LPPFusion

Green Fusion Energy Generator: the power of the sun recreated on Earth

LPPFUSION.COM MIDDLESEX

Hardware | Infrastructure | Technology | Moonshots | Clean Tech

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Why you may want to support us...

1. Achieved the highest confined temperature of any fusion experimental device, over 2 billion degrees, sufficient for hydrogen-boron fusion.
2. Highest fusion energy output per unit energy input of any private fusion experiment, more than a thousand times the closest competitor.
3. Patents issued in the U.S., China, Australia, Canada, and the European Union, with patent pending in India.
4. Collaborating with international network of 40 labs organized by the International Center for Magnetized Plasmas.
5. Raised over $7.5 million from over 500 investors.
6. Research published in leading peer-reviewed journals documenting the LPP Fusion device as the most advanced, privately funded fusion experiment in the world.
7. Easiest path to fusion by using natural instabilities of plasmas, not fighting them. We imitate nature.

Why investors ❤ us

WE'VE RAISED $8,630,224 SINCE OUR FOUNDING

"The alternate fusion schemes offer a potential route to fusion energy that could be faster and much cheaper than other approaches. LPPFusion is a leader in this field."

Dr. Farhat Beg
Director, Center for Energy Research, University of California San Diego

I believe in the idea 🤓 good for our planet
Maricela Higgins ☆

SEE MORE

Our team

Ivana Karamitsos
Chief Information Officer, Communications Director
Ivy studied mathematics and classical music in the former Yugoslavia and received a degree in Computer Science from Binghamton University, SUNY in 2003 before joining our team in 2010.

Dr. Syed Hassan
Research Scientist
Dr. Hassan, a plasma physicist, has more than 20 years experience with the dense plasma focus device. Before joining LPPFusion in 2015, he worked for Purdue University's School of Nuclear Engineering.

Jose Varela
Systems Administrator
Jose joined LPPF in 2015 and is completing his Computer Science degree at Kean University. He's responsible for computer operations, supplying automation, security and productivity lab solutions.

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In the news

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For Humanity to Move Forward, We Need Fusion Energy Now

Dirty

Fossil fuels, producers of carbon and smog, still power 81% of the U.S. energy demand.

Expensive

Clean energy options aren't cheap. Wind and solar are still the most expensive ways to produce electricity.

Intermittent

When clean energy solutions fail, like in the absence of sunlight or wind, we're forced to rely on fossil fuels.

Fusion Energy Revolution

Fossil Fuels--Deadly

Fossil fuels have too little energy density for our needs, so we have to burn 14 billion tons per year, creating pollution that kills 7 million a year.

Expensive

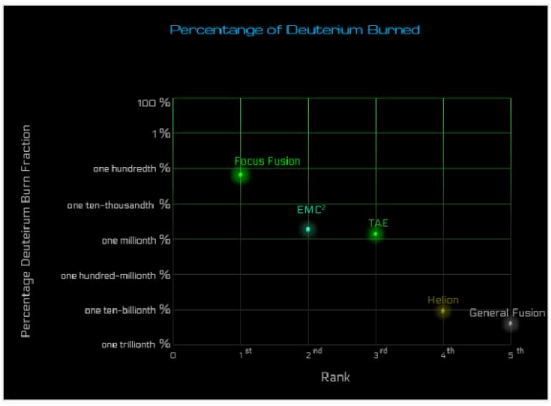
Direct and Indirect Fossil Fuel Costs are over $9 trillion per year, siphoning money from everyone to a few thousand billionaire shareholders, driving a downwards economic cycle.

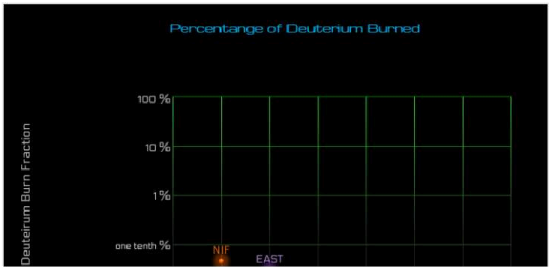
Solar and Wind Can't Do It Alone

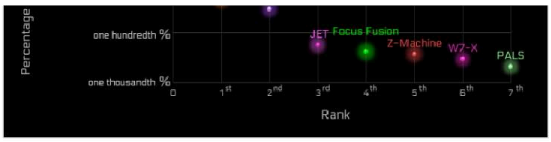
Solar and wind lack the power density and continuous availability to replace fossil fuels by themselves. That would require covering 20% of the world's land and strip-mining the ocean bottoms.

