of these consolidated financial statements requires us to make judgments and estimates that affect the reported amounts of assets, liabilities, revenues and expenses and the disclosure of contingent assets and liabilities in our consolidated financial statements. We base our estimates on historical experience, known trends and events and various other factors that we believe to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions. On an ongoing basis, we evaluate our judgments and estimates in light of changes in circumstances, facts and experience. The effects of material revisions in estimates, if any, are reflected in our consolidated financial statements prospectively from the date of change in estimates.

While our significant accounting policies are described in more detail in Note 2 to our audited consolidated financial statements appearing elsewhere in this Annual Report on Form 10-K, we believe the following accounting policies used in the preparation of our consolidated financial statements require the most significant judgments and estimates.

Revenue Recognition

Cell Engineering Revenue

For certain Cell Engineering revenue agreements, we recognize revenue over the period of performance using a measure of progress based on costs incurred to date relative to total expected costs (i.e., cost-to-cost method). A significant level of judgment is involved in estimating the total expected costs. The amount of revenue recognized in a given period is dependent on the accuracy of our estimates of the cost to complete each project. When estimating total expected costs, we make assumptions and estimates regarding the contracted scope of work, tasks required to complete each project, technical and schedule risks associated with the science, the expected duration of each project, and the total amount of internal and

external (i.e., subcontractor) resources required. We evaluate our measure of progress to recognize revenue for these agreements at each reporting date and, as necessary, adjust the measure of progress and related revenue recognition. We also evaluate contract modifications and amendments to determine whether any changes should be accounted for prospectively or on a cumulative catch-up basis.

Certain customer agreements contain payment in the form of shares of equity securities or other financial instruments that are convertible into equity upon a triggering event. Any non-cash consideration is measured at the estimated fair value of the non-cash consideration at contract inception. For equity securities and financial instruments received that are not actively traded, we generally engage a third-party valuation specialist to determine the estimated fair value of the upfront non-cash consideration. The fair value is generally determined based on a recent round of financing or by using a scenario-based valuation model. Significant unobservable inputs are used in the fair value measurements including expectations regarding future financings of the customer, scenario dates and probabilities, expected volatility, discount rates and recovery rates. Changes in these assumptions can materially affect the value of the non-cash consideration at contract inception and, accordingly, the total amount of revenue recognized for the contract.

Impairment of Long-Lived Assets

We review our long-lived assets for impairment whenever events or changes in circumstances indicate that the carrying value of an asset may not be recoverable. Recoverability is measured by comparing the book values of the assets to the expected future net undiscounted cash flows that the assets are expected to generate. If such assets are considered to be impaired, the impairment to be recognized is measured by the amount by which the book value of the assets exceed their fair value.

Investments in Non-Marketable Equity Securities

We account for our non-marketable equity securities using the measurement alternative, where the carrying value is measured at cost, less any impairment, plus or minus changes resulting from observable price changes in orderly transactions for the identical or a similar investment of the same issuer. Determining whether an observed transaction is similar to the security owned by us requires judgment based on the rights and obligations of the investments.

We evaluate non-marketable equity investments for impairment on a quarterly basis, considering both qualitative and quantitative factors that may have a significant effect on the investment’s fair value. Qualitative factors considered include the companies’ financial and liquidity position, access to capital resources, adverse changes in the economic environment of the investee, and adverse changes in the business prospects of the investee, among others. When indicators of impairment exist, we prepare quantitative assessments of the fair value of our non-marketable equity securities using market and income approaches that require judgment and the use of estimates, including discount rates, assumptions around the investees' expected time to exit event, investee revenues and expenses, and comparable market data of guideline public companies, among others. When our assessment indicates that an impairment exists, we write down the investment to its fair value.

Recently Issued Accounting Pronouncements

See Note 2, “Summary of Significant Accounting Policies,” of our consolidated financial statements contained in Part II, Item 8 of this Annual Report on Form 10-K for a discussion of recently issued accounting pronouncements.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk.

Interest Rate Risk

We are exposed to market risk related to changes in interest rates. Our primary exposure to market risk is interest rate sensitivity, which is affected by changes in the general level of U.S. interest rates, particularly because our cash equivalents are invested in short-term U.S. Treasury obligations. However, because of the short-term nature of the instruments in our portfolio, an immediate change in market interest rates of 100 basis points would not have a material impact on the fair market value of our cash and cash equivalents or on our financial position or results of operations.

Foreign Currency Exchange Rate Risk

We are subject to foreign currency exchange rate risk from the translation of the financial statements of our foreign subsidiaries, whose financial condition and results of operations are reported in their local currencies and then translated into U.S. dollars at the applicable currency exchange rate for inclusion in our consolidated financial statements. Foreign currency translation gain (loss) was $4.1 million and $(0.9) million for the years ended December 31, 2023 and 2022, respectively. Foreign currency translation adjustments are accounted for as a component of accumulated other comprehensive loss within stockholders' equity. Additionally, we have contracted with and may continue to contract with foreign vendors. We do not believe that an immediate 10% increase or decrease in the relative value of the U.S. dollar to other currencies would have a material effect on operating results or financial condition.

Inflation Risk

Inflation generally affects us by increasing our cost of labor, laboratory supplies, consumables and equipment. We do not believe that inflation had a material effect on our business, financial condition or results of operations during the years ended December 31, 2023 and 2022.

Item 8. Financial Statements and Supplementary Data.

Our consolidated financial statements, together with the report of our independent registered public accounting firm, appear beginning on page F-1 in Part IV, Item 15, "Exhibits, Financial Statement Schedules" and are incorporated herein by reference.

Item 9. Changes in and Disagreements With Accountants on Accounting and Financial Disclosure.

None.

Item 9A. Controls and Procedures.

Evaluation of Disclosure Controls and Procedures

Under the supervision and with the participation of our management, including our Chief Executive Officer and Chief Financial Officer, we evaluated the effectiveness of our disclosure controls and procedures (as that term is defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, as amended (the "Exchange Act")) as of December 31, 2023, which is the end of the period covered by this Annual Report. Based on this evaluation, our Chief Executive Officer and Chief Financial Officer concluded that the Company's disclosure controls and procedures were not effective as of December 31, 2023 as a result of a material weakness in our internal control over financial reporting as described below.

Considering the material weakness in the Company's internal control over financial reporting, we performed additional procedures to ensure that our consolidated financial statements included in this Form 10-K were prepared in accordance with accounting principles generally accepted in the United States ("GAAP"). Following such additional procedures, our management, including our Chief Executive Officer and Chief Financial Officer, has concluded that our consolidated financial statements present fairly, in all material respects, our financial position, results of operations and cash flows for the periods presented in this Annual Report, in conformity with GAAP.

Management's Annual Report on Internal Control Over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting as such terms are defined in Exchange Act Rules 13a-15(f) and 15d-15(f). Our internal control over financial reporting is a framework designed under the supervision and with the participation of our management, including our Chief Executive Officer and Chief Financial Officer, and effected by our board of directors, management, and other personnel, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of our financial statements for external purposes in accordance with GAAP. Our internal control over financial reporting includes those policies and procedures that: (i) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of our assets; (ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with GAAP, and that our receipts and expenditures are being made only in accordance with authorizations of management and our directors; and (iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use or disposition of our assets that could have a material effect on the financial statements.

As of December 31, 2023, our management conducted an evaluation of the effectiveness of our internal control over financial reporting based on the criteria established by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in *Internal Control – Integrated Framework* (2013). Based on this evaluation, due to the material weakness described below, we concluded that the Company's system of internal control over financial reporting was not effective as of December 31, 2023.

A material weakness is a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of the Company's annual or interim financial statements will not be prevented or detected on a timely basis. The following material weakness was identified by our management as of December 31, 2023: the Company did not have effective management review controls to address the risks of material misstatement of various significant accounts. Management's evaluation of the completeness and accuracy of data used in the performance of its controls was insufficient, as was the precision of the review, identification and resolution of items requiring follow-up, and/or timeliness of the review.

This material weakness did not result in any material misstatements to the consolidated financial statements and there were no changes to previously released financial statements. Notwithstanding our material weakness, we have concluded that the financial statements and other financial information included in this Annual Report fairly present in all material respects our financial condition, results of operations and cash flows for the periods presented in conformity with accounting principles generally accepted in the United States.

Our independent registered public accounting firm, Ernst & Young LLP ("EY"), who audited the consolidated financial statements included in this Annual Report, issued an adverse opinion on the effectiveness of our internal control over financial reporting due to the identification of the material weakness described above.

Remediation of the Material Weakness in Internal Control Over Financial Reporting

Following the identification of the material weaknesses in our internal control over financial reporting as of December 31, 2022, and with the oversight of the Audit Committee, we commenced remediation efforts to address the material weaknesses and enhance our control environment, including our internal control over financial reporting. While we have remediated the material weakness identified in the prior year associated with the information technology general controls over various key systems and have hired additional personnel with appropriate knowledge, experience and/or training commensurate with our technical accounting and financial reporting requirements, the material weakness described above continues to exist at December 31, 2023. As a result, we expect to continue remediation efforts during the remainder of fiscal 2024. In addition, until remediation steps have been completed and are operated for a sufficient period of time, and subsequent evaluation of their effectiveness is completed, the material weakness described above will continue to exist. Our ongoing remediation efforts include:

- Continued employee training related to internal control over financial reporting specifically focused on data used in the operation of management review controls and the execution of management review controls with an appropriate level of precision and appropriate documentation of the identification and resolution of follow-up items;
- Implementation and enhancement of control activities, including automation of certain control processes; and,
- Development of other tools and enablers, including increasing the standardization of control support and documentation.

Management and our board of directors are committed to the remediation of the material weakness described above, as well as the continued improvement of our internal control over financial reporting. We will continue to implement measures to remedy our internal control deficiencies, and we will continue to assess our internal controls and procedures and take further action as necessary or appropriate to address any other matters we identify.

Changes in Internal Control over Financial Reporting

Except as otherwise noted above under "Remediation of the Material Weakness in Internal Control Over Financial Reporting" including the ongoing remediation efforts described, there were no changes in our internal control over financial reporting (as such term is defined in Exchange Act Rule 13a–15(f) and 15d-15(f)) during the most recent fiscal quarter that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting. Our plans for remediating the material weakness, described above, will constitute changes in our internal control over financial reporting, prospectively, when such remediation plans are effectively implemented.

Report of Independent Registered Public Accounting Firm

To the Stockholders and the Board of Directors of Ginkgo Bioworks Holdings, Inc.

Opinion on Internal Control Over Financial Reporting

We have audited Ginkgo Bioworks Holdings, Inc. internal control over financial reporting as of December 31, 2023, based on criteria established in Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) (the COSO criteria). In our opinion, because of the effect of the material weakness described below on the achievement of the objectives of the control criteria, Ginkgo Bioworks Holdings, Inc. (the Company) has not maintained effective internal control over financial reporting as of December 31, 2023, based on the COSO criteria.

A material weakness is a deficiency, or combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of the company's annual or interim financial statements will not be prevented or detected on a timely basis. The following material weakness has been identified and included in management's assessment. Management has identified a material weakness related to the execution of management review

controls related to various significant accounts. Management's evaluation of the completeness and accuracy of data used in its controls was insufficient, as was the precision of the review, identification and resolution of items requiring follow-up, and/or timeliness of the review.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated balance sheets of the Company as of December 31, 2023 and 2022, the related consolidated statements of operations and comprehensive loss, stockholders' equity and cash flows for each of the three years in the period ended December 31, 2023, and the related notes. This material weakness was considered in determining the nature, timing and extent of audit tests applied in our audit of the 2023 consolidated financial statements, and this report does not affect our report dated February 29, 2024, which expressed an unqualified opinion thereon.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting included in the accompanying Management's Annual Report on Internal Control Over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects.

Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control Over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ Ernst & Young LLP

Boston, Massachusetts

February 29, 2024

Item 9B. Other Information.

None.

Item 9C. Disclosure Regarding Foreign Jurisdictions that Prevent Inspections.

Not applicable.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

The information required by this item is incorporated by reference to the relevant information from our definitive Proxy Statement for our 2024 Annual Meeting of Shareholders, which will be filed not later than 120 days after December 31, 2023.

Item 11. Executive Compensation.

The information required by this item is incorporated by reference to the relevant information from our definitive Proxy Statement for our 2024 Annual Meeting of Shareholders, which will be filed not later than 120 days after December 31, 2023.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.

The information required by this item is incorporated by reference to the relevant information from our definitive Proxy Statement for our 2024 Annual Meeting of Shareholders, which will be filed not later than 120 days after December 31, 2023.

Item 13. Certain Relationships and Related Transactions, and Director Independence.

The information required by this item is incorporated by reference to the relevant information from our definitive Proxy Statement for our 2024 Annual Meeting of Shareholders, which will be filed not later than 120 days after December 31, 2023.

Item 14. Principal Accounting Fees and Services.

The information required by this item is incorporated by reference to the relevant information from our definitive Proxy Statement for our 2024 Annual Meeting of Shareholders, which will be filed not later than 120 days after December 31, 2023.

PART IV

Item 15. Exhibits, Financial Statement Schedules.

(1) As part of this Annual Report on Form 10-K, the consolidated financial statements are listed in the accompanying index to financial statements on page F-1.

(2) Financial statement schedules have been omitted because they are either not required or not applicable or the information is included in the consolidated financial statements or the notes thereto.

(3) Exhibits:

Exhibit Number	Description
2.1†	Agreement and Plan of Merger, dated as of July 24, 2022, by and among Ginkgo Bioworks Holdings, Inc., Pepper Merger Subsidiary Inc. and Zymergen Inc. (incorporated by reference to Exhibit 2.1 of the Company's Current Report on Form 8-K filed with the SEC on July 25, 2022)
2.2	Merger Agreement, dated as of May 11, 2021, by and among Soaring Eagle Acquisition Corp., SEAC Merger Sub Inc. and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 2.1 of SRNG's Current Report on Form 8-K filed with the SEC on May 11, 2021)
2.3	Amendment to the Agreement and Plan of Merger, dated as of May 14, 2021, by and among Soaring Eagle Acquisition Corp., SEAC Merger Sub Inc. and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 2.1 to SRNG's Quarterly Report on Form 10-Q (File No. 001-40097) for the quarter ended March 31, 2021, filed with the SEC on May 24, 2021)

3.1	Certificate of Incorporation of Ginkgo Bioworks Holdings, Inc. (incorporated by reference to Exhibit 3.1 of the Company's Current Report on Form 8-K filed with the SEC on September 20, 2021)
3.2	Amendment to Certificate of Incorporation of Ginkgo Bioworks Holdings, Inc. (incorporated by reference to Exhibit 3.2 of the Company's Current Report on Form 8-K filed with the SEC on September 20, 2021)
3.3	Bylaws of Ginkgo Bioworks Holdings, Inc. (incorporated by reference to Exhibit 3.1 of the Company's Current Report on Form 8-K filed with the SEC on October 27, 2023)
4.1	Specimen Class A Common Stock Certificate of Ginkgo Bioworks Holdings, Inc. (incorporated by reference to Exhibit 4.5 to Amendment No. 3 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on August 4, 2021)
4.2*	Description of Securities of the Registrant
4.3	Warrant Agreement, dated as of February 23, 2021, by and among Soaring Eagle Acquisition Corp. and Continental Stock Transfer & Trust Company, as warrant agent (incorporated by reference to Exhibit 4.1 of SRNG's Current Report on Form 8-K (File No. 001-40097), filed with the SEC on February 26, 2021)
4.4	Assignment and Assumption Agreement, dated as of September 16, 2021, by and among Ginkgo Bioworks Holdings, Inc., Continental Stock Transfer & Trust Company and Computershare Trust Company, N.A. (incorporated by reference to Exhibit 4.4 of the Company's Annual Report on Form 10-K for the year ended December 31, 2021 filed with the SEC on March 29, 2022)
10.1+	Form of Ginkgo Bioworks Holdings, Inc. 2021 Incentive Award Plan (incorporated by reference to Annex E of SRNG's Form S-4/A (File No. 333-256121), filed with the SEC on August 4, 2021)
10.2+	Form of Ginkgo Bioworks Holdings, Inc. 2021 Employee Stock Purchase Plan (incorporated by reference to Annex F of SRNG's Form S-4/A (File No. 333-256121), filed with the SEC on August 4, 2021)
10.3	Registration Rights Agreement, dated as of September 16, 2021, by and among Ginkgo Bioworks Holdings, Inc., Eagle Equity Partners III, LLC and the other Holders signatory thereto. (incorporated by reference to Exhibit 10.4 of Ginkgo's Current Report on Form 8-K filed with the SEC on September 20, 2021)
10.4	Ginkgo Bioworks, Inc. 2008 Stock Incentive Plan, as amended as of June 18, 2014 (incorporated by reference to Exhibit 10.8 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.5	Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan (incorporated by reference to Exhibit 10.9 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.6	Amendment to the Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan, effective May 1, 2019 (incorporated by reference to Exhibit 10.10 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.7	Amendment to the Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan, effective September 9, 2019 (incorporated by reference to Exhibit 10.11 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.8	Amendment to the Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan, effective November 14, 2019 (incorporated by reference to Exhibit 10.12 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.9	Amendment to the Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan, effective April 8, 2020 (incorporated by reference to Exhibit 10.13 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.10	Amendment to the Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan, effective March 15, 2021 (incorporated by reference to Exhibit 10.14 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.11	Form of Incentive Stock Option Agreement, granted under the Ginkgo Bioworks, Inc. 2008 Stock Incentive Plan (incorporated by reference to Exhibit 10.15 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)

10.12	Form of Restricted Stock Unit Agreement, granted under the Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan (incorporated by reference to Exhibit 10.16 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.13	Form of Restricted Stock Agreement, granted under the Ginkgo Bioworks, Inc. 2014 Stock Incentive Plan (incorporated by reference to Exhibit 10.17 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.14	Form of Stock Option Agreement, granted under the Ginkgo Bioworks Holdings, Inc. 2021 Incentive Award Plan (incorporated by reference to Exhibit 10.1 of the Company's Quarterly Report on Form 10-Q, filed with the SEC on August 15, 2022)
10.15	Form of Global Restricted Stock Unit Agreement, granted under the Ginkgo Bioworks Holdings, Inc. 2021 Incentive Award Plan (incorporated by reference to Exhibit 10.2 of the Company's Quarterly Report on Form 10-Q, filed with the SEC on August 15, 2022)
10.16†‡	Lease Agreement, dated December 22, 2011, between Zoom Group LLC and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 10.18 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.17†	First Amendment to Lease Agreement, dated April 1, 2012 (incorporated by reference to Exhibit 10.19 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.18†	Second Amendment to Lease, dated August 1, 2014 (incorporated by reference to Exhibit 10.20 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.19	Third Amendment to Lease, dated August 15, 2014 (incorporated by reference to Exhibit 10.21 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.20†	Fourth Amendment to Lease, dated May 1, 2016 (incorporated by reference to Exhibit 10.22 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.21†	Fifth Amendment to Lease, dated May 31, 2016 (incorporated by reference to Exhibit 10.23 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.22	Sixth Amendment to Lease, dated August 5, 2016 (incorporated by reference to Exhibit 10.24 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.23†	Seventh Amendment to Lease, dated July 31, 2017 (incorporated by reference to Exhibit 10.25 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.24†	Eighth Amendment to Lease, dated March 23, 2018 (incorporated by reference to Exhibit 10.26 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.25†	Ninth Amendment to Lease, dated September 6, 2018 (incorporated by reference to Exhibit 10.27 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.26†	Tenth Amendment to Lease, dated July 29, 2020 (incorporated by reference to Exhibit 10.28 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.27†	Eleventh Amendment to Lease, dated August 14, 2020 (incorporated by reference to Exhibit 10.29 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)
10.28†	Twelfth Amendment to Lease, dated January 13, 2021 (incorporated by reference to Exhibit 10.30 to Amendment No. 1 to the Registration Statement on Form S-4 (File No. 333-256121), filed with the SEC on June 28, 2021)

10.29†	Thirteenth Amendment to Lease, dated September 6, 2021 (incorporated by reference to Exhibit 10.31 to the Registration Statement on Form S-1 (File No. 333-258712), filed with the SEC on September 15, 2021)
10.30	Fourteenth Amendment to Lease Agreement, dated June 1, 2022, by and between BCP-CG 27 Property LLC and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 10.3 of the Company's Quarterly Report on Form 10-Q, filed with the SEC on August 15, 2022)
10.31*	Fifteenth Amendment to Lease Agreement, dated August 9, 2023, by and between BCP-CG 27 Property LLC and Ginkgo Bioworks, Inc.
10.32	Lease Agreement, dated March 18, 2016, by and between Jamestown 21-23-25 Drydock, L.P. and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 10.31 to Amendment No. 1 to the Registration Statement (File No. 333-256121), filed with the SEC on June 28, 2021)
10.33†‡	First Amendment to Lease Agreement, dated August 13, 2018 (incorporated by reference to Exhibit 10.32 to Amendment No. 1 to the Registration Statement (File No. 333-256121), filed with the SEC on June 28, 2021)
10.34†	Second Amendment to Lease Agreement, dated August 10, 2022, by and between IDB 21-25 Drydock Limited Partnership and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 10.4 of the Company's Quarterly Report on Form 10-Q, filed with the SEC on August 15, 2022)
10.35	Sublease, dated December 10, 2019, by and between Stanley Convergent Security Solutions, Inc., and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 10.33 to Amendment No. 1 to the Registration Statement (File No. 333-256121), filed with the SEC on June 28, 2021)
10.36†‡	License Agreement, dated September 11, 2020, by and between Jamestown 21-23-25 Drydock, L.P. and Ginkgo Bioworks, Inc. (incorporated by reference to Exhibit 10.35 to Amendment No. 1 to the Registration Statement (File No. 333-256121), filed with the SEC on June 28, 2021)
10.37†	Offer Letter, dated October 7, 2020, between Ginkgo Bioworks, Inc. and Mark Dmytruk (incorporated by reference to Exhibit 10.38 to Amendment No. 1 to the Registration Statement (File No. 333-256121), filed with the SEC on June 28, 2021)
10.38	Ginkgo Bioworks Holdings, Inc. Non-Employee Director Compensation Program (incorporated by reference to Exhibit 10.39 to Amendment No. 1 to the Registration Statement (File No. 333-256121), filed with the SEC on June 28, 2021)
10.39	Form of Founder Equity Grant Agreement (incorporated by reference to Exhibit 10.40 of SRNG's Form S-4/A (File No. 333-256121), filed with the SEC on August 4, 2021)
10.40	Form of Director and Officer Indemnification Agreement (incorporated by reference to Exhibit 10.41 of SRNG's Form S-4/A (File No. 333-256121), filed with the SEC on August 4, 2021)
10.41	Sponsor Support Agreement, dated as of May 11, 2021, by and among Eagle Equity Partners III, LLC, Ginkgo Bioworks, Inc., Soaring Eagle Acquisition Corp. and certain of its shareholders (incorporated by reference to Exhibit 10.4 of SRNG's Current Report on Form 8-K (File No. 001-40097), filed with the SEC on May 11, 2021)
10.42	Voting Agreement, dated as of July 24, 2022, entered into by SVF Excalibur (Cayman) Limited (incorporated by reference to Exhibit 10.1 of the Company's Current Report on Form 8-K filed with the SEC on July 25, 2022)
21.1*	Subsidiaries of the Registrant
23.1*	Consent of Ernst & Young LLP, Independent Registered Public Accounting Firm
31.1*	Certification of Principal Executive Officer Pursuant to Rules 13a-14(a) and 15d-14(a) under the Securities Exchange Act of 1934, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002
31.2*	Certification of Principal Financial Officer Pursuant to Rules 13a-14(a) and 15d-14(a) under the Securities Exchange Act of 1934, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002
32.1*	Certification of Principal Executive Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
32.2*	Certification of Principal Financial Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002

97*	Policy for Recoupment of Incentive Compensation
101.INS	Inline XBRL Instance Document – the instance document does not appear in the Interactive Data File because XBRL tags are embedded within the Inline XBRL document
101.SCH	Inline XBRL Taxonomy Extension Schema Document
101.CAL	Inline XBRL Taxonomy Extension Calculation Linkbase Document
101.DEF	Inline XBRL Taxonomy Extension Definition Linkbase Document
101.LAB	Inline XBRL Taxonomy Extension Label Linkbase Document
101.PRE	Inline XBRL Taxonomy Extension Presentation Linkbase Document
104	Cover Page Interactive Data File (embedded within the Inline XBRL document)

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* Filed herewith.

† The annexes, schedules, and certain exhibits to this Exhibit have been omitted pursuant to Item 601(b)(2) of Regulation S-K. The Registrant hereby agrees to furnish supplementally a copy of any omitted annex, schedule or exhibit to the SEC upon request.

‡ Certain confidential information contained in this Exhibit has been omitted because it is (i) not material and (ii) of the type that the registrant treats as private or confidential.

\+ Indicates a management contract of compensatory plan.

Item 16. Form 10-K Summary

None.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, as amended, the Registrant has duly caused this Report to be signed on its behalf by the undersigned, thereunto duly authorized**.**

GINKGO BIOWORKS HOLDINGS, INC.

Date: February 29, 2024

By: /s/ Jason Kelly
Jason Kelly
Chief Executive Officer

Pursuant to the requirements of the Securities Exchange Act of 1934, as amended, this Report has been signed below by the following persons on behalf of the Registrant in the capacities and on the dates indicated.

Name	Title	Date
/s/ Jason Kelly **Jason Kelly**	Chief Executive Officer and Director (Principal Executive Officer)	February 29, 2024
/s/ Mark Dmytruk **Mark Dmytruk**	Chief Financial Officer (Principal Financial Officer)	February 29, 2024
/s/ Steven Coen **Steven Coen**	Chief Accounting Officer (Principal Accounting Officer)	February 29, 2024
/s/ Shyam Sankar **Shyam Sankar**	Director, Chair of the Board	February 29, 2024
/s/ Arie Belldegrun **Arie Belldegrun**	Director	February 29, 2024
/s/ Marijn Dekkers **Marijn Dekkers**	Director	February 29, 2024
/s/ Kathy Hopinkah Hannan **Kathy Hopinkah Hannan**	Director	February 29, 2024
/s/ Christian Henry **Christian Henry**	Director	February 29, 2024
/s/ Reshma Kewalramani **Reshma Kewalramani**	Director	February 29, 2024
/s/ Reshma Shetty **Reshma Shetty**	President, Chief Operating Officer and Director	February 29, 2024
/s/ Harry E. Sloan **Harry E. Sloan**	Director	February 29, 2024

GINKGO BIOWORKS HOLDINGS, INC.

Index to Consolidated Financial Statements as of December 31, 2023 and 2022 and for the Years Ended December 31, 2023, 2022 and 2021

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Stockholders and the Board of Directors of Ginkgo Bioworks Holdings, Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Ginkgo Bioworks Holdings, Inc. (the Company) as of December 31, 2023 and 2022, the related consolidated statements of operations and comprehensive loss, stockholders' equity and cash flows for each of the three years in the period ended December 31, 2023, and the related notes (collectively referred to as the "consolidated financial statements"). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company at December 31, 2023 and 2022, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2023, in conformity with U.S. generally accepted accounting principles.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2023, based on criteria established in Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework), and our report dated February 29, 2024 expressed an adverse opinion thereon.

Adoption of New Accounting Standard

As discussed in Note 2 to the consolidated financial statements, the Company changed its method for accounting for leases in 2022 due to the adoption of Accounting Standards Update (ASU) No. 2016-02 *Leases* (ASC 842), and the related amendments.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matter

The critical audit matter communicated below is a matter arising from the current period audit of the financial statements that was communicated or required to be communicated to the audit committee and that: (1) relates to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective or complex judgments. The communication of the critical audit matter does not alter in any way our opinion on the consolidated financial statements, taken as a whole, and we are not, by communicating the critical audit matter below, providing a separate opinion on the critical audit matter or on the accounts or disclosures to which it relates.

Cell Engineering Revenue Recognition

Description of the Matter

Cell Engineering revenues were $143.5 million for the year ended December 31, 2023. As discussed in Note 2 to the consolidated financial statements, for certain Cell Engineering revenue agreements, the Company recognizes revenue over the period of performance using a measure of progress based on costs incurred to date as compared to total estimated costs. The Company evaluates its measure of progress to recognize revenue for these agreements at each reporting period and, as necessary, adjusts the measure of progress and related revenue recognition.

Auditing Cell Engineering revenue recognized using a measure of progress is especially challenging because the determination of the measure of progress involves significant management judgment and assumptions related to the estimated costs to satisfy the applicable performance obligation under the agreement.

How We Addressed the Matter in Our Audit

To test the measure of progress used to recognize revenue for certain Cell Engineering revenue agreements, our audit procedures included, among others, evaluating the identified measure of progress by reviewing customer contracts and the contract analyses prepared by management. We also evaluated the accuracy and completeness of the underlying data used in management's determination of the measure of progress. We tested management's estimate of costs by performing inquiries of individuals responsible for managing the execution of the Cell Engineering revenue agreements and inspecting evidence related to the progress under the agreement. We also performed analytical comparisons of actual costs incurred compared to estimated remaining costs, compared management's historical estimates of remaining costs to actual costs incurred, and performed sensitivity analyses over management's estimates of costs.

/s/ Ernst & Young LLP

We have served as the Company's auditor since 2018.

