Via Electronic Mail

June 15, 2021

Hon. Gary Gensler
Chair,
Securities and Exchange
Commission 100 F St, NE
Washington, DC 20549

Re: Public Input on Climate Change Disclosures

Dear Chair Gensler:

On my behalf of Dynamhex Inc., I appreciate the opportunity to provide comments to the Securities and Exchange Commission (the "Commission") regarding its recent public statement and request for input on climate change disclosure. Dynamhex is submitting this statement to help the SEC and its core principles of protecting investors, capital formation, and more efficient markets[1].

Dynamhex has worked with cities, companies and utilities to provide data and software to help with this process. What we see is that many in the investment world cannot access or use subscriptions to certain data services, know-how and tools which are mostly only available to large-scale institutional investors. As a participant in 40th Annual SEC Small Business Forum and look to engage where we can have the most impact, because most climate tools are reserved for large banks and financial institutions. We want small and diverse businesses focused on data to help markets be efficient for all participants, and thus, we want to share these comments with the broader community.

[1] Dynamhex especially agrees with what you (Chair Gensler) said on CNBC's "Squawk Box", Friday, May 7th, "investors want to understand more information about climate risk and human capital and the drivers of value inside of the businesses and the drivers of risk inside of the businesses." We agree, investors and the investment community more broadly wants to know how their investment choices might impact the world.

Entities need to manage climate change targets and energy transition plans with data-backed, actionable and cost-effective solutions. There are countless standards the SEC can look at and adhere to as well as intermediaries like rating agencies and non-governmental organizations that have their own framework. Investors need pathways and methods to link timely, standardized and localized data using analytical visualizations to science-based emission reduction targets. As a collective, we need better tools and data to facilitate the much-needed collaboration between municipalities, businesses, and stakeholders.

The SEC can support both climate leaders and laggards as they work to make data-driven decisions to prioritize and implement energy strategies in a timely fight against climate change. In doing so, the commission can support the needs of investors looking to understand how cities and corporations around the world are looking to significantly deepen and accelerate their technical efforts. The SEC's rules must promote a sustainable future through transition to cleaner energy across power, building and transportation that helps to democratize and decarbonize our economic system. Much of the action required to slash emissions will need to come from power generators, residents, building owners, and companies within cities, where most of the emissions originate nationally and globally. As a result, the SEC should look at how to measure the current emissions across such heterogenous assets and sources and finally, quantify risks and opportunities of investments and activities that can accurately report emissions reductions according to sets of standard entities are currently applying in measuring and proposing reductions.

For years, we have been helping our customers and clients to visualize complex consumption patterns across individual, corporate and municipal footprint. Such a data-backed application layer was missing from existing industry solutions on the market which limited the number of willing participants interested in translating their operational data into a climate disclosure format. The underlying technology of the product, which was the focus and subject of my four-year long Ph.D. dissertation, has gone through incubation stages garnering the necessary strategic and regulatory approval to implement climate action plans. The technology approach has been peer-reviewed in academic journals and received technology grants due to its innovative concept and ability to scale. Finally, with usage by municipalities for their local ordinances and resolutions, as well as FORTUNE 100 companies, the application is in a unique position to bridge the intent of today with actions of tomorrow.

Throughout the years, we have been privy to a robust understanding of how emission reduction technologies operate on the ground, and which projects outperform in decarbonization of a city or community infrastructure, or how consumers, such as residents, citizens and local organizations, evaluate such services before adoption – all of which would be important to consider as the commission looks to create and implement disclosure standards.

The nature of negative externalities at the heart of climate change means that any and every economic agent is a market participant affected by current and future disclosure standards. Being an immigrant from Bangladesh, a country disproportionately dealing with the effects of climate, the nexus of climate change mitigation and adaptation, and the role markets play in it, constantly guided my academic and professional pursuits.

Below in this letter, I will concentrate on climate change disclosures that should adequately inform investors about the impacts, and opportunities of mitigation – from compliance with international accords, changes in market demand for goods or services, with robust and greater consistency for company filings – and I will do this in four steps, namely (1) the key elements of the disclosure standard for mitigation, (2) enforceability given the disclosure elements, and (3) compatibility of these elements to the broader landscape and market ecosystem to better facilitate market outcomes.

On behalf of Dynamhex, we hope this framework and supporting analytic model can help facilitate the disclosure of consistent, comparable, and reliable information on climate change and inform potential new Commission disclosure requirements, and potential new disclosure frameworks that the Commission looks to adopt or incorporate. Thoughts are also added about how the Commission might best regulate such disclosures.

Sincerely,

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Disclosure elements

The first of four items are related to Questions #1, #2 and #6[2] and describes *what* to disclose at the entity, asset or operations level on climate change mitigation. The technical appendix goes into details around each pertinent aspect, but below is a summary of inputs.

Quantifiable information, which auto-updates and is continuously being augmented in a consistent and standard format should be disclosed according to the new standard. These disclosures and their standard format, structure, reliability threshold and frequency of updates should be set by the commission. These include both market-based and location-based annual scope 1, 2 and 3 emissions, from their corresponding sources (i.e., energy and material inputs at the asset-level, in both BTU of consumption across energy types as well as mass or volumetric units of material consumption) as well as reduction targets (absolute and intensity) and scenarios under which they might meet said targets. Figure 1.a. shows graphically this notion.

Annual percentage progress made to each of the emissions scope should also be required as not to lead to incompatible baselining and targeting. Oversight and regulation around the monitoring and review of these quantifiable and measurable data inputs, and periodical guidance on both data quality and progress towards goals will be foundational to the goals of climate-related disclosures. While all baseline emissions and annual targets

[2] 1. How can the Commission best regulate, monitor, review, and guide climate change disclosures in order to provide more consistent, comparable, and reliable information for investors while also providing greater clarity to registrants as to what is expected of them? Where and how should such disclosures be provided? Should any such disclosures be included in annual reports, other periodic filings, or otherwise be furnished?

2. What information related to climate risks can be quantified and measured? How are markets currently using quantified information? Are there specific metrics on which all registrants should report (such as, for example, scopes 1, 2, and 3 greenhouse gas emissions, and greenhouse gas reduction goals)? What quantified and measured information or metrics should be disclosed because it may be material to an investment or voting decision? Should disclosures be tiered or scaled based on the size and/or type of registrant)? If so, how? Should disclosures be phased in over time? If so, how? How are markets evaluating and pricing externalities of contributions to climate change? Do climate change related impacts affect the cost of capital, and if so, how and in what ways? How have registrants or investors analyzed risks and costs associated with climate change? What are registrants doing internally to evaluate or project climate scenarios, and what information from or about such internal evaluations should be disclosed to investors to inform investment and voting decisions? How does the absence or presence of robust carbon markets impact firms' analysis of the risks and costs associated with climate change?

6. How should any disclosure requirements be updated, improved, augmented, or otherwise changed over time? Should the Commission itself carry out these tasks, or should it adopt or identify criteria for identifying other organization(s) to do so? If the latter, what organization(s) should be responsible for doing so, and what role should the Commission play in governance or funding? Should the Commission designate a climate or ESG disclosure standard setter? If so, what should the characteristics of such a standard setter be? Is there an existing climate disclosure standard setter that the Commission should consider?

should be implemented immediately, the data quality and additional reporting items can be phased over time upon sector-specific or market-specific constraints and discovery.

This process will further help create and strengthen carbon markets, since the current lack of standardization is a barrier to functioning markets in higher perceptions of risk and transaction costs. While the commission can set the standards, and each individual reporting entity can report on that standard, more novel ways of generating, estimating, validating, parsing and storing of such data should be opened up to companies that can specialize in further creating or unlocking value. As a result, reporting entities will shift their focus from a compliance burden to value-creating opportunities.

Enforceability

Second, and relatedly, the locus of activity around sector-specific disclosures should have the flexibility to accommodate idiosyncrasies of sectors and industries, yet enough stringency to reduce or eliminate inconsistency and non-comparability. This notion relates to questions #3, 9 – 11 and 15[3]. In creating these standards and requiring a set of inputs that

[3] 3. What are the advantages and disadvantages of permitting investors, registrants, and other industry participants to develop disclosure standards mutually agreed by them? Should those standards satisfy minimum disclosure requirements established by the Commission? How should such a system work? What minimum disclosure requirements should the Commission establish if it were to allow industry-led disclosure standards? What level of granularity should be used to define industries (e.g., two-digit SIC, four-digit SIC, etc.)?

