



*Beating the Energy Crisis with
Innovation: A Conversation with
Green Entrepreneurs*

July 27, 2022

Bayh-Dole
COALITION

Joe Allen (00:00:03):

Thank you for joining the Bayh-Dole Coalition's webinar on *Beating the Energy Crisis with Innovation, A Conversation with Green Entrepreneurs*. I'm Joe Allen, the executive director of the Bayh-Dole Coalition. If you drive, fly or pay electric bills, it's no surprise to you that the world's experiencing an energy crisis. Today, we're going to talk with four entrepreneurs working on promising technologies that could make lives better here and around the world. These discoveries originated at research universities, which were able to license them for development because of the Bayh-Dole Act, which provides the authorities and the incentives for commercialization by delegating technology management out of Washington, to the creating institutions which know them best. The resulting commercialization system is by far the most successful in the world, but some policymakers want to reintroduce government micromangement. So we'll discuss how that would impact entrepreneurial small companies, which drive American innovation.

Joe Allen (00:01:01):

We'll begin with each of our speakers, making a short introductory statement about their companies. Then we'll bring everyone in for a panel discussion for the remainder of the program. If you would like to pose a question you can do so through the Q and A button on your screen. Finally, if you appreciate and support what the Bayh-Dole Act has done through building effective public and private partnerships, we invite you to join our coalition. You can see how to do so by going to our website, which is www.bayhdolecoalition.org.

Joe Allen (00:01:37):

Our first speaker is Bob Mumgaard. Bob is the co-founder and CEO of Commonwealth Fusion Systems. Bob is responsible for the strategic vision and direction of the company, paving the way for the future of clean, unlimited fusion energy. Since co-founding CFS with the mission of commercializing high field approach to fusion, Bob has grown the company to more than 300 employees and raised more than 2 billion with a B from some of the world's leading investors. CFS is a private commercial fusion company with a scientifically validated approach to commercialization. Prior to co-founding CFS, as an MIT fellow, Bob focused on how entrepreneurship, risk retirement strategies and partnerships could increase the speed of fusion from laboratory to market. He organized and led a team identifying strategies to utilize private finance and traditional academic resources to speed the path to fusion energy, resulting in a collaboration model with MIT. So Bob it's all yours.

Bob Mumgaard (00:02:45):

Thank you so much, Joe. So, what fusion energy is, is it's one of these things that's sort of in the comic books of a potentially very, very impactful energy generation source. It's, how do you build a machine that makes this process that's inside the stars work here on earth, which has the potential to generate unlimited energy without the emissions and fuel and sovereignty constraints. That's only if we actually can develop it and importantly, deliver it to the market at scale, where people go and buy a fusion power plant, instead of buying a fission power plant or buying wind turbines or buying coal plants. And that means it needs to be something that we can manufacture. It needs to be something that we can maintain, it needs to be something that can grow to a big industrial commercial industry.

Bob Mumgaard (00:03:41):

But of course, before any of that can happen, which is when it's paying taxes and when it's employing hundreds of thousands, millions of people as a whole new industry, before any of that can happen, it actually needs to be developed, it needs to be proven to work, and it needs to be attractive to the commercial markets. And so that is the realm of tech transfer from purely ideas, basic science, things that are how the universe works, things that are patents to a world of an industry. And that tech transfer is where entrepreneurship has really shown a big ability to do that, over and over and over again in the US system. Where we take fundamental ideas that we don't know if they're going to work. And we do all the other things that are needed to make them into something that the world can buy.

Bob Mumgaard (00:04:40):

And that step, that is a value of death, that is something that is precarious. And like CFS is a company that you look at it and that should not exist. And it really only exists because of all the blood, sweat and tears of the people that made it. And those people are entrepreneurs like myself, but also the researchers at MIT and also the investors who

have sunk a large amount of capital, hoping that this can do all the things that are needed to make it successful. And those things are much, much bigger than just the, Hey, we had an idea, it was funded by the government, we have a patent. Those are things like recruiting a team to leave their jobs at the large corporations, come and participate in doing this at low salaries, in something that is uncertain that might run out of money in a year.

Bob Mumgaard (00:05:46):

And to do that on the hope that it can be something, something big, something important, something that can return their blood, sweat and tears in terms of equity and payoffs for the technologists. And they do that because they're hopeful that it's fundamentally this investment and they're hopeful that they can through spending their time and their effort and their hundred hour weeks without knowing if they're going to have a paycheck in a year that it's going to get to something that is going to then be a rocket ship, something that is going to be something really, really fun to build and they're going to have a unique opportunity to be able to build that out at scale and really be a tech pull company in that industry.

Bob Mumgaard (00:06:28):

Likewise, the investors, I've pitched to lots of investors and what those investors want to know, is not just, what is the single patent, they want to know that's secure for sure. But they also want to know, what am I going to do to make sure this is successful? How much skin in the game do I have? Because they're putting skin in the game with me and I've been able to convince a lot of them and some big ones to take some really big bets. And those bets they know are only going to pay off if we are successful in developing this technology and doing the 99 things that are needed to be done beyond just what the government did and the original investment at a place like MIT. And that by doing so, we're going to have a position to be able to then monetize that and turn that into a successful company. And that someone isn't going to be able to just short circuit the whole effort, by coming in at the last minute and really taking that away from us.

Bob Mumgaard (00:07:32):

And we're not in this to seek rents, anything like that, this is about fundamental innovation and what are the incentive structures that actually create those fundamental innovations.

Bob Mumgaard (00:07:46):

And I want to tell a bit of a story, CFS started four years before there was ever any investment. And it started with a couple of patents that were funded by the department of energy at MIT, but were nowhere near anything that would ever makes sense as a product. And those four years of toil without any money, without any idea if there's ever going to be any money, of a team coming together, that time it was a few people, but numbered about 30 people at the end of those four years, that's the piece where you could lose this, you could like not have a CFS, it was borderline that that would happen.

Bob Mumgaard (00:08:27):

And so it was already precarious. And those investors looking and said like, okay, we believe that this will be a return in the end and that we can build a really strong company, they finally came in and were convinced to be able to do it on the whole package that the team that had put in blood, sweat and tears, in addition to the work that had been done at MIT in advance. And, I can just think of like, how precarious that was and how we might not have a CFS. And by extension, we might not have things like Tesla or things like Moderna or things like other entrepreneurial technology based companies, if that balance is significantly shifted and if those future upside is not there, that incentive structure wouldn't be there to be able to do this.

Bob Mumgaard (00:09:12):

And I know that I wouldn't be able to convince my family and my wife to go in on this sort of crazy idea to build a fusion company, if there wasn't the potential to actually, individually make a huge, huge impact in the world. And so, Bayh-Dole has been a key component in our building of CFS. And we actually won some licensing awards about how we were clever with MIT within the Bayh-Dole framework, to be able to bring new parties to the table to do something that sounded kind of crazy, like building a commercial fusion company. And that really is, on the premise that when you innovate, you get the proceeds of that innovation and that there's not some back door for someone to short circuit, all that blood, sweat and tears. So with that, I'll turn it back to Joe.

Joe Allen (00:10:12):

Thank you. That was a great opening statement. I really appreciate that. Our next speaker is Matt Maroon. Excuse me. Matt is the CEO of C-Motive. Matt has held product management and leadership roles in a range of startup companies with experience that were both venture capital, as well as blue chip company back. In total, Matt is a six time veteran of cleanup startups focused on next generation energy storage technologies. Since 2004, his career in product management has focused on bridging the gap between the lab and the market, developing and selling new technologies into the rapidly evolving, clean tech market space. With experience in a half a dozen distinct battery chemistries, software and renewable project management applications from mobile to EV to utility storage, Matt has a track record of defining products and go to market strategies that work. So, Matt, I'm going to turn it over to you.

Matt Maroon (00:11:11):

Sure. Tough to follow Bob's story when he's working on fusion and C-Motive may not sound as interesting, but we are developing the next generation of electric motor and generator. Just to give everyone a sense for why this is important. 97% of all electricity on the grid comes out of a generator of some form. So whether that's a generator that's in a wind turbine, or it's a generator that's being powered by burning coal to produce steam, generators are a fundamental way that we produce electricity. On the consumption side, well over 50% of all electricity is consumed by an electric motor. So depending where you're at, if you're at home, you're at the office, there are probably two dozen motors that are within a 50 foot radius of where you're sitting right now that you just take for granted.