Boston, Massachusetts
February 29, 2024

Ginkgo Bioworks Holdings, Inc.
Consolidated Balance Sheets
(in thousands, except per share data)

	As of December 31,	
	2023	2022
Assets		
Current assets:		
Cash and cash equivalents	$ 944,073	$ 1,315,792
Accounts receivable, net	17,157	80,907
Accounts receivable - related parties	742	1,558
Prepaid expenses and other current assets	39,777	51,822
Total current assets	1,001,749	1,450,079
Property, plant and equipment, net	188,193	314,773
Operating lease right-of-use assets	206,801	400,762
Investments	78,565	112,188
Equity method investments	—	1,543
Intangible assets, net	82,741	111,041
Goodwill	49,238	60,210
Other non-current assets	58,055	88,725
Total assets	$ 1,665,342	$ 2,539,321
Liabilities and Stockholders' Equity		
Current liabilities:		
Accounts payable	$ 9,323	$ 10,451
Deferred revenue (includes $5,426 and $10,309 from related parties)	44,486	47,817
Accrued expenses and other current liabilities	110,051	114,694
Total current liabilities	163,860	172,962
Non-current liabilities:		
Deferred revenue, net of current portion (includes $119,053 and $131,188 from related parties)	158,062	174,767
Operating lease liabilities, non-current	221,835	413,256
Warrant liabilities	5,700	10,868
Other non-current liabilities	18,733	31,191
Total liabilities	568,190	803,044
Commitments and contingencies (Note 11)		
Stockholders' equity:		
Preferred stock, $0.0001 par value; 200,000 shares authorized; none issued	—	—
Common stock, $0.0001 par value (Note 12)	199	190
Additional paid-in capital	6,385,997	6,136,378
Accumulated deficit	(5,290,528)	(4,397,659)
Accumulated other comprehensive income (loss)	1,484	(2,632)
Total stockholders' equity	1,097,152	1,736,277
Total liabilities and stockholders' equity	$ 1,665,342	$ 2,539,321

The accompanying notes are an integral part of these consolidated financial statements.

Ginkgo Bioworks Holdings, Inc.
Consolidated Statements of Operations and Comprehensive Loss
(in thousands, except per share data)

	Year Ended December 31,		
	2023	2022	2021
Cell Engineering revenue [1]	$ 143,531	$ 143,666	$ 112,989
Biosecurity revenue:			
Product	28,949	35,455	23,040
Service	78,975	298,585	177,808
Total revenue	251,455	477,706	313,837
Costs and operating expenses:			
Cost of Biosecurity product revenue	7,481	20,646	20,017
Cost of Biosecurity service revenue	46,524	183,570	109,673
Research and development	580,621	1,052,643	1,149,662
General and administrative	385,025	1,429,799	862,952
Impairment of lease assets	96,210	—	—
Total operating expenses	1,115,861	2,686,658	2,142,304
Loss from operations	(864,406)	(2,208,952)	(1,828,467)
Other income (expense):			
Interest income	57,217	20,262	837
Interest expense	(93)	(106)	(2,373)
Loss on equity method investments	(2,635)	(43,761)	(77,284)
Loss on investments	(54,827)	(53,335)	(11,543)
Change in fair value of warrant liabilities	5,168	124,970	58,615
Gain on settlement of partnership agreement	—	—	23,826
(Loss) gain on deconsolidation of subsidiaries	(42,502)	31,889	—
Other income (expense), net	9,138	7,634	(1,733)
Total other income (expense), net	(28,534)	87,553	(9,655)
Loss before income taxes	(892,940)	(2,121,399)	(1,838,122)
Income tax benefit	(71)	(15,027)	(1,480)
Net loss	(892,869)	(2,106,372)	(1,836,642)
Loss attributable to non-controlling interest	—	(1,443)	(6,595)
Net loss attributable to Ginkgo Bioworks Holdings, Inc. stockholders	$ (892,869)	$ (2,104,929)	$ (1,830,047)
Net loss per share attributable to Ginkgo Bioworks Holdings, Inc. common stockholders:			
Basic	$ (0.46)	$ (1.25)	$ (1.35)
Diluted	$ (0.46)	$ (1.25)	$ (1.39)
Weighted average common shares outstanding:			
Basic	1,944,420	1,679,061	1,359,849
Diluted	1,944,420	1,679,839	1,360,373
Comprehensive loss:			
Net loss	$ (892,869)	$ (2,106,372)	$ (1,836,642)
Other comprehensive loss:			
Foreign currency translation adjustment	4,116	(917)	(1,715)
Total other comprehensive gain (loss)	4,116	(917)	(1,715)
Comprehensive loss	$ (888,753)	$ (2,107,289)	$ (1,838,357)

(1) Includes related party revenue of $22,222, $38,813, and $47,161 for the years ended December 31, 2023, 2022, and 2021, respectively.

The accompanying notes are an integral part of these consolidated financial statements.

Ginkgo Bioworks Holdings, Inc.
Consolidated Statements of Stockholders' Equity
(in thousands)

	Common Stock						
	Shares	Amount	Additional Paid-In Capital	Accumulated Deficit	Accumulated Other Comprehensive Loss	Non-Controlling Interest	Total Stockholders' Equity
Balance as of December 31, 2020	1,288,596	$ 129	$ 929,125	$ (467,878)	$ —	$ 8,676	$ 470,052
Issuance of common stock upon exercise or vesting of equity awards	91,080	9	167	—	—	—	176
Vesting of restricted stock - earnouts	38,799	4	(4)	—	—	—	—
Tax withholdings related to net share settlement of equity awards	(797)	—	(9,463)	—	—	—	(9,463)
Founder shares repurchase	(2,707)	—	(24,998)	—	—	—	(24,998)
Issuance of warrants to purchase Series D convertible preferred stock	—	—	300	—	—	—	300
Issuance of Series D and B convertible preferred stock upon exercise of warrants	1,014	—	—	—	—	—	—
Issuance of Series E convertible preferred stock in exchange for warrants	408	—	—	—	—	—	—
Issuance of common stock for a business acquisition	1,634	—	15,160	—	—	—	15,160
Issuance of common stock upon reverse recapitalization, net of offering costs (Note 3)	193,366	19	1,509,610	—	—	—	1,509,629
Assumption of Public and Private Placement Warrants	—	—	(194,453)	—	—	—	(194,453)
Contributions from non-controlling interests	—	—	—	—	—	59,933	59,933
Stock-based compensation expense	—	—	1,579,400	—	—	—	1,579,400
Foreign currency translation	—	—	—	—	(1,715)	—	(1,715)
Net loss	—	—	—	(1,830,047)	—	(6,595)	(1,836,642)
Balance as of December 31, 2021	1,611,393	161	3,804,844	(2,297,925)	(1,715)	62,014	1,567,379
Issuance of common stock upon exercise or vesting of equity awards	124,651	13	239	—	—	—	252
Tax withholdings related to net share settlement of equity awards	(296)	—	(981)	—	—	—	(981)
Issuance of common stock for business and asset acquisitions, net of issuance costs	114,517	12	279,733	—	—	—	279,745
Issuance of common stock pursuant to public offering, net of issuance costs	41,384	4	98,906	—	—	—	98,910
Issuance of common stock in exchange for services	327	—	1,000	—	—	—	1,000
Deconsolidation of subsidiaries	—	—	—	—	—	(55,408)	(55,408)
Acquisition of non-controlling interests	—	—	7,390	—	—	(7,390)	—
Adoption of ASC 842	—	—	—	5,195	—	—	5,195

The accompanying notes are an integral part of these consolidated financial statements.

Ginkgo Bioworks Holdings, Inc.
Consolidated Statements of Stockholders' Equity
(in thousands)

	Common Stock						
	Shares	Amount	Additional Paid-In Capital	Accumulated Deficit	Accumulated Other Comprehensive Loss	Non-Controlling Interest	Total Stockholders' Equity
Stock-based compensation expense	—	—	1,945,247	—	—	2,227	1,947,474
Foreign currency translation	—	—	—	—	(917)	—	(917)
Net loss	—	—	—	(2,104,929)	—	(1,443)	(2,106,372)
Balance as of December 31, 2022	1,891,976	190	6,136,378	(4,397,659)	(2,632)	—	1,736,277
Issuance of common stock upon exercise or vesting of equity awards	98,767	9	546	—	—	—	555
Tax withholdings related to net share settlement of equity awards	(14)	—	(23)	—	—	—	(23)
Settlement of contingent consideration	3,848	—	8,896		—	—	8,896
Issuance of common stock for asset acquisitions	4,771	—	6,820	—	—	—	6,820
Issuance of common stock in exchange for services	2,023	—	2,500	—	—	—	2,500
Forfeiture of restricted stock	(56)	—	—	—	—	—	—
Stock-based compensation expense and other	—	—	230,880	—	—	—	230,880
Foreign currency translation	—	—	—	—	4,116	—	4,116
Net loss	—	—	—	(892,869)	—	—	(892,869)
Balance as of December 31, 2023	2,001,315	$ 199	$ 6,385,997	$ (5,290,528)	$ 1,484	$ —	$ 1,097,152

The accompanying notes are an integral part of these consolidated financial statements.

Ginkgo Bioworks Holdings, Inc.
Consolidated Statements of Cash Flows
(in thousands)

	Year Ended December 31,		
	2023	2022	2021
Cash flows from operating activities:			
Net loss	$ (892,869)	$ (2,106,372)	$ (1,836,642)
Adjustments to reconcile net loss to net cash used in operating activities:			
Depreciation and amortization	70,507	42,552	29,076
Stock-based compensation	229,884	1,930,641	1,606,020
Non-cash customer consideration	(1,373)	(34,263)	(24,185)
Loss on equity method investments	2,635	43,761	77,284
Loss on investments	54,827	53,335	11,543
Change in fair value of notes receivable	2,416	(3,757)	3,508
Change in fair value of warrant liabilities	(5,168)	(124,970)	(58,615)
Change in fair value of contingent consideration liability	9,168	(1,262)	(293)
Loss (gain) on deconsolidation of subsidiaries	42,502	(31,889)	—
Impairment of long-lived assets	121,404	—	—
Deferred income tax benefit	(801)	(14,609)	—
Loss on disposal of equipment	842	3,091	—
Non-cash lease expense	28,313	19,082	—
Non-cash in-process research and development	9,182	1,162	—
Amortization of finance lease right-of-use assets	1,047	1,871	—
Non-cash severance and retention bonus expense associated with an acquisition	—	6,152	—
Other non-cash activity	2,147	283	23
Changes in operating assets and liabilities:			
Accounts receivable ($(644), $3,040 and $614 from related parties)	50,068	55,024	(114,094)
Prepaid expenses and other current assets	10,473	(8,523)	(3,607)
Operating lease right-of-use assets	9,275	13,233	—
Other non-current assets	2,570	921	(539)
Accounts payable	(1,183)	(10,844)	(2,247)
Accrued expenses and other current liabilities	16,899	(39,639)	44,796
Deferred revenue, current and non-current ($(17,018), $(19,324) and $40,743 from related parties)	(35,917)	(36,417)	(10,498)
Operating lease liabilities, current and non-current	(22,800)	(10,792)	—
Deferred rent, non-current	—	—	6,032
Other non-current liabilities	452	31	18,620
Net cash used in operating activities	(295,500)	(252,198)	(253,818)
Cash flows from investing activities:			
Purchases of property and equipment	(40,801)	(52,271)	(56,521)
Deconsolidation of subsidiaries - cash	(42,980)	(55,721)	—
Business acquisitions, net of cash acquired	—	82,367	(12,040)
Asset acquisitions, net of cash acquired	—	(7,639)	—
Purchases of notes receivable (2022: $10,000 from related party)	(350)	(40,000)	—
Proceeds from notes receivable	—	10,000	304
Purchase of investment in equity securities	—	(3,691)	(5,000)
Proceeds from sale of equipment	4,428	—	—
Other	(990)	(439)	—
Net cash used in investing activities	(80,693)	(67,394)	(73,257)

The accompanying notes are an integral part of these consolidated financial statements.

Ginkgo Bioworks Holdings, Inc.
Consolidated Statements of Cash Flows
(in thousands)

	Year Ended December 31,		
	2023	2022	2021
Cash flows from financing activities:			
Proceeds from reverse recapitalization, net of redemptions of $867,253 and offering costs of $108,118 (Note 3)	—	—	1,509,629
Proceeds from exercise of stock options	93	240	167
Repurchases of common stock	—	—	(24,998)
Taxes paid related to net share settlement of equity awards	(23)	(981)	(9,463)
Principal payments on finance/capital leases and lease financing obligation	(1,295)	(1,237)	(1,123)
Contributions from non-controlling interests	—	—	59,933
Proceeds from public offering, net of issuance costs	—	99,303	—
Contingent consideration payment	(1,411)	(521)	—
Payment of equity issuance costs	(580)	(1,467)	—
Net cash (used in) provided by financing activities	(3,216)	95,337	1,534,145
Effect of foreign exchange rates on cash and cash equivalents	(588)	908	(19)
Net (decrease) increase in cash, cash equivalents and restricted cash	(379,997)	(223,347)	1,207,051
Cash and cash equivalents, beginning of period	1,315,792	1,550,004	380,801
Restricted cash, beginning of period	53,789	42,924	5,076
Cash, cash equivalents and restricted cash, beginning of period	1,369,581	1,592,928	385,877
Cash and cash equivalents, end of period	944,073	1,315,792	1,550,004
Restricted cash, end of period	45,511	53,789	42,924
Cash, cash equivalents and restricted cash, end of period	$ 989,584	$ 1,369,581	$ 1,592,928

The accompanying notes are an integral part of these consolidated financial statements.

1. Organization and Basis of Presentation

Business

The mission of Ginkgo Bioworks Holdings, Inc. ("Ginkgo" or the "Company") is to make biology easier to engineer. The Company designs custom cells for customers across multiple markets. Since inception, the Company has devoted its efforts to improving its platform for programming cells to enable customers to leverage biology to create impactful products across a range of industries. The Company's platform comprises (i) equipment, robotic automation, software, data pipelines and tools, and standard operating procedures for high throughput cell engineering, fermentation, and analytics (referred to collectively as the "Foundry"), (ii) a library of proprietary biological assets and associated performance data (referred to collectively as "Codebase"), and (iii) the Company's team of expert users, developers and operators of the Foundry and Codebase.

With a mission to make biology easier to engineer, the Company has recognized the need to invest in biosecurity as a key component of its platform. The Company's Biosecurity business is building a global infrastructure for biosecurity to empower governments, communities, and public health leaders to prevent, detect and respond to a wide variety of biological threats.

On September 16, 2021, Soaring Eagle Acquisition Corp. ("SRNG") consummated a merger transaction pursuant to a merger agreement (the "Merger Agreement"), by and among SRNG, SEAC Merger Sub Inc., a wholly owned subsidiary of SRNG ("Merger Sub"), and Ginkgo Bioworks, Inc. ("Old Ginkgo"), whereby Merger Sub merged with and into Old Ginkgo, the separate corporate existence of Merger Sub ceased and Old Ginkgo survived the merger as a wholly owned subsidiary of SRNG (the "SRNG Business Combination"). In connection with the consummation of the SRNG Business Combination, SRNG changed its name to "Ginkgo Bioworks Holdings, Inc." and, among other transactions contemplated by the Merger Agreement, the existing equity holders of Old Ginkgo exchanged their equity interests of Old Ginkgo for equity interests of Ginkgo. See Note 3 for additional information on the SRNG Business Combination.

2. Summary of Significant Accounting Policies

Basis of Presentation

The accompanying consolidated financial statements have been prepared in conformity with the rules and regulations of the Securities and Exchange Commission ("SEC") and generally accepted accounting principles in the United States of America ("GAAP"). Any reference in these notes to applicable guidance is meant to refer to the authoritative GAAP as found in the Accounting Standards Codification ("ASC") and Accounting Standards Updates ("ASU") of the Financial Accounting Standards Board ("FASB").

The SRNG Business Combination was accounted for as a reverse recapitalization, in accordance with GAAP (the "Reverse Recapitalization"). Under this method of accounting, SRNG was treated as the "acquired" company for financial reporting purposes. Accordingly, for accounting purposes, the Reverse Recapitalization was treated as the equivalent of Old Ginkgo issuing stock for the net assets of SRNG, accompanied by a recapitalization. The net assets of SRNG are stated at historical cost, with no goodwill or other intangible assets recorded.

The consolidated assets, liabilities and results of operations prior to the Reverse Recapitalization are those of Old Ginkgo. The shares and corresponding capital amounts and loss per share prior to the Reverse Recapitalization have been retroactively restated to reflect the Exchange Ratio established in the Merger Agreement.

Principles of Consolidation

The accompanying consolidated financial statements include the accounts of the Company, its wholly owned subsidiaries, majority owned subsidiaries and variable interest entities if the Company is the primary beneficiary. All intercompany accounts and transactions have been eliminated.

As discussed in Note 3, Acquisitions and Divestitures, effective October 3, 2023, the Company deconsolidated its wholly owned subsidiary, Zymergen Inc. ("Zymergen"), following Zymergen's filing for bankruptcy protection under Chapter 11 of the United States Bankruptcy Code.

Reclassifications

Certain prior year amounts have been reclassified for consistency with the current year presentation. In the accompanying consolidated balance sheet, $4.4 million in inventory as of December 31, 2022 was reclassified from inventory, net to prepaid expenses and other current assets. Total current assets as of December 31, 2022 is not changed as a result of this reclassification. In the accompanying consolidated statements of cash flows, (i) $0.2 million and $0.6 million of changes in inventory were reclassified to changes in prepaid expenses and other current assets for the years ended December 31, 2022 and 2021, respectively, (ii) $1.3 million and $0.3 million was reclassified from other non-cash activity to change in fair value of contingent consideration liability for the years ended December 31, 2022 and 2021, respectively, and (iii) $1.2 million was reclassified from other non-cash activity to non-cash in-process research and development for the year ended December 31, 2022. The total cash used in operating activities for the years ended December 31, 2022 and 2021 is not changed as a result of these reclassifications.

Variable Interest Entities

The Company evaluates its variable interests in variable interest entities ("VIE") and consolidates VIEs when the Company is the primary beneficiary. The Company determines whether it is the primary beneficiary of each VIE based on its assessment of whether the Company possesses both (i) the power to direct the activities that most significantly affect the VIE's economic performance and (ii) the obligation to absorb losses that could be significant to the VIE or the right to receive benefits that could be significant to the VIE. The Company reevaluates the accounting for its VIEs upon the occurrence of events that could change the primary beneficiary conclusion. As of December 31, 2023 and 2022, the maximum risk of loss related to the Company's VIEs was limited to the carrying value of its investment in such entities.

Use of Estimates

The preparation of financial statements in conformity with GAAP requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities, revenues and expenses, and the disclosure of contingent liabilities in the consolidated financial statements. The Company bases its estimates on historical experience and other market-specific or relevant assumptions that it believes to be reasonable under the circumstances. Reported amounts and disclosures reflect the overall economic conditions that management believes are most likely to occur, and the anticipated measures management intends to take. Actual results could differ materially from those estimates. All revisions to accounting estimates are recognized in the period in which the estimates are revised.

Concentrations of Credit Risk

Financial instruments that potentially subject the Company to concentrations of credit risk primarily consist of cash and cash equivalents, restricted cash, trade accounts receivable and notes receivable. The Company's cash and cash equivalents and restricted cash are maintained in bank deposit accounts and money market funds that regularly exceed federally insured limits. The Company is exposed to credit risk on its cash, cash equivalents and restricted cash in the event of default by the financial institutions to the extent account balances exceed the amount insured by the Federal Deposit Insurance Corporation. The Company believes that it is not exposed to significant credit risk as its deposits are generally held in financial institutions that management believes to be of high credit quality. To date, the Company has not experienced any material write-offs related to its trade accounts receivable. A portion of the Company's Biosecurity revenue is derived from sales of services to foreign government agencies in certain developing countries. The Company's maximum credit risk exposure with respect to notes receivable is equivalent to the carrying value of the notes as of the balance sheet date. The Company mitigates this risk by requiring collateral for certain notes and monitoring the counterparty's financial condition.

For the year ended December 31, 2023, one customer within the Cell Engineering segment and one customer within the Biosecurity segment accounted for 12% and 11%, respectively, of the Company's total revenue. For the year ended December 31, 2022, two customers within the Biosecurity segment each accounted for 11% of the Company's total revenue. For the year ended December 31, 2021, one customer within the Cell Engineering segment and one customer within the Biosecurity segment accounted for 11% and 17%, respectively, of the Company's total revenue.

Cash and Cash Equivalents

The Company's cash is comprised of bank deposits, overnight sweep accounts and money market funds. The Company considers all highly liquid investments with original maturities of three months or less at the date of purchase to be cash

equivalents. The carrying value of the Company's cash and cash equivalents approximate fair value due to their short-term maturities.

Restricted Cash

Restricted cash primarily includes cash balances collateralizing letters of credit associated with the Company's facility leases and a customer prepayment requiring segregation and restrictions in its use in accordance with the customer agreement. Restricted cash is included in prepaid expenses and other current assets and other non-current assets on the consolidated balance sheet.

Allowance for Credit Losses

The Company maintains an allowance for credit losses to provide for the estimated amounts of receivables that will not be collected over the estimated life of the assets. The allowance is calculated by considering previous loss history, delinquency of receivables balances, current economic conditions and anticipated future economic conditions in the geographies and industries in which the Company's customers operate. To the extent an individual customer's credit quality deteriorates, the Company measures an allowance based on the risk characteristics of the individual customer. Once a receivable is deemed to be uncollectible, such balance is charged against the allowance. The allowance is calculated at each reporting period with changes recorded to general and administrative expense in the consolidated statements of operations and comprehensive loss. Accounts receivable are net of an allowance for credit losses of $1.0 million and $1.1 million at December 31, 2023 and 2022, respectively.

Property, Plant, and Equipment, net

Property, plant and equipment are stated at cost less accumulated depreciation and amortization. Land is stated at cost. Depreciation and amortization are computed using the straight-line method over the estimated useful lives of the assets or the remaining lease term for leasehold improvements. Estimated lives of property, plant and equipment are as follows:

	Estimated Useful Life
Computer equipment and software	2 to 5 years
Furniture and fixtures	7 years
Lab equipment	1 to 5 years
Buildings and facilities	15 to 30 years
Vehicles	5 years
Leasehold improvements	Shorter of useful life or remaining lease term

Expenditures for maintenance and repairs are expensed as incurred. When assets are retired or otherwise disposed of, the related cost and accumulated depreciation or amortization is removed from the balance sheet and any resulting gain or loss is recorded in other income (expense), net in the consolidated statements of operations and comprehensive loss. Construction in progress relates to assets which have not been placed in service as of period end.

Equity Method Investments

The Company utilizes the equity method to account for its investments in common stock, or in-substance common stock, when it possesses the ability to exercise significant influence, but not control, over the operating and financial policies of the investee. The Company uses judgment when determining the level of influence over the operating and financial policies of the investee considering key factors including, among others, the Company's ownership interest, representation on the board of directors, participation in policy-making decisions and material contractual arrangements and obligations. Income and losses are allocated based upon relative ownership interest unless there is a substantive profit-sharing agreement in place.

For investments with a substantive profit-sharing agreement, the Company utilizes the hypothetical liquidation at book value ("HLBV") method to allocate income and losses from the equity method investment. Under the HLBV method, the Company utilizes the capital account at the end of the period assuming the book value of the entity was liquidated or sold

minus the same calculation at the beginning of the period. The difference is the share of earnings or losses attributable to the equity method investment.

Under the equity method, if there is a commitment for the Company to fund the losses of its equity method investees, the Company would continue to record its share of losses resulting in a negative equity method investment, which would be presented as a liability on the consolidated balance sheet. Commitments may be explicit and may include formal guarantees, legal obligations, or arrangements by contract. Implicit commitments may arise from reputational expectations, intercompany relationships, statements by the Company of its intention to provide support, a history of providing financial support or other facts and circumstances. When the Company has no commitment to fund the losses of its equity method investees, the carrying value of its equity method investments will not be reduced below zero. The Company had no commitment to fund additional losses of its equity method investments during the years ended December 31, 2023, 2022 and 2021, other than dissolution costs for Joyn Bio, LLC (see Notes 3 and 6).

The Company evaluates its equity method investments for impairment whenever events or circumstances indicate that the carrying value of the investment may not be recoverable. The Company considers the investee's financial position, forecasts and economic outlook, and the estimated duration and extent of losses to determine whether a recovery is anticipated. An impairment that is other-than-temporary is recognized in the period identified. The Company has not recognized an impairment loss related to its equity method investments for the years ended December 31, 2023, 2022 and 2021.

The Company may elect the fair value option for its equity method investments on an investment-by-investment basis. For all equity method investments accounted for under the fair value option, the Company carries the equity method investment at fair value and records all subsequent changes in fair value as a component of loss on equity method investments in the consolidated statements of operations and comprehensive loss.

Investments

Investments include marketable equity securities in publicly-traded companies, non-marketable equity securities in privately-held companies, Simple Agreement for Future Equity ("SAFE") and warrants, in each case, in which the Company does not possess the ability to exercise significant influence over the investee.

Investments in marketable equity securities of publicly-traded companies and warrants are measured at fair value with subsequent changes in fair value recorded in loss on investments in the consolidated statements of operations and comprehensive loss.

Investments in non-marketable equity securities of privately-held companies and SAFEs, which do not have readily determinable fair values, are carried at cost, less any impairments, plus or minus changes resulting from observable price changes in orderly transactions for the identical or a similar investment of the same issuer. Each period the Company assesses relevant transactions to identify observable price changes, and the Company regularly monitors these investments to evaluate whether there is an indication of impairment. The Company evaluates whether an investment's fair value is less than its carrying value using an estimate of fair value, if such an estimate is available. For periods in which there is no estimate of fair value, the Company evaluates whether an event or change in circumstances has occurred that may have a significant adverse effect on the value of the investment. See Notes 4 and 5 for additional information on Investments.

Fair Value Measurements

The Company categorizes its assets and liabilities measured at fair value in accordance with the authoritative accounting guidance that establishes a consistent framework for measuring fair value and requires disclosures for each major asset and liability category measured at fair value on either a recurring or nonrecurring basis.

ASC 820, *Fair Value Measurement* ("ASC 820"), establishes a fair value hierarchy for instruments measured at fair value that distinguishes between assumptions based on market data (observable inputs) and the Company's own assumptions (unobservable inputs). Observable inputs are inputs that market participants would use in pricing the asset or liability based on market data obtained from sources independent of the Company. Unobservable inputs are inputs that reflect the Company's assumptions about the inputs that market participants would use in pricing the asset or liability and are developed based on the best information available in the circumstances.

ASC 820 identifies fair value as the exchange price, or exit price, representing the amount that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants. As a basis for considering market participant assumptions in fair value measurements, ASC 820 establishes a three-tier fair value hierarchy that distinguishes among the following:

- Level 1- Quoted prices (unadjusted) in active markets for identical assets or liabilities;
- Level 2- Inputs other than quoted prices included within Level 1 that are either directly or indirectly observable; and
- Level 3- Unobservable inputs in which little or no market activity exists, therefore requiring an entity to develop its own assumptions about the assumptions that market participants would use in pricing.

To the extent that the valuation is based on models or inputs that are either less observable or unobservable in the market, the determination of fair value requires more judgment. Accordingly, the degree of judgment exercised by the Company in determining fair value is greatest for instruments categorized in Level 3. A financial instrument's level within the fair value hierarchy is based on the lowest level of any input that is significant to the fair value measurement.

The Company valued its money market fund holdings, notes receivable, marketable equity securities, warrant liabilities and contingent consideration liabilities at fair value on a recurring basis. The carrying amounts of the Company's other financial instruments, which include accounts receivable, certain prepaid expenses and other current assets, accounts payable and accrued expenses and other current liabilities approximate their fair values due to their short-term nature.

Impairment of Long-Lived Assets

The Company reviews its long-lived assets for impairment whenever events or changes in circumstances indicate that the carrying value of an asset may not be recoverable. Recoverability is measured by comparing the book values of the assets to the expected future net undiscounted cash flows that the assets are expected to generate. If such assets are considered to be impaired, the impairment to be recognized is measured by the amount by which the book values of the assets exceed their fair value. See Notes 8 and 10 for a description of impairment losses recorded on long-lived assets.

Business Combinations

The Company accounts for business combinations using the acquisition method of accounting. The Company recognizes the identifiable assets acquired and liabilities assumed at their acquisition-date fair values and recognizes any excess of the total consideration paid over the fair value of the identifiable net assets as goodwill. Any purchase price that is considered contingent consideration is measured at its estimated fair value at the acquisition date and remeasured at each reporting period, with changes in estimated fair value recorded in general and administrative expenses in the consolidated statements of operations and comprehensive loss. Acquisition transaction costs are expensed when incurred. The operating results of an acquisition are included in the Company's consolidated financial statements as of the acquisition date.

Intangible Assets, net

Intangible assets, net consist of certain definite-lived assets including patents, processes and know-how related to technology acquired through business combinations and asset acquisitions. The Company amortizes such intangible assets on a straight-line basis over their estimated useful life.

The Company reviews intangible assets for impairment whenever events or changes in circumstances have occurred which could indicate that the carrying value of the assets are not recoverable. Recoverability is measured by comparing the carrying value of the intangible assets to the future undiscounted cash flows expected to be generated by the asset. In determining the expected future cash flows, the Company uses assumptions believed to be reasonable, but which are unpredictable and inherently uncertain. Actual future cash flows may differ from the estimates used in impairment testing. The Company recognizes an impairment loss when and to the extent that the estimated fair value of an intangible asset is less than its carrying value. The Company has not recognized an impairment loss for the years ended December 31, 2023, 2022 and 2021.