9. What are the advantages and disadvantages of developing a single set of global standards applicable to companies around the world, including registrants under the Commission's rules, versus multiple standard setters and standards? If there were to be a single standard setter and set of standards, which one should it be? What are the advantages and disadvantages of establishing a minimum global set of standards as a baseline that individual jurisdictions could build on versus a comprehensive set of standards? If there are multiple standard setters, how can standards be aligned to enhance comparability and reliability? What should be the interaction between any global standard and Commission requirements? If the Commission were to endorse or incorporate a global standard, what are the advantages and disadvantages of having mandatory compliance?

10. How should disclosures under any such standards be enforced or assessed? For example, what are the advantages and disadvantages of making disclosures subject to audit or another form of assurance? If there is an audit or assurance process or requirement, what organization(s) should perform such tasks? What relationship should the Commission or other existing bodies have to such tasks? What assurance framework should the Commission consider requiring or permitting?

11. Should the Commission consider other measures to ensure the reliability of climate-related disclosures? Should the Commission, for example, consider whether management's annual report on internal control over financial reporting and related requirements should be updated to ensure sufficient analysis of controls around climate reporting? Should the Commission consider requiring a certification by the CEO, CFO, or other corporate officer relating to climate disclosures?

15. In addition to climate-related disclosure, the staff is evaluating a range of disclosure issues under the heading of environmental, social, and governance, or ESG, matters. Should climate-related requirements be one component of a broader ESG disclosure framework? How should the Commission craft climate-related disclosure

form the basis of climate change disclosures, special attention needs to be paid to incorporate enough of the current standards and existing disclosures from bodies, from across different sectors that have already invested heavily in standardizing their sector specific inputs. However, two main points need to be maintained – one, the individual sector-specific disclosure standards must manually map to the overall commission-driven standard under consideration. Next, any subjective assertions or unaccounted inputs to the emissions profile should be enforced as not to lead to "greenwashing" or other accidental or deliberate exclusion. While narratives have their place, the atmospheric concentration is impartial to contexts and organizational nuance. By having the executive board and personnel analyze the requirements for the framework and signing off on the disclosures will mitigate against such possibilities of over-extending narratives at the expense of accurate and comparable emissions data disclosures. Figure 1.b. graphically shows how both targets and scenarios should be robust and standardized enough for easier comparability between different reporting entities, as well as clarity regarding year-on-year emission reduction goals given the validated climate target across the organization's relevant boundary.

Additionally, climate disclosures, should be standalone metrics, not to be lumped in to other "subjective" or "marketable" social categories, such as "S" and "G" in ESG. While all of the elements are very important, the classification of environmental degradation to be equated to social and governance issues, can be misleading and confusing. Much like how physics, chemistry and biology are all tenets of the natural world, yet studied differently at the very basic level, the environmental degradation and the entity's contribution to that degradation should be a standalone matter measured in MT CO2eq and other physical units, at the asset level (LCBS code for each real property mapped to NAICS, GICS and SIC code) for easier strategy or optimization, goal setting and climate target achievement – unencumbered by competing mutual goals that is irrelevant to climate change. Confounding them with non-MT CO2eq metrics invites non-comparability and diverts attention from climate goals and the near-term goal of lowering atmospheric concentrations of greenhouse gas emissions.

requirements that would complement a broader ESG disclosure standard? How do climate-related disclosure issues relate to the broader spectrum of ESG disclosure issues?

Compatibility

Finally, and expanding from the two points above regarding the reporting of MT CO2eq across different geographies, and assets, the importance of compatibility, not just on sectoral inputs, but operational and regulatory outputs will be key – relating to questions #4, 5 and 7 from the SEC request[4]. To make informed capital allocation on funding or not funding specific projects or opportunities, compatible identification of the baseline emissions of owned or leased assets, and upstream and downstream actions will be necessary to decision-making. With more compatibility, the same outcomes that are reported to the regulators, can be used to create new value creating opportunities, such as in supply chain partnerships and other innovative programs. Alignment and integration of available data and standards is thus crucial.

The technical appendix goes in further details regarding how disclosure elements could unlock such value through more efficient allocation of capital for market-based solutions to climate change. Figure 1.c. and 1.d. summarizes how compatibility of the disclosure elements in their standard taxonomy, and in the required framework, not only helps the commission enforce and regulate better information regarding the risks and opportunities for climate change at a single organization, or even asset-level (or sector-specific, such as PCAF, API, SASB, TCFD, etc.), but enables more climate solutions to be transacted in ways that help the focal organization reduce their Scope 1 to 3 emissions. Such a data layer, and subsequent APIs could be provided for private companies, investors and market participants to appropriate assist in significant and verifiable GHG reductions.

[4] 4. What are the advantages and disadvantages of establishing different climate change reporting standards for different industries, such as the financial sector, oil and gas, transportation, etc.? How should any such industry-focused standards be developed and implemented?

5. What are the advantages and disadvantages of rules that incorporate or draw on existing frameworks, such as, for example, those developed by the Task Force on Climate-Related Financial Disclosures (TCFD), the Sustainability Accounting Standards Board (SASB), and the Climate Disclosure Standards Board (CDSB)? Are there any specific frameworks that the Commission should consider? If so, which frameworks and why?

7. What is the best approach for requiring climate-related disclosures? For example, should any such disclosures be incorporated into existing rules such as Regulation S-K or Regulation S-X, or should a new regulation devoted entirely to climate risks, opportunities, and impacts be promulgated? Should any such disclosures be filed with or furnished to the Commission?

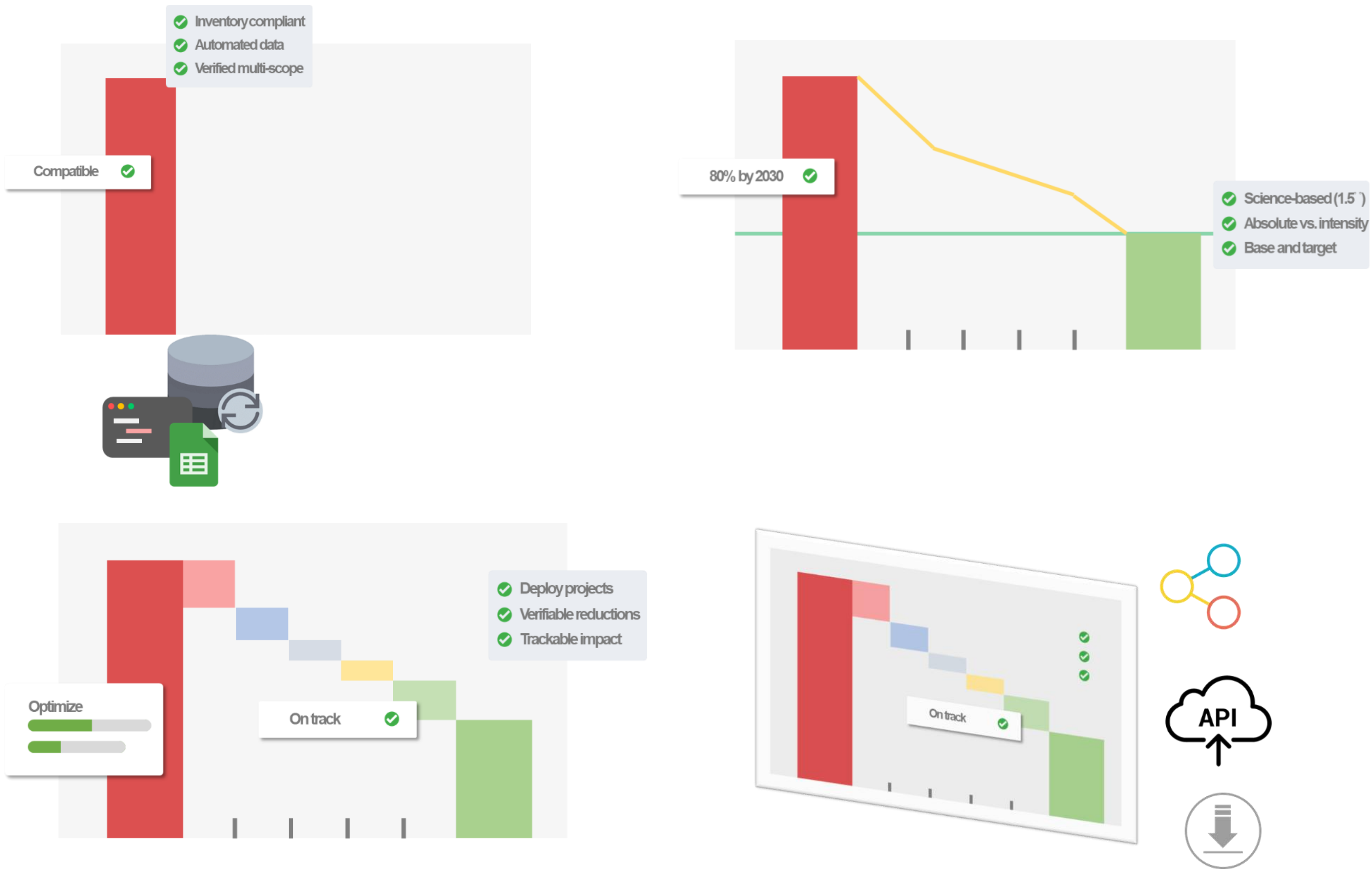


Figure 1: Top left (a): Elements of the disclosure should standardized across each input source. Top right (b): The forward-looking climate targets as well as annual Scope 1 – 3 baselines should be verified. Bottom left (c): Target year and emissions levels should be matched to annual project-level emissions reductions to estimate the extent to which reporting entity is on target. Bottom right (d): The framework shall output disclosures in multiple formats across different reporting framework and stakeholder assessment formats.