Matt Maroon (00:12:02):

So for me this morning, electric toothbrush, the motor in the burr grinder for my coffee pot, or my coffee maker, the motor in my Prius that got me here, all things you really don't think about, until you realize that there is something that's better. And so what we're working on is a fundamental shift of how motors actually function. We're moving from permanent magnet based motors to motors that are powered by electrostatic forces or the same sort of forces if you took a balloon and rubbed it against your hair. The company, I started back about 10 years ago with our two co-founders Justin Reed and Dan Ludois, they were pursuing their doctorate degrees at University of Wisconsin, Madison. They found some work that Ben Franklin did 275 years ago, thought it was interesting and continued to work on it, develop it. The result was a number of patents that now C-Motive has exclusively licensed from the University of Wisconsin-Madison. It is kind of the foundation of everything that we have is the intellectual property that we licensed from UW, as well as what we've been able to build on top of it.

Matt Maroon (00:13:13):

Bob did a great job talking about how hard it is to work at a startup company. And for some perspective, we have not raised \$2 billion yet, we don't have hundreds of employees. We're still at that stage where things are pretty tenuous. We got a staff of 19 people, we are actively out fundraising right now, as I assume many other people are doing. And it's tough, it's very difficult. It's always difficult to raise money. It's even more difficult when you're not working on maybe the sexiest of applications, but still knowing that it is a fundamental shift to how the world creates and consumes electricity.

Matt Maroon (00:13:55):

When Joe and I first met a couple of weeks ago, I was kind of going through my story. And so Joe said, right at the outset, this is my seventh startup company. I have seen the highs and lows of startups. I've had two companies that I work for that unfortunately went bankrupt. One really drove off the cliff in a chapter seven bankruptcy, technology was picked up by an international investor and that technology is no longer available here in the United States. The other company that I was with, the battery company was actually a spin out of work that was foundationally done at Carnegie Mellon University. We raised a lot of money, we had a very successful product. We felt like we were well on our way and, bad timing, bad market forces and unfortunately that company resulted in bankruptcy as well.

Matt Maroon (00:14:44):

Similar story, technology bought up by someone not in the US. Those batteries are currently being manufactured by someone not in the US. There's very clearly a role for the public sector to support startup companies. It is very difficult, again, just referencing back what Bob was saying, it is difficult to keep jumping from one startup to the

next. I think a lot of us do it because we're not just passionate about clean tech or making a difference, but it's kind of a way of life for a lot of us. And so I don't really know where to go with this, outside of saying, what C-Motive org is working on, really could be a fundamental shift to everything that we take for granted now. We have a team here of 19 people that are fully committed to everything that we are doing, that are putting in the long hours, putting in the hard work, that know that they could likely make more money if they work for somebody else, but they're doing it because of the promise of the upside of it.

Matt Maroon (00:15:49):

And if the promise of the upside goes away, it makes our jobs even more difficult. It makes it more difficult to recruit people, it makes it more difficult to keep people motivated. And so we are where we're at today because of the work that everyone here has done, we are where we're at today because of the patents that we have built. But primarily we're where we're at today because of the work in our partnership with UW Madison that kicked the company off to begin with 10 years ago. So Joe, that's my quick introduction.

Joe Allen (00:16:23):

Well, you did a great job. I really appreciate that and your passion certainly comes through. Our next speaker is Marcus Lehmann. Marcus is the founder and CEO of CalWave. Marcus founded CalWave in 2014 and uses his experience in systems engineering, energy systems and entrepreneurship to lead a diverse team of engineers, advisors, and industry partners to unlock the vast and steady carbon free power from ocean waves. Prior to CalWave, Marcus held research positions at UC Berkeley mechanical engineering, the Lawrence Berkeley National Laboratory, and was a project lead of the Cyclotron Road program. Marcus holds a PhD in systems engineering from the Technical University at Hamburg, graduated from the Technical University of Munich and has a master's in mechanical engineering and receives an honors degree in technology management from the Center for Digital Technology and Management. So Marcus, the floor is all yours.

Marcus Lehmann (00:17:19):

Yeah. Thank you so much. And yeah, maybe let me start off with the, a lot of people have found ways to have fun with ocean waves, but what a lot of people don't know is that it's actually the largest unused renewable resource and can provide up to 30% of US electricity demand. And most of the energy is really available along the coastlines and that's where also half of the population in the US lives about 50 miles off the coastlines. And that's where most of the migration comes towards. Next to that, we really have the great benefits that waves can produce power at night and winter times as well as winter nights. And so there are great synergies between the profiles of wind, solar and wave altogether to get us to a hundred percent renewables.

Marcus Lehmann (00:18:10):

And not that long ago, it wasn't actually clear how the dominant design and wind looks like. And at the moment, wind and offshore wind specifically is one of the fastest growing renewables worldwide. And we can see here that people actually invested and built pretty large turbines until then we found the three blade upwind design because it's the most efficient and we can effectively shut it down. So these are critical and high level features of any kinetic and renewable device. And also, from the origin of wind, these were always small teams similar to the White brothers that introduced flight and really the first patents that allowed them to commercialize the patent. And also, I recently gave a talk exactly on that topic. It was quite interesting that they were entrepreneurs, that they had a bicycle shop before, and that really motivated them commercially to develop airplanes and the patents really incentivized them to allow. And the same with wind turbines that then later became the big leading manufacturers, they all started as small teams.

Marcus Lehmann (00:19:21):

And so for wave power, we don't have such a solution yet. And that's why CalWave really is now introducing a new technology that operates fully submerged. And we're not causing any visual impact. We achieve really high performance. And while being submerged, we can really shelter from storms. So that was one of the missing pieces. And by that, our technology really is the equivalent to the modern wind turbine with high performance and effective shutdown at the same time. And this video is from our pilot in San Diego. We've just recovered the

unit last week. We've been operating for 10 months, continuous without any downtime and failures. Initially the department of energy requested to operate for six months. But as we had zero intervention, we then continued and operated longer until for contractual reasons, now we had to recover the unit.

Marcus Lehmann (00:20:17):

And next up for us is a new grid connected farm, also funded by the department of energy rated at 20 megawatts. And here we can operate our next generational larger machine for two years and really start selling power to the grid. Going forward, the big opportunity is really in collaboration with Offshore wind, Offshore wind is one of the fastest growing, exponentially growing sectors in the US. We currently have about 25 gigawatt plant globally, 120 gigawatt. And so there's a big opportunity to co-locate wind and wave farms. Offshore wind in general has a 40 to 50% capacity factor. And so there is some excess capacity there and several studies have found due to the different seasonal variability of wind and wave, we can achieve a joint capacity factor and really provide that base load, renewable power where it's needed.

Marcus Lehmann (00:21:14):

And so briefly to our background, we're coming out of UC Berkeley mechanical engineering, the initial technology or concept was actually developed at MIT by professor Alum, then came to UC Berkeley and invited me to do research with him back in 2012. I came as a visiting scholar from Munich in Germany, and then we filed a first patent in 2013 with the work having being done on Berkeley campus, UC Berkeley filed a patent. And that was really exciting and motivated me to come back and jump into this entrepreneurial endeavor. And got really fortunate to get accepted to a new program called Cyclotron Road embedded in the Berkeley labs. And they really provided critical seed funding. And that kicked us off and was able to still work with researchers and the national labs and UC Berkeley, but still be independent and make our own commercial decisions towards the product.

Marcus Lehmann (00:22:12):

In essence, then we've secured several awards from the department of energy and the respective match funding. But a lot of people don't know that for these big government awards, you always require a certain percentage of match funding. And so for deep tech, especially with the hardware and electricity component, it is very difficult to find private sector capital, but it's extremely critical because that unlocks, and without that, we can't really secure these DOE awards. And so, we're extremely grateful for the investors that came in early and really had the confidence. And with that, I want to pass it on to the next speaker.