Goodwill

Goodwill represents the excess of acquisition cost over the fair market value of the net assets acquired. Goodwill is tested for impairment on an annual basis during the fourth quarter or whenever events or changes in circumstances indicate the carrying amount may not be recoverable. The Company considers various qualitative factors that could indicate impairment such as macroeconomic conditions, industry and market environment, technological obsolescence, overall financial performance of the Company, cash flow from operating activities and market capitalization. If the qualitative assessment indicates that it is more likely than not that the fair value of the reporting unit is less than its carrying amount, the Company performs a quantitative assessment to compare the fair value of the reporting unit to its carrying value, including goodwill. If the carrying value of the reporting unit exceeds the fair value, an impairment loss is recognized. A combination of the income approach and the market approach may be used to determine fair value of the reporting unit. The Company has not recognized an impairment loss for the years ended December 31, 2023, 2022 and 2021. A portion of the goodwill balance was eliminated following the deconsolidation of Zymergen (see Notes 3 and 7).

Leases

The Company adopted ASU 2016-02, Leases (Topic 842) ("ASC 842") on January 1, 2022 using the modified retrospective approach with a cumulative-effect adjustment to the opening balance of accumulated deficit in the period of adoption.

In accordance with ASC 842, the Company determines if an arrangement is or contains a lease at contract inception based on the terms and conditions in the contract. A contract contains a lease if there is an identified asset and the Company has the right to control the asset. For leases with terms greater than 12 months, the Company recognizes a right-of-use asset ("ROU asset") and a lease liability as of the lease commencement date on the balance sheet. ROU assets represent the Company's right to use an underlying asset over the lease term and lease liabilities represent the Company's obligation to make lease payments arising from the lease. Lease ROU assets and liabilities are measured based on the present value of fixed lease payments that are unpaid as of the lease commencement date. The Company's ROU assets balance is reduced by any initial direct costs and lease incentives received or expected to be received. Some of the Company's leases include options to extend or terminate the lease; these options are included in the lease term for calculations of its ROU assets and liabilities when it is reasonably certain that the Company will exercise those options.

The Company's leases are classified as either operating or finance, as determined at inception, with the classification affecting the pattern of expense recognition in the statement of operations. A lease is classified as a finance lease if risks and rewards are conveyed without the transfer of control. For operating leases, expense is generally recognized on a straight-line basis over the lease term. For finance leases, interest on the lease liability is recognized using the effective interest method, while the ROU asset is amortized on a straight-line basis from the commencement date to the earlier of the end of the useful life of the ROU asset or the end of the lease term. Leases with an initial term of 12 months or less which meet the definition of a short-term lease are not recorded on the balance sheet and the lease expense for these leases is recognized on a straight-line basis over the lease term. In limited instances, the Company acts as a lessor, primarily with certain real estate subleases. Finance leases, short-term leases and subleases are not a significant component of the Company's financial condition or results of operations. The current portion of the Company's operating lease liabilities is included in accrued expenses and other current liabilities on the balance sheet.

The Company has lease agreements with both lease and non-lease components (such as real estate taxes, insurance and common area maintenance charges) and has elected the practical expedient to combine these lease and non-lease components for its real estate leases and non-lab equipment leases. The Company has not elected this practical expedient for lab equipment leases and the lease and non-lease components are accounted for separately for these leases. Non-lease components are typically variable in nature and are recognized as lease expense in the period in which they arise.

As most of the Company's leases do not provide an implicit rate, the Company uses an incremental borrowing rate based on the information available at lease commencement date in determining the present value of lease payments and uses the implicit rate when readily determinable. The Company's incremental borrowing rate is based on management's estimate of the rate of interest the Company would have to pay to borrow on a fully collateralized basis over a similar term an amount equal to the lease payments in a similar economic environment.

Revenue Recognition

The Company accounts for revenue in accordance with ASC 606, *Revenue from Contracts with Customers* ("ASC 606"). Under ASC 606, the Company recognizes revenue when the customer obtains control of the promised goods or services at

an amount that reflects the consideration the Company expects to receive in exchange for those goods or services. To determine revenue recognition for arrangements that are within the scope of ASC 606, the Company performs the following five steps: (i) identify the contract(s) with a customer, (ii) identify the promises and distinct performance obligations in the contract, (iii) determine the transaction price, (iv) allocate the transaction price to the performance obligations in the contract, and (v) recognize revenue when (or as) the Company satisfies the performance obligations.

Cell Engineering Revenue

The Company generates license and service revenue through the execution of license and collaboration agreements whereby customers obtain license rights to the Company's proprietary technology and intellectual property for use in the research, development and commercialization of engineered organisms, and derived products. Under these agreements, the Company typically provides research and development services, which includes the provision of a license to the Company's intellectual property. Additionally, the customer obtains license rights to the output of the Company's services in order to commercialize the resulting output of such services. Generally, the terms of these agreements provide that the Company receives some combination of: (1) service fees in the form of (i) upfront payments upon consummation of the agreement or other fixed payments, (ii) reimbursement for costs incurred for research and development services and (iii) milestone payments upon the achievement of specified technical criteria, plus (2) downstream value share payments in the form of (i) milestone payments upon the achievement of specified commercial criteria, (ii) royalties on sales of products from or comprising engineered organisms arising from the collaboration or licensing agreement and (iii) royalties related to cost of goods sold reductions realized by customers.

The Company's collaboration and licensing agreements often contain multiple promises, including (i) licenses and assignments of intellectual property and materials and (ii) research and development services, and the Company determines whether each of the promises is a distinct performance obligation based on the nature of each agreement. As the Company is generally performing research and development services that are highly integrated and interrelated to the licenses and assignments of intellectual property and materials, the promises are generally inseparable. As such, the Company typically combines the research and development services, licenses, and assignments into a single performance obligation. However, for certain agreements, the Company only grants licenses or effects such transfers and assignments upon the successful completion of the research and development services or delivery of a developed product. For these agreements, the Company typically considers (i) the research and development services and (ii) the licenses, transfers, and assignments as distinct performance obligations, as each is transferred separately and has a separately identifiable benefit.

Options to acquire additional goods and services are evaluated to determine if such options provide a material right to the counterparty that it would not have otherwise received without entering into the contract. If so, the option is accounted for as a separate performance obligation. If not, the option is considered a marketing offer which is accounted for as a separate contract upon the counterparty's election of the option.

At contract inception, the Company determines the transaction price, including fixed consideration and any estimated amounts of variable consideration. Any upfront cash payment received upon consummation of the agreement is fixed and generally nonrefundable. Variable consideration is subject to a constraint, and amounts are included in the transaction price to the extent that it is probable that a significant reversal in the amount of cumulative revenue recognized will not occur when the uncertainty associated with the variable consideration is subsequently resolved. Variable consideration may include reimbursement for costs incurred for the Company's research and development efforts, milestone payments upon the achievement of certain technical and commercial criteria, and royalties on sales of products from or comprising engineered organisms arising from the agreement. With respect to the research and development reimbursements and milestone payments, the Company uses the most likely amount method to estimate variable consideration. With respect to agreements that include royalties on sales or other contingent payments based on sales, the Company applies the royalty recognition constraint which requires a constraint until the royalty or value-sharing transaction occurs.

Certain agreements contain payment in the form of shares of equity securities or other financial instruments that are convertible into equity upon a triggering event. Any non-cash consideration is measured at the estimated fair value of the non-cash consideration at contract inception. For equity securities and financial instruments received that are not actively traded, the Company generally engages a third-party valuation specialist to determine the estimated fair value of the upfront non-cash consideration. The fair value is generally determined based on a recent round of financing or by using a scenario-based valuation model. Significant unobservable inputs are used in the fair value measurements including expectations regarding future financings of the customer, scenario dates and probabilities, expected volatility, discount

rates and recovery rates. Changes in these assumptions can materially affect the value of the non-cash consideration at contract inception and, accordingly, the total amount of revenue recognized for the contract.

For agreements with promises that are combined into a single performance obligation, the entire transaction price is allocated to the single performance obligation. For agreements with multiple performance obligations, the transaction price is allocated to the performance obligations using the relative standalone selling price methodology. For agreements featuring variable consideration, the Company allocates variable consideration to one or more, but not all, performance obligations if certain conditions are met. Specifically, the Company assesses whether the variable consideration relates solely to its efforts to satisfy the performance obligation and whether allocating such variable consideration entirely to the performance obligation is consistent with the overall allocation objective. If these conditions are not met, the Company allocates the variable consideration based on the relative standalone selling price methodology. The key assumptions utilized in determining the standalone selling price for each performance obligation include development timelines, estimated research and development costs, commercial markets, likelihood of exercise (in the case of options considered to be material rights), and probabilities of success.

For agreements where the licenses or assignments are considered separate performance obligations or represent the only performance obligation, the Company recognizes revenue at the point in time that the Company effectively grants the license as the licenses or assignments represent functional intellectual property. For agreements where the licenses and the research and development services represent a combined performance obligation, the Company recognizes revenue over the period of performance using a measure of progress based on costs incurred to date as compared to total estimated costs.

The Company evaluates its measure of progress to recognize revenue at each reporting period and, as necessary, adjusts the measure of progress and related revenue recognition. The Company's measure of progress and revenue recognition involves significant judgment and assumptions, including, but not limited to, estimated costs and timelines to complete its performance obligations. The Company evaluates contract modifications and amendments to determine whether any changes should be accounted for prospectively or on a cumulative catch-up basis. The Company utilizes the right to invoice practical expedient when it has a right to consideration in an amount that corresponds directly with the value of the Company's performance to date.

Royalties are recognized as revenue when sales have occurred as the Company applies the sales or usage-based royalties recognition constraint. The Company has determined the application of this exception is appropriate because the license granted in the agreement is the predominant item to which the royalties relate.

As the Company receives upfront payments for technical services under certain of its arrangements, the Company evaluates whether any significant financing components exist given the term over which the fees will be earned may exceed one year. Based on the nature of the Company's agreements, there are no significant financing components as the purpose of the upfront payment is not to provide financing, but rather to secure technical services, exclusivity rights, and Foundry capacity, or the timing of transfer of those goods or services is at the discretion of the customer.

Deferred revenue represents consideration received by the Company in excess of revenue recognized and primarily results from transactions where the Company receives upfront payments and non-cash equity consideration. In instances where the Company has received consideration in advance for an undefined number of technical development plans ("TDPs") under its customer agreements, the Company records the advance payments as deferred revenue, net of current portion on the consolidated balance sheet. Upon the execution of a specific TDP, the Company reclassifies the estimated consideration to be earned under that TDP within the next twelve months as current deferred revenue. The Company also classifies unexercised material rights related to future TDPs as deferred revenue, net of current portion on the consolidated balance sheet. When a TDP is executed, and the material right is exercised, the amount allocated to the material right, which will be earned within the next twelve months, is reclassified to current deferred revenue. All other deferred revenue is classified as current or non-current based on the timing of when the Company expects to earn the underlying revenue based upon the projected progress of activities under the TDP.

Biosecurity Revenue

The Company has generated Biosecurity revenue through its commercial pathogen testing, sequencing, and analysis services provided to governments and other organizations. Service revenue also consists of biomonitoring and bioinformatic support services. The Company recognizes product and service revenue using the five-step model under ASC 606.

Before the fourth quarter of 2023, product revenue consisted of sales of lateral flow assay ("LFA") diagnostic test kits, polymerase chain reaction ("PCR") sample collection kits, and pooled test kits, which the Company sold to customers on a standalone basis. Product revenue was billed and recognized when the test kits were shipped, and risk of loss is transferred to the carrier. The Company's test kits were generally not subject to a customer right of return except for product recalls under the rules and regulations of the U.S. Food and Drug Administration ("FDA"). The Company elected to include shipping and handling fees billed to customers as a component of Biosecurity revenue.

Service revenue generally consists of multiple promised goods and services including, but not limited to, sample collection, sample storage and transportation, outsourced laboratory analysis, access to results reported through a web-based portal, analytical reporting of results, and overall program management. Service revenue is generally recognized ratably over time as the related services are performed, which depicts the pattern of transfer to the customer.

The Company's contracts with customers are generally two years or less in length and contain a fixed amount of consideration. Under typical payment terms for testing services, amounts are billed monthly in arrears for services performed or in advance based on contractual billing terms.

Options to acquire additional goods and services are evaluated to determine whether they provide the counterparty with a material right that it would not have otherwise received without entering into the contract. If so, the option is accounted for as a separate performance obligation. If not, the option is considered a marketing offer, and upon the counterparty's election of the option, it is accounted for as a separate contract.

Cost of Biosecurity Revenue

The cost of Biosecurity service revenue consists of costs related to the Company's end-to-end pathogen testing, sequencing, and analysis services. This includes costs incurred for sample collection equipment and materials, outsourced laboratory analysis, access to results reported through a proprietary web-based portal, and reporting of results to public authorities. Additionally, the cost of Biosecurity service revenue includes direct labor cost associated with bioinformatics, lab network management, delivery logistics, and customer support. Before the fourth quarter of 2023, cost of Biosecurity product revenue consisted of costs associated with the sale of diagnostic and sample collection test kits, which included costs incurred to purchase test kits from third parties.

Research and Development Costs

Research and development costs are expensed as incurred. Research and development costs consist of direct and indirect internal costs related to specific projects and initiatives, acquired intellectual property deemed to be in-process research and development, as well as fees paid to other entities that conduct certain research and development activities on the Company's behalf.

Patent Costs

The Company expenses all costs as incurred in connection with the filing, prosecution, maintenance, defense, and enforcement of patent applications, including direct application fees and related legal and consulting expenses. Patent costs are included in general and administrative expenses within the consolidated statements of operations and comprehensive loss.

Stock-Based Compensation

The Company measures and recognizes compensation expense for all stock-based awards based on estimated grant-date fair values recognized over the requisite service period. For awards that vest solely based on a service condition, the Company recognizes compensation expense on a straight-line basis over the requisite service period. For awards that vest based on multiple conditions, the Company recognizes compensation expense using the accelerated attribution method on a tranche-by-tranche basis over the requisite service period such that the amount of compensation expense recognized at each reporting period is at least equal to the vested tranches at that date. For awards with a performance-based vesting condition, the Company recognizes stock-based compensation when achievement of the performance condition is deemed probable. Upon achieving a performance condition that was not previously considered as probable, the Company records a cumulative catch-up adjustment to reflect the portion of the grantee's requisite service that has been provided to date. For awards with market conditions, the compensation expense recognized over the requisite service period is not reversed if the market condition is not satisfied. The Company recognizes forfeitures as they occur.

The Company estimates the grant date fair value of stock options using the Black-Scholes option-pricing model. The Black-Scholes option-pricing model requires the input of subjective assumptions, including expected term, expected volatility, risk-free interest rate and expected dividend yield. The expected term is determined using the "simplified" method, which estimates the expected term as the average of the vesting term plus the contractual term. The Company uses the "simplified" method as it does not have sufficient historical data regarding employee exercise behavior. Expected volatility is based on the historical volatility of the stock prices of similar publicly traded peer companies. The risk-free interest rate is based on the yield available on U.S. Treasury zero-coupon issues similar in duration to the expected term of the stock options. The Company has not paid, and does not expect to pay, dividends in the foreseeable future.

For awards with market conditions, the Company recognizes stock-based compensation based on the estimated grant date fair value of the awards determined using a Monte Carlo simulation model, which incorporates various assumptions including expected stock price volatility, risk-free interest rates, expected term, and expected dividend yield. The Company estimates volatility using a weighted average of its own historical volatility and the historical volatility of selected comparable publicly-traded companies due to the limited time period of historical market data for the Company's Class A common stock. The risk-free interest rate is based on the yield available on U.S. Treasury zero-coupon issues similar in duration to the expected term of the awards. The expected term is equal to the contractual term and a dividend yield of zero is assumed.

Income Taxes

The Company accounts for income taxes using the asset and liability method, which requires the recognition of deferred tax assets and liabilities for the expected future tax consequences of events that have been recognized in the consolidated financial statements or in the Company's tax returns. Under this method, deferred tax assets and liabilities are determined based on differences between the financial statement carrying amounts and the tax bases of the assets and liabilities using the enacted tax rates in effect in the years in which the differences are expected to reverse. A valuation allowance against deferred tax assets is recorded if, based on the weight of the available evidence, it is more likely than not that some or all of the deferred tax assets will not be realized. Potential for recovery of deferred tax assets is evaluated by considering several factors, including estimating the future taxable profits expected, estimating future reversals of existing taxable temporary differences, considering taxable profits in carryback periods, and considering prudent and feasible tax planning strategies.

The Company accounts for uncertain tax positions using a more-likely-than-not threshold for recognizing and resolving uncertain tax positions. The evaluation of uncertain tax positions is based on factors including, but not limited to, changes in the law, the measurement of tax positions taken or expected to be taken in tax returns, the effective settlement of matters subject to audit, new audit activity, and changes in facts or circumstances related to a tax position. The Company evaluates uncertain tax positions on an annual basis and adjusts the level of the liability to reflect any subsequent changes in the relevant facts surrounding the uncertain positions. The Company accounts for interest and penalties related to uncertain tax positions as part of its provision for income taxes. As of December 31, 2023 and 2022, the Company did not have any uncertain tax positions and no accrued interest or penalties related to uncertain tax positions. The Company does not expect a material change in unrecognized tax benefits in the next twelve months.

Comprehensive Loss

Comprehensive loss is defined as the change in equity during a period from transactions and other events and circumstances from non-owner sources. Other comprehensive loss consists of foreign currency translation adjustments.

Net Loss per Share

The Company follows the two-class method when computing net loss per share attributable to Ginkgo Bioworks Holdings, Inc. common stockholders as the Company has issued shares that meet the definition of participating securities. The two-class method determines net loss per share for each class of common and participating securities according to dividends declared or accumulated and participation rights in undistributed earnings. The two-class method requires earnings for the period to be allocated between common and participating securities based upon their respective rights to share in the earnings as if all earnings for the period had been distributed. During periods of loss, there is no allocation required under the two-class method since the participating securities do not have a contractual obligation to fund the losses of the Company.

Basic net loss per share is computed by dividing the net loss attributable to Ginkgo Bioworks Holdings, Inc. common stockholders by the weighted average number of common shares outstanding during the period. Diluted net loss per share is computed using the weighted average number of common shares outstanding during the period increased to include the effect of dilutive potential common shares, such as outstanding stock options, unvested restricted stock awards, unvested restricted stock units, warrants and contingently issued shares. Dilutive securities are excluded from the calculation of diluted weighted average common shares outstanding if their effect would be anti-dilutive based on the treasury stock method.

Recent Accounting Pronouncements

Recently Adopted Accounting Pronouncements

In March 2022, the FASB issued ASU 2022-02, *Financial Instruments - Credit Losses (Topic 326): Troubled Debt Restructurings and Vintage Disclosures*. The amendments in this ASU eliminate the accounting guidance for troubled debt restructurings ("TDRs") by creditors while enhancing disclosure requirements for certain loan refinancings and restructurings by creditors when a borrower is experiencing financial difficulty. Specifically, rather than applying the recognition and measurement guidance for TDRs, an entity must evaluate whether a modification results in a new loan or a continuation of an existing loan. The Company adopted ASU 2022-02 on January 1, 2023. The adoption of ASU 2022-02 did not have a material impact on the Company's consolidated financial statements and related disclosures.

Recently Issued Accounting Pronouncements

In December 2023, the FASB issued ASU 2023-09, *Income Taxes (Topic 740),* which focuses on improvements to income tax disclosures primarily related to the rate reconciliation and income taxes paid information. The amendments in this ASU require that public business entities on an annual basis (1) disclose specific categories in the tabular rate reconciliation, using both percentages and reporting currency amounts, and (2) provide additional information for reconciling items that meet a quantitative threshold. In addition, all entities are required to disclose income taxes paid, net of refunds received disaggregated by federal, state/local, and foreign and by jurisdiction if the amount is at least 5% of total income tax payments, net of refunds received. The amendments in this ASU are effective for annual periods beginning after December 15, 2024, with early adoption permitted. The amendments should be applied on a prospective basis, with retrospective application permitted. The Company is currently evaluating the impact that this ASU will have on its disclosures in the consolidated financial statements.

In November 2023, the FASB issued ASU 2023-07, *Segment Reporting (Topic 280)*. This standard requires that a public entity disclose, on an annual and interim basis, significant segment expenses that are regularly provided to the chief operating decision maker ("CODM") and included within each reported measure of segment profit or loss, as well as other segment items and a description of its components. Additionally, it requires disclosure of the title and position of the CODM and an explanation of how the CODM uses the reported measure(s) of segment profit or loss in assessing segment performance and deciding how to allocate resources. The ASU does not change how a public entity identifies its operating segments, aggregates those operating segments, or applies the quantitative thresholds to determine its reportable segments. The standard is effective for fiscal years beginning after December 15, 2023, and interim periods within fiscal years beginning after December 15, 2024. Early adoption is permitted. The Company is currently evaluating the impact that this ASU will have on its disclosures in the consolidated financial statements.

In June 2022, the FASB issued ASU 2022-03, *Fair Value Measurement of Equity Securities Subject to Contractual Sale Restrictions*. This standard clarifies that a contractual restriction on the sale of an equity security is not considered part of the unit of account of the equity security, and therefore is not considered in measuring fair value. It also introduces required disclosures for equity securities subject to contractual sale restrictions. This standard becomes effective for the Company on January 1, 2024, with early adoption permitted. The Company does not expect the adoption of the ASU to have a material impact on the Company's consolidated financial statements and related disclosures.

3. Acquisitions and Divestitures

Fiscal 2022 Acquisitions

Zymergen

On October 19, 2022 (the "Zymergen Closing Date"), the Company acquired all of the outstanding equity of Zymergen Inc. ("Zymergen"), a company that specializes in integrating computational and manufacturing technologies to design,

develop, and commercialize bio-based breakthrough products in a broad range of industries (the "Zymergen Acquisition"). Under the merger agreement ("Agreement and Plan of Merger"), on the Zymergen Closing Date, each share of Zymergen common stock that was issued and outstanding as of immediately prior to the effective time was automatically cancelled, extinguished and converted into the right to receive 0.9179 shares of the Company's Class A common stock and cash in lieu of any fractional shares.

The following table summarizes the acquisition date fair value of the purchase price consideration transferred for Zymergen (in thousands):

Fair value of Class A common stock issued to Zymergen shareholders [(1)]	$ 236,331
Fair value of replacement Ginkgo RSUs and Ginkgo Class A common stock issued under Zymergen RIFs attributable to pre-combination services [(2)]	1,571
Less: Cash severance and retention bonuses incurred for the benefit of the combined company [(3)]	(6,152)
Total Zymergen purchase price consideration	$ 231,750

(1) As consideration for the Zymergen Acquisition, the Company delivered to Zymergen stockholders 99.4 million shares of its Class A common stock, of which approximately 96.9 million represents consideration transferred for the Zymergen Acquisition under ASC 805. The fair value of the Company's Class A common stock issued as consideration transferred was determined based on $2.44 per share, which was the closing price of the Company's Class A common stock on the Zymergen Closing Date. An immaterial amount related to the incremental value received by the holders of Zymergen stock options was excluded from total consideration transferred and recognized as post-combination compensation expense.

(2) Represents the fair value of the replacement Ginkgo RSUs and Ginkgo Class A common stock issued under the Zymergen RIFs attributable to pre-combination services. The remaining portion of the fair value is associated with future service and will be recognized as stock-based compensation expense in the period subsequent to the Zymergen Acquisition over the remaining service period.

(3) Represents cash bonuses payable to Zymergen employees in accordance with Zymergen severance and retention plans at the Zymergen Closing Date. These payments were determined to be for the benefit of the combined company, and accordingly, a portion of the fair value otherwise recognized as consideration transferred was allocated to post-combination compensation expense.

The Zymergen Acquisition was accounted for as a business combination in accordance with ASC 805, *Business Combinations* ("ASC 805"). The Company allocated the consideration transferred to the tangible and identifiable intangible assets acquired and liabilities assumed based on their respective estimated fair values on the acquisition date. During 2023, as a result of updated information about facts and circumstances that existed at the acquisition date regarding the collectability of an acquired accounts receivable balance and accrued expenses under a collaboration agreement, the Company recorded a measurement period adjustment to the estimated fair values initially recorded as of October 19, 2022, which resulted in a decrease to goodwill of $2.2 million, an increase to accounts receivable of $1.8 million, and a decrease to accrued expenses and other current liabilities of $0.4 million. Goodwill is primarily attributed to Zymergen's assembled workforce and the expected synergies from combining operations and has been assigned to the Cell Engineering segment. Goodwill is not expected to be deductible for tax purposes

The following table presents the final allocation of the purchase price to the assets acquired and liabilities assumed as of the acquisition date (in thousands):

	Final Allocation
Cash and cash equivalents	$ 150,553
Accounts receivable	2,817
Inventory	1,166
Prepaid expenses and other current assets	11,592
Property and equipment	97,194
Operating lease right-of-use assets	205,349
Intangible assets	18,600
Goodwill	10,660
Other non-current assets	11,898
Accounts payable	(13,907)
Deferred revenue	(8,189)
Accrued expenses and other current liabilities	(55,541)
Operating lease liabilities	(194,582)
Deferred tax liability	(5,690)
Other non-current liabilities	(171)
Net assets acquired	$ 231,750

The fair value of intangible assets was determined using the relief from royalty method of the income approach. The fair value measurements were primarily based on significant inputs not observable in the market and thus represent a Level 3 measurement. The significant inputs used included the estimated annual net cash flows (including projected revenues attributable to the asset, royalty rates and obsolescence rates), and the discount rate that reflects the risks inherent in the future cash flows. Property and equipment is mostly comprised of lab equipment, leasehold improvements and construction in progress. The fair value of property and equipment was primarily determined using the cost approach, which estimates fair value by determining the replacement or reproduction cost of an asset of comparable utility, adjusted for loss in value due to depreciation and economic obsolescence.

The following table presents the final purchase price allocation and remaining useful lives for identifiable intangible assets acquired as of the acquisition date (in thousands):

	Estimated fair value	Estimated useful life (in years)
Developed technology	$ 14,900	10
Database	3,700	7
Total	$ 18,600	

In conjunction with the Agreement and Plan of Merger, Zymergen initiated a reduction-in-workforce implemented in stages (each a “RIF”) for the benefit of the combined company. Under the RIFs, employees received enhanced severance benefits consisting of cash bonuses and accelerated vesting of their outstanding Zymergen restricted stock units ("Zymergen RSU"). These benefits were triggered upon a change in control occurring within twelve months of the employee’s termination date. The Company recognized $11.1 million in cash-based severance and stock-based compensation costs in the consolidated statements of operations and comprehensive loss for the year ended December 31, 2022 related to the RIFs.

In August and September 2022, Zymergen also approved the grant of retention bonuses to certain employees denominated in cash and/or Zymergen RSUs designed to retain and reward key talent of Zymergen during the pendency of the proposed Zymergen Acquisition and thereafter. These retention bonuses were deemed for the benefit of the combined company. A portion of the retention bonuses vested and became payable upon the closing of the Zymergen Acquisition, with the remaining portion recognized as post-combination compensation expense over the requisite service period. The Company

recognized $7.4 million in cash-based retention and stock-based compensation costs in the consolidated statements of operations and comprehensive loss for the year ended December 31, 2022.

The Company's revenue and net loss for the year ended December 31, 2022 included $2.2 million and $26.0 million, respectively, from Zymergen since the Zymergen Closing Date.

The Company incurred transaction and integration costs of $11.9 million during fiscal year 2022, which were included in general and administrative expenses, inclusive of a success fee which was partly paid in 0.3 million shares of Ginkgo Class A common stock. Additionally, the Company incurred $1.7 million of equity issuance costs during fiscal year 2022, which were included in additional paid-in capital in the consolidated balance sheet.

Supplemental Pro Forma Information (unaudited)

The following supplemental pro forma financial information presents the combined results of operations of the Company and Zymergen as if the acquisition had occurred on January 1, 2021. The pro forma financial information is presented for informational purposes only and is not necessarily indicative of the operating results that would have been realized if the Zymergen Acquisition had been completed on January 1, 2021, or of future operating results. The pro forma financial information reflects pro forma adjustments to give effect to certain events the Company believes to be directly attributable to the Zymergen Acquisition, including depreciation and amortization expense related to acquired tangible and intangible assets, acquisition-related costs, stock-based compensation expense, retention and severance bonuses, and adjustments to align inventory and leasing accounting policies.

	Year Ended December 31,	
(in thousands)	**2022**	**2021**
Total revenue	$ 489,670	$ 330,580
Net loss	$ (2,366,005)	$ (2,235,586)

Zymergen Bankruptcy and Deconsolidation

On October 3, 2023, Zymergen and certain of its subsidiaries filed voluntary petitions for relief under Chapter 11 of the United States Bankruptcy Code (the "Zymergen Bankruptcy") in the U.S. Bankruptcy Court for the District of Delaware ("Bankruptcy Court"). Neither the Company nor any of its other subsidiaries filed for bankruptcy protection. Zymergen has been operated as a distinct legal entity, separate and apart from the Company, since it was acquired in October 2022. Shortly after its acquisition, the Company entered into a non-exclusive license with Zymergen with respect to Zymergen's intellectual property, including its databases, automation, and software capabilities.