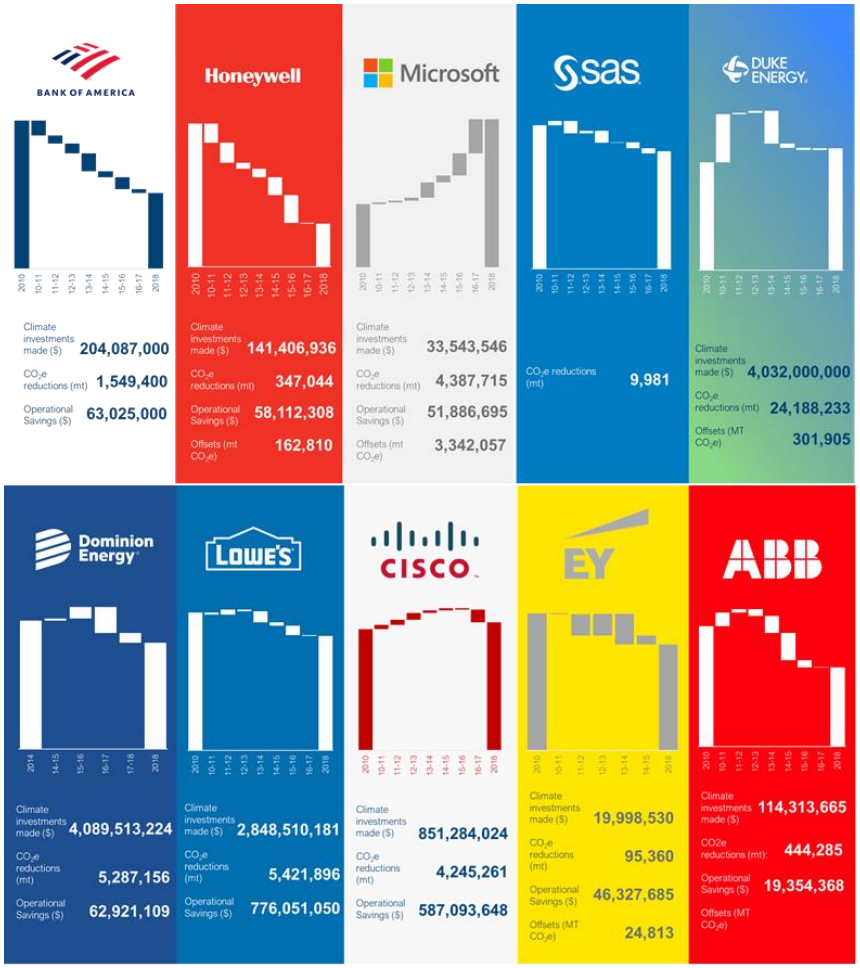


Figure 2: Compatible way of understanding metrics and targets for GHG mitigation. Example shows select companies, for informational purposes only.

Technical Appendix

1 Introduction

The problem of reducing emissions is one of the most challenging and important for the future threatened by climate change. Climate change mitigation is complex because most clean energy plans require significant collaboration - portions of the emissions are controlled by different groups. Power is controlled by electric utilities, whereas transportation planning and building codes are what cities control. Each structure is what building owners' control, but behavior is what tenants and residents control. No one solution meets climate targets independently which brings us to the underlying problem – Each party are all necessary, yet independently insufficient to meet goals.

The sheer climate action planning complexity and underlying data analyses is too burdensome for one party or a single side of the market to achieve on their own. In such cases, unnecessary coordination costs are added that limits the reach of the market - and this is especially true in climate change mitigation. Increase in the consumption and production rates causes increase of emissions. However different individuals or organizations do not always choose to adapt net-zero solutions for running their households and businesses as is often explained by the fact that such solutions come with a higher cost.

If all market participants were to choose an environment-friendly solution the humankind would be able to prevent the occurring climate change. In Section 2 I explain that the probability of such a future is extremely small if business-as-usual scenarios unfolds without intentionally decarbonizing economies. I introduce a probabilistic model, which allows to compute and estimate the probability of achieving a desirable amount of emissions (critical emissions) by a group of entities, registrants or organizations. This is the bulk of what disclosures around climate change should be meant to contextualize. If one is given the critical emission value at the level of an individual entity, I explain in Section 3 how this can be achieved by solving an optimization problem, only when the disclosures are standardized, machine-readable, continuously updating and integrative with different climate accounting standards and formats.

Before I formulate it mathematically I need to introduce some notations, which simplify the focus on sectors, assets, regional boundaries and action. I assume that there are 4 entity types among which U power utilities, P cities, J entities and V many solutions.

For the purpose of modelling one can aggregate cities and organizations in those cities together. To solve climate change, we cannot ignore cities and the impact of location-based carbon accounting because mathematically speaking municipalities and their regional boundaries account for a majority of US and global emissions. Cities also control drivers for decarbonization, such as building codes, taxation, ordinances, transportation planning etc. Cities should be leading decarbonization, but they are still falling behind due to the lack of a data disclosure framework.

There are over 30,000 city or town communities in the US, with thousands of power generators and electric utilities selling electricity with varying emissions mix, some are in states with climate plans and energy goals as executive orders, and equal amounts of clean energy solution providers, while others are not. To think that accidentally all of these disparate generating entities and community goals will converge to solve the planetary crisis in under 10 years is near zero, in current ad hoc ways in which mitigation is planned and attempted to be implemented in.

In the following I am going to consider events like

$$\text{"Entity } j \text{ takes climate action } v \text{ and purchases inputs from upstream provider } u\text{".} \quad (1)$$

In order to simplify the mathematical model further I am combining climate actions, or solutions v and upstream provider, such as utilities, u by considering instead pairs $v' = (v, u)$, which I call refined solutions. In this new terminology the former event (1) reads "entity j takes solution v'". Since the letter v (resp. V) is not anymore used, I am going to denote refined solutions v' by the former v and their total number by V. Each particular disclosing organization j possesses r_j many assets (vehicles, plants, real estate units, etc.). In particular, the emission/consumption profile of a entity j is built up of emission/consumption profiles of their artifacts or assets. This asset-organization relationship is expanded upon in Section 3, when I discuss algorithms for reduction of consumption and emissions at the level of single disclosing entity.

2 Encoding disclosure tenets into the climate change framework

When studying large and complicated systems it is usually impossible to understand the behaviour of individual elements of the system. One instead tries to model the behaviour of "typical" representatives e.g. based on what has been already learnt about the system. In this section I attempt to describe emission profiles of different entities, assuming that they behave randomly.

Under some mild independence assumptions I am able to derive a formula for the probability function of total (i.e. from all entities in a certain group) emissions. However, before that I introduce a discrete probabilistic model. This model shows that the situation when every reporting entity takes a climate action or deploys a solution that is good for the environment due to its emissions reduction ability (in a specified sense) is rather unrealistic, that is, its probability decreases to zero exponentially fast as the number of entities or disclosing companies increases.

This means that coordination, not mere disclosures are the key feature for successful and higher probability impact on climate. As such, disclosures should be developed with the integration in mind, such that collaboration is facilitated around all the disclosing entities across the system and sub-system. Only this, as mathematically show, will lead to different economic agents and actors, be it investors, regulators, insurers, asset owners and regulators, to make sound decisions in the correct direction. Metrics and targets, thus should be starting point.