Joe Allen (00:22:58):

Well, thank you very much. Our next speaker is Peter Stern. Peter is CEO of Voyant Photonics, a frontier tech company, developing active sensing systems for machine perception. Peter spent the last 25 years creating and growing companies in a wide variety of sectors spanning the financial services to social media and now semiconductors. In 1996, Peter co-founded Datek Online, which revolutionized the retail brokerage rule by providing low cost instantaneous executions. By 1997, it was the fourth largest online stock brokerage firm. Peter served as Datek Online CTO director and president until its multi-billion dollar merger to form the second largest stock brokerage firm in 2009. Next, Peter started Zenbe, acquired by Facebook in 2010 to bring web and mobile collaboration services to businesses and consumers.

Joe Allen (00:23:57):

Peter then became the first CEO of Bitly, a link shortener used in social media. Over the next two years, he tripled the size of the team and raised \$15 million in funding and grew revenue tenfold. Before moving to New York and working on technology startups, Peter spent six years designing in field testing, military R&D projects, including lasers, helicopters, and classified electro optic sensors. Peter's an early stage investor and mentor, and he helped start and ran the open field entrepreneurial fund at Carnegie Mellon to invest in early stage technology companies and remains on the board of the Swartz Center for Entrepreneurship. So Peter it's all yours.

Peter Stern (00:24:38):

Oh, wow. Sounds like a lot when you say it Joe, I forgot about all that stuff. So hi, my name's Peter Stern and I'm currently the CEO of an early stage semiconductor startup called Voyant. And yes, I'm kind of aware that the

phrase semiconductor startup is in oxymoron. I spent the first six or so years in my career, as Joe mentioned at real jobs, I was lucky and I loved my nice secure jobs with decent pay. And then I spent most of the subsequent three decades creating a series of startups in a variety of different industries. And each time I kind of set out to make the world better by creating goods or services that I felt were needed and achievable. Sometimes I succeeded and sometimes I failed. Along the way I've invested and mentored and been on the boards of well over a hundred startups. I also ran the fund that Joe mentioned helping spawn university spinouts. So I think with some confidence, I can say that being an entrepreneur truly sucks.

Peter Stern (00:25:27):

I don't know where this idea that you read about that creating or working in a startup is a glorious ticket to fame, riches or freedom. I think it's because nobody gets invited to speak at things like this, talking about how scared and miserable they are. It certainly makes it harder to get employees and customers or investors to sign up if you talk too much about the risks of any startup, but let's face it, you could Google this, 90% of all startups, regardless of the industry, completely fail. Let's think about what this means. This means that 90% of the time, investors in startups lost all over their money, the employees in the startups got laid off usually unexpectedly without any benefits. And the companies that try to work with these startups got burned and they probably don't want to deal with startups anymore. Making it even harder for startups trying to sell into the economy.

Peter Stern (00:26:10):

Nevertheless, startups do play an important role in our economy. Simply they take on huge amounts of risk that are unacceptable to established entrance or companies and they try to create something new. Now think of any big company that was a startup in the last 30 years, Facebook, Amazon, Microsoft, Uber, pick something you use today, is what they're doing so hard that nobody else was thinking about it? Of course not. Thousands of people probably have that idea at the time that company's created. Ideas are almost worthless. There were dozens of Facebooks that failed and there were hundreds of Amazons that failed. We don't talk about those or those people or that lost money from investors.

Peter Stern (00:26:46):

More specifically, technology spinouts like the ones we're talking about here, government or university tech transfers to commercial success are incredibly difficult and rare. Most universities have databases with thousands of patents or research papers entered into their tech transfer databases. Maybe one out of about thousand ever even gets looked at and some incredibly small proportion of the remainder ever even attempt ... no one even attempts to make those into commercial realities. Now startups in sometimes big companies provide the money, expertise and drive to turn these assets, these IP assets into something of value to the economy. By the way, you can Google that too. Harvard Biz Review, everybody writes about this. An idea demonstrated in a university lab, no matter what it is, engineering, drug discovery, it doesn't matter, it's pretty constant, that represents less than 1/20th of the work, time and investment needed to bring that product to market.

Peter Stern (00:27:36):

Now, just as startups provide a service to the economy, so does government, but government's role is not to pick winners or products or decide pricing. That is exactly what a free market is good at. I would argue that's the only thing the free market is good at. Now I've been doing this for so long, it's hard to find my favorite experience to explain why I think this way. So I might as well pick the latest thing that I'm working on now, Voyant Photonics. Now because of my background, I was asked by a venture capitalist in New York to help a Columbia high tech spinout. Steve and Chris, the founders, over there were working on something incredible, something that I have wanted to exist since the early nineties involving lasers and light radar, Steve and Chris could have gotten real jobs in industry or academia. Everyone in their field is super hot by the way, they could have gotten incredible jobs at Google or Facebook creating the next generation of data center technology. It sounds really boring, but it pays really well.

Peter Stern (00:28:25):

Instead, they're over there creating a kind of imaging chip that will allow machines to see incredibly better than they can now. Now, the reason we don't have robot butlers or autonomous cars is not because we're not good at computers or making robots. It's because machines can't see. But here at Voyant, we're trying to use ... no, not here at Voyant,

that's not what we're trying to do. Sorry. Where industry is trying to use cameras and massive amounts of software to get robots to see, but we forget that our perception systems in our brains and eyes have had 500 million year head start and we still can't see in the dark or really that reliably, we guess a lot. Machines can't guess or they'll kill people.

Peter Stern (00:29:01):

So Voyant sensors will let machines understand complicated scenes involving fast moving objects in bright sunlight, perfect darkness. And it costs so low that this ability can be packaged into pretty much any device. Remember when movie cameras were the size of refrigerators and they'd only be in studios. Now there are billions of cameras packaged in everything, enabling services that we couldn't even dream of 10 years ago. Instagram, Pinterest, home skin cancer screenings. What did you use a camera for today? We're trying to make the same revolution with machine perception using our LIDAR sensors. Now, when I joined Voyant full time, Steve and Chris had a small team and they'd just accomplished something incredible. They built a working prototype of their chips. These are semiconductor chips, like one centimeter square, and they had manufactured their chips in a commercial semiconductor manufacturing plant called the fab. Now, Steve and Chris have been working on their designs in a research fab for years, but almost everything made in research fabs can't be imported into a commercial fab, unless we can make them cost effectively or at scale.

Peter Stern (00:30:01):

It usually takes millions of dollars and many years to support a useful design into a commercial fab. It's a lot of trial and error. Now technology spinouts are really hard. Go read some back issues of Nature magazine, it's a premier scientific journal and you'll see that almost all the scientific articles that talk about a great breakthrough, never actually impact anybody. Steve and Chris, however, knowing this, raised a small round from some early stage investors who were willing to sponsor the huge amounts of financial and technical risks needed for this project in the hopes of getting outsized gains in the far future. Steve and Chris also managed to get a DARPA brand because the government already sees huge potential for this technology as well.

Peter Stern (00:30:40):

Now then working for almost free for a couple of years, Steve and Chris and their team got a workable design on their first attempt in a commercial fab. This is a crazy good accomplishment. Every expert I spoke to said it would take three years and \$5 million to get there. And Steve and Chris pulled it off in less than a year with less than \$1 million. So of course I joined the team then to help them raise the real money needed and create these products and bring this to market.

Peter Stern (00:31:03):

Now we had a world changing idea, we had exclusive IP license from Columbia, which was probably created from government grants. We had some even better IP that we developed on our own. We had an incredible team and we had a working prototype of a millimeter size chip on which we had packed thousands of electro optical components, each on average the size of coronavirus. Despite all this, I could not raise the money. We needed more than \$10 million to get to the next level of technical milestones that would attract customers. And we could not get investors to pony up the \$10 million or even a dollar.

Peter Stern (00:31:34):

I spent a year working for free. The entire team took huge pay cuts to extend our lifetime. And yeah, there was a pandemic and yeah, investors did not want to take on this level of risk. They loved the pitch, they loved our vision for the future, but there were no term sheets, no checks and thus, there was no payroll. Now I've raised a lot of money for a lot of companies and I don't think I'm the worst at this. It was just that hard. I was getting ready to lay everyone off the week before Christmas. And at literally the 11th hour, I found some investors. And once someone believes in you, others believe in you. And in two weeks, right before Christmas, I went from planning our layoffs to having to turn investors away from an oversubscribed round.