In connection with the Zymergen Bankruptcy, also on October 3, 2023, the Company entered into an asset purchase agreement with Zymergen (the "Zymergen APA") as the stalking horse bidder under Section 363 of the U.S. Bankruptcy Code to acquire exclusive rights to substantially all of Zymergen's intellectual property assets and certain other assets. The Company's bid included a $6.2 million cash component and the potential assumption of a facility lease (previously included in the Company's consolidated financial statements prior to Zymergen's deconsolidation discussed below) with a remaining minimum commitment of $37.4 million and a remaining lease term of approximately 9 years. The Company's bid also included an undertaking by the Company to offer employment to 91 of Zymergen's employees (provided such employees remain employed by Zymergen at the closing of the transactions contemplated by the Zymergen APA) whereby the Company would assume any post-closing employment obligations and maintain salary and certain employee benefits levels for a one-year period. On December 14, 2023, Zymergen concluded its auction. On December 21, 2023, the Bankruptcy Court approved the sale of substantially all of Zymergen's assets to the Company through certain of the Company's affiliates as contemplated by the Zymergen APA.

While as of December 31, 2023, Zymergen remained a wholly-owned subsidiary of the Company, as a result of the bankruptcy proceedings, the Company no longer had a controlling financial interest over Zymergen as defined under ASC 810, *Consolidation*, and therefore has deconsolidated Zymergen's financial position as of October 2, 2023. The deconsolidation included the derecognition of the carrying amounts of Zymergen's consolidated assets and liabilities that were previously included in the Company's consolidated financial statements. Upon deconsolidation, the Company recorded a loss of $42.5 million, representing the remaining net book value of the Company's investment that was reduced to a fair value of zero. Subsequent to the deconsolidation, the Company accounts for its investment in Zymergen using the cost method of accounting, which is recorded at zero in the Company's consolidated balance sheet as of December 31,

2023. Zymergen's results of operations were removed from the Company's consolidated statements of operations and comprehensive loss beginning October 3, 2023. The historical financial results for Zymergen have not been classified as a discontinued operation because it does not represent a strategic shift with a major effect on the Company's operations and financial results.

The following table presents Zymergen's consolidated assets and liabilities which have been deconsolidated from the Company's consolidated balance sheet as of October 2, 2023. The amounts presented are before the elimination of intercompany balances.

	October 2, 2023
Assets	
Current assets:	
Cash and cash equivalents	$ 34,321
Accounts receivable, net	11,047
Prepaid expenses and other current assets	11,190
Total current assets	56,558
Property, plant and equipment, net	8,938
Operating lease right-of-use assets	135,800
Intangible assets, net	16,679
Goodwill	10,660
Other non-current assets	19,486
Total assets	248,121
Liabilities	
Current liabilities:	
Deferred revenue	730
Accrued expenses and other current liabilities	20,426
Total current liabilities	21,156
Non-current liabilities:	
Operating lease liabilities, non-current	184,301
Other non-current liabilities	172
Total liabilities	205,629
Net assets deconsolidated	$ 42,492

The following table presents Zymergen's results of operations for the periods presented, included in the Company's consolidated statements of operations and comprehensive loss prior to the elimination of intercompany balances.

	Period from January 1, 2023 - October 2, 2023	Period from October 19, 2022 - December 31, 2022
Total revenue	$ 8,370	$ 2,249
Total operating expenses	200,975	29,459
Loss from operations	(192,605)	(27,210)
Total other income, net	23,620	1,260
Loss before income taxes	(168,985)	(25,950)
Income tax provision	14	3
Net loss	$ (168,999)	$ (25,953)

Related Party Transactions

Prior to the deconsolidation, the Company had an existing employee leasing arrangement with Zymergen. The employee leasing charges were considered intercompany transactions and were eliminated in the Company's consolidated financial statements. As of the deconsolidation date, the employee leasing charges are now considered related party transactions and have been recognized in the Company's consolidated financial statements. Employee lease expense totaled $4.9 million for the period from October 3, 2023 to December 31, 2023. The Company had $1.7 million due to Zymergen as of December 31, 2023 included in accrued expenses and other current liabilities on the balance sheet.

Bayer Acquisition and Joint Venture Dissolution

On October 17, 2022, the Company completed an asset purchase under the Asset Purchase Agreement ("APA") with Bayer CropScience LP, a Delaware limited partnership ("Bayer"). Pursuant to the APA, the Company acquired certain assets and liabilities of Bayer, including Bayer's 175,000-square-foot West Sacramento Biologics Research & Development site, team, and internal discovery and lead optimization platform.

Concurrently with the APA, Bayer and Ginkgo entered into the Joint Venture Termination Agreement ("JV Termination Agreement") and the Technical Development Agreement ("Bayer TDA"). The JV Termination Agreement initiated the dissolution of Joyn Bio, LLC ("Joyn Bio"), the joint venture created by Ginkgo and Bayer in 2017, and provided for the disbursement of contributed intellectual property back to the respective owners, the disbursement of joint ownership of certain intellectual property rights created by Joyn Bio, including with respect to Joyn Bio's nitrogen fixation technology to each party, the disbursement of property and equipment as agreed to by the parties, the assumption by Ginkgo of Joyn Bio's two real estate leases and the transfer of certain employees to Ginkgo. Under the Bayer TDA, (i) Ginkgo will grant Bayer exclusive licenses to Ginkgo's joint ownership right, title and interest to Joyn Bio's nitrogen fixation intellectual property, (ii) for a three-year period, the parties will research, develop and produce microbial strains and related processes to enable the research, development, production, manufacturing and commercialization of Bayer products in agriculture as part of cell programs pursuant to TDPs agreed to by the parties, including one targeted to nitrogen fixation and (iii) for a three-year period, Ginkgo will provide certain non-cell-engineering services to Bayer related to product support as described in statements of work agreed to by the parties. In consideration for all programs, services and related licenses, Ginkgo will receive $90.0 million in equal quarterly installments over the three-year term plus royalties on worldwide net sales of certain Bayer products developed under the Bayer TDA.

The APA, JV Termination Agreement and Bayer TDA were accounted for as a single transaction as they were entered into at the same time and in contemplation of one another, the occurrence of each agreement was dependent on the occurrence of the other agreements, and the work performed under the Bayer TDA will utilize the tangible assets acquired from Bayer under the APA and the IP distributed to Ginkgo under the JV Termination Agreement.

The assets acquired under the APA and JV Termination Agreement meet the definition of a business and were accounted for under ASC 805. The Bayer TDA was accounted for under ASC 606. A summary of the purchase price relating to the business combination is as follows (in thousands):

Cash	$ 79,825
Fair value of previously held equity interest in Joyn Bio	14,000
Fair value of notes receivable from Joyn Bio	10,119
Total purchase consideration	$ 103,944

Prior to the completion of the business combination, the Company, through its majority-owned holding company Cooksonia, LLC ("Cooksonia"), held a 50% equity interest in Joyn Bio that was accounted for as an equity method investment. The Company remeasured its 50% equity interest in Joyn Bio at fair value as of the acquisition date and recorded a gain of $14.0 million equal to the difference between the carrying value of its equity method investment in Joyn Bio of zero and the fair value of $14.0 million on the acquisition date. The gain is included within loss on equity method investments in the consolidated statements of operations and comprehensive loss for the year ended December 31, 2022.

Additionally, prior to the completion of the business combination, Joyn Bio had issued to Ginkgo a series of convertible promissory notes in the aggregate principal amount of $10.0 million (see Note 20). The notes were effectively settled as part of the business combination and were included as part of the consideration transferred for the business combination. The carrying value of the notes prior to the acquisition was $4.8 million due to losses attributable to the equity method investment being allocated to the notes receivable as a result of the equity method investment being reduced to zero during the year ended December 31, 2022. The Company recorded a gain on the notes receivable of $5.3 million within other income (expense), net in the consolidated statements of operations and comprehensive loss for the year ended December 31, 2022 for the excess of the $10.1 million outstanding principal and accrued interest over their carrying value of the notes.

The following table presents the final allocation of the purchase price to the assets acquired and liabilities assumed as of the acquisition date (in thousands):

Property, plant, and equipment	$ 83,951
Intangible assets	11,500
Goodwill	11,172
Deferred tax liability	(2,679)
Net assets acquired	$ 103,944

The fair value of Ginkgo's equity interest in Joyn Bio pre-dissolution was determined using a discounted cash flow method. The fair value of intangible assets, which consists of Joyn Bio's developed technology, was determined using the relief from royalty method of the income approach. Significant assumptions used in the valuations included the estimated annual net cash flows (including projected future revenues and costs, terminal growth rates, royalty rates and obsolescence rates), and a discount rate that reflects the risks inherent in the future cash flows. Property, plant, and equipment consists of land, buildings, site improvements and personal property. The fair value of land was determined using the sales comparison approach and the fair value of the buildings, site improvements and personal property was determined using the cost and sales comparison approaches. Under the cost approach, the Company estimated the cost to acquire or construct comparable assets and made adjustments for physical deterioration. Intangible assets consist of Joyn Bio's developed technology and have an estimated useful life of five years. Goodwill primarily reflects the value of future programs expected to arise after the acquisition and the assembled workforce. Goodwill is not expected to be deductible for tax purposes.

The Company incurred $0.2 million and $3.0 million in costs associated with the winding up and dissolution of Joyn Bio during the years ended December 31, 2023 and 2022, respectively, which were recorded within operating expenses. Dissolution costs are shared equally between Ginkgo and Bayer. The joint venture was fully dissolved in the third quarter of 2023. The Company incurred transaction and integration costs of $12.0 million during the year ended December 31, 2022 related to the business combination, which were included in general and administrative expenses in the consolidated statements of operations and comprehensive loss. The transaction does not represent a material business combination and, therefore, pro forma financial information is not provided. Operating results of the acquired business have been included in the consolidated statements of operations and comprehensive loss since the date of acquisition and were not material to the Company's results of operations for the year ended December 31, 2022.

Altar

On October 3, 2022, the Company acquired all of the outstanding shares of capital stock of Altar SAS ("Altar"), a French biotechnology company with a proprietary adaptive evolution platform. A fleet of Altar's automated adaptive laboratory evolution instruments will be integrated into Ginkgo's Foundry to serve customers across various industries. The total purchase consideration was $12.0 million and consisted of $2.8 million in cash, $1.4 million in restricted shares of Ginkgo Class A common stock subject to forfeiture if certain vesting conditions are not met, $5.6 million in unrestricted shares of Ginkgo Class A common stock, $1.6 million in contingent consideration and $0.6 million in assumed liabilities. The Company accounted for the transaction as a business combination under ASC 805. The net assets acquired primarily consisted of $8.4 million of intangible assets related to Altar's developed technology and $4.7 million of goodwill, which is not deductible for tax purposes. The business is reported as part of the Company's Cell Engineering reportable segment. The Company incurred $2.3 million in acquisition related costs during the year ended December 31, 2022, which were included in general and administrative expenses. Pro forma information has not been presented because it is not material to the financial statements. Altar's results of operations have been included in the consolidated statements of operations and comprehensive loss since the date of acquisition and were not material to the Company's results of operations for the year ended December 31, 2022.

FGen

On April 1, 2022, the Company acquired all of the outstanding equity interests of FGen AG ("FGen"), a company organized under the laws of Switzerland that specializes in strain development and optimization. FGen has developed an ultra-high-throughput screening platform built on nanoliter reactor technology which the Company believes will enhance its cell screening capabilities and potentially increase the likelihood of finding enzymes, pathways, and strains or cell lines that perform to diverse cell program specifications.

The Company accounted for the transaction as a business combination under ASC 805. Accordingly, the assets and liabilities acquired were recorded at their estimated fair value on the date of acquisition. FGen's results of operations have been included in the consolidated statements of operations and comprehensive loss since the date of acquisition and were not material to the Company's results of operations for the year ended December 31, 2022. The FGen acquisition does not represent a material business combination and, therefore, pro forma financial information is not provided.

The consideration paid was comprised of common stock and contingent consideration as follows (in thousands):

Fair value of Class A common stock	$	17,015
Fair value of contingent consideration - restricted stock		3,842
Fair value of contingent consideration - milestones		8,464
Total FGen consideration	$	29,321

The Company issued 5.7 million shares of its Class A common stock on the acquisition date comprised of 4.0 million unrestricted shares valued at $17.0 million based on the closing market price of $4.20 per share and 1.7 million restricted shares classified as contingent consideration and subject to vesting conditions. The contingent consideration in the form of restricted stock was valued at $3.8 million as of the acquisition date based on management's estimate of the number of shares expected to vest and the closing market price of $4.20. The restricted shares were issued in three tranches with separate vesting conditions. Tranches 1 and 2 vest based on the price difference between the 15-day volume weighted average price ("VWAP") of Ginkgo's Class A common stock calculated on the date immediately prior to closing and the 15-day VWAP calculated on the date immediately prior to Ginkgo's filing of the registration statement to register the unrestricted shares. The contingency was resolved on April 4, 2022 when the Company filed its Form S-1 registration statement and a total of 0.5 million shares vested and 0.6 million shares were forfeited related to tranches 1 and 2. The remaining 0.7 million tranche 3 restricted shares will vest on the 24-month anniversary of the closing, provided, however, that the number of shares that vest will be reduced by any post-closing purchase price adjustments and indemnity claims. The estimated fair value of tranche 1 and 2 shares on the registration statement date was $1.9 million, which was reclassified from a liability into stockholders' equity upon the determination of the number of shares that vested. The Company recognized a $0.8 million loss on the change in fair value of the contingent consideration related to tranche 1 and 2, which is included in general and administrative expenses in the consolidated statements of operations and comprehensive loss for the year ended December 31, 2022.

As part of the acquisition, the Company is required to make milestone payments up to a maximum of $25.0 million, with $20.0 million payable based on the successful integration and deployment of the FGen technology across the Company's programs over a 36-month period and $5.0 million payable to certain employees based on continuing service. The milestones are payable in cash or Class A common stock at the election of the Company. The $5.0 million payable to employees is accounted for separately from the business combination as post combination compensation expense to be recognized over the requisite service period. The fair value of the $20.0 million in contingent consideration on the acquisition date was determined using a scenario-based method. The significant assumptions used include the expected time of achievement and probability of success related to each milestone and a discount rate.

The Company allocated the purchase price to the tangible and identifiable intangible assets acquired and liabilities assumed based on their respective estimated fair values on the acquisition date. During the year ended December 31, 2022, the Company recorded measurement period adjustments which did not have a material impact on goodwill.

The intangible assets acquired consist of FGen's developed technology which was measured at fair value using the multi-period excess earnings method under the income approach. Under this method, an intangible asset's fair value is equal to the present value of the incremental after-tax cash flows attributable only to the intangible asset after deducting charges representing the contribution of other assets to those cash flows. The significant assumptions used include the estimated annual net cash flows (including revenue growth rates, EBITDA and EBIT margins, applicable tax rate, and contributory asset charges), a discount rate, and the tax amortization benefit. Goodwill represents the amount by which the purchase price exceeds the estimated fair value of the net assets acquired and primarily reflects the value of future programs expected to arise after the acquisition.

The Company incurred $1.7 million of acquisition-related costs during the year ended December 31, 2022, which were included in general and administrative expenses in the consolidated statements of operations and comprehensive loss.

The following table presents the final allocation of the purchase price to the assets acquired and liabilities assumed as of the acquisition date (in thousands):

	Final Allocation
Cash and cash equivalents	$ 1,430
Accounts receivable	144
Other non-current assets	10
Property and equipment	34
Intangible assets [1]	21,100
Goodwill [2]	10,615
Accounts payable and accrued expenses	(29)
Deferred revenue	(104)
Deferred tax liability	(3,879)
Net assets acquired	$ 29,321

(1) Estimated useful life of 15 years.

(2) Non-deductible for tax purposes.

Asset Acquisitions

On October 3, 2022, the Company completed the acquisition of all of the outstanding equity interests in Circularis Biotechnologies, Inc., (“Circularis”), a biotechnology company with a proprietary circular RNA and promoter screening platform. The aggregate purchase consideration was $18.6 million, of which $4.3 million was paid in cash, $10.2 million was paid in Ginkgo Class A common stock, $3.7 million represents contingent consideration and $0.4 million represents direct transaction costs. The Company accounted for the transaction as an asset acquisition as substantially all of the value received was concentrated in the acquired developed technology. The Company allocated the purchase consideration primarily to the developed technology intangible asset, which is being amortized over a useful life of five years. Additionally, the purchase agreement includes $2.5 million of employee retention payments, which will be recognized as compensation expense over the requisite service period.

On August 17, 2022, the Company acquired certain epidemiological data infrastructure assets from Baktus, Inc., a Delaware-based public benefit corporation. The Company accounted for the transaction as an asset acquisition as the value

being acquired primarily relates to a single identifiable intangible asset. The total purchase consideration was $11.1 million and consisted of $2.0 million in cash, $8.4 million in Ginkgo Class A common stock and $0.7 million of direct transaction costs. Of the shares issued, 0.3 million are restricted shares that will vest on the 18-month anniversary of the closing and will be reduced by any indemnity claims. The restricted shares are classified as contingent consideration liability in the consolidated balance sheet (see Note 4). Additionally, the purchase agreement includes $1.0 million of employee retention payments, which will be recognized as compensation expense over the requisite service period. As a result of the acquisition, the Company recognized $11.2 million in intangible assets consisting of developed technology, customer relationships and assembled workforce and $0.1 million in deferred revenue.

Fiscal 2021 Acquisitions

SRNG Business Combination

On September 16, 2021 (the “Closing Date”), the Company and SRNG completed the merger transaction contemplated by the Merger Agreement (the “Closing"), with Old Ginkgo surviving the merger as a wholly owned subsidiary of SRNG.

Pursuant to the Merger Agreement, SRNG acquired all of the outstanding equity interests of Old Ginkgo for approximately $15.8 billion in aggregate consideration in the form of common stock of Ginkgo valued at $10 per share (the “Base Equity Consideration”). The Base Equity Consideration was allocated among Old Ginkgo equity holders based on an exchange ratio of 49.080452 ("Exchange Ratio"). Accordingly, upon the closing of the SRNG Business Combination, all shares of Old Ginkgo Class A common stock and Old Ginkgo Class B common stock issued and outstanding immediately prior to the SRNG Business Combination converted into Ginkgo Class A common stock and Ginkgo Class B common stock, respectively, each with a par value of $0.0001 per share, based on the Exchange Ratio. All equity awards under Old Ginkgo's stock incentive plans were assumed by the Company and converted into comparable equity awards that are settled or exercisable for shares of the Company’s common stock. As a result, (i) each outstanding stock option to acquire Old Ginkgo common stock was converted into an option to purchase approximately 49.080452 shares of Ginkgo common stock, (ii) each outstanding share of restricted common stock was converted into approximately 49.080452 shares of restricted common stock of Ginkgo and (iii) each outstanding award of restricted stock units was assumed and converted into a restricted stock unit having the same terms and conditions as applied to the Old Ginkgo restricted stock unit so converted but relating to approximately 49.080452 shares of common stock of Ginkgo.

In addition to the Base Equity Consideration, the equity holders of Old Ginkgo received approximately 188.7 million shares of Ginkgo common stock (the “Earnout Consideration”), which are subject to forfeiture to the extent that the vesting conditions described below are not satisfied on or before the fifth anniversary of the Closing, which is September 16, 2026 (the "Earnout Period"). If at any point during the trading hours of a trading day, for any 20 trading days within any period of 30 consecutive trading days during the Earnout Period, the trading price per share of the Company's Class A common stock is greater than or equal to:

- $12.50, then 25% of the Earnout Consideration will immediately vest;
- $15.00, then an additional 25% of the Earnout Consideration will immediately vest;
- $17.50, then an additional 25% of the Earnout Consideration will immediately vest; and
- $20.00, then the remaining 25% of the Earnout Consideration will immediately vest.

The Company evaluated the earnout shares and concluded that they qualify for the scope exception from derivative accounting in ASC 815-10-15-74 and meet the criteria for equity classification under ASC 815-40. The Company determined that the earnout shares underlying rollover equity awards (i.e., restricted stock awards, restricted stock units and options) granted under the Company's stock incentive plans (together the "Rollover Equity Awards") that are unvested as of the Closing Date are within the scope of ASC 718 (see Note 13). The remaining earnout shares issued to holders of Old Ginkgo common stock and those earnout shares underlying vested Rollover Equity Awards were initially measured at fair value at Closing and recorded within additional paid-in-capital ("APIC") and had no net impact on APIC. Since those earnout shares are equity-classified, there is no remeasurement unless reclassification is required. Upon meeting an earnout target, the earnout shares delivered to the equity holders are recorded in equity as shares outstanding with the appropriate allocation to par value of common stock and APIC. The first earnout target of $12.50 was met on November 15, 2021 and, as a result, approximately 38.8 million earnout shares became vested and outstanding.

In connection with the entry into the Merger Agreement, Eagle Equity Partners III, LLC, a Delaware limited liability company (the “Sponsor”), forfeited 11.5 million of its shares of Ginkgo Class A common stock and an additional 16.7 million of its shares of Ginkgo Class A common stock (the "Sponsor Earnout Shares") became subject to vesting and

forfeiture conditions identical to those applicable to the Earnout Consideration issued to Old Ginkgo equity holders. Similar to the Earnout Consideration, the Sponsor Earnout Shares were accounted for as equity classified instruments and were included as merger consideration and recorded in additional paid-in capital. The Sponsor Earnout Shares are considered legally issued and outstanding shares of common stock subject to restrictions on transfer and do not participate in the earnings or losses of the Company prior to vesting.

The SRNG Business Combination is accounted for as a reverse recapitalization, in accordance with GAAP. Under this method of accounting, SRNG was treated as the "acquired" company for financial reporting purposes. Accordingly, the SRNG Business Combination was treated as the equivalent of Old Ginkgo issuing stock for the net assets of SRNG, accompanied by a recapitalization. The net assets of SRNG are stated at historical cost, with no goodwill or other intangible assets recorded.

PIPE Investment

On May 11, 2021, concurrently with the execution of the Merger Agreement, SRNG entered into subscription agreements with certain accredited investors (the "PIPE Investors"). In connection with the consummation of the SRNG Business Combination on September 16, 2021, the PIPE Investors collectively consummated investments for 76.0 million shares of the Company's Class A common stock at a price of $10.00 per share (the "PIPE Shares") for an aggregate amount of $760.0 million (the "PIPE Investment").

Summary of Net Proceeds

The following table summarizes the elements of the net proceeds from the SRNG Business Combination (in thousands):

Cash - SRNG Trust and cash (net of redemptions)	$ 857,747
Cash - PIPE Investment	760,000
Less: Payment of underwriter fees and other offering costs	(108,118)
Net proceeds from the SRNG Business Combination	$ 1,509,629

Summary of Shares Issued

The following table summarizes the number of shares of common stock outstanding immediately following the consummation of the SRNG Business Combination (in thousands):

SRNG shares outstanding prior to the SRNG Business Combination	215,625
Less: redemption of SRNG shares prior to the SRNG Business Combination	(86,725)
Less: SRNG shares forfeited	(11,534)
Common stock of SRNG [(1)]	117,366
Shares issued pursuant to the PIPE Investment	76,000
SRNG Business Combination and PIPE Investment shares	193,366
Conversion of Old Ginkgo Series B preferred stock to common stock	203,346
Conversion of Old Ginkgo Series C preferred stock to common stock	228,641
Conversion of Old Ginkgo Series D preferred stock to common stock	302,465
Conversion of Old Ginkgo Series E preferred stock to common stock	170,227
Conversion of Old Ginkgo common stock [(2)]	387,016
Total shares of Ginkgo common stock outstanding immediately following the SRNG Business Combination	1,485,061

(1) Includes 16.7 million shares of Class A common stock, the Sponsor Earnout Shares, that are subject to forfeiture if certain earnout conditions are not met, as the shares are legally outstanding as of the Closing of the SRNG Business Combination.

(2) Excludes 283.4 million shares of Class A and Class B common stock underlying rollover equity instruments (i.e., restricted stock units and stock options) and 0.3 million shares of Class A and Class B common stock underlying unvested restricted stock awards.

4. Fair Value Measurements

The following tables present information about the Company's financial assets and liabilities measured at fair value on a recurring basis (in thousands):

		As of December 31, 2023			
	Classification	Total	Level 1	Level 2	Level 3
Assets:					
Money market funds	Cash and cash equivalents	$ 913,729	$ 913,729	$ —	$ —
Synlogic, Inc. warrants [1]	Investments	654	—	654	—
Marketable equity securities [2]	Investments	19,190	18,401	789	—
Notes receivable	Prepaid expenses and other current assets	12,293	—	—	12,293
Notes receivable	Other non-current assets	13,601	—	11,765	1,836
Total assets		$ 959,467	$ 932,130	$ 13,208	$ 14,129
Liabilities:					
Public Warrants	Warrant liabilities	$ 3,794	$ 3,794	$ —	$ —
Private Placement Warrants	Warrant liabilities	1,906	—	60	1,846
Contingent consideration	Accrued expenses and other current liabilities	18,468	—	—	18,468
Contingent consideration	Other non-current liabilities	5,805	—	—	5,805
Total liabilities		$ 29,973	$ 3,794	$ 60	$ 26,119

		As of December 31, 2022			
	Classification	Total	Level 1	Level 2	Level 3
Assets:					
Money market funds	Cash and cash equivalents	$ 1,089,026	$ 1,089,026	$ —	$ —
Synlogic, Inc. warrants [1]	Investments	1,937	—	1,937	—
Marketable equity securities [2]	Investments	25,714	21,312	4,402	—
Notes receivable	Other non-current assets	37,660	—	30,000	7,660
Total assets		$ 1,154,337	$ 1,110,338	$ 36,339	$ 7,660
Liabilities:					
Public Warrants	Warrant liabilities	$ 6,900	$ 6,900	$ —	$ —
Private Placement Warrants	Warrant liabilities	3,968	—	108	3,860
Contingent consideration	Accrued expenses and other current liabilities	6,378	—	—	6,378
Contingent consideration	Other non-current liabilities	18,095	—	—	18,095
Total liabilities		$ 35,341	$ 6,900	$ 108	$ 28,333

(1) The fair value of Synlogic, Inc. warrants is calculated as the quoted price of the underlying common stock, less the unpaid exercise price of the warrants.
(2) Marketable equity securities classified as Level 2 reflect a discount for lack of marketability due to regulatory sales restrictions.

Transfers to/from Levels 1, 2 and 3 are recognized at the end of the reporting period in which a change in valuation technique or methodology occurs. Transfers from Level 2 to Level 1 during the years ended December 31, 2023 and 2022 were due to a lapse of regulatory sales restrictions on marketable equity securities. The estimated fair value of a portion of the Private Placement Warrants was transferred from a Level 3 to Level 2 fair value measurement as of December 31, 2022, as the transfer of Private Placement Warrants to anyone other than the initial purchasers or any of their permitted transferees results in the Private Placement Warrants having substantially the same terms as the Public Warrants. The

Company determined that the fair value of the transferred Private Placement Warrants is equivalent to that of Public Warrants. There were no other transfers to/from Levels 1, 2, or 3 during any of the periods presented.

Notes Receivable

For all of its notes receivable, the Company has elected the fair value option, for which changes in fair value are recorded in other income (expense), net in the consolidated statements of operations and comprehensive loss.

As of December 31, 2022, the Company held a $30.0 million senior secured note previously purchased from Bolt Threads, Inc. ("Bolt Threads"). In December 2023, the Company and Bolt Threads exchanged the $30.0 million senior secured note for (i) a $11.8 million senior secured note with an estimated fair value of $11.8 million, (ii) a $10.0 million convertible promissory note with an estimated fair value of $12.2 million, (iii) a $5.3 million reduction in the technical services credit previously due to Bolt Threads and recorded as deferred revenue and (iv) a non-exclusive license to certain intellectual property of Bolt Threads with an estimated fair value of $1.6 million, which was expensed as in-process research and development in the accompanying consolidated statements of operations and comprehensive loss for the year ended December 31, 2023. The new senior secured note receivable bears interest at 12% per annum, is due December 31, 2027 and is included in other non-current assets as of December 31, 2023 at its estimated fair value. The convertible promissory note bears interest at 8% per annum, is convertible into equity securities of Bolt Threads upon a qualified financing, a non-qualified financing, or special purpose acquisition company transaction, at a conversion price equal to 80% of the price paid per share under the respective conversion scenario, or is otherwise payable on demand any time after the maturity date of October 4, 2024. The convertible promissory note is included in prepaid expenses and other current assets as of December 31, 2023 at its estimated fair value.

The Company used the yield method to value the senior secured note. Under this method, the estimated future cash flows, consisting of principal and interest payments, are discounted to present value using an applicable market yield or discount rate. Increases or decreases in the market yield or discount rate would result in a decrease or increase, respectively, in the fair value measurement. The market yield is determined using a corporate bond yield curve corresponding to the credit rating category of the issuer. The fair value of senior secured note is based on observable market inputs, which represent a Level 2 measurement within the fair value hierarchy.

In addition to the convertible promissory note issued by Bolt Threads, the Company holds a series of convertible debt instruments issued by customers as payment for Cell Engineering services. The Company used a scenario-based method to value the convertible debt instruments issued by customers and by Bolt Threads. Under this method, future cash flows are evaluated under various payoff scenarios, probability-weighted, and discounted to present value. The significant unobservable (Level 3) inputs used in the fair value measurement as of December 31, 2023 were scenario probabilities of between 5% and 85%, a discount rate of 17.0% and estimated time to event date of one to two years. The significant unobservable (Level 3) inputs used in the fair value measurement as of December 31, 2022 were scenario probabilities of between 15% and 55%, a discount rate of 12.5% and estimated time to event date of one to three years. Significant changes in these inputs could have resulted in a significantly lower or higher fair value measurement. As of December 31, 2023, the convertible debt instruments had an unpaid principal balance of $21.0 million and a fair value of $14.1 million. As of December 31, 2022, the convertible debt instruments had an unpaid principal balance of $7.5 million and a fair value of $7.7 million.