2.1 Input data - Climate metrics and targets

In this subsection, I consider so called discrete model for estimating the probability of climate change. For this let us assume that different entities take solutions independently. The probability of entity j taking solution v equals $P(j, v)$ with $0 \leq P(j, v) \leq 1$. As a consequence, for any entity j I have

$$\sum_v P(j, v) = 1,$$

where the sum runs over the set of V solutions. The last expression literally means that a given entity randomly picks one of the V many solutions. If I am given n entities $j_1, \ldots, j_n$ which take solutions $v_1, \ldots, v_n$, the probability of the event that j_i takes v_i equals

$$P(j_1, v_1) \cdot \ldots \cdot P(j_n, v_n). \tag{2}$$

Now I am going to illustrate how large the probability of climate change is according to this model. For this let me assume that there are $V_+ < V$ many solutions that are considered positive from the point of view of the climate change. For each particular entity taking any of these V_+ solutions leads to relatively small emissions (relative to some margin). Thus, the probability that a entity j adopts a positive solution equals

$$P(j, +) = \sum_{v_+} P(j, v_+) \leq 1, \tag{3}$$

where the summation goes over the set of V_+ positive solutions. If there are n entities $j_1, \ldots, j_n$ whose probabilities satisfy $P(j_i, +) \leq p$, $i = 1, \ldots, n$, for some $p < 1$, then the probability of positive impact on the climate change from these n entities equals

$$P(j_1, +) \cdot \ldots \cdot P(j_n, +) \leq p^n, \tag{4}$$

where the initial assumption about statistical independence of events "entity j takes solution v" is used. Larger n gets, smaller this probability is, because p^n tends to 0 as $n \to +\infty$. If, for example $p = 1/2$, the above estimate implies

$$P(j_1, +) \cdot \ldots \cdot P(j_n, +) \leq \frac{1}{2^n} \tag{5}$$

and one can clearly see the rate of convergence to zero of this probability, see Fig.2.

Figure 1: Plots of points (n, A_n) with the second coordinate $A_n = a_1 \cdot \ldots \cdot a_n$ being the product of n numbers $a_1, \ldots, a_n$ randomly picked in the interval $[0, p]$, and the (blue) graph of the function $x \mapsto p^x$. The left (right) plot corresponds to $p = 0.5$ (resp. $p = 0.6$).

As a consequence, the discrete model under the above independence assumptions implies that the probability of positive impact on the climate change is globally very small (tends to zero as the number of entities one consider increases).

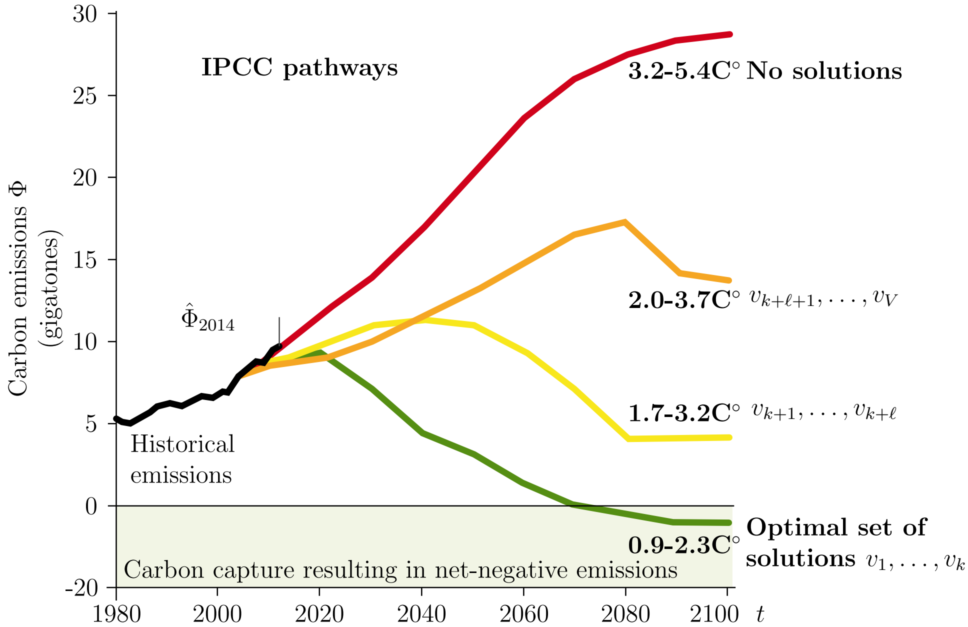
2.2 Robustness of the climate disclosures

In this subsection I propose a different, more realistic model, that also incorporates the amount of emissions caused by taking different solutions. Again here independence of the events "entity j takes solution v" is going to be assumed, where by $P(j, v)$ I denote the probability of the above event. I assume that at a given reference time moment t_0 the entity j emits $\Phi_0(j)$ units, which could include Scope 1, 2 and 3 emissions for the entity in their sectors.

The decade of climate action should start immediately (2021). And while corporations and governments are setting goals for 2030 or 2050, the only way we can reach them is if we set goals for 2021 and for each month and year after that leading up to the goal year. The best way to predict the future is to make it, and an annual cadence of measurement and verification would enable that.

For the disclosures to be meaningful, the framework needs to work backward from the very metric it is meant to expand upon, namely the climate. As such, below is the global view of climate, using the proxy by the historic level of carbon emissions per year. This orients the forward-looking aspect of disclosures across multiple levels.

In the diagram below I depict the global view of emissions $\Phi_0(j)$ across all j and will show how different solutions and climate actions that disclosing entities need to take, which can impact the carbon emission profile globally, nationally or across sectors. It is desirable that optimal solutions $v_1, \ldots, v_k$, as will be shown that Algorithm 3 produces all get into the green area of the diagram, where the impact on the climate change is the lowest. Other solutions are distributed as follows: some ℓ many of them get into sub-optimal "yellow" regime and the remaining ones are found in the sub-critical orange zone. When there are no solutions, the global system is in the critical red area.



Now, let us introduce a discrete random variable $\delta\Phi(j)$ that will be responsible for emissions caused by the disclosing entities annual operations and business activities. It takes the value $\delta\Phi(j,v)$ with probability $P(j,v)$. Then the emissions of the reporting entity j that took solution v equal $\Phi(j,v) = \Phi_0(j) + \delta\Phi(j,v)$ and $\Phi(j) = \Phi_0(j) + \delta\Phi(j)$ becomes itself a random variable. I assume that a given entity j can adopt only one solution at a time and that the random variable $\delta\Phi(j)$ is supported on $\{\Phi(j,v) : v = 1, \dots, V\}$ (that is, with nonzero probability it takes only these values). Under these assumptions I can compute the average emissions of the entity j:

$$\mathbb{E}(\Phi(j)) = \sum_{v=1}^{V} \Phi(j,v) \cdot P(j,v) = \Phi_0(j) + \mathbb{E}(\delta\Phi(j)) = \Phi_0(j) + \sum_{v=1}^{V} \delta\Phi(j,v) \cdot P(j,v).$$

I am interested in the total emissions from all entities

$$\Phi = \sum_{j=1}^{J} \Phi(j),$$

which is again a random variable. Given the independence assumptions that I made about entities behaviours', the expected total emissions equal

$$\mathbb{E}(\Phi) = \sum_{j=1}^{J} \sum_{v=1}^{V} \Phi(j,v) \cdot P(j,v) \;=\; \sum_{j=1}^{J} \Phi_0(j) + \sum_{j=1}^{J} \sum_{v=1}^{V} \delta\Phi(j,v) \cdot P(j,v),$$

where $\sum_{j=1}^{J} \Phi_0(j) =: \Phi_0$ are total emissions at the beginning. In order for the climate change to occur the total emissions need to be smaller than a certain critical value $\hat{\Phi} > 0$ or, equivalently, the total reduction $\delta\Phi := \Phi - \Phi_0$ needs to be smaller than a certain critical reduction amount $\delta\hat{\Phi} = \hat{\Phi} - \Phi_0 < 0$. The fact that $\delta\Phi$ (respectively $\delta\hat{\Phi}$) takes negative values is quite natural, since it equals the quantity that one needs to add to Φ_0 in order to obtain (in general smaller) Φ (respectively, achieve $\hat{\Phi}$). Moreover, all quantities $\Phi(j) = \Phi_t(j)$, $\Phi = \Phi_t$, $\delta\Phi(j) = \delta\Phi_t(j)$, $\delta\Phi = \delta\Phi_t$, $\hat{\Phi}(j) = \hat{\Phi}_t(j)$, $\hat{\Phi} = \hat{\Phi}_t$, $\delta\hat{\Phi}(j) = \delta\hat{\Phi}_t(j)$, $\delta\hat{\Phi} = \delta\hat{\Phi}_t$ are time-dependent, this will be reflected by a subscript t on several occassions.