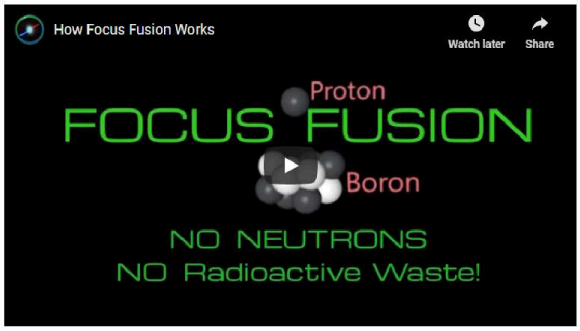
We are on the Fastest Path to Fusion Energy

Humanity needs to switch to a more powerful, denser source of energy that can entirely replace fossil fuels. That source is fusion energy. LPPFusion is developing the densest form of fusion, with the most power in the least space. It is what we call Focus Fusion: safe, clean, unlimited and far cheaper than any present-day energy source. We are also on the fastest path to fusion. Our published experimental results are thousands of times better than that of any other private fusion company, and close to the best results from government fusion projects with far more resources.







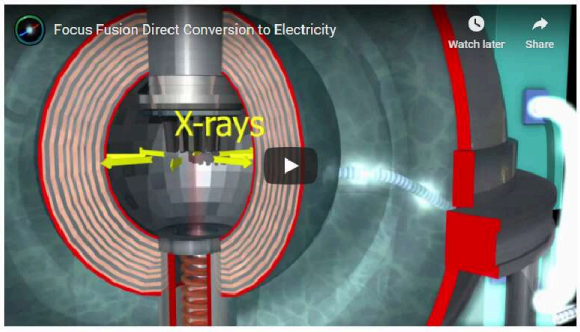


- Helium is the only by-product of our reaction.
- Our technology produces no radioactive waste.
- Our two fuel sources, hydrogen and boron, are essentially unlimited. They come from regular water, seawater, and boron deposits, enough to last billions of years.
- We can spread out our small generators to decentralize the power grid and reduce dependency on the fragile grid system.

Direct Conversion to Electricity

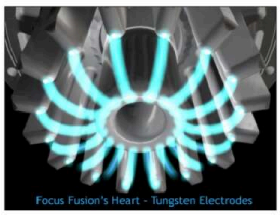
Since Edison's time, there's been one main way to produce electricity. A heat source — whether it's coal, oil, or nuclear fission — boils water to produce steam that spins the turbine of an electric generator.

Our Focus Fusion generators will be different · Free of expensive turbines and generators, we will produce electricity in a fundamentally different and much cheaper way than previous energy sources. The energy from fusion comes out of the same process that powers the sun and is released in the form of a high-energy, electrically-charged beam of helium nuclei. This electric energy is captured by an electric circuit by allowing the pulsed beam to generate electric currents through a series of coils, similar to how a transformer or a particle accelerator in reverse works. The process of induction used here has been employed in electrical technology since the 19th century — we've just figured out an efficient way to harness it.



This conversion to electricity can be highly efficient, probably around 70%, and fuel costs will be negligible, as a 5 MW plant will require only 10 pounds of highly-attainable hydrogen-boron fuel per year.

A 5 MW Focus Fusion generator, which will not require expensive turbines, will cost around $300,000 and produce electricity for less than half a cent per kWh, ten times less than the cheapest current technology.