Peter Stern (00:32:12):

I don't know why the team didn't quit. I don't understand how we survived that long. Would you work for half pay for eight months at your job with the likelihood that you're simply going to get laid off at the end? Does that happen at big companies? No, I don't think so. It only happens at startups. Now, more than a year later, I'm heading

towards the same situation. We have incredible development kits or samples. And once again, we've managed to produce our incredible product during a pandemic in record time. And let me tell you, supply chain issues are not easy to small companies or hardware companies, customers and investors are impressed across the board with our accomplishments. And they're excited about our roadmap, but it's still a long, scary road ahead to get to market. We need to raise more money and that's going to be really hard.

Peter Stern (00:32:54):

The macro situation right now is not helpful. There's a lot of luck involved here. And my luck in timing points fundraising has been really bad. Let me tell you what would make this absolutely impossible. If an investor thought that our IT was not ours, if an investor thought that if you're using DARPA to fund less than 1/40th of our pathway to market, that there was even the slightest chance that the government in the future could set pricing for our products based on some subjective idea on what is fair. I've walked away from deals for a lot less than that. I've advised others to walk away from deals where there's the slightest issue involving IP ownership or control. The risks are so huge in these situations for all the companies presenting here, that if you can't avoid that single risk, you just don't get involved, that investor, period.

Peter Stern (00:33:37):

Which means that none of these deals would get funded, none of these startups would get funded, Voyant would not have been funded at all in the first place. Now, not only startups, but large corporations would also avoid the tough challenges if they could not be secure in the rewards. If government wants prices to be fair, create a raised level playing field so multiple entities can compete in the same technology space. But if you even hint a price setting like this, well, it's going to really short circuit innovation. I know you probably hear that a lot, but it's true.

Peter Stern (00:34:08):

I get a lot of perspective when I work with business people and entrepreneurs in the Middle East or in Central America. And I learned by world changing technologies or companies that don't start in those regions. It's because of the lack of the kinds of protections that we're talking about here. If you can't be secure in the rewards, you don't make the investment. Now take on the challenge, shoulder the risk, raise the money, change the world, pay your investors. That's the process. If your investors don't believe in the last step, they don't believe in you and you don't even start technology innovation. Thanks.

Joe Allen (00:34:41):

That was great. Let's bring everybody back on camera now and we're going to have our panels and we'll raise a couple questions when everybody gets back on and spend the rest of the time discussing some of the realities. I love working with entrepreneurs because you all were great to lend your time here and I think you really gave us an eye opener about what the realities are of commercializing new technologies from small companies, which is the driver of the US economy. I mean, we do this better than anybody in the world, and it's unfortunate that a lot of people just sort of take this for granted and take unfortunately, our innovation system for granted and want to make it more like those of developing countries.

Joe Allen (00:35:23):

So I want to build on what Peter had just talked about, last week, The Wall Street Journal had a front page article and the headline is early money shrinks for younger startups. And it's about how there's a big pullback in companies willing to fund companies exactly like before we're talking about today. So Peter talked about some of his experience and some of the rest you did. So let me just throw this out for the whole panel to elaborate on, because for a lot of folks, raising funding is something that they've never had to do before. And so what's it like trying to raise capital for a company like yours? And what factors do investors look at for agreeing to back you and building on what Peter and Bob and some other folks said, how important are strong patent rights for a small company that's actually trying to raise money on an early stage technology. So anybody wants to weigh in, please do so.

Bob Mumgaard (00:36:20):

I'll start. So it's extremely hard. And it's actually one of these things that is counterintuitive, the bigger the impact, the harder it is because inevitably the bigger the impact, it means that you're going to spend investor money doing things like building prototypes, not just pounding on a computer for code, but actually out there in the world with things that blow up, that don't work right, that the patent drawing doesn't make any sense because it turns out you

can't build it that way and that you're going to have to figure out how to build tens of thousands of them. And how to manufacture them, where to manufacture them and all that. And that is like a long road. So that first check is a first step down a road that everyone looks at and says, this is a long, hard road. And so should I take that first step?

Bob Mumgaard (00:37:12):

And one of the reasons you take that first step is because you believe that if you do get it all the way at the end, there is success and success looks like a big profitable company that can employ lots of people that can be competitive in the world market and that can win. And that that winning will pay for all the hardship of all those steps. And then from an investor's point of view, all the steps that they took that didn't get to the end, that need to be subsidized by the ones that actually got there. And so if we actually take that destination out at the end, it means we take fewer of those first steps. And importantly, it will mean we take fewer those first steps on the roads that are the hard roads that lead to the best destinations. And from a company like ours, it's super hit and miss on being able to do that. And it's surprising how precarious it is.

Matt Maroon (00:38:14):

I was just going to say, before I jumped on the call here at 11:45 central, I was talking to an investor. When I get off of this call in 22 minutes, I will be talking to an investor. It is a full time job to make connections, to reach out, to follow up and is it hard? I don't know, you get kind of in the practice of giving the spiel, I could do it here again, that part is not hard, but it's a lot of time and it's a lot of organization. And all of that time means that I am not doing what I should be doing to contribute to the development, the specification, the development of this next generation of motor, right? You could reasonably say that the company takes a step back when you're fundraising, particularly at a company of our size right now, where every hour from every person matters and contributes to us getting to the end.

Matt Maroon (00:39:11):

And then just ... and I do not want this to sound like I'm claiming victim here, but it's really hard to raise money if you're in Madison, Wisconsin, we are not in Seattle, we are not in Boston, we are not in New York, we are not in Austin, Texas, I am not in the bay area. I have worked at startups on both coasts and there's a lot of smart people that live in Madison, Wisconsin, there's a lot of smart people live in Chicago, Illinois, there's a lot of smart people that live not in Cambridge. And so, again, not to do the woe is me thing, but that is a step of credibility that I'm working to overcome right now. That yeah, you can get great technology that comes out of the University of Wisconsin, Madison, and yeah, you could have great technology that's developed by people that aren't PhDs. That stigma still unfortunately exists in the world that we live in with many traditional venture capital groups that we all think about.

Peter Stern (00:40:07):

And to that, I would only add, I mean, I think these guys get the point across, raising money takes a huge amount of time from a startup that's completely not core to actually building the product or service for people, but is required. If you think about the fact that 90% of startups fail and my experience about half of technology companies actually achieve the milestones that they set out to do, maybe even more than half, but still the failure rate's 90%, not 50%, which means there this healthy set of people that accomplished exactly what they set out to do, and they still are unable to raise money. And I think that says a lot about the risks and barriers to success for technology spinouts involving money losing.

Joe Allen (00:40:47):

Marcus, do you want to add anything to that?

Marcus Lehmann (00:40:49):

Yeah. And I think just looking at this group here, we're all working on really hard steep tech science based innovation that can really move the needle on climate change. I always show that energy flow chart where you see majority of our primary energy is still coming from fossil fuels and all the software in the world doesn't change that. And then we see a lot of great news that a lot of capital is flowing now into climate and clean tech. But if you actually start peeling off the onion and take a closer look, the majority goes to some form or another of software SaaS in the energy space, but not a lot actually goes to be tech. And then on top of that, and that's the reason why in Silicon Valley, there's always that famous value of death. And I think some now capture that better in saying for climate tech, there are actually four values of death from formation to demonstration to scale up.

Marcus Lehmann (00:41:45):

And so I think being subject to supply chain time delays, hardware just takes more time. And so the typical five year VC structure is just not a fit for ... often is not a fit for the VC model. And so without the IP being able to protect us and giving us the incentive to actually be able to then capitalize on that technology that makes it even harder to find private sector capital. And I think once you remove that, you're essentially a nonprofit and nonprofits raise money from philanthropics, but they barely ever fund technology development. And also for us to scale up exactly the fourth value of death for post demonstration, for scale up, we often need help from corporate partnerships because they know how to do industrial things. And for them they can't really engage in nonprofit or not having any protection of the technology. And so essentially that would really prevent us as a startup to then really scale up where it starts to move the needle on an industrial scale.

Joe Allen (00:42:56):

And if you can, let's put the hat on on the people across the table from you, what's life like for the people that are putting their money into startup comp... especially technology companies where the payoff may be years down the road, and this is real money, this is not government money. This is money out of your pocket, money out of people that trusted you. What's it like being a venture capitalist investing in folks like yourself. So anybody want to talk about what life is like from the other side of the table?