Our goal is to estimate the probability of Φ being smaller than $\hat{\Phi}$. It is equal to

$$\begin{aligned} P(\Phi < \hat{\Phi}) &= \int_{\Phi(j_1)=0}^{\hat{\Phi}} P\left(\sum_{j=2}^{J} \Phi(j) < \hat{\Phi} - \Phi(j_1)\right) d\Phi(j_1) \\ &= \int_{\Phi(j_1)=0}^{\hat{\Phi}} \int_{\Phi(j_2)=0}^{\hat{\Phi}-\Phi(j_1)} \cdots \int_{\Phi(j_{J-1})=0}^{\hat{\Phi}-\sum_{j=1}^{J-2}\Phi(j)} P\left(\Phi(j_J) < \hat{\Phi} - \sum_{j=1}^{J-1} \Phi(j)\right) d\Phi(j_{J-1}) \dots d\Phi(j_2) d\Phi(j_1). \end{aligned} \tag{6}$$

By $d\Phi(j)$ in the above formula I denote the probability distribution of the random variable $\Phi(j)$, recall that it is determined by the values $\Phi(j, v)$ and $P(j, v)$ for $v = 1, \dots, V$. For a single entity j it is possible to give a closed form expression for the probability for its emissions being smaller than the critical value $\hat{\Phi}$:

$$P(\Phi(j) < \hat{\Phi}) = \sum_{v=1}^{V} \chi(\Phi(j, v) < \hat{\Phi}) P(j, v),$$

where

$$\chi(A) = \begin{cases} 1, & \text{if } A \text{ occurs,} \\ 0, & \text{otherwise,} \end{cases}$$

is the indicator function of the probabilistic event A. Equivalently, the probability of the entity j's reduction being smaller than $\delta\hat{\Phi}$ is given by

$$P(\delta\Phi(j) < \delta\hat{\Phi}) \;=\; \sum_{v=1}^{V} \chi\left(\delta\Phi(j, v) < \delta\hat{\Phi}\right) P(j, v). \tag{7}$$

The above semi-explicit formula for $P(\Phi < \hat{\Phi})$ allows us to compute the probability of reducing emissions to an arbitrary (a priori set) value $\hat{\Phi}$, provided we are given probability distributions of individual entities behaviours' and assuming their statistical independence.

In comparison with the former discrete model, the latter continuous one allows to model more complicated events incorporating subtleties of different entities' behaviours.

It is also more realistic since one cannot a priori say what are good or bad solutions from the point of view of climate change: at a particular time it all depends on the level of emissions caused by taken solutions, as even the most net-zero aligned solutions incur emissions, which is naturally included in the continuous model.

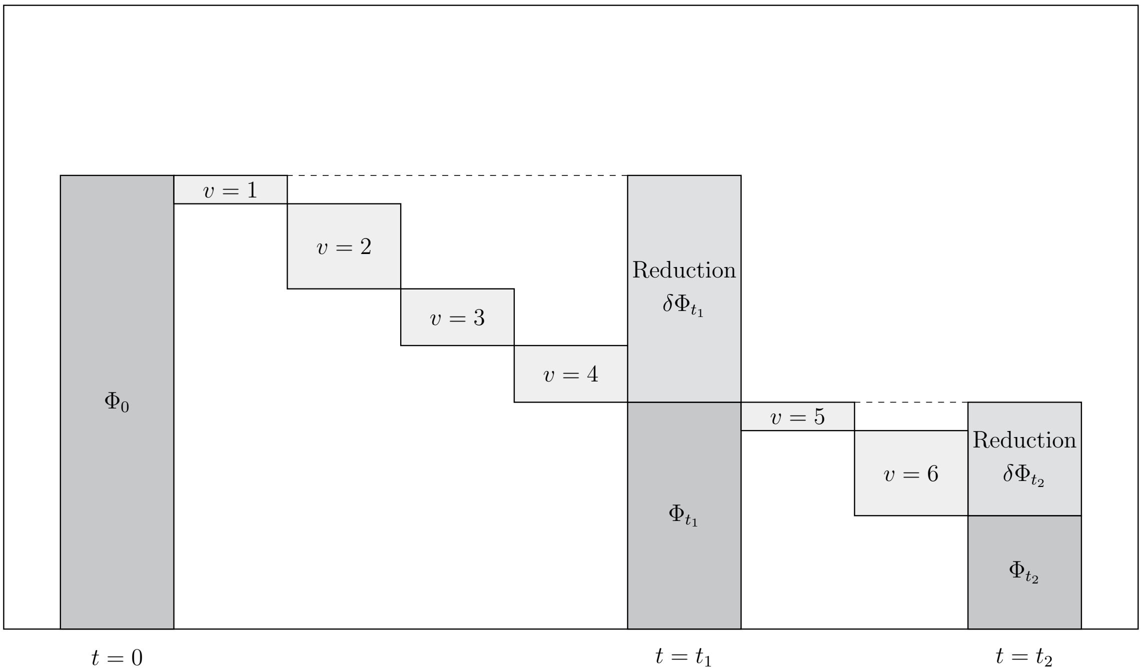
For example, disclosing entities, such as Corporate and municipal managers can now understand and identify their end-use efficiency upgrade opportunities, depending on their building stock parameters, as well as supplement consumption of energy by evaluating rooftop PV potential. As a result, the standard can help disclosing tap into retrofit potentials, such as through energy efficiency, at a granular level, querying which city parcel or building structure, by principle use and square footage is a good candidate for upgrades, such as from Central Air-Source Heat Pump to Variable-Speed Heat Pump, who some vendors are who could provide such services at a given cost, how the entity would engage and provide incentives or suggested financing packages for the property owner to do so, and how much progress would this would make on a company or city's climate action or emission reduction plan. Together, this affords decision-makers to develop and implement data-backed and strategic pathways toward a clean energy future by visualizing and modeling the potential impacts of their climate or energy action plans as well as being guided by experts and learning from peers all of whom are using the same framework.

Globally, climate bonds, which are funding city-level energy, building and transportation projects have capped over USD 225 billion this year. Visa and Alphabet together are issuing USD 6 billion in green bond infrastructure. The financial industry is following suite, with the new PCAF methodology, made up of Citi, Bank of America and Morgan Stanley among others, linking banks' carbon footprint in their debt instruments, both residential mortgages and auto loans, with the goal of making long-term decarbonization investments. After the public Blackrock letter about measuring climate impact, with several others like Microsoft following suit by pledging USD 1B over the next 48 months to create a low-carbon economy, joining many others. While some financial data exists internally for the lenders, accurate technical data on low-carbon solutions, as well as community-centric ones are once again the limiting factor to deep decarbonization.

Using data layers to facilitate such discussions is paramount, as most cities that can issue bonds for climate today still can't answer the even basic question of how much of their current city-wide ordinance or climate goal could be met if certain v actions were enacted, such as if all rooftops were to go PV solar, or how many tax exempt, city-owned buildings, or corporations with tangible climate targets within the cities geographic boundaries could make climate positive infrastructural investments. Knowing this allows climate finance to be accessed for deep decarbonization, at scale. If this was not the case, a new marketplace could be created already- one where utilities, corporations, banks and individuals transacted to optimize their carbon footprint with near-term investments, products, projects and services.

In this way each of the 30,000 cities and towns in the U.S. would be able to make cost-effective progress on emissions reductions through a machine-readable, and publicly-available roadmap because all these citizens knew what these goals mean. Marketplaces would allow crowdfunding through mini-bonds investments to larger projects, given everyone now knows their own household emissions footprints, as well as that of their communities. USD 4.5B of voluntary emissions offsets are being shipped across the globe without a tangible net-reduction of emissions; if they could instead be bond coupons converted from their personalized footprints, citizens could turn offsets to investments and fund projects in their communities and make money over time, instead of funding a project overseas that they can neither track nor track ownership of. Advanced frameworks with granular data can make this new world happen - and it comes at a time when corporations are setting targets, low-carbon solutions providers are ramping up while the climate positive investments are an all-time high.

The figure below illustrates that implementation of different climate actions results in the drawdown of Scope 1 to 3 emissions, with time for each disclosing entity.



2.3 A market facilitated by standard disclosures

Let us recall that the emission function $\Phi(j)$ of the entity j is built up as follows:

$$\Phi(j) \;=\; \sum_{\alpha} \Phi^{\alpha}(j), \tag{8}$$

where $\Phi^\alpha(j)$ denote the amount of emissions coming from the energy type $\alpha \in \{A, B, C\}$. The quantity $\Phi^\alpha(j)$ is linked to the consumption $\varepsilon^\alpha(j)$ by j of the energy α via the formula

$$\Phi^\alpha(j) \;=\; \gamma^\alpha \cdot \varepsilon^\alpha(j), \tag{9}$$

where γ^α is the emission factor of the energy type α. Note that γ^α does not depend on a particular entity j, as one would expect.