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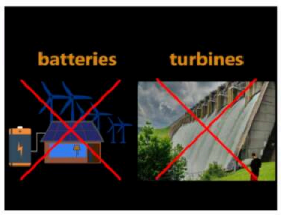

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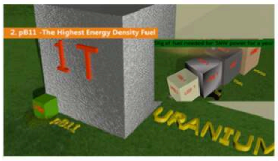
We're Different From Other Fusion Companies

We've chosen a far easier path than that pursued by the big government-backed fusion efforts. They've tried to stabilize the natural instabilities — wriggliness — of the extremely hot, electrically conducting plasma where the fusion reactions occur. Our strategy is to use these natural instabilities of plasmas to concentrate energy. And we use a different fuel — hydrogen-boron — which produces no radioactive waste and almost no destructive neutrons. This allows us to use a device, the dense plasma focus, that is so small you can hold its heart in your hands. Because we've chosen an easier path, we've already achieved the highest confined temperatures of any fusion device in the world and are second in the race to produce more energy out of our device than goes into it, even with only $6 million invested so far. We believe we are way ahead of many projects with billions behind them and thousands of times ahead of any other privately financed fusion projects, but we need your help.

Your Investment Will Help Make Universal Clean Energy a Reality

We'll use our investment round to fund the final stage of our research that will lead to the demonstration of net energy production. Your money will be used to finance a year of research, hiring at least one more researcher, initiating testing of the hydrogen-boron fuel, and making timely purchases of major experimental equipment, specifically additional beryllium for more electrodes.

We've proven that we can achieve the highest confined temperatures of any fusion device in the world. Our next research step is to prove that we can produce more energy than we put in, which requires beryllium for more electrodes. Success in this research will enable us, with $50-100 million in additional government and grant funding, to carry out a 3-year engineering and development program that will produce a working prototype generator that will eventually be suitable for mass production.



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Neither governments nor big corporations are funding this research. But you can ·

Usually science research projects of national importance for humanity are funded with tax money. But fusion research does not have 4% of the annual budget of the Apollo program, not a half percent of that of the 2003 Iraq War. Unfortunately our government has not invested in fusion, and certainly not in Focus Fusion. Our budget is $600,000 a year--too little for optimum speed.

Historically, those who ruled society stood in the way of the development of new sources of energy, because control over power production has always been tied up with political and economic power. New ways of producing power threaten the Powers That Be. When feudal lords were the Powers That Be, they fought against the use of coal, which threatened their fuel monopoly based on the woodlands. But those kings and lords were swept aside by revolutions and new types of societies developed fossil fuel power as the basis of the

Industrial Revolution. Society went forward and those Powers that Be became the Powers that Were.

Fusion power threatens the multi-trillion-dollar profits of the fossil-fuel industry and of the world financial system, which has been tightly tied to petroleum for decades. Now you have the power to decide if the oil, gas and coal barons--today's Powers That Be--will become the Powers that Were. By funding fusion, you can Flip the Power.

Investor Q&A

+ EXPAND ALL

What does your company do?

We're on a near-term path to achieving nuclear fusion energy at a low enough cost to replace all fossil-fuel based energy sources and end fossil fuel use. We will harness the energy source that powers the sun to create clean, safe energy. If we secure the funding to complete our project, we believe this will be the most fundamental change in technology in decades. It will flip the power from fossil to fusion.

Where will your company be in 5 years?

To achieve the future we want for ourselves and our children, we must replace fossil fuels with a cheap, clean, safe, and unlimited energy source. Our small, decentralized 5 MW generators will use hydrogen and boron fuel, both of which are essentially unlimited in nature, to allow a direct conversion of energy to electricity without expensive turbines or radioactive waste. We believe costs will be 10x cheaper than existing energy sources, meaning our Focus Fusion technology can change the world.

What is your goal?

We're combining a device called the plasma focus with hydrogen-boron fuel to create a new, clean, cheap and ecologically safe source of energy. We call our approach Focus Fusion.We're in the process of completing the scientific work that will prove that, in the laboratory, this device can produce more energy than goes into it. This has never been accomplished with controlled fusion.After the scientific feasibility is proven, we will move on to the engineering, licensing and mass production phases.

How is fusion different from nuclear power plants?

Nuclear fission, which is what produces nuclear energy today, involves neutrons as both inputs and outputs from the reaction. Neutrons induce a lot of radioactivity and produce radioactive waste. The only way you can change neutrons' energy into electricity is by converting it to heat, which produces steam, which turns a turbine, which powers a generator. It's what we've been doing over a hundred years, since Edison, and all that is very expensive.
What we're running is called an aneutronic fusion reaction; which means no neutrons into the reaction, and no neutrons come out of the fusion reaction between hydrogen and boron fuel. The fuel comes from abundant elements, and the reaction produces helium, a harmless gas.
Since Focus Fusion produces no destructive neutrons and its energy is produced as charged particles, a direct conversion of the moving electric charges into electricity is possible without using expensive turbines. This makes the energy far cheaper than any existing energy source. There is no air pollution, and no radioactive waste. The hydrogen-boron fuel is essentially unlimited because hydrogen comes from water and boron is present in seawater. And because its energy is very concentrated, more concentrated than in any other fuel, a small amount of fuel goes a long way.