Peter Stern (00:43:27):

Well, I've been on both sides of the table so many years now. For my startups, for my high tech frontier tech type high risk startups, and there's really nothing called a secure startup so I don't have one of those, but I don't take money from friends and family. I've got a lot of friends and family saying based on your track record, oh my gosh, let me invest, please. I'm sure it's going to work out great. And I can't take it because I don't want the stress of losing friends' money. I don't want to take the stress of losing my friend's kids college education. I can't take that kind of stress. I can take the stress of losing professional people's money, it's aggregated, they're making a hundred different bets. And so if they lose on my bet, I can sleep at night.

Peter Stern (00:44:04):

But that's literally what I think of, like for a small fund, I'm [inaudible 00:44:08]. I will often say, this is not right for that level of investment for your fund. It's just too much concentrated risk. The only reason this stuff works is because the investors, the only reason they're willing to make a bet is because they get to decentralize their risk. They're not risking all of their money on any one of us. But that's why it's so hard for us to get them to give us the money in the first place though, to be fair.

Joe Allen (00:44:31):

Yeah. Bob, do you want to [crosstalk 00:44:33]-

Bob Mumgaard (00:44:35):

Yeah, there's a lot of options of where you can put money. Right? And there's a lot of money in the world. There's a lot of money that flows in other countries. Right. And where does it flow? It doesn't necessarily flow in other countries to early stage, super, super high impact companies, that is like a uniquely American thing. Right? And why does it happen here? I think it happens, not because the Americans are some fundamentally different people, because we've built institutions that incentivize it and they just barely incentivize it, they don't overly incentivize it. And those are things like Bayh-Dole and things like the university ecosystem where those startups, whether it's Google or startups that underpin Tesla, where they come out of, that sort of unique partnership between the university and academia, the government research and development and funding, the venture capitalists and the entrepreneur.

Bob Mumgaard (00:45:38):

And we've managed to build something in the United States that is replicable and is the engine of the innovation in the world. And those investors allocate capital there. And if we change it, I think they'll stop. And they'll allocate capital into real estate and they'll allocate capital into safe bets because these risky ones will get too risky.

Joe Allen (00:46:02):

Great point. In fact, people may not know this, but Google came out of two kids at Stanford who came up with a

search engine with some National Science Foundation funding. Stanford could not find anybody that wanted to license it because there already were search engines, who wants another search engine? So finally the kids came into the Licensing office and asked if they could get the rights to their own invention because under Bayh-Dole, it's owned by the university. The university said, yeah. And they thought so little of it, they didn't even charge them a royalty. So again, even though you may think, Hey, here's a technology that is lights out. The reality is it's really hard to find people that are doing what you're doing.

Joe Allen (00:46:41):

Let me move to another topic because there's a lot of misunderstanding about what it is exactly you do. And some of the critics of our system say that if a company licenses a university invention which supported by years and maybe millions and millions of dollars of government funding, that the development risks are minimal. Is that your experience? I see Bob's laughing. So I assume that's not your experience.

Bob Mumgaard (00:47:05):

Absolutely not. If the development risk were for a minimal, why would we need to go and raise money to get it to the point where you could actually make money?

Marcus Lehmann (00:47:16):

And maybe along the lines of your previous questions. I mean, if you see that the US is not the only government that invests heavily in R&D and also the examples you mentioned often companies started by immigrant founders and myself being from Europe, there is a reason why a lot of people come to the US and specifically Silicon Valley because these institutions and protection frameworks are there. And it's quite interesting, having spent quite some time in the kind of Berkeley, Silicon Valley startup ecosystem, they have been attempts by governments to replicate Silicon Valley and they often have failed or there're not a lot of counter examples. And the interesting part of it is like, why? They have extremely brilliant scientists, they have a lot of money. Why was it not able to replicate?

Marcus Lehmann (00:48:04):

I mean, one argument I often see is that, all these different things that come together were not there, especially the protection of your IP, of the individual, of your company and your assets and they could be taken away from the government. So having that incentive structure and protection structure is the foundation. And then you're also directly competing against Silicon Valley at the same time. It's not that you're starting a new Silicon Valley from scratch, you're always competing with talent moving to Silicon Valley. And so I think removing the foundation is extremely dangerous in that entire ecosystem of capital flow, of talent and IP.

Joe Allen (00:48:49):

So Matt go ahead.

Matt Maroon (00:48:53):

The only other thing I would add is like, there's a lot of risk. It just doesn't stop when you get something out of the lab, right? The risk is not retired when you mix two beakers of chemicals together and you get the reaction you want, you still have to go from all right, we're making something that's this big, we need to make something that's this big. And we don't need to make one of them, we need to make 10,000 of them. There's product risk, there's scale up risk, there's cost modeling risk, right? We will all, if we have not experienced it before, have prototypes that we are taping hundreds of dollars of bills to to ship out the door, just to get something out the door that is not a sustainable business model, obviously, to lose margin on every single product.

Matt Maroon (00:49:32):

There's risk in getting your stuff out in the channel. There are risks of anyone wanting to buy in, whether or not you have a commercialization strategy. There are risks in managing the warranty and whether or not a warranty you put on a product is worth the paper it's printed on. To think that the risk stops when the science works is very shortsighted and just not the reality of it. And this is why obviously venture capital exists, this is why there are different types of investors, because there are investors that will take those risks that feel more comfortable with some of those risks and not other of those risks. And that's what takes us so damn long to find the right ones.

Because you got to find the person that is willing to take the right risk at the right time. It's not a yes or no question, it is a time based continuously finding and addressing the risks. So there's a lot more to it than just like, I got a patent, thing works on the bench. There's a lot more that turns into like millions of dollars.

Peter Stern (00:50:31):

Let me give you a very specific example, Joe, about something we work on that emphasizes Matt's point where like, forget about customer risk and marketing risk and business execution risk. Forget about all the soft stuff that you had great technology and you built it into the wrong product. Forget about ... they call that soft. Let's forget about all the soft stuff. Now I don't want to get too much in the details about what we do here because I've seen the audience slip into comas and maybe die. But in academia, there's this idea of hero results. So let's suppose like take chip design. People are building wafers, are building chips in academic fabs or industrial fabs. This is not where your computer chips come from, this is not where your phone chips come from, or your automotive chips, these are different factories altogether.

Peter Stern (00:51:13):

And they'll spend years to make one wafer that has maybe a hundred chips on it to get one individual chip out of tens of thousands that they've made that demonstrates their idea to some level of efficacy. And from that thing, that one chip that they spent years of free labor and years of free access to machinery, to get one working bad example and they go, ah, we've invented this new thing. It's amazing. It will change the world. And now from this one hero result, they call them hero results. New term, I learned at this job, hero results. We have to make a wafer with a hundred chips and for us to be viable, a hundred of those chips have to work. Okay maybe 99, maybe 89, but not one out of 10 000. 99 out of a hundred have to work.

Peter Stern (00:52:05):

Now, to go from the hero result that we got for the IP at Columbia to the working thing is literally years and millions and millions of dollars, maybe decades in some cases like in Bob's case, it goes from decades and billions of dollars. So the idea that the IP by itself has this incredibly large value. It has value, but it's very, it's tiny value. It's not a big value. And honestly, if we could give up our Columbia IP and redo our DARPA IP, we would be happy to do that. It would just be simpler. So it's really hard. I know from a layman's point of view, it's like, well wait, what's so hard. They have it working in the lab. How hard is it to put in 10 million cars? Well, it turns out, that's actually the hardest part by several orders of magnitude.

Joe Allen (00:52:55):

And I think, one thing that people may not appreciate is under our system, 70% of the university licenses go to small companies, not big companies. You all are taking risks that frankly established companies won't take. Now maybe you may merge with an established competently down the road. But to think that just because the governments put hundreds of millions of dollars into some research project, that they've also de-risked what's coming out the other end, is simply untrue. And the other thing about it is what makes us unique is our innovation system is driven by small companies like yourself, again, nothing against big companies, but you are the ones who take risks that the other folks can't make. And as you said very well, the odds of success on any particular venture are pretty daunting.