In view of these dependencies I can now extend the continuous model from Subsection 2.2 to include consumption values $\varepsilon^\alpha(j)$. Recall that $\Phi(j, v)$ denoted the emissions of the entity j when solution v is taken. It will be assumed that $\Phi(j, v)$ splits as follows

$$\Phi(j, v) \;=\; \sum_\alpha \Phi^\alpha(j, v) \;=\; \sum_\alpha \gamma^\alpha \cdot \varepsilon^\alpha(j, v), \tag{10}$$

where $\Phi^\alpha(j, v) = \gamma^\alpha \cdot \varepsilon^\alpha(j, v)$ and $\varepsilon^\alpha(j, v)$ is the consumption of the energy α by the entity j that has taken the solution v. If now the entity j take the solution v randomly with probability $P(j, v)$, then ε^α (and hence also $\Phi^\alpha = \gamma^\alpha \cdot \varepsilon^\alpha$) becomes a random variable: j consumes the amount $\varepsilon^\alpha(j, v)$ of the energy α with probability $P(j, v)$. The total consumption of the energy α is the function

$$\varepsilon^\alpha \;=\; \sum_{j=1}^{J} \varepsilon^\alpha(j), \tag{11}$$

whose γ^α multiple gives the total emissions coming from the energy type α. Summing up over α, I can obtain the total energy consumption

$$\varepsilon \;=\; \sum_\alpha \varepsilon^\alpha \;=\; \sum_\alpha \sum_{j=1}^{J} \varepsilon^\alpha(j). \tag{12}$$

Finally, I am ready to produce the analogue of formula (6) for consumption amounts. The probability that the total consumption of the energy α is less than some critical value $\hat{\varepsilon}^\alpha$ equals

$$P(\varepsilon^\alpha < \hat{\varepsilon}^\alpha) = \int_{\varepsilon^\alpha(j_1)=0}^{\hat{\varepsilon}^\alpha} P\left(\sum_{j=2}^{J} \varepsilon^\alpha(j) < \hat{\varepsilon}^\alpha - \varepsilon^\alpha(j_1)\right) d\varepsilon^\alpha(j_1)$$

$$= \int_{\varepsilon^\alpha(j_1)=0}^{\hat{\varepsilon}^\alpha} \int_{\varepsilon^\alpha(j_2)=0}^{\hat{\varepsilon}^\alpha - \varepsilon^\alpha(j_1)} \cdots \int_{\varepsilon^\alpha(j_{J-1})=0}^{\hat{\varepsilon}^\alpha - \sum_{j=1}^{J-2} \varepsilon^\alpha(j)} P\left(\varepsilon^\alpha(j_J) < \hat{\varepsilon}^\alpha - \sum_{j=1}^{J-1} \varepsilon^\alpha(j)\right) d\varepsilon^\alpha(j_{J-1}) \dots d\varepsilon^\alpha(j_2) d\varepsilon^\alpha(j_1).$$

By $d\varepsilon^\alpha(j)$ in the above formula I denote the probability distribution of $\varepsilon^\alpha(j)$, recall that it is completely determined by the values $\varepsilon^\alpha(j, v)$ and $P(j, v)$ for $v = 1, \dots, V$. For a single entity j this reduces to

$$P(\varepsilon^\alpha(j) < \hat{\varepsilon}^\alpha) \;=\; \sum_{v=1}^{V} \chi(\varepsilon^\alpha(j, v) < \hat{\varepsilon}^\alpha) P(j, v). \tag{13}$$

It will be important to consider the following more general version of (13):

$$P(\varepsilon^\alpha(j) \in (\varepsilon^\alpha_-, \varepsilon^\alpha_+)) \;=\; \sum_{v=1}^{V} \chi(\varepsilon^\alpha(j,v) \in (\varepsilon^\alpha_-, \varepsilon^\alpha_+))P(j,v),$$

where $(\varepsilon^\alpha_-, \varepsilon^\alpha_+) \subseteq \mathbb{R}$ is an arbitrary interval of real numbers. This last formula is especially important for the purpose of estimation of the probability of fitting of a collection of α-energies to given ranges:

$$\begin{aligned} &P\left(\varepsilon^A(j) \in (\varepsilon^A_-, \varepsilon^A_+) \,\&\, \varepsilon^B(j) \in (\varepsilon^B_-, \varepsilon^B_+) \,\&\, \varepsilon^C(j) \in (\varepsilon^C_-, \varepsilon^C_+)\right) \\ &= \sum_{v=1}^{V} \chi\left(\varepsilon^A(j,v) \in (\varepsilon^A_-, \varepsilon^A_+) \,\&\, \varepsilon^B(j,v) \in (\varepsilon^B_-, \varepsilon^B_+) \,\&\, \varepsilon^C(j,v) \in (\varepsilon^C_-, \varepsilon^C_+)\right) P(j,v). \end{aligned}$$

3 Asset-level scenario tracking

In this section I formulate and discuss an optimization problem that allows an individual entity to achieve desirable amounts of emissions/consumptions. For this let us denote by $\Phi^\alpha(j)$ the emissions incurred by consumption of the energy α by the entity j and by $\hat{\Phi}^\alpha(j)$ the critical emissions (to be achieved). Similarly, let us reserve $\delta\Phi^\alpha(j)$ and $\delta\hat{\Phi}^\alpha(j)$ for the reductions of the entity j and for the critical reduction (to be achieved) respectively. Recall also that each entity j possesses r_j many artifacts or assets, whose emission/consumption profiles $\Phi(j,r)/\varepsilon(j,r)$[1] are in general very different. It is exactly for this reason that we need to distinguish between different assets of the same reporting entity when optimizing energy consumption and reducing emissions.

Let us assume that we need to achieve the total amount $\hat{\Phi}_t$ of emissions by the time t or reduce the emissions by $\delta\hat{\Phi}_t$. At the initial moment of time $t = 0$ the consumption profiles are given by $\Phi_0(j,r)$, $r = 1, \ldots, r_j$. The idea is to distribute reduction quotas to individual assets (and ultimately to reporting entities) according to their consumption profiles at the beginning ($t = 0$). For this let me denote by

$$S(j,r) \;=\; \frac{\Phi_0(j,r)}{\Phi_0}, \quad \Phi_0 \;=\; \sum_{j=1}^{J} \sum_{r=1}^{r_j} \Phi_0(j,r), \tag{14}$$

the share (percentage) of the rth asset of the reporting entity j in the total consumed energy by $t = 0$. Then the reduction quotas are distributed as follows:

$$\delta\hat{\Phi}_t(j,r) \;=\; S(j,r) \cdot \delta\hat{\Phi}_t. \tag{15}$$

[1]Not to confuse with the already introduced notation $\Phi(j,v)$ from Section 2.

The total reduction amount of the entity j is obtained by summing up the GHG reduction quotas over their assets:

$$\delta\hat{\Phi}_t(j) \;=\; \sum_{r=1}^{r_j} \delta\hat{\Phi}_t(j,r) \;=\; \sum_{r=1}^{r_j} S(j,r)\cdot\delta\hat{\Phi}_t. \tag{16}$$

In this way, every entity receives a reduction quota that is proportional to his/her emissions at the previous moment of time ($t = 0$). Summarising, this algorithm distributed quotas in a proportional manner: more you emit, more (proportionally) you need to reduce your future emissions.

4 Integrating disclosures and standards together

In this section I am going to illustrate how one can model the problem of minimization of emissions using graphs, but only when the appropriate data is required in the disclosure.

The jth reporting entity is represented by a node, whose size is proportional to the total amount Φ_j of their emissions. If jth entity uses U many climate solutions over time, its representing node is connected to U many nodes that represent the solutions, see Figure 2. Also, the sizes of these nodes are proportional to their share Φ_u, $u = 1,\ldots,U$, in the total emission Φ_j. In particular, one has the formula

$$\Phi_j \;=\; \sum_{u=1}^{U} \Phi_u. \tag{17}$$

The problem of minimization of emissions consists of reducing Φ_j to some critical amount of emissions $\Phi_c < \Phi_j$. Such a reduction can only occur when some of the used solutions u are replaced by some more efficient solutions v, $v = 1,\ldots,V$. Let me denote by $\delta\Phi_{u,v}$ the amount of reduction of emissions of the entity j under replacement of u by some v. Suppose that for each u, $u = 1,\ldots,U$ one chooses $v(u)$ (by which u is going to be replaced). Then the total reduction $\delta\Phi_j$ for the jth entity can be computed as follows:

$$\delta\Phi \;=\; \sum_{u=1}^{U} \delta\Phi_{u,v(u)}. \tag{18}$$

The target emissions Φ_T is then the difference of the initial emissions and the total reduction, that is,

$$\Phi_T \;=\; \Phi_j - \delta\Phi_j \;=\; \sum_{u=1}^{U}\Phi_u - \sum_{u=1}^{U}\delta\Phi_{u,v(u)} \;=\; \sum_{u=1}^{U}\left(\Phi_u - \delta\Phi_{u,v(u)}\right). \tag{19}$$