What is the history behind this technology?

Scientists studying the sun were the first to discover fusion. Hans Bethe in the 1930s first hypothesized it to be the basic power source for the sun and all the stars — something that is now long-confirmed by many scientists. The first technological use of fusion was in thermonuclear weapons. It was clear that humans could release fusion energy, but only in an uncontrolled and destructive way. Soon after that, the previously secret projects to control fusion for peaceful purposes were declassified and many different ideas were put forward on how to control the plasma, which is a gas capable of carrying an electrical current within which the fusion reactions occur. Many different devices were invented in the 1950s and 60s, including the one we use: the dense plasma focus device.
In the 1970s, unfortunately, a key decision was made to prematurely focus the main source of government funding on a single type of device: the Tokamak device. In the view of many researchers in the field, that was a big mistake. It was very premature because we didn't know which way fusion was going to work, and which would be the fastest and cheapest. The net result was funding for almost all other fusion energy research approaches pretty much dried up. The approach that was chosen turned out to be very expensive. That has been the big hold-up over this last 40 to 50 years. All the big government projects basically put all of their eggs in one basket, and the other approaches were starved for funding. Many young plasma scientists were even forced out of the field altogether.

What advances has Focus Fusion made recently?

We've achieved two out of the three conditions you need to generate net energy (meaning more energy out than goes into the system):

1. Adequate temperature: These reactions occur at an extremely high temperature. Last year, we achieved the highest temperature of any fusion experiment in the world.

2. Adequate confinement time: The fusion reactions require enough time to take place. They don't need a lot of time, only a few hundred-millionths of a second.

However, we still need to achieve adequate density. The denser the plasma, the faster the burn, and the greater the fusion energy yield. We have also achieved a high efficiency of energy transfer into the plasmoid, where the fusion reactions occur.
Other fusion energy researchers are trying to achieve those same three conditions. Right now, comparing devices in an objective way using the same deuterium fuel, we have achieved the second highest ratio of fusion energy output to device energy input for any fusion device. We are only 1/3 behind the leading Joint European torus device in the UK, whose budget is four hundred times ours.

This year, we have begun experiments with new, beryllium electrodes. While we are just starting these experiments, we have already achieved the highest-purity plasma yet achieved in fusion devices.
The problem with most of the other approaches is that even if they succeed, they wouldn't be cheap because they will be using conventional energy conversion. Only those using hydrogen-boron fuel, like ours, can be economical.
On the business end of fusion energy research, the biggest news is that private research efforts are a new trend now. We refer to it as Fusion 2.0. These new research efforts are smaller, cheaper and thus able to run new experiments more quickly as compared to government-funded fusion research programs. New fuels like pB11 (hydrogen-boron), new architectural designs, and experimenting with new materials are also cheaper and faster with the smaller, private efforts. In addition, both the NJ state legislature and the US Congress are considering bills to match private fusion funding with public funds.

When someone thinks of investing in this kind of thing, it seems like it's all about who is going to get there first. Do you have to be there first?

It's important who gets a working, economical fusion generator first. But right now, no one has done this. The race is still on. The first key milestone is to get more energy out of an experimental fusion device than you put into it. No one has achieved this goal, net energy, either. A good way to judge how the race is right now is to look at the ratio of fusion energy out to total energy in, using the same fusion fuel, deuterium. By that measure, our results are the best that have been achieved in the past 23 years, only about one third below the best results ever achieved, which were obtained by the JET tokamak in 1997. No other private energy companies have published papers showing how much, if any, fusion energy their devices produced. However, we can use their published results to calculate two other measures. One is the product of plasma density, confinement time and temperature. By that measure we are ahead of our closest private competitor, EMC2, by a factor of two hundred. Another measure is burn fraction, the fraction of deuterium that would undergo fusion at the published plasma conditions. By that measure we are more than a thousand times ahead of EMC2 and a million times ahead of our best-funded competitor, TAE. Of course, this does not show who will win this race. But it does show where it stands now.