Joe Allen (00:53:44):

So let's go on to one of the big things that's being banded about in Washington right now, by some of the people who basically are not fans of the Bayh-Dole Act. And they're arguing that the Bayh-Dole Act should be misapplied so anyone who doesn't like the price of a product based on a federally funded invention, should be able to ask the government to march in and license your rival so they can copy it if your price isn't reasonable, which is a term which is not defined in the law because that's not how the law works.

Joe Allen (00:54:13):

So if our system worked that way, that if you finally get something across the finish line, you're out in the market and basically, your brother-in-law who doesn't like you or rival company, whoever, somebody who just has their nose at a joint that day can say, Hey, I don't like the price you're charging and they could petition the agency that

funded the original research and if the agency agreed, then they could license people to copy what you've done. How would that impact our system? How would that impact your ability to get funding? And how would that impact your willingness to put your time and effort into actually trying to get these things developed?

Matt Maroon (00:54:52):

What's the point?

Peter Stern (00:54:53):

It just wouldn't work. Like none of us would have even raised a single dollar. We wouldn't have even been trying to do this. Like nothing would happen. That's how it works in Guatemala and that's how it works in Egypt. And that's why you've never heard of anything coming out of Guatemala or Egypt. I mean, it just can't work that way. You can't, after the success has been demonstrated, control the outcome. Like it just doesn't make any sense from a capitalistic market driven point of view and it will just completely halt innovation. It'll utterly halt it. I know that sounds overly dramatic, but I can walk you through any example, any number of examples.

Bob Mumgaard (00:55:34):

It's like, imagine if you're like, oh, we have a blockbuster movie, blockbuster movie, it's this huge success. But now, because it was filmed in the United States, we're going to go in after the fact and we're going to change who the actors that got paid were and actors that weren't involved in the movie at all, they now get to decide that they're in the blockbuster and they get paid by that blockbuster or replace them all. It doesn't work. This is a labor of love. It's as artistic to develop a technology as it is to do anything else and to go in and say, at the end, we're going to change it based on the outcome really is a perverse incentive and something that is a very, very different view of fairness than I think the American ideal is.

Peter Stern (00:56:29):

Yeah.

Joe Allen (00:56:32):

Marcus and anybody else just want to ... go ahead, please.

Peter Stern (00:56:37):

[crosstalk 00:56:37]-

Marcus Lehmann (00:56:37):

I agree with what's been stated, but essentially you would implode or remove that foundation of the VC model and then suddenly you cannot achieve these 10 X returns and exits anymore. And that means VC will not be possible anymore. And then there is no venture capital and without ... it's like taking the rain out of a rainforest, it's going to turn into a desert. So yeah, you've really got to get the ecosystem going and keep the exits and the capital flowing.

Peter Stern (00:57:06):

I think Bob, or maybe I can't remember who mentioned this, but I think one of the ideas that people don't really understand about early stage innovation and the VC funding, or even funding for Facebook and Uber, is that in a good VC fund, like the top Cortel of VC funds, they essentially lose their money on 29 out of 30 investments. It used to be nine out of 10, but now it's 29 out of 30. And so they make all of the money. Let's suppose they're paying ... their returns on a VC fund aren't incredible. They're like, 4 X, which if you correlate it with the risk and the lockup, it's not really that much, but it's like, let's suppose a good firm, 4 X, maybe 8 X in some extreme cases. They're making all of that money on one out of 30 investments. That's their risk level.

Peter Stern (00:57:51):

If you take it so that one out of 30, they lose the money in the 29, they're not getting a rebate on the 29 out of 30, are they? No. So if they can't make outside returns on the one 30th that they don't know which one's going to pay out, or they would just invest in those, they got to invest into 30 to get to that one. If they don't get the outsized return on that one, they will just fail or close up shop. It just won't work it ... worth it anymore. And that's the thing that I think people don't understand. They think that, oh, they get like a little bit of return here and a little bit of return

there. So it's okay if we cap something somewhere, but what you're talking about Joe is, the one out of 30, we're going to cap that one. And that's why, what you're saying is so no offense idiotic from a VC point of view.

Bob Mumgaard (00:58:36):

[crosstalk 00:58:36]-

Matt Maroon (00:58:37):

I was just going to say, there's an entire world impact thing that we've discussed the capital reasons of why no one would be incentivized and who's making money. How many good ideas just wouldn't find their way into the marketplace. Right? How many things are we trying to battle all at once, whether it's clean energy or renewable or more efficiency or whatever the case may be. Like, are we just going to give up on the last 10, 20 years worth of stuff that has been developed and be like, eh, yeah, we're just going to skip over that generation that could have actually done some good.

Bob Mumgaard (00:59:08):

And I'd just add on too like-

Matt Maroon (00:59:09):

There is that element of it that I think has to be considered at some point is like, if we're okay with the status quo, doesn't seem like anyone is so, yeah.

Bob Mumgaard (00:59:18):

And I'd add into it too, that it's precarious already. So the single line in the acts that people will talk about using, as Allen talked about is that, the government can March in, right. And when your university spin out, that line is in your license. And the only reason that anyone's okay with it is because it's never been used. Right. And it hasn't been used in all sorts of different times of big strife. We're not talking about whether or not we're happy about a price of something. The times that we expect that would ever be used are like mobilized world war. Like when the government has invalidated patents in the past or done anything like what you're talking about. It's like the patent for the airplane in World War I, where like we are at massive, massive societal importance and those types of things, it's like, well, that's a risk that if that happened, our company would for the greater good be affected, not be zeroed out, not be treated unfairly, but be affected, that maybe that could happen, but it hasn't ever happened.

Bob Mumgaard (01:00:32):

That's the type of conversation that happens between a license office and a startup venture capitalist is like, okay, we'll sign up for this. We know this is a risk, but we know it's super, super, super low probability and that the types of things that would trigger it, we all agree are civilization scale. And that is way different than, well, I think that maybe I could do a better job knowing not nearly as much about any of this from the people that actually did it, from the people that put the work in to do it. That's very, very different.

Joe Allen (01:01:13):

Listen, those are great points. And let me just add, as a staffer for Senator Bayh, we put this thing through, there's a reason margin rights have never been used because the driver behind margin rights is to make sure that if somebody's licensed for a technology, they're making good faith efforts to develop it. And again, Congress is very concerned you might have a big company license, something to stop it because it could threaten an existing product. The reason it's never been used is universities are enforcing their licenses. As you know, you have milestones to meet. If you're not meeting your milestones, they'll go back and say, Hey, what's going on? And typically, when companies run into problems and maybe it's not working out, they'll just cancel the agreement. So the reason that margin rights have never been used is because people are making good faith efforts to commercialize the technology.

Joe Allen (01:02:03):

If they're not, a lot of times they'll stop the license or the university will terminate it. Bayh-Dole was never intended and this is the reason that margin right, these petitions have been rejected that have tried to use price control is Bayh-Dole was never intended for the government to come back in once you get across the finish line and then second guess what the price is. Which is why reasonable pricing is not defined in the law. So I don't want to get into that too much, but again, what the people that are pushing this, are people that didn't like Bayh-Dole in the

beginning. They don't like patent rights, they think all the stuff should be in the public domain. Before Bayh-Dole, there were never commercialized, but the reason we passed Bayh-Dole is we had 40 years of experience with stuff just lying there as research papers, not being commercialized, certainly not by small companies.

Joe Allen (01:02:52):

But again, you have a lot of people that just have ... or from academia that people that just basically don't like patents, which let's go into the next question by the same people who want to march in and basically take that ... license other people to make things cheaper are now arguing that the patent system is a barrier to innovation. And they're arguing that important breakthroughs in energy production or environmental protections or life sciences and drugs particularly, should be freely available for anyone to copy around the world, so that that would be more equitable. That that way you'd have everybody have same access to these technologies, these breakthroughs.

Joe Allen (01:03:35):

In fact, the UN secretary general, the US just agreed not too long ago to have developing countries have the ability to just ignore patent rights to COVID vaccines. And now COVID therapeutics, even though the world's awash in vaccines now, because that would be fair. As soon as that was done, the UN secretary general said, Hey, that's a great idea. We ought think about the same thing with energy technologies. And by the way, India and Ch... and this will, I'm sorry to ... unfortunately, this is the world that I live in and India and China are defined as developing countries. So they're able to ... you don't have to steal technology anymore, you can just basically take it.