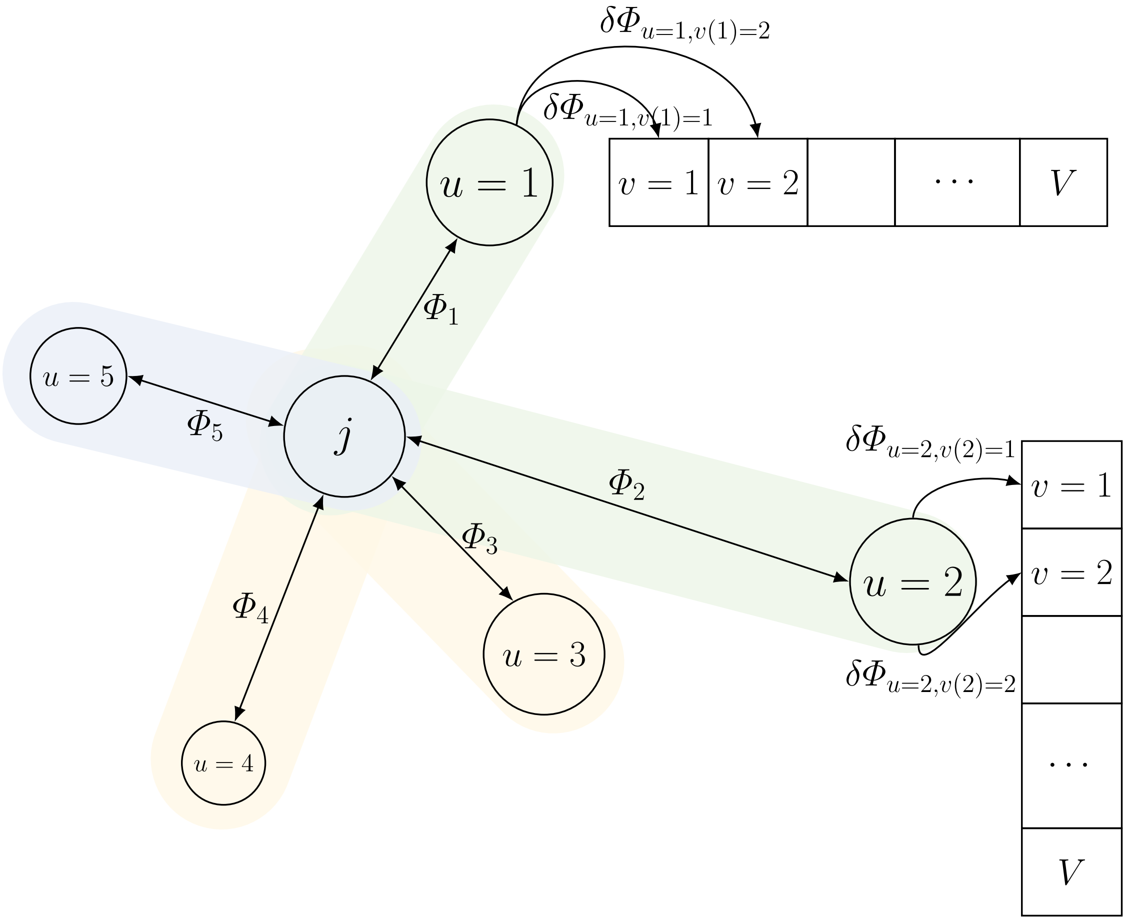


Figure 2: Illustration of the emission reduction for the entity j.

Finally, checking whether the critical emission amount Φ_c has been reached boils down to comparing Φ_c with Φ_T.

Based on the proposed model, I design an algorithm that reduces Φ to $\Phi_T \leq \Phi_c$ and uses as few substitutions $u \to v$ as possible.

Algorithm 1: Emission minimization with the smallest number of climate actions

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Result: The target emission amount $\Phi_T \leq \Phi_c$ and a minimal collection of substitutions $U_{min} \to V_{min}$.

Set $\Phi_T = \Phi$, $k = 1$;
while *While* $\Phi_T > \Phi_c$ **do**
    pick k many solutions $u_1, \ldots, u_k$;
    pick k many substitutions $v_1, \ldots, v_k$;
    if $\sum_{i=1}^{k} \delta\Phi_{u_i,v_i} \geq \Phi_T - \Phi_c$ **then**
        $\Phi_T = \Phi - \sum_{i=1}^{k} \delta\Phi_{u_i,v_i}$;
        $U_{min} = \{u_1, \ldots, u_k\}$;
        $V_{min} = \{v_1, \ldots, v_k\}$;
    else
        repeat with another k-tuple of solutions and substitutions until all such combinations are considered;
    end
    $k = k + 1$;
end

Even if the obtained reduction strategy involves the smallest possible number of substitutions $u \to v$, the realization of such a strategy might be quite costly. That is why it makes sense to study the problem of emission reduction which incurs least costs. For this let me denote by P_v the price of implementing the solution v. Then the emission reduction can be achieved with the following algorithm.

Algorithm 2: Emission minimization with least cost burden to reporting entity

Result: The target emission amount $\Phi_T \leq \Phi_c$, the smallest cost P and an optimal set of substitutions $U_{opt} \rightarrow V_{opt}$.

1 Set $\Phi_T = \Phi$, $P = \sum_{v=1}^{V} P_v$;
2 **for** $k = 1,\ k \leq V,\ k = k + 1$ **do**
3   pick k many solutions $u_1, \ldots, u_k$;
4   pick k many substitutions $v_1, \ldots, v_k$;
5   **if** $\sum_{i=1}^{k} \delta\Phi_{u_i,v_i} \geq \Phi_T - \Phi_c$ *and* $\sum_{i=1}^{k} P_{v_i} < P$ **then**
6         $\Phi_T = \Phi - \sum_{i=1}^{k} \delta\Phi_{u_i,v_i}$;
7         $P = \sum_{i=1}^{k} P_{v_i}$;
8         $U_{opt} = \{u_1, \ldots, u_k\}$;
9         $V_{opt} = \{v_1, \ldots, v_k\}$;
10   **end**
11   return to steps $3 - 5$ unless all sets $\{u_1, \ldots, u_k\}$, $\{v_1, \ldots, v_k\}$ are considered;
12 **end**

It might be important to do emission reduction that involves solutions yielding maximal savings. For this purpose I design the following algorithm, where S_v denotes the savings associated to the solution v.

Algorithm 3: Emission minimization with the maximum project savings

Result: The target emission amount $\Phi_T \leq \Phi_c$, the maximal savings S and an optimal set of substitutions $U_{opt} \rightarrow V_{opt}$.

1 Set $\Phi_T = \Phi$, $S = 0$;
2 **for** $k = 1,\ k \leq V,\ k = k + 1$ **do**
3   pick k many solutions $u_1, \ldots, u_k$;
4   pick k many substitutions $v_1, \ldots, v_k$;
5   **if** $\sum_{i=1}^{k} \delta\Phi_{u_i,v_i} \geq \Phi_T - \Phi_c$ *and* $\sum_{i=1}^{k} S_{v_i} > S$ **then**
6         $\Phi_T = \Phi - \sum_{i=1}^{k} \delta\Phi_{u_i,v_i}$;
7         $S = \sum_{i=1}^{k} S_{v_i}$;
8         $U_{opt} = \{u_1, \ldots, u_k\}$;
9         $V_{opt} = \{v_1, \ldots, v_k\}$;
10   **end**
11   return to steps $3 - 5$ unless all sets $\{u_1, \ldots, u_k\}$, $\{v_1, \ldots, v_k\}$ are considered;
12 **end**

Remark 1. *In either algorithm the set V_{opt} of optimal solutions may contain "inefficient" solutions. For example, there could be $k - 1$ optimal climate solutions and just one sub-optimal one since the algorithms work in a greedy way: they search through combinations* *of solutions until they find one combination that is cumulatively good (e.g., reaches Φ_c), but it does not imply that all solutions in V_{opt} are independently optimal.*

4.1 Supply-chain emissions

In this section I would like to propose a new model, that would describe entity-solution relation in a different way - where Scope 1 of one disclosing entity, is Scope 2 or 3 of another. This unlocks more synergy through alignment of multiple baseline emissions and reduction targets, than the current ad hoc, non-integrated way of looking at disclosures.

Throughtout this section I am going to assume that each entity can at the same time be a solution and, vice versa, each solution can act as a entity - the basis of corporate supply chain, and how materials, energy and capital flows from one reporting entity to another, such as banks, oil and gas companies, power utilities and materials sector companies. This is reflected in the fact that in our worlds individual entities, households, corporations and governments, very often play role of both consumers and suppliers. Said this let $\{1, \ldots, J\}$ be the set of all entities/solutions.