Why are JET and other tokamaks so well-funded?

In the early 1970's, the tokamak device (the type of device used in JET and in the much larger ITER project still under construction) seemed the best bet for fusion. But at the time, and much more so now, there are many other promising approaches, almost all of which are cheaper.
Why have they stuck with it for the last 40 years? In part, this is bureaucratic inertia: how much they've invested already in these projects, and the fact that there are now significant commercial interests involved in some of them. There is a reluctance to concede that a mistake has been made and that other routes may be faster. It is also easier to fund one gigantic project than dozens of small ones.

What problems are you aiming to solve?

We have mentioned before that one of the factors fusion researchers are still working on is to get adequate plasma density. To get a high density, it is necessary to have pure plasma. We have just this year achieved that goal with our new beryllium electrodes.

Next, we will switch from the experimental fuel we have been using, deuterium, which is a form of hydrogen, to our final fuel: a mix of hydrogen and boron. This fuel burns much faster, so it will give us a big boost in fusion yield. Using that fuel, we intend to reach the goal of the scientific phase of our work, which is to get more energy out of the device than is put in.

At this point, we will need a much larger development project to create a working prototype generator that actually produces electricity. The main problem to solve there is how to get waste heat out of this very small device and keep it relatively cool. This is a challenge, but we see it as being within the limits of existing cooling technology.

You say you can convert the energy directly into electricity. How?

Most of the energy comes out in the form of an ion beam. The beam goes into a form of a high-tech transformer, which collects the energy into an electric circuit. The process of induction used here has been employed in electrical technology since the 19th century. Recent work by other researchers has shown this can be done for an ion beam with over 80% efficiency. The second part of the energy comes out in the form of X-rays, which are captured in an onion-like array of photoelectric receptors. They collect the energy and, again, convert that into electricity. The photoelectric process is also well known. Since both these devices are very compact, they can be much cheaper than the large and complex steam turbines now used to produce electricity.

Do you expect to be fully funded by private backers, or is there also public money available to you?

We think that if we get net energy, meaning we produce more than we take in, then we have a very good prospect of getting some government funding in addition to private funding for the development stage. We will have demonstrated beyond anyone's doubt that this is the fastest approach. We have a reasonable hope of getting government funds as well as private funds for the $50 million to $100 million it would take to do the engineering development stage.

What do you feel is holding you back?

We don't have the funding that we've needed for this, and that holds us back in two major ways. We don't have the money to hire as much staff as we need to make the project run efficiently. Having more people in the lab would probably cut our development time by 50%. And second, we've had significant hold-ups because of supplier delays. Money could cure that by allowing us to order things way in advance. For example, there are significant delays with beryllium. It is not a common material in the industry, and so there are delays in getting hold of it. We should be ordering another bunch of beryllium right now, but the last time we ordered it, the raw material itself cost $70,000. With $1 million in hand, it would be much easier to order $70,000 worth of stuff that we may not need for another year.

How do you take this research and turn it into something that's making money?

money?

Net positive energy is the goal of the research phase. Then you need the development phase to turn a research device that we fire once every 15 minutes into a generator that can fire pretty much as often as the spark plug in your car: about 200 times per second. The key engineering challenge we have to overcome is cooling the device. Any device produces some wasted energy in the form of heat that you need to take out of the device. Nothing is 100% efficient. That will have to be solved, and we think we know how to solve it. But that takes a lot of engineering and requires working out all the kinks in the energy collection. All of that would probably take about three years once we had adequate funding, which is somewhere between $50 million and $100 million.

At the end of that, we would have a prototype ready to be manufactured. This would be something that can be run down an assembly line. We think the fastest way to change that into income would be selling licenses to very large entities, such as government energy corporations, or possibly very large companies like General Electric. We would do some manufacturing on our own, mainly to gain the manufacturing expertise in order to advise our licensees.

Even though our technology is much cheaper than existing energy sources, the market is huge. We expect mass production of these units. A very conservative estimate of profit within 10 years of achieving a prototype is $1.5 billion per year. Since licensees can expect similar profits, we expect them to have substantial up-front payments. Thus, we expect revenue in the several-hundred-million-dollar range soon after a prototype is demonstrated. These projections are not guaranteed.