Joe Allen (01:04:14):

So without me putting my finger on the scale anymore, assuming that was the case, and you get across the finish line, and now these international bodies can say, Hey, we really like what Bob did, that's just really critical. We should be able to just take his ... ignore his intellectual property rights and not only make it here, but even export it. So what would that do to our system, assuming that the international bodies in their wisdom decide to expand what they've just done for COVID vaccines to environmental technologies, energy technologies, agriculture, anything that's important?

Peter Stern (01:04:51):

But even for COVID vaccines, I mean, think about it. So obviously a bunch of companies spent a lot of money and we can argue whether that's fair or they should have spent more money or should have spent less, but they spent huge amounts, I mean, billions, maybe hundreds. I mean, like at least \$50 billion of their energy creating these vaccines. And they did that because they knew at least governments would buy them for some kind of price. And that was actually part of the conversation, right? Between government and industry. We will promise we'll buy 300 million doses at this price, regardless of what it costs. And so these companies spent huge amounts of effort.

Peter Stern (01:05:26):

And if that financial reward wasn't secure, those companies should not invest in solving for the next pandemic. They should stick to what they're doing, maybe hair loss or cancer drugs or something, but they should not focus their efforts on the pandemic solution next time. Why would they do that? That is a disservice to their customers, to their investors, that they would not rationally do that. I would sell my stock if they did that again. Right. Everybody, their stock prices would plummet. The CEO would get fired. There is no way those companies would step up. Right? Why would [inaudible 01:06:00]. So is that really what we want to set up for the future? And I'll stop talking there, but the same thing would apply to energy.

Bob Mumgaard (01:06:07):

It's interesting the idea that patent rights are a barrier to innovation in energy. It's actually fundamentally wrong historically. We, a) we believe in competition, right? Competition is out there, that's what a great thing that is in the world. Well, what do we want to compete on? Should we compete on secrecy? Because without patent rights, what you get is you get guilds. Like before we had patents, we had guilds. We were able to keep ... some people have the knowledge more than others because they didn't tell it to anybody.

Bob Mumgaard (01:06:39):

And with patents, what we said is no, open. Patents say, I tell you how to do this, which means that you can now go

figure out a way to compete against it. But I get the right to do it exclusively for a period of time, protected by the government. And that idea is what broke the guilds and led to the industrial revolution. And you wouldn't have James Watt and the steam engine without patents, like literally all the way back to the beginning of energy. Every single energy innovation that has happened, has happened in a competitive environment where patents were really important. Westinghouse, Edison, Watt, Tesla and Musk today.

Peter Stern (01:07:23):

That's not true. Some energy innovations are so important they're not patented, they are kept secret. For example, fast Fourier transform is a beautiful example of this. It's a signal processing algorithm. It was originally created by, I think Exxon engineers doing seismic graph analysis to look for oil, the highest profit thing you could do in corporate America in the fifties. And they found this algorithm that they could find oil better essentially. And they kept it a secret for like 15 or 20 years. And then it was independently discovered by researchers at some university. And that's what's in our cell phones now, but Exxon discovered it and kept it secret. Imagine the world impact if they had been able to license that for a profit to other industries for the preceding 20 years, we'd be on the moon for free.

Matt Maroon (01:08:17):

I don't know about everyone else. I've had products that have been stolen. So maybe I'm coming in with my own head trash on this one, where you have your ... in that case, my battery that's out on the market and low and behold, I see one that looks remarkably similar to it. Patents are, obviously as we've talked about, they're kind of an insurance policy that investors look at as some level of protection to make sure that you can continue to operate, make profit, everything else. We at least are not exclusively focused on our patents to protect ourselves. Right? We are constantly striving towards getting better and always be one step ahead in our lab, in the development in whatever the case may be. So that in the case when someone does take it and do it, whether that's legal or not legal, it is going to happen. You got to accept that reality and plan for that sort of contingency.

Matt Maroon (01:09:08):

Probably easier if you're a motor technology where you're working on success of generations of different elements, things we truly can keep trade secret that you cannot reverse engineer, probably different than a fusion reactor where, it's probably different, but that's the practical reality of the way we have to handle it. We can't ... what am I going to do? How am I going to litigate? I don't have the cash to litigate that even if it did come up, right? So, we have to innovate our way around some of the protection as well.

Marcus Lehmann (01:09:40):

And maybe moving along on the reverse engineering side of things, in our case, we just see us as a wind turbine. It's significantly easier and we want to export it all over the world. But once someone might get a hand on it, we have trade secrets on the control and other things, but still, someone trained in the state of the art might be able to take this apart. And we've seen that in the aerospace, in the automotive industry where very similar, if not identical products were offered at trade fairs. And luckily there was patent protection and other IP protection and they were able to be removed.

Marcus Lehmann (01:10:19):

But essentially what we're doing, if that would be implemented is reduce the competitive landscape to the pure cost of manufacturing and labor. And then the question is also from a UN perspective, is it good to incentivize essentially moving all manufacturing and production to areas where they might actually not have labor protection? They might actually not require healthcare for their workers and so on, because what it comes down to then is who can produce the cheapest and at the lowest cost, meaning with the lowest overhead on their labor. And that's the very dangerous progress I want to say.

Joe Allen (01:11:00):

Well, it is unfortunate as you get older like I have, you see that we have to apparently learn the same lessons over and over again because before 1980, before we passed Bayh-Dole, we were doing exactly these policies. If the government funded research, it was put in the public domain, it was licensed non exclusively, there was no ability to protect your investment. And so what happened, other countries came over here and looked at our basic research, they went through our federal labs, went through our universities, got some great ideas, went back there and turned

them into products. And the reason we passed Bayh-Dole was we said, how can we be charging the taxpayers hundreds of billions of dollars of cutting edge research if we're not even developing it.

Joe Allen (01:11:40):

And so if you go back before 1980, we were doing exactly what these people were talking about. The problem was it was being commercialized abroad and basically our economy was hollowing out. And the reason we've had this entrepreneurial Renaissance for the last 50 years is because we started strengthening the patent system and incentivizing people like yourselves, that if you take a risk, you can actually control, have a patent right, it's enforceable. And hopefully if you cross the finish line, you in fact can make money out of it. Nothing wrong with that. But it's like we've gone back 50 years now and people are trying to reinstall the same ideas that failed before.

Joe Allen (01:12:22):

But for people that don't remember that, they have to go back and learn the lessons again, but it's a painful lesson to learn. So let's go back to some of the general things because you guys have done a great job talking about it, and I'm going to get your blood pressure up. But unfortunately it is good to have people that actually have real experience talk about what some of these theories would actually do in real life. So going back to where we started, based on your experiences, what would you say is the essential characteristics if somebody wants to be a small business entrepreneur?

Matt Maroon (01:12:58):

Short memory.

Matt Maroon (01:13:03):

I think I for better or for worse, this is my seventh one. It has taken my ... I have a 15 year old daughter that has gone to school in five cities, seven different schools because it was always the ... because I didn't go to work, because I didn't want to work for a big company. Right? Because I wanted to actually matter and do something, not just be whatever my employee ID number was and was working on whatever small widget.

Matt Maroon (01:13:29):

It is certainly not for everybody. There are plenty of people that I know, people that are friends and family that want that sort of like security in 9:00 to 5:00. And I go in, I do my job and I go home and that is wonderful for them, but it's not a lifestyle for me. So the thing that ... so short memory, learning from those failures, but not dwelling on them because if you dwell on them, you will drive yourself crazy. Because there are unfortunately going to be more failures than there are going to be successes. You just hope that the size of the success outweighs the cumulative effect of all the failures along the way.

Joe Allen (01:14:05):

Okay. Anybody else have some advice for people that want to jump into this?

Peter Stern (01:14:12):

Two. Can I say two things?

Joe Allen (01:14:14):

Sure.

Peter Stern (01:14:15):

One thing is persistence. A lot of people don't like failure, persistence implies you failed and have to try again. A lot of people like to be good at what they do and not fail. And I get that. I'm not really good at anything so I don't mind failing and trying again. I do lots of different things, just my makeup. I'm not really good at anything. So persistence and the willingness to fail. And then the other key quality that I've seen drive success is the ability to be effective outside your comfort zone. So imagine you're really good at one thing, like you're a baker and you're really good at baking, you bake the best thing, but if you want to run a bakery, you got to deal with employees and the rent and customers and deal with a lot of shit that you're not the expert at.