In December 2023, the Company entered into an amendment with a customer regarding two outstanding convertible promissory notes, with an aggregate principal amount of $10.3 million. The Company used a scenario-based method to value the convertible notes as of the amendment date. The significant unobservable (Level 3) inputs used in the fair value measurement as of the amendment date included scenario probabilities of between 10% and 75%, a discount rate of 15%, time to event date of up to one year, and estimated fair value per share of the equity securities to which the Company would be entitled to upon conversion of the notes, obtained from a third-party valuation.

The following table provides a reconciliation of notes receivable measured at fair value using Level 3 significant unobservable inputs (in thousands):

	2023	2022
Balance at January 1,	$ 7,660	$ 11,559
Additions	2,653	7,660
Additions from note exchanges and amendments	13,939	—
Proceeds from notes receivable	—	(10,404)
Settlements	(7,707)	—
Change in fair value	(2,416)	705
Write-off	—	(1,860)
Balance at December 31,	$ 14,129	$ 7,660

Warrant Liabilities

The fair value of the Public Warrants is based on the observable quoted price of such warrants on the New York Stock Exchange. The fair value of the Private Placement Warrants is estimated using the Black-Scholes option pricing model, which is considered to be a Level 3 fair value measurement. The primary unobservable input used in the valuation of the Private Placement Warrants is expected stock-price volatility. The Company estimated the volatility of its Private Placement Warrants using a Monte-Carlo simulation of the redeemable Public Warrants that assumes optimal exercise of the Company's redemption option at the earliest possible date. The risk-free interest rate is based on the U.S. Treasury zero-coupon yield curve for a maturity similar to the expected remaining life of the warrants. The expected life of the warrants is assumed to be equivalent to their remaining contractual term. The dividend yield is based on the historical rate, which the Company anticipates remaining at zero. Refer to Note 9 for additional details on the Company’s warrant liabilities.

The following table provides quantitative information regarding Level 3 inputs used in the recurring valuation of the Private Placement Warrants as of their measurement dates:

	December 31, 2023	December 31, 2022
Exercise price	$ 11.50	$ 11.50
Stock price	$ 1.69	$ 1.69
Volatility	70.5 %	71.5 %
Term (in years)	2.71	3.71
Risk-free interest rate	4.01 %	4.11 %

The following table provides a reconciliation of the Private Placement Warrants measured at fair value using Level 3 significant unobservable inputs (in thousands):

	2023	2022
Balance at January 1,	$ 3,860	$ 58,558
Transfer to Level 2	—	(125)
Change in fair value	(2,014)	(54,573)
Balance at December 31,	$ 1,846	$ 3,860

Contingent Consideration

Each reporting period the Company remeasures its contingent consideration liability associated with business acquisitions to its estimated fair value. The fair value of contingent consideration liability related to restricted stock was estimated using the quoted price of Ginkgo's Class A common stock, an estimate of the number of shares expected to vest, probability of vesting, and a discount rate. The fair value of contingent consideration liability related to earnout payments was estimated using unobservable (Level 3) inputs as illustrated in the table below. Material increases or decreases in these inputs could result in a higher or lower fair value measurement. Changes in the fair value of contingent consideration are recorded in general and administrative expense in the consolidated statements of operations and comprehensive loss.

The Company can settle all contingent consideration liabilities, other than those related to the Dutch DNA acquisition, in cash or shares of Class A common stock at the Company's election. During the year ended December 31, 2023, the Company settled $10.8 million in contingent consideration liabilities through payment of $1.9 million in cash and vesting of 5.5 million shares of restricted stock valued at $8.9 million. Of that amount, $1.4 million related to the Circularis asset acquisition was recorded as an increase to the acquired intangible asset with an offset to additional paid-in-capital as the contingent consideration liability was deemed improbable until the filing of a registration statement. During the year ended December 31, 2022, the Company settled $2.6 million in contingent consideration liabilities through payment of $0.7 million in cash and vesting of 0.5 million shares of restricted stock valued at $1.9 million.

The following table provides quantitative information regarding Level 3 inputs used in the fair value measurements of contingent consideration liabilities as of the periods presented:

Contingent Consideration Liability	Valuation Technique	Unobservable Input	December 31, 2023 Range	December 31, 2022 Range
Earnout payments (FGen, Dutch DNA and Altar acquisitions) [1]	Probability-weighted present value	Probability of payment	10% - 100%	2% - 100%
		Discount rate	13.4 %	12.2% - 13.1%
Earnout payments (Dutch DNA acquisition) [1]	Discounted cash flow	Projected years of payments	2025-2028	2025-2028
		Discount rate	10.3 %	12.0 %

(1) For FGen and Altar acquisitions, see Note 3. In July 2021, the Company acquired Dutch DNA Biotech B.V. ("Dutch DNA") and is obligated to make contingent earnout payments up to a maximum of $20.0 million, payable upon the achievement of certain technical and commercial milestones by Dutch DNA, as outlined in a Technical Development Agreement executed between the Company and Dutch DNA prior to the close of the acquisition.

The following table provides a reconciliation of the contingent consideration liability measured at fair value using Level 3 significant unobservable inputs (in thousands):

	2023	2022
Balance at January 1	$ 24,473	$ 8,467
Additions	1,397	19,912
Change in fair value	9,168	(1,262)
Settlements and payments	(10,765)	(2,644)
Balance at December 31,	$ 24,273	$ 24,473

Nonrecurring Fair Value Measurements

The Company measures the fair value of certain assets, including investments in privately held companies without readily determinable fair values, on a nonrecurring basis when events or changes in circumstances indicate that the carrying amount of the assets may not be recoverable and when there are observable price changes for the identical or similar security of the same issuer. The fair value of non-marketable equity securities is classified within Level 3 of the fair value hierarchy when the Company estimates fair value using unobservable inputs. It is classified within Level 2 when the estimate is based on an observable transaction price paid by third-party investors for the identical or similar security of the same issuer.

Investment Impairments

During the years ended December 31, 2023 and 2022, the Company recorded impairment charges of $33.0 million and $10.1 million, respectively, related to its investment in Genomatica preferred stock. The fair value estimates used to determine the impairment charges in 2023 were derived using the guideline public company method under the market approach, while an enterprise value analysis was performed in 2022, with an equal weighting between discounted cash flow analyses and the guideline public company method. Significant unobservable (Level 3) inputs included estimated annual net cash flows (including revenue and expense growth rates and capitalization rates), the weighted-average cost of capital used to discount future cash flows, and the selection of guideline public company multiples for revenue and EBITDA. Material increases or decreases in these inputs could result in higher or lower fair value measurements.

During the year ended December 31, 2023, the Company recorded an $8.3 million impairment loss related to a non-marketable equity security. The fair value measurement was determined by deriving an equity value of the investee from a recent financing transaction in the investee's own securities, which occurred in September 2021, and applying a downward market adjustment of 87% to the implied equity value. The equity value was then allocated to the different classes of the securities of the investee using the option-pricing model ("OPM"). The OPM involves making assumptions around the investees' expected time to liquidity and volatility derived from selected guideline public companies. These assumptions are considered Level 3 inputs.

During the year ended December 31, 2023, the Company recorded a $1.8 million impairment loss related to a SAFE to write-down its carrying amount to its estimated fair value. The fair value measurement of the impairment loss was determined using the scenario-based method, whereby dissolution scenarios with partial recovery and no recovery were probability weighted 15% and 85%, respectively, and discounted to present value using a discount rate of 14%.

SAFEs

During the years ended December 31, 2023 and 2022, the Company received a total purchase amount of $11.0 million and $39.5 million, respectively, in SAFEs from customers as prepayment for Cell Engineering services. The Company used a scenario-based method to value the SAFEs as of each contract inception date, which resulted in total fair value of $4.5 million and $22.1 million for SAFEs received during the years ended December 31, 2023 and 2022, respectively. Under the scenario-based method, future cash flows are evaluated under qualified financing and dissolution scenarios with partial recovery and no recovery in dissolution. The cash flows under each scenario are probability-weighted and discounted to present value. The significant unobservable (Level 3) inputs used in the fair value measurement at contract inception during 2023 were scenario probabilities of between 20% and 60%, discount rate of 14% and estimated time to event date of one to two years. The significant unobservable (Level 3) inputs used in the fair value measurement at contract inception during 2022 were scenario probabilities of between 18% and 65%, discount rate of 13% and estimated time to event date of one to two years.

Additionally, the Company recorded impairments of lab equipment and assets related to an operating lease. Refer to Note 10 for additional detail.

5. Investments and Equity Method Investments

The Company partners with other investors to form business ventures, including Motif FoodWorks, Inc. ("Motif"), Allonnia, LLC ("Allonnia"), Arcaea, LLC ("Arcaea"), Verb Biotics, LLC ("Verb"), BiomEdit, LLC ("BiomEdit") and Ayana Bio, LLC ("Ayana") (collectively "Platform Ventures"). The Company also partners with existing entities, including Genomatica, Inc. ("Genomatica") and Synlogic, Inc. ("Synlogic") (collectively, "Legacy Structured Partnerships") with complementary assets for high potential synthetic biology applications. The Company holds equity interests in these Platform Ventures and Legacy Structured Partnerships. The Company also holds equity interests in other public and private companies as a result of entering into collaboration and license revenue arrangements with these entities.

The Company accounts for its investments in Platform Ventures under the equity method. The Company's marketable equity securities consist of Synlogic common stock, Synlogic warrants and the shares of common stock of other publicly traded companies. Marketable equity securities are measured at fair value with changes in fair value recorded in other (expense) income in the consolidated statements of operations and comprehensive loss. The Company's non-marketable equity securities consist of preferred stock of Genomatica and preferred and common stock of other privately held companies without readily determinable fair values. Non-marketable equity securities are initially recorded using the measurement alternative at cost and subsequently adjusted for any impairment and observable price changes in orderly transactions for the identical or a similar security of the same issuer. Impairment losses and adjustments from observable price changes are recorded in loss on investments in the consolidated statements of operations and comprehensive loss.

The Company also holds investments in early-stage synthetic biology product companies via SAFEs. The Company enters into SAFE agreements in conjunction with a revenue contract with a customer under which the Company grants the customer a prepaid Cell Engineering services credit equal to the principal amount of the SAFE (the "Purchase Amount"), which may be used and drawn down as payment for the Company's research and development services. The SAFEs will automatically convert into shares of preferred stock equal to the Purchase Amount divided by the discount price, which is calculated as the price per share sold in a qualified equity financing multiplied by a discount rate. The SAFEs also provide the Company with the right to future equity of the entity in a liquidation scenario or the cash-out amount in liquidation and

dissolution scenarios or at the election of the SAFE issuer prior to an agreed outside date. The Company initially records SAFEs at fair value (see Note 4) and adjusts the carrying amount of the instrument at each reporting period for any impairments.

Investments and equity method investments consisted of the following (in thousands):

	As of December 31,	
	2023	2022
Investments:		
SAFEs	$ 23,898	$ 22,108
Non-marketable equity securities	22,938	17,544
Marketable equity securities	17,563	20,895
Genomatica preferred stock	11,885	44,885
Synlogic common stock	1,627	4,819
Synlogic warrants	654	1,937
Total	$ 78,565	$ 112,188
Equity method investments [(1)]:		
BiomEdit	$ —	$ 369
Other	—	1,174
Total	$ —	$ 1,543

(1) Equity method investments in Platform Ventures with a carrying value of zero as of December 31, 2023 and 2022 were excluded from the table.

Loss on investments and equity method investments consisted of the following (in thousands):

	Year Ended December 31,		
	2023	2022	2021
(Loss) gain on investments:			
Genomatica	$ (33,000)	$ (10,115)	$ —
Non-marketable equity securities	(9,928)	(195)	—
Marketable equity securities	(4,682)	(28,269)	(13,854)
Synlogic common stock	(3,192)	(10,526)	1,649
SAFEs	(2,742)	—	—
Synlogic warrants	(1,283)	(4,230)	662
Total	$ (54,827)	$ (53,335)	$ (11,543)
Loss on equity method investments:			
BiomEdit	$ (1,461)	$ (8,503)	$ —
Joyn Bio [(1)]	—	(3,043)	(17,230)
Allonnia	—	—	(12,698)
Arcaea	—	—	(47,356)
Verb Biotics	—	(15,900)	—
Ayana	—	(15,989)	—
Other	(1,174)	(326)	—
Total	$ (2,635)	$ (43,761)	$ (77,284)

(1) The loss on equity method investment in Joyn Bio for the year ended December 31, 2022 is comprised of a $17.0 million loss offset by a $14.0 gain on the remeasurement of the retained equity interest in Joyn Bio at fair value as of the acquisition date (see Note 3). The loss on equity method investment in excess over the carrying value of zero of the equity method investment in Joyn Bio during

the year ended December 31, 2022 was recorded as a reduction in the convertible promissory notes receivable from Joyn Bio (see Note 20).

The components of loss on investments for each period were as follows (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Impairment charges	$ (44,043)	$ (10,310)	$ —
Ongoing mark-to-market adjustments on marketable equity securities	(9,157)	(43,025)	(11,543)
Downward adjustments from observable price changes	(1,627)	—	—
Total loss on investments	$ (54,827)	$ (53,335)	$ (11,543)

The carrying value for non-marketable equity securities accounted for using the fair value measurement alternative and held as of December 31, 2023, including cumulative unrealized losses, were as follows (in thousands):

	As of December 31, 2023
Total initial cost	$ 114,701
Impairment charges	(54,353)
Downward adjustments from observable price changes	(1,627)
Carrying value	$ 58,721

6. Variable Interest Entities

Consolidated Variable Interest Entities

As of December 31, 2023 and 2022, the Company consolidated Cooksonia, LLC ("Cooksonia"), a variable interest entity ("VIE"), as the Company holds a variable interest in and is deemed the primary beneficiary of the VIE. The Company initially held a 70% equity interest in Cooksonia, which was formed by the Company and certain other investors for the purposes of holding the Company's investment in Joyn Bio. The Company concluded that it held a variable interest in and was the primary beneficiary of Cooksonia as it controlled the most significant activities of Cooksonia by controlling 100% of the board of directors of Cooksonia and held a controlling financial interest in Cooksonia. In 2022, in conjunction with the termination of the Joyn Bio joint venture (see Note 3), the Company acquired the remaining 30% non-controlling interest in Cooksonia. The acquisition of the non-controlling interest did not result in a change of control, accordingly, the Company accounted for the acquisition as an equity transaction with no gain or loss recognized in the consolidated statements of operations and comprehensive loss. The carrying amount of the non-controlling interest in Cooksonia was adjusted to zero and Cooksonia became a wholly owned subsidiary of the Company as of December 31, 2022.

2022 Deconsolidation

The Company holds an interest in 9.0 million common units (representing 100% of common units at inception) in each of Ayana and Verb, two Platform Ventures formed in September 2021 by the Company and certain of its investors. The Company has agreed to provide Ayana and Verb with certain licenses to intellectual property for use in the development or production of products that the parties agree to research and develop under technical development plans ("TDPs"). Additionally, in September 2021, Ayana and Verb entered into a Series A Preferred Unit Purchase Agreement under which each entity sold 9.0 million Series A preferred units to certain of the Company's investors for aggregate proceeds of approximately $30.0 million each. During 2021, the Company concluded that it held a variable interest in and was the primary beneficiary of Ayana and Verb as it controlled the most significant activities of these entities. These conclusions were reached because, as of the primary beneficiary assessment dates in 2021, for both Verb and Ayana: (i) the Company had substantive control of the board of directors; (ii) all capital contributions were made by related parties of Ginkgo; and (iii) Ginkgo or its related parties comprised the entirety of the joint steering committee ("JSC"), the governing body which holds significant oversight with respect to the entities' research and development programs.

During 2022, Verb and Ayana each hired a new chief executive officer who was not an affiliate, related party or agent of Ginkgo. The chief executive officer was also appointed to each entity's JSC and board of directors. As a result, the

Company concluded it no longer had substantive control of each entity's JSC and board of directors. Accordingly, the Company concluded that it was no longer the primary beneficiary of Verb and Ayana as it no longer controlled the most significant activities of the entities. As a result of this change in the primary beneficiary determination, the Company deconsolidated Verb in the first quarter of 2022 and Ayana in the third quarter of 2022 and recorded a gain on deconsolidation of $31.9 million for the year ended December 31, 2022 in the consolidated statements of operations and comprehensive loss. The gain on deconsolidation was equal to the fair value of the retained interest in each entity as of the deconsolidation date and was calculated using the option pricing method. The option pricing method used a back-solve methodology to infer the total equity value based on the pricing of the Series A preferred unit financing, which is the most recent financing transaction to the deconsolidation event.

The JSC, with equal representation from each of Verb or Ayana and Ginkgo, governs the TDPs under which the Company will perform agreed-upon research and development services in return for consideration on a cost-plus basis for all services provided. Ginkgo has agreed to provide Verb and Ayana with licenses to certain of its intellectual property for use in the development, production and commercialization of each entity's products under the TDPs. The Company's common unit investment in Verb and Ayana is accounted for as an equity method investment, and accordingly, Verb and Ayana are related parties of Ginkgo. The initial carrying value of the equity method investment was equal to the fair value of the retained interest of $15.9 million for Verb and $16.0 million for Ayana as of the applicable deconsolidation date. The Series A preferred units issued by Verb and Ayana receive a liquidation preference prior to common units. As such, the Company concluded that this represents a substantive profit-sharing arrangement and the Company is recognizing earnings and losses on the equity method investment using the HLBV method. The Company recorded a loss on its equity method investment in Verb and Ayana of $31.9 million in the year ended December 31, 2022, due to a basis difference associated with in-process research and development identified as part of the initial accounting for the equity method investment. This loss reduced the carrying value of the equity method investment in each of Verb and Ayana to zero. There is no commitment for the Company to provide further financial support to Verb and Ayana, and therefore the carrying value of the equity method investment will not be reduced below zero.

Unconsolidated Variable Interest Entities

With respect to the Company’s investments in Motif, Allonnia, Genomatica, Arcaea, BiomEdit, Verb and Ayana (subsequent to the deconsolidation of Verb and Ayana) (collectively, the “Unconsolidated VIEs”), the Company has concluded these entities represent VIEs. However, although the Company may have board representation and is involved in the ongoing development activities of the entities via its participation on the JSC, the Company has concluded that it is not the primary beneficiary of these entities. This conclusion is supported by the fact that: (i) the Company does not control the board of directors of any of the Unconsolidated VIEs, and no voting or consent agreements exist between the Company and other members of each respective board of directors or other investors, (ii) the holders of preferred security interests in the Unconsolidated VIEs hold certain rights that require their consent prior to taking certain actions, which include certain significant operating and financing decisions, and (iii) the Company’s representation on the JSC of each respective entity does not give it control over the development activities of any of the Unconsolidated VIEs, as all JSC decisions are made by consensus and there are no agreements in place that would require any of the entities to vote in alignment with the Company. As the Company’s involvement in the Unconsolidated VIEs does not give it the power to control the decisions with respect to their development or other activities, which are their most significant activities, the Company has concluded that it is not the primary beneficiary of the Unconsolidated VIEs.

With respect to Cooksonia’s investment in Joyn Bio prior to the joint venture’s termination on October 17, 2022 (see Note 3), as Cooksonia did not control Joyn Bio’s board of directors, it did not have the power to control the decisions related to the development activities of Joyn Bio, which were its most significant activities. Accordingly, the Company has concluded that Cooksonia was not the primary beneficiary of Joyn Bio. The Company provided $10.0 million in financial support to Joyn Bio during the year ended December 31, 2022 in the form of convertible promissory notes (see Note 20), which were deemed necessary to fund Joyn Bio’s operations pre-dissolution. Joyn Bio was fully dissolved in the third quarter of 2023.

Additionally, the Company holds equity interests in certain privately-held companies that are not consolidated as the Company is not the primary beneficiary. As of December 31, 2023 and 2022, the maximum risk of loss related to the Company’s unconsolidated VIEs was limited to the carrying value of its investments in such entities.

Refer to Notes 5 and 16 for additional details on the Company’s investments and equity method investments.

7. Goodwill and Intangible Assets, net

All goodwill is allocated to the Cell Engineering reporting unit and segment identified in Note 15. Changes in the carrying amount of goodwill consisted of the following (in thousands):

	As of December 31,	
	2023	2022
Beginning balance	$ 60,210	$ 21,312
Goodwill acquired in acquisitions	—	39,712
Deconsolidation of Zymergen	(10,660)	—
Measurement period adjustments [1]	(2,120)	(548)
Impact of foreign currency translation	1,808	(266)
Ending balance	$ 49,238	$ 60,210

(1) For the year ended December 31, 2023, the measurement period adjustment is primarily related to the Zymergen acquisition. See Note 3 for a description.

Intangible assets, net consisted of the following (in thousands):

	Gross Carrying Value [1]	Accumulated Amortization [1]	Net Carrying Value	Weighted Average Amortization Period (in years)
December 31, 2023				
Developed technology [2]	$ 105,279	$ (22,663)	$ 82,616	8.8
Customer relationships	380	(261)	119	0.9
Assembled workforce	190	(184)	6	0.3
Total intangible assets	$ 105,849	$ (23,108)	$ 82,741	
December 31, 2022				
Developed technology	$ 115,824	$ (8,825)	$ 106,999	9.4
Database	3,700	(107)	3,593	6.8
Customer relationships	380	(71)	309	1.6
Assembled workforce	190	(50)	140	1.0
Total intangible assets	$ 120,094	$ (9,053)	$ 111,041	

(1) Gross carrying value and accumulated amortization include the impact of cumulative foreign currency translation adjustments.

(2) During 2023, the Company deconsolidated $13.5 million of developed technology and $3.2 million of database intangible assets related to the deconsolidation of Zymergen (see Note 3).

Amortization expense was $15.7 million, $5.6 million and $1.2 million for the years ended December 31, 2023, 2022 and 2021, respectively. The estimated future amortization expense for intangible assets remaining as of December 31, 2023 is as follows (in thousands):

2024	$ 13,747
2025	13,623
2026	13,623
2027	10,548
2028	3,442
Thereafter	27,758
Total	$ 82,741

8. Leases

The Company leases real estate for office and lab space as well as equipment used in research and development activities under operating and finance leases.

The Company's real estate leases have initial lease terms ranging from 24 months to 14.4 years and are all classified as operating. Real estate leases may contain periods of free rent, tenant improvement incentives, expansion options, rent escalation clauses at pre-determined rates or at the prevailing market rates at the time of the increase, and options to extend or terminate the lease without cause at the option of either party during the lease term. The Company is not reasonably certain to exercise these options at the commencement of the lease. Equipment leases have initial lease terms ranging from 36 to 60 months and are classified as operating or finance if the lease contains bargain purchase options which the Company is reasonably certain to exercise.

Variable lease cost for real estate leases primarily consists of certain non-lease components such as real estate taxes, insurance and common area maintenance charges. These non-lease components are typically variable in nature and are recognized as lease expense in the period in which they arise. None of the Company's lease agreements contain material restrictive covenants or residual value guarantees.

In September 2023, Zymergen ceased the use of and exited a leased facility consisting of approximately 300,000 square feet of office and laboratory space in Emeryville, California. The facility was used pursuant to an operating lease with a minimum term expiring in August 2033. Zymergen's ceasing to use the space resulted in an impairment loss of $96.2 million, including $36.6 million for the right-of-use asset and $59.6 million for the related leasehold improvements. The impairment loss represents the amount by which the carrying value of the assets exceed their estimated fair values, as determined using a discounted cash flow model under the income approach. The fair value measurements are based on significant inputs not observable in the market and therefore represent Level 3 fair value measurements. The key inputs used in the valuation were estimated sublease rental income and a discount rate of 8.5%. The impairments are presented as impairment of lease assets in the consolidated statement of operations and comprehensive loss for the year ended December 31, 2023.

The following table presents the components of total lease cost (in thousands):

	Year Ended December 31,	
	2023	2022
Operating lease cost	$ 59,588	$ 35,242
Finance lease cost:		
Amortization of ROU assets	1,047	1,871
Interest on lease liabilities	79	104
Finance lease cost	1,126	1,975
Variable lease cost	15,862	8,879
Sublease income	(11,170)	(5,190)
Total lease cost	$ 65,406	$ 40,906

Rent expense under operating leases was $17.7 million for the year ended December 31, 2021.

Supplemental cash flow information related to the Company's operating leases were as follows (in thousands):

	Year Ended December 31,	
	2023	2022
Cash paid for amounts included in the measurement of lease liabilities:		
Operating cash flows from operating leases	$ 44,051	$ 13,587
Operating cash flows from finance leases	83	92
Financing cash flows from finance leases	1,295	1,237

Supplemental balance sheet information related to operating leases were as follows:

	As of December 31,	
	2023	2022
Weighted average remaining lease term - operating leases (in years)	10.1	10.3
Weighted average remaining lease term - finance leases (in years)	1.5	2.3
Weighted average discount rate - operating leases	7.1 %	8.1 %
Weighted average discount rate - finance leases	3.7 %	3.7 %

The following table summarizes the maturity of the Company's lease liabilities (in thousands):

Years Ending December 31,	Operating leases	Finance leases
2024	$ 43,566	$ 1,082
2025	45,216	455
2026	39,400	20
2027	39,356	—
2028	40,592	—
Thereafter	222,910	—
Total undiscounted payments	431,040	1,557
Less: imputed interest	(190,327)	(21)
Total lease liability	240,713	1,536
Less: current portion of lease liability	(18,878)	(1,055)
Lease liabilities, non-current	$ 221,835	$ 481

In addition to the lease liabilities in the table above, as of December 31, 2023, the Company had $396.5 million of undiscounted commitments related to an operating real estate lease that was signed but not yet commenced. The lease is expected to commence in 2024 and has a lease term of 15 years.

The Company subleases a portion of its office and lab space to certain of its equity method investees, which are considered related parties. These lease agreements generally have lease terms of up to 5 years and may include renewal options. Related party sublease income for the years ended December 31, 2023, 2022 and 2021 was $2.1 million, $3.5 million and $1.1 million, respectively, included within other income (expense), net in the consolidated statements of operations and comprehensive loss.

9. Warrant Liabilities

Upon the closing of the SRNG Business Combination, the Company assumed 34.5 million publicly-traded warrants ("Public Warrants") and 17.3 million private placement warrants (the "Private Placement Warrants") held by the Sponsor. Both the Public Warrants and the Private Placement Warrants were issued in conjunction with the consummation of SRNG's initial public offering on February 26, 2021. Each whole warrant entitles the holder to purchase one share of the Company's Class A common stock at a price of $11.50 per share, subject to adjustments. The warrants will expire five years from the completion of the SRNG Business Combination, or earlier upon redemption or liquidation.

No Public Warrants will be exercisable for cash unless the Company has an effective and current registration statement covering the issuance of the shares of common stock issuable upon exercise of the Public Warrants. On November 23, 2021, the Company's registration statement covering such shares became effective. The Company may redeem the outstanding Public Warrants:

- in whole and not in part
- at a price of $0.01 per Public Warrant;
- upon not less than 30 days' prior written notice of redemption to each warrant holder; and

- if, and only if, the reported closing price of the ordinary shares equals or exceeds $18.00 per share (as adjusted for share sub-divisions, share capitalizations, reorganizations, recapitalizations and the like) for any 20 trading days within a 30-trading day period ending three business days before the Company sends the notice of redemption to the warrant holders.

If the Company calls the Public Warrants for redemption, as described above, its management will have the option to require any holder that wishes to exercise the Public Warrants to do so on a "cashless basis," as described in the warrant agreement. The exercise price and number of ordinary shares issuable upon exercise of the Public Warrants may be adjusted in certain circumstances including in the event of a share dividend, extraordinary dividend or recapitalization, reorganization, merger or consolidation. However, except as described above, the Public Warrants will not be adjusted for issuances of ordinary shares at a price below its exercise price. Additionally, in no event will the Company be required to net cash settle the Public Warrants.

The Private Placement Warrants are identical to the Public Warrants, except that (i) the Private Placement Warrants will be exercisable on a cashless basis and be non-redeemable so long as they are held by the initial purchasers or their permitted transferees and (ii) the Private Placement Warrants and the Class A ordinary shares issuable upon exercise of the Private Placement Warrants were entitled to registration rights, which was satisfied on November 23, 2021 when the Company's registration statement covering such shares became effective. If the Private Placement Warrants are held by someone other than the initial purchasers or their permitted transferees, the Private Placement Warrants will be redeemable by the Company and exercisable by such holders on the same basis as the Public Warrants.

As of December 31, 2023, the aggregate value of the Public Warrants and the Private Placement Warrants was $3.8 million and $1.9 million, respectively, representing warrants outstanding to purchase 34.5 million shares and 17.3 million shares, respectively, of the Company's Class A common stock. The warrants are accounted for as liabilities in accordance with ASC 815-40 and are presented within warrant liabilities on the consolidated balance sheet. The warrant liabilities are measured at fair value at inception and on a recurring basis, with changes in fair value presented within change in fair value of warrant liabilities in the consolidated statements of operations and comprehensive loss. See Note 4 for additional information.