I will construct an oriented tree (oriented graph without cycles), whose vertices will be in one-to-one correspondence with the set of entities. If entity j_1 uses a solution of the entity j_2, then there is an oriented edge (arrow) from j_2 to j_1, see Figure 3. Of course, in practice there could be a situation when certain entity is a supplier for another entity, which in turn is a supplier for the first. In this model I exclude such scenarios. I now implement an "update-like" simplification of the graph, that causes direct dependencies, according to the following rule: to each sequence of oriented arrows

$$j_1 \to j_2 \to j_3 \to \cdots \to j_{k-1} \to j_k$$

of maximal length I insert "contracted" edges (if not yet present)

$$j_1 \to j_3, \ldots, j_1 \to j_{k-1}, j_1 \to j_k$$

and when all contracted edges are inserted I delete all intermeditate arrows

$$j_2 \to j_3, \ldots, j_{k-1} \to j_k$$

from all such maximal edge sequences. Figure 4 illustrates this procedure applied to the graph in Figure 3.

Observe that the resulting modified tree has only roots (sources of edges) and leaves (targets of edges). This structure reflects which entities are eventual suppliers to each other, it kind of "forgets" intermediate dependencies (transition vertices) between entities.

Finding entities that do value low-carbon solutions is thus, still a relatively low-efficiency way high cost way other reporting entities who are suppliers and vendors interested in delivering emissions reduction for their clients. The coordination costs of climate

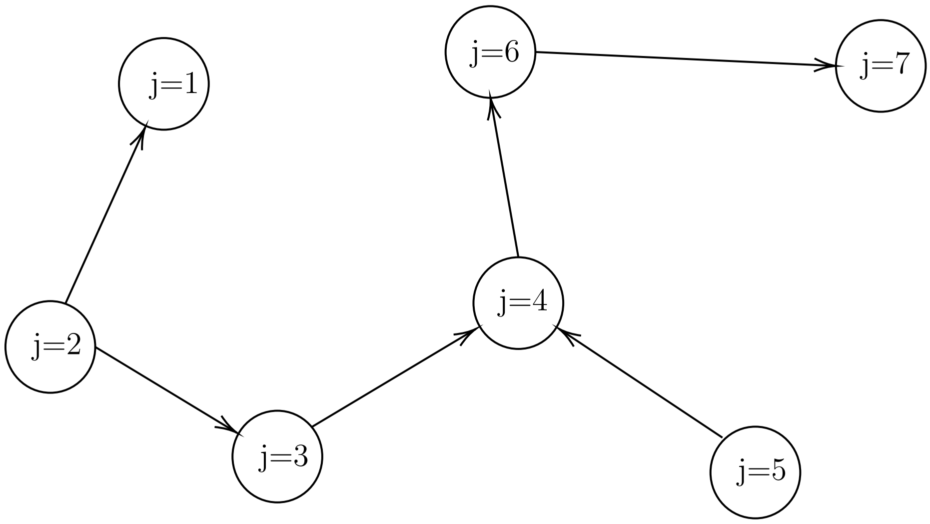

Figure 3: An example of an oriented tree with $J = 7$.

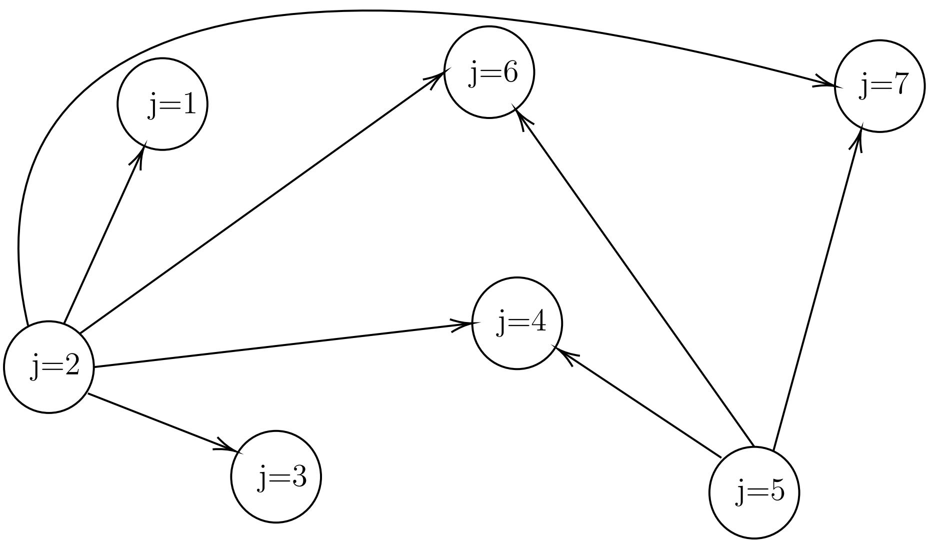

Figure 4: The simplified tree with $J = 7$.

change mitigation has been holding progress back, even adoption of low-hanging fruit solutions. It is unsurprising as a result, that climate action has been a niche, only led by a few large corporations and cities, and not mass-market yet. If something is too expensive or uncertain, no matter how important or helpful for the climate, it won't be invested into, bought or used - most will then come up with excuses to justify climate inaction.

A better data and model, as shown above, can subdue the sheer complexity inherent in current emissions reductions by integrating services data which would connect entities, such as enterprises, utilities and cities who are increasingly setting targets, with v solution vendors, such as energy suppliers like solar and wind generators, energy efficiency service providers, through common applications with measurable emissions reductions which help entities reach their targets. For example, the data layer aggregates and analyzes information from meter-level profiles within a geographic region to help predict demand so different demand response programs can be designed and deployed. This helps users like power producers or energy suppliers, understand who is wasting and who is conserving energy among their entities. By geo-targeting their entities and ratepayers in designated areas with unexpectedly high energy bills, higher emissions profile or even at-risk communities, and thus allow users to control its own energy usage. They can also extend clean prosumers or efficient users' custom incentives and better manage the efficacy of rebates or manage their supply-side optimization. The triangulation of such framework data will enable users to audit, understand, and budget their full on-site emissions, across regional resolutions, in addition to considering renewable energy and energy efficiency projects to decarbonize their mix on the upstream side etc.

Utilities can communicate with entities about demand response interventions, but also package efficiency upgrades to service or rate changes, with subsequent avoided emissions quantification. As such, the data can also form the basis of evaluation, measurement and verification of various energy efficiency and renewable energy programs - all targeted toward rapid decarbonization. Traditionally, the unit has only been kWh or dollars, but in the emissions reduction world, not having an avoided emissions metric would be detrimental. By programmatically allowing asset owners to set climate targets, a framework as above, will also help in evaluating v vendors alike to assess cost-effective technologies and services for deployment and adoption to meet net-zero goals. Overtime, the program also conducts measurement and verification to make sure the emissions reductions and not reversed, or worse lead to higher emissions elsewhere.

At this stage, the above models show how atomic elements of the disclosure framework and standard can unlock and facilitate much needed collaboration while addressing current market failures that hold back net-zero or climate actions. For brevity, we will summarize our ideas through the above models and look forward to future opportunities to collaboratively develop use cases.

5 Conclusion

With more and more organizations setting targets in every city and industry, this framework can ingest spatial data, empirical models and project finance metrics to triangulate these targets and turn these corporate and municipal climate commitments into potential clean energy projects. Both financial, environmental and impact data is needed for all these reporting entities as decision makers. Each of these reporting entities, as well as their stakeholders, residents and utilities, would first need to know how much of their overall emissions come from energy, how much from transportation and mobility, how much from wastes, water treatment etc. Only then can they begin to think of solutions.

A tailor-made mitigation plan would emerge from these disclosure sets, one that is sectorally accurate, politically feasible, economically viable and with the environmental impact trackable. Whereas technological and environmental data, i.e. clean energy and emissions reductions, show the “what”, the “how”, i.e. how these specific projects are to be funded or financed by various instruments is untethered. Combining traditional finance and climate finance is the next step to targeting investment-grade climate change mitigation action. This can only be done if robust reporting framework speaks directly to the current interoperability issue. Technical, market and environmental datasets are necessary but independently insufficient.

A framework would create the Lingua franca of climate action and climate-positive transactions, integrated as a metric in municipal resolutions on mitigation that have been passed at council level to track city-wide carbon goals, connecting entities who are reporting entities like enterprise, utilities, cities, with other reporting entities, such as vendors, service providers, such as low-carbon solution providers, like solar and wind generators, energy efficiency through a uniform and common applications. Meeting climate targets by facilitating transactions, i.e. creating, funding and tracking emissions reduction projects, decarbonization programs, directing ESG funds and climate bonds to specific areas, is easier when all parties are on the same page.