What do you anticipate the public reaction being?

Most of the public doesn't quite know what fusion is, and if they hear the word nuclear, they get scared immediately. We don't call the process nuclear, because people think nuclear explosions, nuclear fission, Chernobyl, Fukushima and such. But fusion is entirely different from nuclear fission. We need to explain that this is not only the cheapest form of energy you can get but also the safest.
The second challenge is that non-technical people really have no clue about fusion science. Right now, almost all our investors have technical backgrounds. We now need to explain things well enough for any college graduate to follow, and eventually, any 15-year-old. We don't think that people need to understand all the science behind fusion to participate. You don't need to know how the electric car works in order to buy it. But we think we can explain the essential points.
We are prepared for quite a political battle to implement this technology because the fossil fuel industry has a lot of political clout. They're probably going to try to claim that our technology is unsafe, so we have to be ready. We need to start that education now so that when we are challenged people already understand the technology. It's a huge educational challenge, and we hope that by the time this is ready for manufacturing, hundreds of millions of people will already know what it is and understand it.

What's compelling you to devote your time and lives to this work?

We think this is the only way to get energy so cheap that it would not only replace fossil fuels, but it would allow for the full development of the entire world, eradication of poverty, and most importantly, the return of an ecologically clean and green food chain cycle that would lead to better health for all living beings.

If you look at the investment needed to raise the entire planet to the standard of living now enjoyed in Western Europe, it is totally impossible with existing energy sources, aside from all of the pollution you'd be creating. With this energy source, it's not impossible. It would be almost inevitable. So the reward is both revolutionary and liberating.

No scientist has said what we're doing is impossible. Even if it is difficult, which it is, the payoff is so great that it is worth putting every effort we have into it.

Is there enough beryllium and boron for this technology to supply world energy needs?

Right now, world boron production from mines is ten times as much as would be needed if all the present world's energy were produced by Focus Fusion generators. If boron on the land ever becomes scarce, boron in seawater could supply the present world energy needs for over a billion years.
Beryllium is produced in low volume right now because demand is very small. Nonetheless, just doubling production that would allow for the production of enough Focus Fusion generators to double US electricity capacity in two years. To achieve energy abundance for everyone in the world in a generation, beryllium production would have to be ramped up ten-fold, to about 5,000 tons per year.
However, that is very possible. Beryllium is not rare. It is about as abundant in the Earth's crust as lead. Lead production today is over two million tons per year.

How is the fuel fed in and the products removed?

The fuel will be slowly leaked in from a canister through gas lines. Five kilograms of fuel will last an entire year, so the fuel canister can be replaced only once a year, if that. The product gas, helium, will be carried away from the plasmoid by an ion beam. Once the beam is decelerated, giving its energy into the ion beam energy collectors, the helium will be drained off into collection canisters. As enough helium is accumulated, any hydrogen mixed in with it will be chemically removed and the helium will be sold to those who need it.

What protections do non-voting shareholders have?

The shareholder's agreement offers strong protections that the sole voting shareholder (Eric Lerner) can't take any unfair share of the profits, nor excessive compensation. The non-voting share arraignment is intended solely to prevent hostile take-overs.

What protections do shareholders have against dilution?

Our shareholder's agreement guarantees that no more than 400,000 shares will be issued prior to a public offering. This is only a third more than the 300,000 shares now outstanding.

What is the market capitalization of LPPFusion?

The market capitalization of LPPFusion at $125/share is $37 million. We have raised $7.6 million in cash investments and have had $210,000 in gross income (this was from donations).

Can these shares trade now?

No, there is no market for them now. This is a medium-term investment and should only be made with money that you won't need for the next five years. There is a mechanism for selling shares to other shareholders, but we can't in any way guarantee they will be sold that way, as most investors will want to see their money go towards the research. Once we have a working prototype and sell licenses, we expect to have a public offering, and then these shares will be trading freely.

Will the patents expire too soon?

Our initial patents will expire in 2026, seven years from now. We expect that this will give us time to develop the prototype and license the technology. However, we also expect to produce new patents in the near future, which will extend IP protection much longer.