10. Supplemental Information

Cash, Cash Equivalents and Restricted Cash

The reconciliation of cash, cash equivalents and restricted cash reported within the consolidated balance sheet to the totals shown within the consolidated statements of cash flows is as follows (in thousands):

	2023	2022	2021
Cash and cash equivalents	$ 944,073	$ 1,315,792	$ 1,550,004
Restricted cash included in prepaid expenses and other current assets [1]	4,789	8,221	—
Restricted cash included in other non-current assets [1]	40,722	45,568	42,924
Total cash, cash equivalents and restricted cash	$ 989,584	$ 1,369,581	$ 1,592,928

(1) Includes cash balances collateralizing letters of credit associated with the Company's facility leases and a customer prepayment requiring segregation and restrictions in its use in accordance with the customer agreement.

Prepaid Expenses and Other Current Assets

Prepaid expenses and other current assets consisted of the following (in thousands):

	As of December 31,	
	2023	2022
Notes receivable (Note 4)	$ 12,293	$ —
Prepaid expenses	10,360	18,145
Prepaid insurance and insurance recoveries	10,063	16,960
Restricted cash	4,789	8,221
Other receivables	1,546	1,561
Security deposits	318	2,084
Inventory	46	4,364
Other current assets	362	487
Prepaid expenses and other current assets	$ 39,777	$ 51,822

Property, Plant and Equipment, net

Property, plant and equipment, net consisted of the following (in thousands):

	As of December 31,	
	2023	2022
Lab equipment	$ 147,185	$ 183,292
Leasehold improvements	71,564	125,307
Buildings and facilities	47,034	46,019
Construction in progress	15,830	23,426
Computer equipment and software	14,780	15,219
Furniture and fixtures	6,458	8,206
Land	6,060	6,060
Total property, plant, and equipment	308,911	407,529
Less: Accumulated depreciation and amortization	(120,718)	(92,756)
Property, plant, and equipment, net	$ 188,193	$ 314,773

Depreciation and amortization expense for the years ended December 31, 2023, 2022 and 2021 totaled $54.8 million, $36.9 million and $26.9 million, respectively.

During the year ended December 31, 2023, the Company identified excess lab equipment at two of its facilities whereby the assets were sold, classified as held for sale or otherwise impaired, resulting in aggregate impairment losses of $25.2 million, included in general and administrative expense in the consolidated statement of operations and comprehensive loss.

Other Non-Current Assets

Other non-current assets consisted of the following (in thousands):

	As of December 31,	
	2023	2022
Restricted cash	$ 40,722	$ 45,568
Notes receivable (Note 4)	13,601	37,660
Finance lease right-of-use assets, net	2,230	3,256
Other assets	1,502	2,241
Other non-current assets	$ 58,055	$ 88,725

Accrued Expenses and Other Current Liabilities

Accrued expenses and other current liabilities consisted of the following (in thousands):

	As of December 31,	
	2023	2022
Professional fees and securities litigation costs	$ 27,884	$ 12,178
Operating lease liabilities	18,878	28,032
Contingent consideration liability	18,468	6,378
Employee compensation and benefits	15,678	19,441
Deferred other income	4,009	—
Biosecurity costs	3,564	15,401
External research and development expenses	2,739	1,844
Property and equipment	2,667	11,624
Finance lease liabilities	1,055	1,300
Lab supplies	861	3,434
Other current liabilities	14,248	15,062
Accrued expenses and other current liabilities	$ 110,051	$ 114,694

Supplemental cash flow information

The following table presents supplemental cash flow information for each reporting period (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Cash paid for interest	$ 83	$ 92	$ 2,370
Cash paid for income taxes	670	—	61
Non-cash investing and financing activities:			
ROU assets obtained in exchange for new operating lease liabilities upon adoption of ASC 842	$ —	$ 147,744	$ —
ROU assets obtained in exchange for new finance lease liabilities upon adoption of ASC 842	—	3,397	—
ROU assets obtained in exchange for new operating lease liabilities	27,668	79,984	—
ROU assets obtained in exchange for new finance lease liabilities	—	1,729	—
Purchase of minority interest in Cooksonia	—	7,390	—
Purchases of equipment through capital leases	—	—	1,981
Lease financing obligation for build-to-suit lease	—	—	6,120
Purchases of property and equipment included in accounts payable and accrued expenses	2,915	12,881	1,815
Equity received in related parties	—	8,873	61,554
Convertible financial instruments received for Cell Engineering services	4,542	29,074	—
Equity securities and warrants received for Cell Engineering services	17,450	3,423	10,000
Conversion of convertible promissory notes to preferred stock	—	—	195
Non-cash consideration paid for the acquisition of Zymergen	—	231,750	—
Common stock issued for acquisitions	6,820	40,382	15,087
Acquisition date fair value of contingent consideration liability	—	19,912	8,760
Acquisition date fair value of warrant liabilities	—	—	194,453
Settlement of contingent consideration liability	8,896	—	—
Equity issuance costs in accounts payable and accrued expenses	—	578	—

11. Commitments and Contingencies

Purchase Obligations

On August 29, 2023, the Company entered into a five-year strategic cloud and artificial intelligence ("AI") partnership with Google Cloud, intended to enable the Company to develop and deploy AI tools for biology and biosecurity. The partnership includes minimum annual commitments to purchase cloud hosting services in exchange for various discounts on such services. The minimum annual commitments are as follows: year 1, $8.0 million; year 2, $28.0 million; year 3, $54.0 million; year 4, $86.0 million; and year 5, $113.0 million. The minimum commitments may be terminated by the Company upon payment of a cancellation fee representing a percentage of the remaining purchase commitment. The Company also entered into an agreement pursuant to which Google Cloud will provide up to $56.3 million in cash funding upon the Company's achievement of certain milestones, which are expected over the next three years. The costs of Google Cloud services are recorded as research and development expenses as incurred in the accompanying consolidated statements of operations and comprehensive loss. Milestone payments received are recognized as a reduction of the associated Google Cloud services costs within research and development expenses when achieved. The first two milestones are initially recognized as liabilities until they become non-refundable upon the Company's achievement of a certain milestone. As of December 31, 2023, the remaining aggregate commitment was $286.1 million.

On March 31, 2022, the Company entered into a four-year supply agreement with Twist for the purchase of diverse products including synthetic DNA. The agreement is effective as of April 1, 2022 and obligates the Company to spend a minimum of $58.0 million over the four-year term with the following minimum annual commitments (each annual year is

defined as April 1 to March 31): year 1, $10.0 million; year 2, $13.0 million; year 3, $16.0 million; and year 4, $19.0 million.

Contingent Consideration Related to Asset Acquisitions

On April 5, 2023, the Company entered into an Asset Purchase Agreement ("APA") with StrideBio to acquire StrideBio's adeno-associated virus capsid discovery and engineering platform assets, with a secondary closing contingent upon the transfer of certain additional in-license agreements to Ginkgo. The secondary closing was finalized in October 2023. The Company accounted for the transaction as an asset acquisition as substantially all of the fair value of the assets acquired was concentrated in a single identifiable asset. The fair value of the consideration transferred totaled $7.6 million and consisted of 4.8 million shares of Ginkgo's Class A common stock valued at $6.8 million and a $0.8 million contingent holdback, all of which was expensed as in-process research and development during the year ended December 31, 2023. The APA, as amended, also provides for royalty payments of up to $21.3 million payable in cash or shares of Class A common stock at the Company's election until the earlier of the tenth anniversary date of the initial closing and the date on which the aggregate amount of the royalty payments equals the amount cap. The royalties are calculated based on 10% of the net licensing revenue and 40% of all consideration received for a license or sale of a product incorporating the acquired platform assets. No amounts for the royalty payments have been recorded during the year ended December 31, 2023.

The Company routinely acquires rights to intellectual property that may provide for payment of future contingent consideration, including royalties, should revenue be generated from the use of such.

Legal Proceedings

From time to time, the Company may in the ordinary course of business be named as a defendant in lawsuits, indemnity claims and other legal proceedings. The Company accrues for a loss contingency when it concludes that the likelihood of a loss is probable and the amount of loss can be reasonably estimated. The Company adjusts its accruals from time to time as it receives additional information. The Company does not believe any pending litigation to be material, or that the outcome of any such pending litigation, in management's judgment based on information currently available, would have a material adverse effect on the Company's results of operations, cash flows or financial condition.

Indemnification Agreements

The Company enters into standard indemnification agreements and has agreements with indemnification clauses in the ordinary course of business. Under such arrangements, the Company indemnifies, holds harmless and agrees to reimburse the indemnified party for losses suffered or incurred by the indemnified party, who are generally the Company's business partners. The terms of these indemnification arrangements are generally perpetual and effective any time after contract execution. The maximum potential liability resulting from these indemnification arrangements may be unlimited. The Company has never incurred costs to defend lawsuits or settle claims as a result of such indemnifications and the Company is not aware of any indemnification arrangements that could have a material effect on its financial position, results of operations or cash flows, and it has not accrued any liabilities related to such obligations as of December 31, 2023.

Registration Rights

In connection with the closing of the SRNG Business Combination, the Company entered into an amended and restated registration rights agreement (the "Registration Rights Agreement") among the Company, SRNG and certain Old Ginkgo stockholders. Pursuant to the Registration Rights Agreement, the Company will be required to register for resale securities held by the stockholders. The Company will have no obligation to facilitate more than two demands per calendar year for each of the SRNG or the Ginkgo Holders (as defined in the Registration Rights Agreement) that the Company register such stockholders' securities. In addition, the holders have certain "piggyback" registration rights with respect to registrations initiated by the Company. The Company will bear the expenses incurred in connection with the filing of any registration statements pursuant to the Registration Rights Agreement.

12. Stockholders' Equity

Capitalization

The following table presents the Company's authorized, issued, and outstanding common stock as of the dates indicated (in thousands):

	Authorized	Issued	Outstanding
Common stock as of December 31, 2023			
Class A	10,500,000	1,639,885	1,525,058
Class B	4,500,000	379,108	356,257
Class C	800,000	120,000	120,000
	15,800,000	2,138,993	2,001,315
Common stock as of December 31, 2022			
Class A	10,500,000	1,448,235	1,337,499
Class B	4,500,000	383,649	354,477
Class C	800,000	200,000	200,000
	15,800,000	2,031,884	1,891,976

Shelf Registration Statement

On October 4, 2022, the Company filed with the Securities and Exchange Commission ("SEC") a shelf registration statement on Form S-3 (File No. 333-267743), which was declared effective on October 14, 2022. Under the shelf registration, the Company may offer and sell from time to time, in one or more series or issuances and on terms determined at the time of the offering, any combination of its Class A common stock, preferred stock, warrants and/or units up to an aggregate amount of $500 million. As of December 31, 2023, approximately $400 million remain available under the shelf registration.

Underwritten Public Offering

On November 15, 2022, the Company entered into an underwriting agreement (the "Underwriting Agreement") with BTIG, LLC (the "Underwriter"), pursuant to which the Company agreed to issue and sell to the Underwriter an aggregate of 41.4 million shares at a public offering price of $2.4164 per share, representing an underwriting discount of 9%. Under the terms of the Underwriting Agreement, the Company granted the Underwriter an option exercisable for 30 days to purchase up to an additional 6.2 million shares of its Class A common stock, which expired unexercised. The shares were sold pursuant to an effective shelf registration statement on Form S-3 (File No. 333-267743) and a related prospectus supplement filed with the SEC. The net proceeds to the Company from the offering was approximately $98.9 million, after deducting estimated offering expenses. The Company intends to use the net proceeds of this offering to offset the cash used to finance the acquisition of certain of the assets and liabilities of Bayer and for other general corporate purposes.

Preferred Stock

The Company is authorized to issue 200.0 million shares of preferred stock with a par value $0.0001 per share. The Company's board of directors are authorized, without stockholder approval, to issue such shares of preferred stock in one or more series, to establish from time to time the number of shares to be included in each such series, and to fix the designations, powers, voting, and other rights, preferences and privileges of the shares. There were no issued and outstanding shares of preferred stock as of December 31, 2023.

Common Stock

The Company is authorized to issue 15,800.0 million shares of common stock, including 10,500.0 million shares of Class A common stock, par value $0.0001 per share, 4,500.0 million shares of Class B common stock, par value $0.0001 per share, and 800.0 million shares of Class C common stock, par value $0.0001 per share.

Voting

Holders of Class A common stock are entitled to one vote per share and holders of Class B common stock are entitled to ten votes per share. Holders of Class C common stock are not entitled to vote except as otherwise expressly provided in the certificate of incorporation or required by applicable law.

Dividends

Common stockholders are entitled to receive dividends, as may be declared by the board of directors. Different classes of common stock are legally entitled to equal per share distributions whether through dividends or liquidation. No dividends have been declared to date.

Conversion

Each share of Class B common stock is convertible at any time at the option of the holder into one share of Class A common stock. Generally, shares of Class B common stock will convert automatically into Class A common stock upon the holder ceasing to be an Eligible Holder (i.e., director, employee, trust or legal entity of Ginkgo), unless otherwise determined by affirmative vote of a majority of independent directors of Ginkgo.

Common Stock Reserved for Future Issuances

The Company had the following common stock reserved for future issuance as of the date indicated (in thousands):

	December 31, 2023
Shares available for grant under the 2021 Plan	183,048
Restricted stock units outstanding	152,168
Warrants to purchase Class A common stock	51,825
Shares available for grant under the ESPP	20,000
Shares available for grant under the 2022 Inducement Plan	8,805
Stock options issued and outstanding	7,688
Total common stock reserved for future issuances [(1)]	423,534

(1) Excludes unvested earnout shares which are restricted shares issued to equity holders of Old Ginkgo as part of the SRNG Business Combination (Note 3) and are recorded in equity as shares outstanding upon satisfying the vesting conditions.

13. Stock-Based Compensation

The following table summarizes stock-based compensation expense by financial statement line item in the Company's consolidated statements of operations and comprehensive loss for the periods presented (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Research and development	$ 145,879	$ 731,996	$ 926,730
General and administrative	84,005	1,198,645	755,835
Total	$ 229,884	$ 1,930,641	$ 1,682,565

2022 Inducement Plan

On October 16, 2022, the Company's Board of Directors adopted the Ginkgo Bioworks Holdings, Inc. 2022 Inducement Plan (the "2022 Inducement Plan"), which is a non-shareholder approved equity incentive plan adopted pursuant to the "inducement exception" provided under NYSE Listed Company Manual Section 303A.08. Pursuant to the terms of the 2022 Inducement Plan, the Company may grant nonstatutory stock options, stock appreciation rights, restricted stock units, restricted stock and other stock-based awards as an inducement material to individuals being hired or rehired following a bona fide period of interruption of employment, as an employee of the Company or any of its subsidiaries, including in connection with a merger or acquisition. The terms of the 2022 Inducement Plan are substantially similar to the terms of

the Company's 2021 Incentive Award Plan. The Company has reserved 25.0 million shares of the Company's common stock (which may be shares of Class A common stock or Class B common stock) for issuance under the 2022 Inducement Plan. As of December 31, 2023, 8.8 million shares are available for future issuance under the 2022 Inducement Plan.

2021 Incentive Award Plans

On September 16, 2021, the 2021 Incentive Award Plan (the "2021 Plan") became effective. The 2021 Plan provides for the grant of stock options, including incentive stock options ("ISOs") and nonqualified stock options, stock appreciation rights, restricted stock, dividend equivalents, RSUs and other stock or cash-based awards to employees, consultants and directors of Ginkgo and its subsidiaries.

The aggregate number of shares of common stock available for issuance under the 2021 Plan, which may be issued as Class A common stock and/or Class B common stock, was initially 200.4 million shares. As of December 31, 2023, 183.0 million shares are available for future issuance under the 2021 Plan. The number of shares of common stock reserved for issuance under the 2021 Plan will automatically increase for ten years on January 1 of each year in an amount equal to the lesser of (a) 4% of the aggregate number of shares of common stock outstanding on the final day of the immediately preceding calendar year and (b) such smaller number of shares as is determined by the Board. The maximum number of shares of common stock that may be issued pursuant to the exercise of incentive stock options granted under the 2021 Plan is 200 million shares. Shares issued under the 2021 Plan may consist of authorized but unissued shares, shares purchased on the open market or treasury shares.

2021 Employee Stock Purchase Plan

On September 16, 2021, the 2021 Employee Stock Purchase Plan (the "ESPP") became effective. The ESPP authorizes (i) the grant of options that are intended to qualify for favorable U.S. federal tax treatment under Section 423 of the Internal Revenue Code of 1986 (the "Section 423 Component") and (ii) the grant of options that are not intended to be tax-qualified (the "Non-Section 423 Component"). All of the Company's employees are expected to be eligible to participate in the ESPP. However, with respect to the Section 423 Component, an employee may not be granted rights to purchase stock under the ESPP if the employee, immediately after the grant, would own (directly or through attribution) stock possessing 5% or more of the total combined voting power or value of all classes of the Company's common stock.

The ESPP permits the Company to deliver up to 20 million shares of common stock pursuant to awards issued under the ESPP, which may be Class A common stock and/or Class B common stock. The number of shares of common stock reserved for issuance under the ESPP will automatically increase each January 1 by an amount equal to the lesser of (a) 1% of the aggregate number of shares of common stock outstanding on the final day of the immediately preceding calendar year and (b) such smaller number of shares as is determined by the Board, provided that no more than 100 million shares may be issued under the Section 423 Component. Prior to or in connection with issuing any shares of common stock under the ESPP, the ESPP administrator may convert awards covering shares of Class B common stock to Class A common stock. As of December 31, 2023, no awards have been granted under the ESPP.

2014 Stock Incentive Plan

The 2014 Stock Incentive Plan (the "2014 Plan") provided for the Company to grant options, stock appreciation rights, restricted stock, restricted stock units ("RSUs") and other stock-based awards. From and after the effective date of the 2021 Incentive Award Plan, the Company ceased granting awards under the 2014 Plan. However, the 2014 Plan continues to govern the terms and conditions of the outstanding awards previously granted thereunder. Shares of common stock underlying any awards that are forfeited, cancelled, repurchased, or otherwise terminated by the Company under the 2014 Plan will be added back to the shares available for issuance under the 2021 Incentive Award Plan.

2008 Stock Incentive Plan

The 2008 Stock Incentive Plan (the "2008 Plan") provided for the Company to grant options and restricted stock awards ("RSAs"). From and after the effective date of the 2014 Stock Incentive Plan, the Company ceased granting awards under the 2008 Plan. However, the 2008 Plan continues to govern the terms and conditions of the outstanding awards previously granted thereunder. Shares of common stock underlying any awards that are forfeited, cancelled, repurchased, or otherwise terminated by the Company under the 2008 Plan will be added back to the shares available for issuance under the 2021 Incentive Award Plan.

Stock Options

Options outstanding under the 2008 Plan and 2014 Plan are fully vested. Options outstanding under the 2021 Plan consist of awards granted to non-employee directors and are of two types: (i) initial awards granted to newly elected or appointed directors, which vest in three equal annual installments, and (ii) subsequent awards, which vest on the earlier of the first anniversary of the grant date or the day prior to the next annual shareholder meeting. All stock options expire no later than ten years after the grant date. The exercise price of each option under the 2021 Plan is equal to the closing price of the Company's common stock on the date of grant.

A summary of stock option activity for the year ended December 31, 2023 is presented below:

	Number of Shares (1)	Weighted Average Exercise Price per Share	Weighted Average Remaining Contractual Term	Aggregate Intrinsic Value (2)
	(in thousands)		(in years)	(in thousands)
Outstanding as of December 31, 2022	10,501	$ 0.34		
Granted	979	1.90		
Exercised	(5,431)	0.02		
Outstanding as of December 31, 2023	6,049	0.89	3.24	$ 6,810
Exercisable as of December 31, 2023	4,928	0.60	1.85	6,810

(1) Excludes 1.7 million shares underlying options issued outside the accounting for compensation awards under ASC 718.

(2) The aggregate intrinsic value is calculated as the difference between the Company's closing stock price on the last trading day of the year and the exercise prices, multiplied by the number of in-the-money stock options.

The aggregate intrinsic value of stock options exercised during the years ended December 31, 2023, 2022 and 2021 was $9.1 million, $21.5 million and $91.0 million, respectively. The weighted-average fair value of options granted during the years ended December 31, 2023, 2022, and 2021 was $1.43, $1.92 and $8.97 per share, respectively, and was calculated using the following key inputs in the Black-Scholes option-pricing model:

	Year Ended December 31,		
	2023	2022	2021
Risk-free interest rate	3.94%	3.13%	0.11%
Dividend yield	—%	—%	—%
Expected volatility	93.0%	76.9%	88.6%
Expected term	5.5 years	5.6 years	0.96 years

As of December 31, 2023, there was $0.9 million of unrecognized compensation expense related to stock options recognizable over a weighted-average period of 0.8 years.

Restricted Stock and Restricted Stock Units

RSAs granted under the 2014 Plan are subject to a service-based vesting condition and generally vest in equal monthly installments over four years. RSUs granted under the 2014 Plan are subject to two vesting conditions: (i) a service-based vesting condition that is generally met over four years with 25% of the shares vesting on the first anniversary of the grant date with monthly vesting thereafter, and (ii) a performance-based vesting condition that is met through a liquidity event in the form of either a change of control or an initial public offering ("the performance condition"). RSUs granted under the 2021 Plan are subject to a service-based vesting condition only that is generally met over four years with 25% of the shares vesting on the first anniversary of the grant date with monthly vesting thereafter.

Prior to the SRNG Business Combination, no stock-based compensation expense had been recognized related to RSUs granted under the 2014 Plan as the performance condition was not probable of being met and the SRNG Business Combination did not meet the definition of a liquidity event as defined in the 2014 Plan. As a result of the SRNG Business Combination, on November 17, 2021 ("Modification Date") the Board of Directors modified the vesting terms of RSUs

granted under the 2014 Plan to allow 10% of the RSUs that met the service condition as of the closing of the SRNG Business Combination (the "10% RSUs") to vest with respect to the performance condition, effective as of November 19, 2021, the date on which the Form S-8 registration statement covering such shares became effective. In addition, on November 17, 2021 the Board of Directors modified the vesting terms of the remaining RSUs granted under the 2014 Plan such that they will vest in full with respect to the performance condition on or before March 15, 2022 (the original service-based vesting condition is still applicable). As a result of these modifications, the performance condition for all RSUs granted under the 2014 Plan became probable of being met during the fourth quarter of 2021. As the performance condition was not probable of being met prior to the modification, the RSU awards were remeasured using the price of $13.59 per share as of the Modification Date pursuant to ASC 718 and the Company recorded a cumulative-catch up adjustment to reflect the change in the probability assessment. The modification resulted in approximately $1,492.2 million of incremental stock-based compensation expense recognized in the fourth quarter of 2021 based on the Modification Date fair value. The Company cash settled the 10% RSUs for a total cash payment of $76.5 million equal to the fair value of the stock on the Form S-8 effective date. Subsequent to the modification, compensation expense for the modified RSUs is recognized using an accelerated attribution method over the requisite service period for each employee award. The Company recognized $116.4 million and $1,678.4 million of compensation expense related to the modified RSUs in the years ended December 31, 2023 and 2022, respectively.

In September 2021, the Board of Directors modified the terms of RSUs granted to non-employee directors by adding a cash settlement feature to the awards which allowed the non-employee directors to elect to settle in cash up to 50% of their RSUs that were vested with respect to the service condition on or prior to December 31, 2021 (the "50% RSUs"). The director RSUs were subject to the same performance condition as all other RSUs granted under the 2014 Plan. In the fourth quarter of 2021, all directors elected to cash settle the 50% RSUs. As a result, the 50% RSUs were classified as liability awards and the liability was measured at fair value at each reporting date. In the first quarter of 2022, the Company cash settled the 50% RSUs, or approximately 3.2 million RSUs, for a total cash payment of $9.8 million.

A summary of the RSU and RSA activity for the year ended December 31, 2023 is presented below:

	Restricted Stock Units		Restricted Stock Awards	
	Number of Shares	Weighted Average Grant Date Fair Value	Number of Shares	Weighted Average Grant Date Fair Value
	(in thousands)		(in thousands)	
Nonvested as of December 31, 2022	134,437	$ 5.84	4	$ 1.99
Granted	103,811	1.39	—	—
Vested	(63,878)	5.72	(4)	1.99
Forfeited	(22,202)	3.79	—	—
Nonvested as of December 31, 2023	152,168	3.15	—	1.99

The weighted average grant date fair value of RSUs granted during the years ended December 31, 2023, 2022 and 2021 was $1.39, $3.19 and $13.53, respectively. The weighted average grant date fair value of RSUs granted during the year ended December 31, 2021 of $13.53 per share represents the weighted average of the Modification Date fair value and any post modification grant date fair values. No RSAs were granted during 2023, 2022, and 2021.

The aggregate fair value of the RSUs that vested during the years ended December 31, 2023, 2022 and 2021 was $365.3 million, $1,783.8 million and $1,149.5 million, respectively. The aggregate fair value of the RSAs that vested during the years ended December 31, 2023, 2022 and 2021 was de minimis, $0.4 million and $0.5 million, respectively.

As of December 31, 2023, there was $316.5 million of unrecognized compensation expense related to RSUs recognizable over a weighted-average period of 3.0 years.

Earnouts

As described in Note 3, the holders of Rollover Equity Awards outstanding immediately prior to the effective time of the SRNG Business Combination received a proportional amount of the Earnout Consideration, which is divided into four equal tranches subject to vesting during the five years after the Closing Date (the "Earnout Period"). The earnout shares in respect of the Rollover Equity Awards are subject to the same terms and conditions as the underlying Rollover Equity

Awards (including with respect to vesting and termination-related provisions). Additionally, the earnout shares in respect of the Rollover Equity Awards are subject to a market condition that will be met when the trading price of the Company's common stock is greater than or equal to $12.50, $15.00, $17.50 and $20.00 for any 20 trading days within any period of 30 consecutive trading days during the Earnout Period (collectively, the “Earnout Targets”). To the extent that the Earnout Targets are not achieved during the Earnout Period, the portion of the Earnout Consideration that remains subject to vesting and forfeiture at the end of the Earnout Period will be forfeited to Ginkgo for no consideration and cancelled.

As described above, the earnout shares related to Old Ginkgo RSUs (“Earnout RSUs”) are subject to the same performance condition as the underlying RSUs. As a result of the November 2021 modification to the RSUs described above, the performance condition became probable of being met in the fourth quarter of 2021. The modification resulted in approximately $173.5 million of incremental stock-based compensation expense recognized in the fourth quarter of 2021 related to the Earnout RSUs based on the Modification Date fair value. The first earnout target of $12.50 per share was met on November 15, 2021 and the earnout shares related to the first tranche of the Earnout Consideration for which the service condition had also been met became vested and were settled, less shares withheld to cover tax withholding obligations. The Company recognized $13.3 million and $193.3 million of compensation expense related to the modified Earnout RSUs in the years ended December 31, 2023 and 2022, respectively.

The grant date fair value of Earnout RSUs was estimated on the Closing Date and remeasured on the Modification Date using a Monte Carlo simulation model with the following assumptions:

	Year Ended December 31, 2021
Risk-free interest rate	0.84% - 1.21%
Expected volatility	53.1% - 81%
Expected term (in years)	4.83 - 5
Dividend yield	— %

A summary of activity during the year ended December 31, 2023 for the Earnout RSUs and the earnout shares underlying Old Ginkgo RSAs ("Earnout RSAs") is presented below:

	Number of Shares (in thousands)	Weighted Average Grant Date Fair Value
Nonvested as of December 31, 2022	23,520	$ 12.79
Vested	(571)	13.34
Forfeited	(339)	12.44
Nonvested as of December 31, 2023	22,610	12.78

The aggregate fair value of the Earnout RSUs and Earnout RSAs that vested during the year ended December 31, 2023 was $7.6 million.

As of December 31, 2023, there was $4.0 million of unrecognized compensation expense related to earnout shares recognizable over a weighted-average period of 1.3 years.

14. Revenue Recognition

Disaggregation of Revenue

The following table sets forth the percentage of total Cell Engineering revenue by industry:

	Year Ended December 31,		
	2023	2022	2021
Pharma and biotech	30 %	22 %	8 %
Agriculture	24	8	8
Industrial and environment	16	12	16
Food and nutrition	16	9	25
Consumer and technology	8	45	36
Government and defense	6	4	7
Total Cell Engineering revenue	100 %	100 %	100 %

The Company's revenue is derived from customers located primarily in the United States. For the years ended December 31, 2023, 2022, and 2021, the Company's revenue from customers within the United States comprised 82%, 88% and 86%, respectively, of total revenue.

Contract Balances

The Company recognizes a contract asset when the Company transfers goods or services to a customer before the customer pays consideration or before payment is due, excluding any amounts presented as accounts receivable. The Company had no contract asset balances as of December 31, 2023 and 2022.

Contract liabilities, or deferred revenue, primarily consist of payments received in advance of performance under the contract or when the Company has an unconditional right to consideration under the terms of the contract before it transfers goods or services to the customer. The Company's collaborative arrangements with its investees and related parties typically include upfront payments consisting of cash or non-cash consideration for future research and development services and non-cash consideration in the form of convertible financial instruments and equity securities for licenses that will be transferred in the future. The Company records the upfront cash payments and fair value of the convertible financial instruments and equity securities as deferred revenue.

The Company also invoices customers based on contractual billing schedules, which results in the recording of deferred revenue to the extent payment is received prior to the Company's performance of the related services. Contract liabilities are recognized as revenue as (or when) the Company performs under the contract.

During the year ended December 31, 2023, the Company recognized $65.9 million of revenue that was included in the contract liabilities balance of $222.6 million as of December 31, 2022. During the year ended December 31, 2022, the Company recognized $45.6 million of revenue that was included in the contract liabilities balance of $189.2 million as of December 31, 2021.

Performance Obligations

The aggregate amount of the transaction price that was allocated to performance obligations that have not yet been satisfied or are partially satisfied as of December 31, 2023 and 2022 was $110.0 million and $123.5 million, respectively. The Company has elected the practical expedient not to provide the remaining performance obligation disclosures related to contracts for which the Company recognizes revenue on a cost-plus basis in the amount to which it has the right to invoice and for contracts with a term of one year or less. As of December 31, 2023, of the performance obligations not yet satisfied or partially satisfied, nearly all is expected to be recognized as revenue during the years 2024 to 2027. When a milestone subject to the variable consideration constraint is achieved, the Company updates its estimate of the transaction price to include the milestone payment and records a cumulative catch-up in revenue. During the years ended December 31, 2023, 2022 and 2021, the Company recorded $2.3 million, $10.0 million and $6.4 million, respectively, of cumulative catch-up in revenue primarily due to recognition of previously constrained variable consideration related to milestones.

15. Segment Information

Prior to 2022, the Company operated as a single reportable segment. In the first quarter of 2022, the Company reorganized its operations into two operating and reportable segments: Cell Engineering and Biosecurity. The reorganization reflects changes made to the Company's internal management structure and how the Company's chief operating decision makers ("CODMs") evaluate operating results and make decisions on how to allocate resources. All prior-period comparative segment information was recast to reflect the current reportable segments in accordance with ASC 280, *Segment Reporting*. The Company's reportable segments are described as follows:

- Cell Engineering consists of research and development services performed under collaboration and license agreements relating to the Company's cell programming platform. The Company's cell programming platform includes two core assets: the Foundry, highly efficient biology lab facilities, enabled by investment in proprietary workflows, custom software, robotic automation, and data science and analytics, which is paired with the Company's Codebase, a collection of biological "parts" and a database of biological data used to program cells. The Cell Engineering segment includes costs incurred for the development, operation, expansion and enhancement of the Foundry and Codebase. Cell Engineering revenue is derived from service fees and downstream value share in the form of milestone payments, royalties or equity interests.
- Biosecurity consists of the Company's end-to-end biomonitoring and bioinformatic support services primarily provided to public health authorities. Biosecurity revenue is derived from fees for data, analytics, and services. Before the fourth quarter of 2023, Biosecurity revenue was also derived from sales of test kits.

The reportable segments are the segments of the Company for which discrete financial information is available and for which segment results are regularly reviewed by the Company's CODMs, comprised of the Chief Executive Officer and the Chief Operating Officer, for purposes of allocating resources and assessing financial performance. The Company's CODMs evaluate the financial performance of the Company's segments based upon segment revenues and operating income. The Company's measure of segment operating income for management reporting purposes excludes the impact of stock-based compensation expense, depreciation and amortization and changes in fair value of certain contingent liabilities. The Company's CODMs do not evaluate operating segments using asset information. The accounting policies used in the preparation of reportable segments financial information are the same as those used in the preparation of the Company's consolidated financial statements.

The following table presents summary results of the Company's reportable segments for the periods indicated (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Revenue:			
Cell Engineering	$ 143,531	$ 143,666	$ 112,989
Biosecurity	107,924	334,040	200,848
Total revenue	251,455	477,706	313,837
Segment cost of revenue:			
Biosecurity	54,005	204,216	129,690
Segment research and development expense:			
Cell Engineering	353,493	273,356	160,634
Biosecurity	1,599	1,937	31,035
Total segment research and development expense	355,092	275,293	191,669
Segment general and administrative expense:			
Cell Engineering	215,263	168,586	74,407
Biosecurity	55,514	56,353	31,039
Total segment general and administrative expense	270,777	224,939	105,446
Segment operating (loss) income:			
Cell Engineering	(425,225)	(298,276)	(122,052)
Biosecurity	(3,194)	71,534	9,084
Total segment operating loss	(428,419)	(226,742)	(112,968)
Operating expenses not allocated to segments:			
Stock-based compensation [(1)]	234,908	1,940,920	1,687,607
Impairment of long-lived assets	121,404	—	—
Depreciation and amortization	70,507	42,552	28,185
Change in fair value of contingent consideration liability	9,168	(1,262)	(293)
Loss from operations	$ (864,406)	$ (2,208,952)	$ (1,828,467)

(1) Includes $5.0 million, $10.3 million, and $5.0 million in related employer payroll taxes for the years ended December 31, 2023, 2022, and 2021, respectively.

16. Significant Collaboration Transactions

BiomEdit, LLC

In April 2022, the Company, along with one of its investors and third-party investors, including Elanco Animal Health Inc. ("Elanco"), launched BiomEdit, LLC ("BiomEdit"), a microbiome innovation company that intends to discover, design and develop novel probiotics, microbiome derived bioactives and engineered microbial medicines in the field of animal health. Concurrently with the launch, the Company entered into (i) an Intellectual Property Contribution Agreement ("BiomEdit IP Agreement") that granted BiomEdit a license to certain of the Company's intellectual property, (ii) a Technical Development Agreement ("BiomEdit TDA") that establishes the terms under which the Company will provide technical research and development services, and (iii) a Common Unit Issuance Agreement ("BiomEdit CUIA") which compensates the Company for its intellectual property contribution. Contemporaneous with these agreements, BiomEdit entered into a Series A Preferred Unit Purchase Agreement under which it sold 6.7 million Series A preferred units to one of the Company's investors and a third-party investor, for aggregate proceeds of approximately $32.5 million. After the initial closing, BiomEdit may issue up to an additional 1.5 million Series A preferred units (the "Additional Units") to one or more purchasers reasonably acceptable to the existing holders of Series A preferred units. In a subsequent closing during the first quarter of 2023, BiomEdit sold 0.8 million Additional Units for aggregate proceeds of $4.0 million and closed its Series A preferred unit financing.

Under the BiomEdit IP Agreement, the Company licensed certain intellectual property to BiomEdit for use in the development or production of BiomEdit's products that the parties will subsequently agree to research and develop under technical development plans ("TDP"). The license rights provide BiomEdit with the ability to commercialize the specified products from the corresponding TDP under the BiomEdit TDA. In return for the license to the intellectual property, BiomEdit issued the Company 3.9 million common units upon execution of the BiomEdit CUIA, with 0.7 million of those units subject to forfeiture in the event BiomEdit does not sell all of the Additional Units. Under the BiomEdit TDA, the parties jointly agree on TDPs, through equal representation on a joint steering committee, under which the Company will perform agreed-upon research and development services in return for consideration on a fixed fee or cost-plus basis for all services provided.

Accounting Analysis

The common unit investment in BiomEdit is considered an equity method investment as a result of the Company's ability to exercise significant influence over BiomEdit's financial and operating policies through its ownership of common units. The initial carrying value of the equity method investment in BiomEdit is the fair value of the nonforfeitable common units of $8.9 million received in exchange for the BiomEdit IP Agreement which, as discussed below, is being accounted for as non-cash consideration under ASC 606. The Company determined that the 0.7 million common units held by Ginkgo subject to forfeiture are considered variable consideration that is fully constrained at contract inception until the contingencies related to the issuance of the additional shares are resolved. Upon the closing of BiomEdit's Series A preferred unit financing in 2023, Ginkgo forfeited 0.3 million common units and retained 0.4 million common units for total consideration of $1.1 million. The fair value of BiomEdit's common units was determined at inception of the agreements using the option pricing method. The option pricing method used a back-solve methodology to infer the total equity value based on the pricing of the Series A preferred unit financing, which was contemporaneous with the BiomEdit IP Agreement.

The Series A preferred units issued by BiomEdit receive a liquidation preference prior to common units. As such, the Company concluded that this represents a substantive profit-sharing arrangement, and the Company is recognizing earnings and losses on the equity method investment using the HLBV method. The Company recorded a $1.5 million loss on its equity method investment in BiomEdit during the year ended December 31, 2023, which reduced the carrying value of the equity method investment in BiomEdit to zero. There is no commitment for the Company to provide further financial support to BiomEdit, and therefore the carrying value of the equity method investment will not be reduced below zero.

The relationship with BiomEdit is a vendor-customer relationship and is within the scope of ASC 606, as the provision of services and corresponding license rights are considered a part of the Company's ordinary activities. The common units issued to the Company represent non-cash consideration. While the BiomEdit TDA has been executed by the parties and provides the payment terms for future services, the BiomEdit TDA does not provide for any transfer of goods or services between the parties. However, the Company will provide licenses and services upon execution of the contemplated TDPs. Accordingly, the Company concluded that the BiomEdit TDA, in combination with the BiomEdit CUIA, met the definition of a contract under ASC 606. Each TDP executed under the BiomEdit TDA will be accounted for in accordance with ASC 606.

The Company's performance obligations under the BiomEdit TDA consist of four material rights to future technical research and development services and commercial licenses under individual TDPs that the Company expects to execute. The material rights represent an advance payment for the license rights, which will be granted upon the execution of future TDPs. As there is no additional payment for these license rights when future TDPs are executed, the Company has determined that there is a material right associated with each of the contemplated TDPs under the BiomEdit TDA. The Company has allocated approximately $2.2 million of the upfront non-cash consideration to each of the four material rights based on the estimated standalone selling price of the performance obligations. In 2023, the additional $1.1 million of non-cash consideration, which represents previously constrained variable consideration, was allocated to each of the four performance obligations under the arrangement with BiomEdit of $0.3 million each consistent with the initial relative selling price allocation.

Upon the execution of a TDP underlying a material right, the Company is obligated to provide technical research and development services under the TDP and a license to applicable patents and other intellectual property designed and developed under the TDP. The technical research and development services and license provided under a TDP are highly interdependent and interrelated with one another. Without the Company's knowledge, expertise, and platform, there would not be a licensable strain or other commercializable product to transfer to BiomEdit. Further, BiomEdit has rights to intellectual property created as part of each TDP, irrespective of the result of the development. Therefore, each executed

TDP underlying a material right consists of one combined performance obligation for the technical research and development services and license to be provided by the Company.

For each TDP underlying a material right, the transaction price consists of (i) either a fixed fee or, if a cost-plus arrangement, variable consideration for the most likely amount of estimated consideration to be received and (ii) non-cash consideration allocated to the material rights. As the services performed by the Company under a TDP create or enhance an asset that

BiomEdit controls as the asset is created or enhanced, the Company satisfies the performance obligation and recognizes revenue over time. The Company uses an input method that compares total costs incurred relative to total estimated cost to complete to estimate progress under the contract. Any revisions to the estimated total budgeted costs to complete, and the resulting impact on revenue recognition, are reflected in the period of the change through a cumulative catch-up adjustment.

As of December 31, 2023 and 2022, the Company had a deferred revenue balance of $7.7 million and $8.1 million, respectively, with BiomEdit. During the years ended December 31, 2023 and 2022, the Company recognized revenue of $2.2 million and $1.0 million, respectively, from services provided to BiomEdit.

Arcaea, LLC

Summary of Arrangement

Arcaea was formed in March 2021 to focus on the application of synthetic biology in the personal care products industry. In March 2021, the Company entered into (i) an Intellectual Property Contribution Agreement (“Arcaea IP Agreement”) that granted Arcaea a license to certain of the Company’s intellectual property, (ii) a Technical Development Agreement (“Arcaea TDA”) that establishes the terms under which the Company will provide technical research and development services, and (iii) a Common Unit Issuance Agreement (“Arcaea CUIA”) which compensates the Company for its intellectual property contribution. Contemporaneous with these transactions, Arcaea entered into a Series A Preferred Unit Purchase Agreement under which it sold 1.8 million Series A preferred units to certain of the Company’s investors, for aggregate proceeds of approximately $19.5 million. The Series A Preferred Unit Purchase Agreement provided for the sale and issuance of up to an additional 7.2 million Series A preferred units subsequent to the initial closing. In subsequent closings during 2021, Arcaea issued an additional 5.1 million Series A preferred units to existing and third-party investors for aggregate proceeds of approximately $57.1 million and closed its Series A preferred unit financing. As a result, the Company received an additional 5.2 million common units in Arcaea for total consideration of $35.5 million.

Under the Arcaea IP Agreement, the Company licensed certain intellectual property to Arcaea for use in the development or production of Arcaea’s products that the parties will subsequently agree to research and develop under TDPs. The license rights provide Arcaea with the ability to commercialize the specified products from the corresponding TDP under the Arcaea TDA. In return for the license to the intellectual property, Arcaea has agreed to issue the Company up to 9.0 million common units in accordance with certain terms and conditions set forth within the agreements. The Company received 1.8 million common units upon execution of the Arcaea CUIA and an additional 5.2 million common units upon subsequent closings of the Series A preferred unit financing in 2021 (as discussed above). No additional common units are expected to be issued to the Company.

Under the Arcaea TDA, the parties jointly agree on TDPs, through equal representation on a joint steering committee, under which the Company will perform agreed-upon research and development services in return for consideration on a fixed fee or cost-plus basis for all services provided.

Accounting Analysis

The common unit investment in Arcaea is considered an equity method investment as a result of the Company’s ability to exercise significant influence over Arcaea’s financial and operating policies through its ownership of common units. The initial carrying value of the equity method investment in Arcaea is the fair value of the common units of $11.9 million received in exchange for the Arcaea IP Agreement which, as discussed below, was accounted for as deferred revenue at inception. The fair value of Arcaea’s common units was determined at inception of the agreements using the option pricing method. The option pricing method used a back-solve methodology to infer the total equity value based on the pricing of the Series A preferred unit financing, which was contemporaneous with the Arcaea IP Agreement. Further, the Company determined the rights to up to an additional 7.2 million common units did not meet the definition of a freestanding financial instrument and are not representative of a derivative. The right to the additional common units is considered variable

consideration that is fully constrained at inception and until the contingencies related to the issuance of the additional shares are resolved.

The Series A preferred units issued by Arcaea receive a liquidation preference prior to common units. As such, the Company concluded that this represents a substantive profit-sharing arrangement, and the Company is recognizing earnings and losses on the equity method investment using the HLBV method. The Company recorded a $11.9 million loss on its equity method investment in Arcaea in 2021. The loss allocated to the Company primarily relates to Arcaea's accounting for the non-cash consideration related to the Arcaea IP Agreement as in-process research and development, which resulted in the full value of the Company's intellectual property contribution being expensed in 2021. As of December 31, 2021, the carrying value of the equity method investment in Arcaea has been reduced to zero. There is no commitment for the Company to provide further financial support to Arcaea, and therefore the carrying value of the equity method investment will not be reduced below zero.

The relationship with Arcaea is a vendor-customer relationship and is within the scope of ASC 606, as the provision of services and corresponding license rights are considered a part of the Company's ordinary activities. The common units issued to the Company represent non-cash consideration. While the Arcaea TDA has been executed by the parties and provides the payment terms for future services, the Arcaea TDA does not provide for any transfer of goods or services between the parties. However, the Company will provide licenses and services upon execution of the contemplated TDPs. Accordingly, the Company concluded that the Arcaea TDA, in combination with the Arcaea CUIA, met the definition of a contract under ASC 606. Each TDP executed under the Arcaea TDA will be accounted for in accordance with ASC 606.

The Company's performance obligations under the contract consist of ten material rights to future technical research and development services and commercial licenses under individual TDPs that the Company expects to execute under the Arcaea TDA. The material rights represent an advance payment for the license rights, which will be granted upon the execution of future TDPs. As there is no additional payment for these license rights when future TDPs are executed, the Company has determined that there is a material right associated with each of the contemplated additional TDPs under the Arcaea TDA. The Company has allocated approximately $1.2 million of the upfront non-cash consideration to each of the ten material rights based on the estimated standalone selling price of the performance obligations. During the year ended December 31, 2021, the additional $35.5 million of non-cash consideration, which represents previously constrained variable consideration, was allocated to each of the ten performance obligations under the arrangement with Arcaea of $3.6 million each consistent with the initial relative selling price allocation. Unexercised material rights are recorded as non-current deferred revenue until such time as the parties execute a TDP conveying a commercial license.

Upon the execution of a TDP underlying a material right, the Company is obligated to provide technical research and development services under the TDP and a license to applicable patents and other intellectual property designed and developed under the TDP. The technical research and development services and license provided under a TDP are highly interdependent and interrelated with one another. Without the Company's knowledge, expertise, and platform, there would not be a licensable strain or other commercializable product to transfer to Arcaea. Further, Arcaea has rights to intellectual property created as part of each TDP, irrespective of the result of the development. Therefore, each executed TDP underlying a material right consists of one combined performance obligation for the technical research and development services and license to be provided by the Company.

For each TDP underlying a material right, the transaction price consists of variable consideration for the most likely amount of estimated consideration to be received under the cost-plus arrangement and non-cash consideration allocated to the material rights. As the services performed by the Company under a TDP create or enhance an asset that Arcaea controls as the asset is created or enhanced, the Company satisfies the performance obligation and recognizes revenue over time. The Company uses an input method that compares total costs incurred relative to total estimated cost to complete to estimate progress under the contract. Any revisions to the estimated total budgeted costs to complete, and the resulting impact to revenue recognition, are reflected in the period of the change through a cumulative catch-up adjustment.

As of December 31, 2023 and 2022, the Company had a deferred revenue balance of $33.1 million and $38.3 million, respectively, with Arcaea. During the years ended December 31, 2023, 2022 and 2021, the Company recognized revenue of $6.0 million, $13.5 million and $3.7 million, respectively, from services provided to Arcaea.

Allonnia, LLC

Summary of Arrangement

In December 2019, the Company entered into (i) an Intellectual Property Contribution Agreement ("Allonnia IP Agreement") that granted Allonnia a license to certain of the Company's intellectual property, (ii) a Technical Development Agreement ("Allonnia TDA") that establishes the terms under which the Company is providing technical development services, and (iii) a Common Unit Issuance Agreement which provides for the issuance of common units of Allonnia to the Company in exchange for the license rights granted under the Allonnia IP Agreement. Contemporaneous with these agreements, Allonnia entered into a Series A Preferred Unit Purchase Agreement under which Allonnia sold 3.0 million Series A Preferred Units to certain of the Company's investors, as well as a third-party investor, for aggregate proceeds of approximately $33.0 million. Allonnia also agreed to issue an additional 0.6 million Series A Preferred Units to a strategic partner as compensation for the delivery of future services to Allonnia. The Series A Preferred Unit Purchase Agreement also provided for the sale and issuance of up to an additional 5.4 million Series A Preferred Units subsequent to the initial closing. In 2020, Allonnia issued an additional 1.8 million Series A Preferred Units, 1.7 million of which were sold for aggregate proceeds of $18.5 million and 180,000 of which were issued in exchange for the rights to certain intellectual property which will vest based on the achievement of milestones associated with the development of the intellectual property received. In 2021, Allonnia issued an additional amount of less than 0.1 million Series A Preferred Units for aggregate proceeds of $0.2 million and closed its Series A Preferred Unit financing. In 2023, Allonnia raised an additional $30 million through a Series A extension.

Under the Allonnia IP Agreement, the Company licensed intellectual property to Allonnia for use in the development or production of its products that the parties will subsequently agree to develop under TDPs. The license rights provide Allonnia with the ability to commercialize the specified products from the corresponding strain or enzyme, which can only be developed by the Company under the Allonnia TDA. The Company received 3.6 million common units as consideration for the license upon execution of the Allonnia IP Agreement and an additional 1.9 million common units during the year ended December 31, 2021 in connection with the closing of the Series A preferred unit financing.

Under the Allonnia TDA, the parties jointly agree, through equal representation on a joint steering committee, on TDPs for specific strains and enzymes, in which the Company will perform agreed upon development services in return for consideration on a fixed fee or cost-plus basis for all services provided.

Accounting Analysis

The common unit investment in Allonnia is considered an equity method investment as a result of the Company's ability to exercise significant influence over Allonnia's financial and operating policies through its ownership of common units. The initial carrying value of the equity method investment in Allonnia is the fair value of the common units of $24.5 million received in exchange for the Allonnia IP Agreement which, as discussed below, was accounted for as deferred revenue at inception. The fair value of Allonnia's common units was determined at inception of the agreements using the option pricing method. The option pricing method used a back-solve methodology to infer the total equity value based on the pricing of the Series A Preferred Unit financing, which was contemporaneous with the Allonnia IP Agreement. Further, the Company determined the rights to up to an additional 5.4 million common units did not meet the definition of a freestanding financial instrument and are not representative of a derivative. The right to the additional common units is considered variable consideration that is fully constrained at inception and until the contingencies related to the issuance of the additional shares are resolved. This contingency was resolved in 2021 when the Company received an additional 1.9 million common units in connection with the closing of the Series A preferred unit financing.

The Series A Preferred Units issued by Allonnia receive a liquidation preference prior to common units. As such, the Company concluded that this represents a substantive profit-sharing arrangement and the Company is recognizing earnings and losses on the equity method investment using the HLBV method. The Company recorded a loss on equity method investment of $24.5 million in 2019 and $12.7 million in 2021 as a result of the application of the HLBV method. The loss allocated to the Company primarily relates to Allonnia's accounting for the non-cash consideration related to the Allonnia IP Agreement as in-process research and development, which resulted in the full value of the Company's intellectual property contribution being expensed in the year that the shares were issued. As of December 31, 2021, the carrying value of the equity method investment in Allonnia has been reduced to 0. There is no commitment for the Company to provide further financial support to Allonnia and therefore the carrying value of the equity method investment will not be reduced below zero.

The relationship with Allonnia is a vendor-customer relationship and is within the scope of ASC 606 as the provision of services and corresponding license rights are considered a part of the Company's ordinary activities and the common units represent non-cash consideration. While the Allonnia TDA has been executed by the parties and provides the payment terms for future services, the Allonnia TDA does not provide for any transfer of goods or services between the parties. However, the Company will provide licenses and services upon execution of the contemplated TDPs. Accordingly, the Company concluded that the Allonnia TDA met the definition of a contract under ASC 606 and each TDP executed under the Allonnia TDA will be accounted for in accordance with ASC 606.

The Company's performance obligations under the contract consist of ten material rights related to the estimated number of TDPs the parties expect to execute under the Allonnia TDA. The material rights represent an advance payment for the license rights which will be granted upon the execution of each TDP. As there is no additional payment for these license rights upon execution of a TDP, the Company has determined that there is a material right associated with each of the contemplated future TDPs. The Company has allocated $2.5 million of the upfront non-cash consideration to each of the 10 performance obligations under the contract based on the estimated standalone selling price of the performance obligations. Unexercised material rights are recorded as non-current deferred revenue until such time as the parties execute a TDP.

Upon the execution of each TDP, the Company is obligated to provide development services under the TDP and a license to applicable patents and other intellectual property to the ingredient developed under the plan. The license and research and development services under a TDP are highly interdependent and interrelated with one another. Without the Company's knowledge, expertise, and platform, there would not be a licensable strain or other commercializable product to transfer to Allonnia. Further, Allonnia has rights to all development intellectual property created as part of each TDP, irrespective of the result of the development. Therefore, each executed TDP consists of one combined performance obligation for the license and research and development services to be performed by the Company.

For each TDP, the transaction price consists of variable consideration for the most likely amount of estimated consideration to be received under the cost-plus arrangement and the $2.5 million allocation of the fixed non-cash consideration. As the services performed by the Company create or enhance an asset that Allonnia controls as the asset is created or enhanced, the Company satisfies the performance obligation and recognizes revenue over time. The Company uses an input method that compares total costs incurred relative to total estimated cost to complete to estimate progress under the contract. Any revisions to the estimated total budgeted costs to complete, and the resulting impact to revenue recognition, are reflected in the period of the change through a cumulative catch-up adjustment. In 2022, the additional non-cash consideration of $12.7 million, which represents previously constrained variable consideration, was allocated to all of the performance obligations consistent with the initial relative selling price allocation and a cumulative catch up was recognized for the TDPs in process.

As of December 31, 2023 and 2022, the Company had a deferred revenue balance of $36.1 million and $35.9 million, respectively, with Allonnia. During the years ended December 31, 2023, 2022 and 2021, the Company recognized revenue of $0.5 million, $4.3 million and $5.1 million, respectively, from services provided to Allonnia.

Motif FoodWorks, Inc.

Summary of Arrangement

In September 2018, the Company entered into (i) an Intellectual Property Contribution Agreement ("Motif IP Agreement") with Motif that granted Motif a license to certain of the Company's intellectual property and (ii) a Technical Development Agreement ("Motif TDA") that establishes the terms under which the Company is providing technical development services.

Under the Motif IP Agreement, the Company licensed intellectual property to Motif for use in strain development to produce ingredients that the parties will subsequently agree to develop under TDPs. The license rights provide Motif with the ability to commercialize the specified ingredients from the corresponding strain, which can only be developed by the Company under the Motif TDA. In return for the license to the intellectual property, Motif granted the Company 9.0 million shares of common stock. Concurrent with the Motif IP Agreement, Motif also sold 8.1 million shares of Series A preferred stock to certain of the Company's investors, as well as third-party investors, for aggregate proceeds of approximately $90.0 million.

The Motif TDA governs the procurement of the Company's expertise and technical development services to collaborate in the research, development, and commercialization of specified ingredients. Under the Motif TDA, the parties jointly agree

on TDPs for specific ingredients, in which the Company will perform agreed upon development services in return for consideration on a fixed fee or cost-plus fixed margin basis for all services provided. At inception, the Company estimated that it would execute ten TDPs with Motif.

Accounting Analysis

The investment in Motif common stock is considered an equity method investment as a result of the Company's ability to exercise significant influence over the financial and operating policies through its common stock ownership. The initial carrying value of the equity method investment in Motif is the fair value of the common stock received in exchange for the Motif IP Agreement of $65.1 million which, as discussed below, is being accounted for as non-cash consideration under ASC 606. As Motif's Series A preferred stockholders receive a liquidation preference prior to common stock, the Company concluded that this represents a substantive profit-sharing arrangement. Accordingly, the Company is recognizing earnings and losses on the equity method investment using the HLBV method. The Company recorded a loss on equity method investment of $65.1 million from inception through December 31, 2018 which reduced the carrying value to zero. The loss allocated to the Company primarily relates to Motif's accounting for the non-cash consideration related to the Motif IP Agreement as in-process research and development, which resulted in the full value of Company's intellectual property contribution being expensed in the period ended December 31, 2018, at which time the carrying value of the equity method investment in Motif had been reduced to zero. There is no commitment for the Company to provide further financial support to Motif and therefore the carrying value of the equity method investment will not be reduced below zero. As a result, no loss was recognized during the years ended December 31, 2023, 2022 and 2021 on the equity method investment.

The overall arrangement with Motif is a vendor-customer relationship and is within the scope of ASC 606 as the provision of development services and corresponding license rights are considered a part of the Company's ordinary activities. The licenses contemplated under the Motif IP Agreement are contingent upon a TDP being agreed to by the parties under the Motif TDA and only relate to strains that are developed under a TDP. While the TDPs require approval by the parties, the parties initially estimated that ten TDPs would be negotiated under the arrangement.

The Company's performance obligations under the Motif IP Agreement consist of ten material rights, related to the initial set of ingredients that the parties desired to develop in the first two years. The material rights represent an advance payment for the license rights which will be granted upon the execution of each TDP. As there is no additional payment for these license rights upon execution of a TDP, the Company has determined that there is a material right associated with each of the contemplated TDPs. The common stock received under the Motif IP Agreement is considered non-cash consideration and has been recognized at fair value. The Company determined the fair value of the common stock was $65.1 million at inception of the agreement with the assistance of a third-party valuation specialist, which was initially recorded as non-current deferred revenue. The option pricing model used a back-solve methodology to determine the total equity value based on the pricing of the Series A financing, which was contemporaneous with the Motif IP Agreement. The Company has allocated $6.5 million to each of the ten material rights. The Company allocated the transaction price based on the estimated standalone selling price of the material rights which is, in turn, based on the intrinsic value of the right and the probability of exercise.

Upon the execution of each TDP, the Company is obligated to provide development services under the TDP and a license to applicable patents and other intellectual property to the ingredient developed under the plan. The license and research and development services under a TDP are highly interdependent and interrelated with one another. Without the Company's knowledge, expertise and platform, there would not be a licensable strain or other commercializable product to transfer to Motif. Further, Motif has rights to all development intellectual property created as part of each TDP, irrespective of the result of the development. Therefore, each executed TDP consists of one combined performance obligation for the license and research and development services to be performed by the Company.

For each TDP, the transaction price consists of variable consideration for the most likely amount of estimated consideration to be received under the fixed fee or cost-plus arrangement and the $6.5 million which was allocated to the associated material right under the Motif IP Agreement. As the services performed by the Company create or enhance an asset (i.e., the specified ingredient) that Motif controls as the asset is created or enhanced, the Company satisfies the performance obligation and recognizes revenue over time. The Company uses an input method that compares total costs incurred relative to total estimated cost to complete to estimate progress under the contract. Any revisions to the estimated total budgeted costs to complete, and the resulting impact to revenue recognition, are reflected in the period of the change through a cumulative catch-up adjustment.

As of December 31, 2023 and 2022, the Company had a deferred revenue balance of $45.4 million and $52.0 million, respectively, with Motif. During the years ended December 31, 2023, 2022 and 2021, the Company recognized revenue of $6.7 million, $1.9 million and $20.2 million, respectively, from services provided to Motif.

Genomatica, Inc.

2016 Genomatica Agreement

In 2016, the Company purchased Series A preferred stock of Genomatica, Inc. ("Genomatica"), a biotechnology company specializing in the development and manufacturing of intermediate and specialty chemicals from both sugar and alternative feedstocks. The Company also entered into a Collaboration Agreement with Genomatica ("Genomatica Collaboration") in connection with the financing. The Genomatica Collaboration was entered into to share expertise on biotechnology solutions. Specifically, Genomatica provided the Company with scale-up and process optimization functions, and the Company has provided Genomatica with certain technology development functions generally centered on high throughput strain engineering capabilities. The Genomatica Collaboration's focus was on obtaining new customers for either party that could benefit from the combined expertise of both parties, and the agreement provides for profit-sharing allocations between Genomatica and the Company depending on the category of the potential product. Each party is responsible for their own costs incurred under an agreed upon TDP.

2018 Genomatica Agreement

In September 2018, the Company entered into a stock purchase agreement with Genomatica under which it received $40.0 million of Series B preferred stock from Genomatica. In lieu of cash consideration, the Company entered into a Foundry Terms of Service Agreement ("Genomatica FSA") with Genomatica in which the Company would provide up to $40.0 million in services at no charge to Genomatica ("Initial Prepayment"). The Genomatica FSA terminated the Genomatica Collaboration and changed the pricing terms for work performed under TDPs to a cost-plus fixed margin agreement. Genomatica can apply a portion of the $40.0 million in prepaid services to outstanding invoices under the Genomatica FSA, subject to certain limitations that require cash payment for services over certain monthly thresholds. Further, while the Genomatica FSA replaced the Genomatica Collaboration, any fees that would have been paid to or by the Company under contracts previously governed by the Genomatica Collaboration continued to be shared between the parties. These amounts are either (i) added to, if payable to the Company, or (ii) reduced from, if payable to Genomatica, the balance of the prepaid services over the term of the arrangement, with certain restrictions. As of December 31, 2021 and 2020, the Company has received $8.3 million and $6.9 million, respectively, under the Genomatica FSA. All contracts previously governed by the Genomatica Collaboration have ended as of December 31, 2021, therefore, no additional payments are expected.

Accounting Analysis

The Company concluded the preferred stock investment was not in-substance common stock and therefore did not qualify for accounting as an equity method investment. Rather, the Company concluded the preferred stock investment should be accounted for as an equity security as it represents an ownership interest in Genomatica that is not mandatorily redeemable nor does the Company have the unilateral right to redeem the preferred stock. Genomatica's preferred stock is not exchange-traded and does not have a readily determinable fair value. Therefore, the Company accounts for the Genomatica preferred stock under the measurement alternative for equity investments that do not have a readily determinable fair value, which in this case is at historical cost. As of December 31, 2023 and 2022, the cost of the investment in Genomatica preferred stock was $11.9 million and $44.9 million, respectively, and is included in investments on the consolidated balance sheet.

Under the Genomatica Collaboration, the Company was entitled to receive a portion of fees earned from third party customers of Genomatica that were within the scope of the agreement. The Company accounted for the collaboration under ASC 808, however the Company applied ASC 606 by analogy for measurement and recognition purposes. Under the Genomatica Collaboration, the Company's promises consisted of (i) licenses to the Company's intellectual property, related to the specified development work, and (ii) research and development services. The Company determined that there was a single, combined performance obligation consisting of research services and licenses to certain intellectual property. The Company recognized the revenue for the combined performance obligation using an over-time input method, as the Company's performance under the contract created or enhanced the target product or strain as such product or strain was developed. The Company measured progress based on the cost incurred relative to total forecasted cost.

The Genomatica FSA represents a modification to the Genomatica Collaboration that resulted in a change in transaction price from milestones to a cost-plus fixed margin structure. The Genomatica FSA did not result in the addition of any distinct promised goods or services, and the Company's remaining obligation post-modification was to finish the partially satisfied development work that had commenced under the Genomatica Collaboration. This performance obligation was satisfied during the year ended December 31, 2019 and the parties have entered into subsequent TDPs under the Genomatica FSA.

As of December 31, 2023 and 2022, the Company had a deferred revenue balance of $2.0 million and $6.3 million, respectively, with Genomatica. During the years ended December 31, 2023, 2022 and 2021, the Company recognized revenue of $4.2 million, $10.9 million and $12.9 million, respectively, from services provided to Genomatica.

Joyn Bio, LLC

Summary of Arrangement

In September 2017, the Company and certain other investors formed Cooksonia for the purposes of holding the Company's investment in Joyn Bio. Concurrently, Cooksonia entered into a commitment agreement with Bayer CropScience LP ("Bayer") to form Joyn Bio. The purpose of Joyn Bio was to research, develop, discover, and commercialize engineered microbes for use in agriculture. The initial program used advanced techniques in biology to study and engineer naturally occurring soil microbes and their nitrogen-fixing genes to enable crops to produce their own fixed nitrogen and reduce the nitrogen fertilizer required.

The Company contributed $5.0 million in cash and certain intellectual property to Cooksonia in exchange for a 70% equity interest in Cooksonia ("Class A Units"). Cooksonia received $20.0 million in cash from another investor, who is a related party of the Company, for a 20% equity interest in Cooksonia ("Class B Units"). Cooksonia also received certain intellectual property from Genomatica and issued Genomatica a 10% equity interest in Cooksonia ("Cooksonia Class C Units") and paid Genomatica $5.0 million in cash. Subsequently, Cooksonia contributed $20.0 million and all intellectual property received from the Company and Genomatica in exchange for a 50% equity interest in Joyn Bio. Bayer contributed $20.0 million in cash funding plus specified intellectual property. In addition, Bayer committed to contribute up to an additional $60.0 million to be paid subject to certain funding procedures. In return, Bayer obtained a 50% equity interest in Joyn Bio. The agreements may be terminated by mutual agreement, following a change in control, and for breach.

Joyn Bio was governed by a Board of Managers ("Joyn Bio Board") comprised of equal representation of the Company and Bayer. The Joyn Bio Board had all the rights, powers, obligations, and authority to manage the business and affairs of Joyn Bio.

The Company also entered into a Foundry Services Agreement ("Joyn Bio FSA") with Joyn Bio under which the Company will provide Joyn Bio with technical services and preferred access to the Company's facilities. Joyn Bio paid the Company a nonrefundable $20.0 million prepayment for services to be provided under the Joyn Bio FSA ("Joyn Bio Prepaid Services"). The Joyn Bio Prepaid Services can be utilized for technical services performed by the Company, its subcontractors, and third parties involved in the performance of the overall technical services. Amounts due to the Company are applied to the balance of Joyn Bio Prepaid Services as earned. During the year ended December 31, 2019, Joyn Bio made an additional $15.0 million prepayment for services ("Joyn Bio Additional Prepaid Services"). Under certain Joyn Bio termination scenarios, any amount of unused Joyn Bio Additional Prepaid Services shall be repaid by the Company to Joyn Bio.

Accounting Analysis

From inception, the Company's investment in Cooksonia has represented a controlling financial interest, resulting in consolidation of Cooksonia within the Company's consolidated financial statements (see Note 6). The initial cash and in-kind contributions the Company made to Cooksonia have been recorded at carrying value as the transaction was with entities under common control. All assets of Cooksonia after the initial investments, net of the amounts paid to Genomatica, were contributed to Joyn Bio for a 50% equity interest in Joyn Bio. The initial carrying value of the Company's equity interest in Cooksonia was $13.1 million, comprised of the initial $5.0 million cash investment and an $8.1 million adjustment for Cooksonia's claim on net assets in accordance with ASC 810, *Consolidation,* recognized to reflect a certain investor's liquidation preference in a termination event that represents a substantive profit-sharing agreement. The initial carrying value of the non-controlling interest was comprised of cash and intellectual property contributions from the other investors of $29.7 million, less the $8.1 million adjustment for the non-controlling interest holders' claim on the net assets of Cooksonia.

Cooksonia accounted for its 50% equity interest in Joyn Bio as an equity method investment based on the size of its equity interest and its influence on the board of directors. The equity method investment in Joyn Bio was recorded at an initial carrying value of $97.9 million, which was the fair value of Cooksonia's interest in Joyn Bio. The fair value was determined by management with the assistance of a third-party valuation specialist. The option pricing model used a back-solve methodology to determine the total equity value based on the pricing of the Class B Units which were exchanged for cash. The license of intellectual property to Joyn Bio has been accounted for under ASC 606 as described below. Upon liquidation, the net assets of Joyn Bio are not distributed in accordance with each party's respective ownership interest. Depending on the circumstances or type of liquidation event, Bayer or Cooksonia may receive certain preference payments or priority in the assets that are distributed. These preferences represent a substantive profit-sharing arrangement and, accordingly, Cooksonia recognized earnings and losses on its equity method investment using the HLBV method. Refer to Note 6 for additional details on Cooksonia's investment in Joyn Bio.

The Company accounted separately under ASC 606 for Cooksonia's contribution of its intellectual property and the services performed by the Company under technical project plans governed by the Joyn Bio FSA. The Company accounted for the intellectual property sale and the technical services separately as the two agreements were not negotiated with a single commercial objective, the consideration under each agreement was not interdependent, and the intellectual property contribution from Cooksonia was separate and distinct from the research and development services performed under the Joyn Bio FSA.

The Company considers the granting of licenses to the Company's intellectual property as part of its ordinary business activities, and therefore Cooksonia's contribution of intellectual property to Joyn Bio represented a contract with a customer. The intellectual property contained multiple licenses for which control transferred at inception and all revenue associated with the licenses was recognized during the year ended December 31, 2017.

The Joyn Bio FSA functioned as a master services agreement that provided a framework for the research and development services relationship between the Company and Joyn Bio. The Joyn Bio FSA did not create a contract under ASC 606 as it did not identify goods or services to be performed nor did it define consideration under the contract. Upon the execution of a technical project plan under the Joyn Bio FSA, the arrangement qualified as a contract under ASC 606.

The Company accounted for each technical project separately. Each technical project plan provided for distinct services in the context of the contract, was separately negotiated with Joyn Bio, focused on different specified strains with separate scopes of work, and had its own budget. The sole performance obligation under each individual technical project plan consisted of the research and development services as the requisite licenses were transferred prior to the execution of the technical project plans. The transaction price for each technical project plan was determined at plan inception based on the consideration that the Company negotiated in exchange for the services to be provided. The Company's performance under each technical project plan created or enhanced assets under Joyn Bio's control. Joyn Bio received the benefits of the output of the research and development services which allowed Joyn Bio to make strategic business decisions on the direction of each product candidate. Therefore, the Company satisfied the respective performance obligations and recognized revenue over time.

On October 17, 2022, Bayer and Ginkgo entered into the JV Termination Agreement, which initiated the dissolution of Joyn Bio (see Note 3). Upon dissolution, the Company's deferred revenue balance with Joyn Bio was applied to Bayer's Technical Development Agreement with the Company.

During the years ended December 31, 2022 and 2021, the Company recognized revenue of $2.9 million and $5.3 million, respectively, from services provided to Joyn Bio for which the balance was applied against deferred revenue.

Amyris, Inc.

During 2017, the Company terminated its collaborative relationship with Amyris, Inc. ("Amyris") as provided in the Amyris Collaboration Agreement and executed a settlement arrangement ("Partnership Agreement") under which the Company is entitled to receive (i) value share payments owed to the Company under the Amyris Collaboration Agreement, (ii) payments of $0.8 million each quarter commencing on December 31, 2018 through the quarter ended September 30, 2022, and (iii) payments due under an interest bearing $12.0 million promissory note.

The parties amended the agreements during the year ended December 31, 2020 to defer certain payments and provide Amyris waivers for noncompliance with certain covenants. As of December 31, 2020, the Company was owed (i) the $12.0 million principal balance on the promissory note which matures on October 19, 2022 and (ii) payments under the

Partnership Agreement, as amended, which includes quarterly payments of $0.2 million to $0.3 million through September 2022 and an end of term payment of $9.8 million on October 19, 2022.

The Company concluded that all amounts due are a settlement for accounting purposes as the payments are being made without any obligation from the Company to Amyris. The balance due on the promissory note and right to payments due under the Partnership Agreement are not recognized in the Company's financial statements until the gain is realized. The Company recognizes any payments made under the Partnership Agreement and promissory note, including interest, when the cash is received as a component of other income (expense). On November 15, 2021, the Company received a $22.8 million payment from Amyris in full settlement of all amounts due under the Partnership Agreement including (i) the $12.0 million principal balance on the promissory note and all interest due, (ii) all quarterly payments due under the Partnership Agreement through September 2022 and (iii) an end of term payment of $9.8 million. Payments received from Amyris are recorded as gain on settlement of partnership agreement in the consolidated statements of operations and comprehensive loss.

Synlogic, Inc.

Summary of Arrangement

In June 2019, the Company entered into several agreements with Synlogic, a publicly traded clinical-stage biopharmaceutical company focused on advancing drug discovery and development for synthetic biology-derived medicines. The Company entered into a Subscription Agreement with Synlogic whereby it purchased 6.3 million shares of common stock at $9.00 per share for a total purchase price of $57.1 million, which represented a 19.9% equity interest in Synlogic. The Company also entered into a Warrant Agreement whereby it received the right to purchase 2.5 million shares of common stock of Synlogic at an exercise price of $9.00 per share. The Company made a nonrefundable prepayment related to the exercise price of the warrant equal to $8.99 per share for a total payment of $22.9 million. The warrant is only exercisable to the extent the Company's interest in Synlogic does not exceed 19.99%. The Company also entered into a Foundry Services Agreement ("Synlogic FSA") whereby Synlogic provided $30.0 million in cash as a nonrefundable prepayment for Cell Engineering services. The prepaid Cell Engineering services can be utilized for development of collaboration strains. Services performed under the services agreement will be applied to the prepaid amount based on the contractual rates included in the contract, based on costs incurred plus a fixed margin. Work will be performed under the Synlogic FSA pursuant to TDPs. Each TDP will pursue the development of a specific collaboration strain and/or production protocol. The Synlogic FSA will terminate upon the earlier of the exhaustion of the prepayment amount in full or the fifth anniversary of the effective date of the agreement and may be extended in certain circumstances. On February 8, 2024, Synlogic announced its decision to cease operations and evaluate strategic options for the company.

Accounting Analysis

The overall arrangement with Synlogic includes the Subscription Agreement whereby the Company purchased shares of Synlogic common stock, the Warrant Agreement whereby the Company prepaid a significant portion of the exercise price of the warrant to purchase Synlogic common stock, which is nonrefundable, and the Synlogic FSA whereby the Company will perform services for Synlogic. The Company concluded that these agreements should be considered one arrangement for accounting purposes as they were entered into at the same time and negotiated as a package with a single commercial objective.

At inception, the common stock investment in Synlogic was considered an equity method investment as the Company did not have a controlling financial interest in Synlogic but did have the ability to influence the financial and operating policies through its ownership of common stock. The Company elected to apply the fair value option to account for the equity method investment as the fair value of Synlogic's common stock is objectively determinable based on quoted market prices in an active market for the identical securities. At inception, the fair value of the equity method investment in Synlogic was recorded at $35.8 million as a component of equity method investments on the consolidated balance sheet. In 2021, due to a decrease in the level of ownership, the investment no longer qualifies for the equity method and was reclassified from equity method investments to investments in the consolidated balance sheet, and from loss on equity method investments to loss on investments in the consolidated statements of operations and comprehensive loss for all periods presented. However, the Company continues to apply the fair value option to account for its investments in Synlogic. The Company has also elected to apply the fair value option to account for the warrant to purchase Synlogic common stock, which at inception was recorded at $14.4 million as a component of investments on the consolidated balance sheet. See Note 4 for additional information related to the fair value measurements of Synlogic common stock and the Synlogic warrants and

Note 5 for additional information related to the net gains and losses recognized during the periods presented related to these securities.

The Company concluded that the TDPs represent contracts with a customer and will be accounted for under ASC 606. At inception, Synlogic prepaid $30.0 million for services under the Synlogic FSA. The prepaid services were reduced by $29.8 million, which represents the excess of the aggregate $80.0 million the Company paid to purchase Synlogic's common stock and warrant over the respective fair values of those instruments. This resulted in a deferred revenue balance of $0.2 million at inception, which is being recognized over the period in which the Company will provide services to Synlogic. The Company recognized nominal amounts of revenue during each of the years ended December 31, 2023, 2022 and 2021 from services provided to Synlogic. As of December 31, 2023 and 2022, the Company had a deferred revenue balance of less than $0.1 million with Synlogic.

17. Employee Benefit Plan

The Company has a 401(k) retirement plan covering substantially all employees. Under the retirement plan, employees make voluntary contributions and the Company makes a 5% non-elective contribution for all employees based on compensation, subject to Internal Revenue Service contribution limits. For the years ended December 31, 2023, 2022 and 2021, the Company contributed $8.2 million, $6.1 million and $3.7 million, respectively, to the retirement plan.

18. Income Taxes

For the years ended December 31, 2023, 2022 and 2021, the loss before income taxes consisted of the following (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Domestic	$ (890,986)	$ (2,118,095)	$ (1,837,497)
Foreign	(1,954)	(3,304)	(625)
Total	$ (892,940)	$ (2,121,399)	$ (1,838,122)

For the years ended December 31, 2023, 2022 and 2021, the Company recorded the following income tax benefit (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Current:			
State	$ 690	$ 271	$ 1
Foreign	123	159	—
Total current	813	430	1
Deferred:			
Federal	—	(10,500)	(413)
State	—	(3,943)	(912)
Foreign	(884)	(1,014)	(156)
Total deferred	(884)	(15,457)	(1,481)
Income tax benefit	$ (71)	$ (15,027)	$ (1,480)

A reconciliation of income tax benefit computed at the statutory corporate income tax rate to the effective income tax rate for the years ended December 31, 2023, 2022 and 2021 is as follows:

	Year Ended December 31,		
	2023	2022	2021
Federal income tax at statutory rate	21.0 %	21.0 %	21.0 %
State income tax	1.3	—	4.5
Change in valuation allowance	13.6	0.8	(23.9)
Stock-based compensation	(14.2)	(16.7)	(0.2)
Executive compensation	8.1	(5.3)	(2.0)
Tax credits	0.8	0.6	0.9
Investments in subsidiaries and other	(29.0)	—	—
Other	(1.6)	0.3	(0.2)
Effective tax rate	— %	0.7 %	0.1 %

The Company's deferred tax assets and liabilities consist of the following (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Deferred tax assets:			
Net operating loss carryforwards	$ 277,559	$ 434,020	$ 174,127
Tax credit carryforwards	64,157	74,336	37,455
Capitalized research and development costs	185,462	162,601	—
Accrued expenses	616	1,330	2,690
Deferred revenue	36,225	46,798	45,928
Stock-based compensation	83,037	124,126	318,049
Amortizable intangibles	5,505	6,010	3,834
Lease liabilities	60,197	113,665	—
Investments in subsidiaries	58,447	—	—
Tenant allowance	—	—	2,927
Other	952	863	—
Deferred tax assets before valuation allowance	772,157	963,749	585,010
Valuation allowance	(711,778)	(833,086)	(583,107)
Deferred tax assets, net of valuation allowance	60,379	130,663	1,903
Deferred tax liabilities:			
Amortizable intangibles	(16,873)	(23,583)	(4,722)
Property, plant, and equipment	(410)	(13,405)	(830)
Lease right-of-use assets	(52,409)	(103,357)	—
Basis differences	—	—	(1,522)
Deferred tax liabilities	(69,692)	(140,345)	(7,074)
Net deferred taxes	$ (9,313)	$ (9,682)	$ (5,171)

Activity in the deferred tax assets valuation allowance is summarized as follows (in thousands):

	Beginning of Period	Additions (Subtractions)	End of Period
Deferred tax assets valuation allowance:			
Year Ended December 31, 2023	$ 833,086	$ (121,308)	$ 711,778
Year Ended December 31, 2022	$ 583,107	$ 249,979	$ 833,086

The Company has evaluated the positive and negative evidence bearing upon its ability to realize the deferred tax assets. The Company considered its history of cumulative net losses incurred since inception and has concluded that it is more likely than not that it will not realize the benefits of the deferred tax assets. Accordingly, a valuation allowance has been established against the deferred tax assets as of December 31, 2023 and 2022 that are not expected to be realized. The Company reevaluates the positive and negative evidence at each reporting period. The valuation allowance decreased on a net basis by approximately $121.3 million during the year ended December 31, 2023 primarily due to the deconsolidation of Zymergen which impacted deferred tax positions related to net operating loss and tax credit carryforwards, lease liabilities and right of use assets, and investments in subsidiaries, partially offset by an increase in the deferred tax asset related to capitalized research and development costs, as required by the Tax Cuts and Jobs Act of 2017.

As of December 31, 2023, the Company had federal net operating loss carryforwards of approximately $1.0 billion, of which $139.2 million will begin to expire in 2029 and $884.1 million can be carried forward indefinitely. As of December 31, 2023, the Company had state net operating loss carryforwards of approximately $998.2 million, of which $869.2 million will begin to expire in 2030 and $129.0 million can be carried forward indefinitely. As of December 31, 2023, the Company had foreign net operating losses of approximately $1.7 million, which can be carried forward indefinitely.

As of December 31, 2023, the Company had federal research and development tax credit carryforwards of approximately $40.4 million, which will begin to expire in 2029. As of December 31, 2023, the Company also had state research and development and investment tax credit carryforwards of approximately $30.1 million, which will begin to expire in 2030.

Under Sections 382 and 383 of the U.S. Internal Revenue Code, if a corporation undergoes an ownership change, the corporation’s ability to use its pre-change net operating loss carryforwards and other pre-change tax attributes, such as research tax credits, to offset its post-change income and taxes may be limited. In general, an ownership change generally occurs if there is a cumulative change in its ownership by 5% stockholders that exceeds 50 percentage points over a rolling three-year period. Similar rules may apply under U.S. state tax laws. The Company may have experienced an ownership change in the past and may experience ownership changes in the future as a result of future transactions in its share capital, some of which may be outside of the Company’s control. As a result, if the Company earns net taxable income, the Company's ability to use its pre-change net operating loss carryforwards, or other pre-change tax attributes, to offset U.S. federal and state taxable income and taxes may be subject to significant limitations.

We assess the impact of various tax reform proposals and modifications to existing tax treaties in all jurisdictions where we have operations to determine the potential effect on our business and any assumptions we have made about our future taxable income. We cannot predict whether any specific proposals will be enacted, the terms of any such proposals or what effect, if any, such proposals would have on our business if they were to be enacted. There was no major tax legislation enacted during 2023, in the jurisdictions in which we operate, that will have a material impact on the Company’s consolidated financial statements.

The Company files tax returns as prescribed by the tax laws of the jurisdictions in which the Company operates. In the normal course of business, the Company is subject to examination by U.S. federal, state, local, and foreign taxing authorities, where applicable. There are currently no tax examinations in progress. As of December 31, 2023, with few exceptions, the Company is no longer subject to U.S. federal, state, local, or foreign examinations by tax authorities for tax years before 2014. To the extent the Company has tax attribute carryforwards, the tax years in which the attribute was generated may still be adjusted upon examination by the Internal Revenue Service or state taxing authorities to the extent utilized in a future period.

The Company accounts for uncertain tax positions using a more likely than not threshold for recognizing and resolving uncertain tax positions. The evaluation of uncertain tax positions is based on factors that include, but are not limited to, changes in tax law, the measurement of tax positions taken or expected to be taken in tax returns, the effective settlement of matters subject to audit, new audit activity and changes in facts or circumstances related to a tax position. The Company

evaluates uncertain tax positions on an annual basis and adjusts the level of the liability to reflect any subsequent changes in the relevant facts surrounding the uncertain positions. The Company accounts for interest and penalties related to uncertain tax positions as part of its provision for income taxes. As of December 31, 2023 and 2022, the Company had no recorded liabilities for uncertain tax positions and had no accrued interest or penalties related to uncertain tax positions. The Company does not expect a material change in unrecognized tax benefits in the next twelve months.

19. Net Loss per Share

The Company computes net loss per share of Class A common stock and Class B common stock using the two-class method required for participating securities. The earnings per share amounts are the same for the different classes of common stock because the holders of each class are legally entitled to equal per share distributions whether through dividends or liquidation. The calculation of basic and diluted earnings per common share is as follows (in thousands, except per share amounts):

	Year Ended December 31,		
	2023	2022	2021
Numerator:			
Net loss attributable to Ginkgo Bioworks Holdings, Inc. stockholders, basic	$ (892,869)	$ (2,104,929)	$ (1,830,047)
Less: change in fair value of warrant liabilities	—	—	58,615
Less: change in fair value of contingent consideration common shares liability	—	3,143	—
Net loss attributable to Ginkgo Bioworks Holdings, Inc. stockholders, diluted	$ (892,869)	$ (2,108,072)	$ (1,888,662)
Denominator			
Weighted average common shares outstanding, basic	1,944,420	1,679,061	1,359,849
Effect of dilutive securities:			
Warrants	—	—	525
Contingent consideration common shares	—	777	—
Weighted average common shares outstanding, diluted	1,944,420	1,679,839	1,360,373
Basic net loss per share	$ (0.46)	$ (1.25)	$ (1.35)
Diluted net loss per share	$ (0.46)	$ (1.25)	$ (1.39)

The following potential common shares, presented based on amounts outstanding at each period end, were excluded from the calculation of diluted net loss per share attributable to Ginkgo Bioworks Holdings, Inc. common stockholders for the periods presented because including them would have been anti-dilutive (in thousands):

	As of December 31,		
	2023	2022	2021
Unvested RSUs	152,168	134,436	168,322
Ginkgo and Sponsor earnout shares [1]	152,122	156,781	160,995
Warrants to purchase Class A common stock	51,825	51,825	—
Outstanding stock options	7,688	12,711	25,229
Unvested RSAs	—	4	183
	363,803	355,757	354,729

(1) Represents earnout shares for which the service-based and/or market-based vesting conditions have not been satisfied.

20. Related Parties

The Company's significant transactions with its related parties are primarily comprised of revenue generating activities under collaboration and license agreements.

Significant related party transactions included in the consolidated balance sheet, excluding the Company's investments and equity method investments, are summarized below (in thousands):

	As of December 31,	
	2023	2022
Accounts receivable:		
Allonnia	$ 322	$ 140
Ayana	233	403
Arcaea	126	335
Verb	61	361
BiomEdit	—	288
Other equity investees	—	31
	$ 742	$ 1,558
Deferred revenue, current and non-current:		
Motif FoodWorks	$ 45,426	$ 52,018
Allonnia	36,062	35,876
Arcaea	33,066	38,334
BiomEdit	7,712	8,144
Genomatica	2,018	6,250
Ayana	56	—
Other equity investees	139	875
	$ 124,479	$ 141,497

Significant related party transactions included in the consolidated statements of operations and comprehensive loss, excluding the losses on the Company's investments and equity method investments, are summarized below (in thousands):

	Year Ended December 31,		
	2023	2022	2021
Cell Engineering revenue:			
Motif FoodWorks	$ 6,660	$ 1,937	$ 20,224
Arcaea	6,024	13,490	3,676
Genomatica	4,232	10,861	12,868
BiomEdit	2,171	1,016	—
Ayana	1,323	1,266	—
Verb	584	2,359	—
Allonnia	523	4,332	5,126
Joyn Bio	—	2,896	5,254
Other equity investees	705	656	13
	$ 22,222	$ 38,813	$ 47,161

Refer to Notes 5 and 16 for additional details on the Company's investments and equity method investments held in its related parties.

Beginning in April 2022, the Company purchased a series of convertible promissory notes from its then equity method investee, Joyn Bio, in the aggregate principal amount of $10.0 million for the purpose of financing Joyn Bio's working

capital needs. Each convertible promissory note was unsecured, had a maturity date of March 31, 2023 and an interest rate of 4.5% per annum. The notes were automatically convertible into equity at a 20% discount upon a qualifying equity financing. Additionally, the Company could elect to convert the notes into equity at a 20% discount upon a non-qualifying equity financing, at maturity, or elect to be repaid in cash upon a change in control or initial public offering. The Company evaluated the notes' conversion and redemption features for embedded derivatives and determined that there is no embedded derivative to record. The Company also determined that the convertible notes are not in-substance common stock and therefore are not considered an additional investment in the equity method investee. During the year ended December 31, 2022, the carrying amount of the notes was reduced by $5.3 million, which represents the excess loss on the equity method investment in Joyn Bio over the carrying value of the investment, which has been reduced to zero during the year ended December 31, 2022. The outstanding balance of the notes receivable was effectively settled as part of the business combination transaction with Bayer and Joyn Bio described in Note 3 and was included as part of the consideration paid for the business combination.

21. Subsequent Events

On January 18, 2024, the Company, through certain of its affiliates, completed its acquisition of substantially all of Zymergen's assets, and on February 5, 2024, Zymergen's plan of liquidation was confirmed by the Bankruptcy Court. All of the Company's interests in the Zymergen entities were extinguished and terminated as of February 23, 2024. Refer to Note 3 for additional details on the Company's acquisition of Zymergen's assets.

On February 27, 2024 the Company entered into a land and building development and lease agreement whereby the landlord will secure the site and fund the construction and fit out of a biotechnology facility in the Qatar Free Zones. Once the fit out of the space is complete, Ginkgo will lease the space for an 18 year term and pay an annual fixed rent component comprised of 9.5% of the total facility development costs, which are estimated to be $25.0 million, and a variable rent component of 3.5% of any future annual net revenue generated at the facility. The agreement also contains a $5.0 million minimum commitment on capital expenditures due prior to the rent commencement date.