Peter Stern (01:15:00):

You're an expert in the kitchen making those croissants. But when it comes to negotiating the lease on the corporate

kitchen or whatever, like industrial kitchen that, you go, ah, scary and you can't be scared of operating outside your comfort zone. And if you want to take that bakery based on your excellent baked goods to a national chain, that's a whole other level of operating outside your comfort zone. And so you have to be willing to operate out of your comfort zone effectively without having a nervous breakdown, which is hard for a lot of people. Especially technology people, technology people are usually ... like the better you are at technology, maybe the not so good you are at the other things. And that's why it's harder.

Marcus Lehmann (01:15:38):

And I think modern psychology has found that, if we go to the basic theory of motivation, human motivation, what drives people, people are the happiest in their jobs if they have autonomy, mastery and purpose. And so I think entrepreneurship is kind of the best vehicle for that. And if you take a pure rational Homo economicus that only goes after maximizing his profit, you would not be able to have entrepreneurship. So there needs to be some irrational motivation to do the things we're doing and stick with it, be persistent. If you just want to go make money, then you're better off in other industries where everything is nice and safe.

Marcus Lehmann (01:16:19):

And so I think it takes a certain personality that is willing to take the risk to achieve that level of that motivation. And I mean, in our case, we're certainly driven by climate change being the most important and pressing problem to work on for our generation. And also somewhat the duty of our previous generations of engineers that have developed all forms of combustion engines to now clean up what has resulted to where we are today. And so yeah, I think undermining exactly that vehicle is as I said before, is very dangerous

Joe Allen (01:16:52):

Bob, any advice for people that are thinking about going down this path?

Bob Mumgaard (01:16:56):

Yeah, actually, I think you have to be able to hold two things that are seemingly contradictory in your mind at the same time without reconciling them and to live that way. And it's actually to some people on this call who are working in politics, it's actually very similar, the two things are the same. And those are one, you have to be able to look at your current situation, assess it pragmatically and say, this is where we are and this is what needs to be done. And even when that looks terrible, you got to do it. But at the same time, you also have to hold the fundamental belief that you're going to be successful. And that even though it's long and it's hard and all those, some of those got to do it, you believe that you're going to be successful in the end and that it's worth doing and it's going to have a huge impact.

Bob Mumgaard (01:17:53):

And I think that's actually from friends that are on the hill, that's like passing legislation, that you're going off into the unknown, into the slog, into the marsh, but you believe that you're going to get through it and you believe on the other end it's going to be worth it. And that's an entrepreneurship mindset. And everyone that is going to do this and involved in this has to have that. And fundamentally the idea that the fruits of the labor are going to be yours is one of the pieces that's that part of that duality.

Joe Allen (01:18:22):

Well as somebody who was actually on the hill, let me just add to that. If you want to do successful legislation, you're much better off talking to people like you folks, who actually have real experience than people with a theory that have never done it before, because you can pass legislation that does a lot of damage if you get it wrong and the theorists have lots of time on their hands and they're never held accountable. You folks don't have a lot of time on your hands. But the reason Bayh-Dole works is because we went to people who actually knew something about commercializing technology, we did not have any theorists testify about Bayh-Dole, not a single one. We weren't interested in your theory.

Joe Allen (01:19:01):

We went to people and said, okay, how have you've done this and what should we do to make it better? So let's just close with one last question, because you all have talked about a lot of challenges. What pleasant surprise

have you run into? What was the kind of thing that really kind of made your day that was kind of unexpected that popped up as you were either developing this or some other experience you had. So what are the fun parts about entrepreneurship in addition to all the challenges? Anybody had any fun?

Matt Maroon (01:19:31):

I mean the best thing is always, when you see that someone bought the thing that you made, right? If you can go out in the world and point at it and be like, huh, I did that thing. That's what we all want. Right? There's the payoff. But we all want to make a difference and the clearest way to make a difference and the most direct way to measure it is like, how many people have paid me for this thing?

Joe Allen (01:19:54):

That's a sincere metric.

Matt Maroon (01:19:57):

Yeah.

Joe Allen (01:19:59):

Anybody else had a pleasant experience you want to share?

Peter Stern (01:20:02):

Well, when you're doing high tech spinout stuff, there are always those moments where the thing works and you're basically seeing the future for the first time. So like, I think these guys all experience that periodically, we turned on our chips for the first time and scanned the street and we got to see the street in a new way using our special kind of robotic sensors. And that was really exciting, but longer term as a multigenerational or multi decade entrepreneur, the thing that I really like is when you ... startups are engines for people as well as they are for ideas. Right? And so you have this person, like when I was building the other companies, I would literally hire people off the street. Like, wow, you have the right perspective. I like the way you think. Yeah, you're like the second assistant at the juice stand, but do you want to come and work in my office, I could to use your help?

Peter Stern (01:20:48):

And then that person becomes an SVP of a major financial institution within five years, even though they have, maybe some second rate college degree from some fourth year university in something that has nothing to do with finance, but because they were able to work at a startup and get skills and basically grow and demonstrate their success in a dynamic and complicated environment, their career is secure. And this happens at all forms of startups where that person comes in and they really maybe have no reason to think about upward mobility from their starting point. But I think startups really are a mechanism for upward mobility. That's a fancy way of saying it. I prefer to take my juice stand friends, and now they're SVPs at Citibank and that wouldn't have happened except for startups.

Joe Allen (01:21:33):

Great. Bob or Marcus, anything that comes to mind you'd like to share?

Bob Mumgaard (01:21:38):

I'd say the people. So you build this team. Right? And everyone is making a tough decision to come work at a startup. It's not an easy decision. And they make it and then they're all in and everyone's all in together. In some ways I heard someone describe it once as like, big companies are like societies, everyone's sort of doing their thing. Startups are like cults, like they're all in, like, we're going and we're going to do this, we're going to get there together. And we're going to ... this real belief in that team and against the obstacles. And you can see it, you can see that belief manifest itself in actual progress and doing things that like ... they say, working in a startup is like five years of experience in two years. And it's because you get all these opportunities that come from that team.

Joe Allen (01:22:31):

Marcus?

Marcus Lehmann (01:22:32):

Certainly, seeing the fruits of your labor. We just as mentioned, recovered our unit last week. And we had our

program managers from the department of energy coming and seeing the device and meeting the team for the first time. And I think seeing their excitements. Because for us sometimes we're so in the trenches and day to day, and then seeing them actually how excited they were, that with their help and their funding now we actually built this and people have been working on that industry since the seventies and we've not heard a lot of stories where someone actually deployed for the first time and it worked for 10 months or longer than intended without any downtime interruption. So I think, yeah, just then being able to see the fruits of the proper planning and actually the patience, the department of energy really allowed us to take the time to de-risk it and not rush and do it on not enough capital. So I think that seeing that patience and thorough engineering now paying off and the excitements of everyone involved, it was really rewarding.

Joe Allen (01:23:34):

Well listen, I got to tell you, this has been one of the most fun webinars I've ever done. Having you all on has just been fantastic. You're all very busy, I really do appreciate your time. I think this has been an eye opener for a lot of folks who've not had your experiences. And most of us have not had your experiences. So to be talking to people on the front line with technologies that are really not only driving our economy, but can make a huge difference in the wellbeing of people around the world. Hopefully people will come out of this with a greater appreciation of what we're doing. And rather than finding things to criticize, appreciate our system and support it because without folks like yourself, it's going to be a very bleak future. But with the kind of things you're working on, it really is one of the reasons why America is such a great place to be. So we really appreciate that.

Joe Allen (01:24:22):

Also, thank you for all the folks who joined us today. I also want to thank Max Bodach, who is behind the scenes, who put the webinar together. You always want to keep Max happy because Max's going to make you look good and Max can make you look bad. But Max did an awful lot of work on putting this together for us and we really appreciate it. I hope that everyone will join us again for our future programs. And that also you'll consider joining the Bayh-Dole Coalition. This program is an example of what we're trying to do to let people understand these policies are critical. There's a lot at stake on keeping our system whole and healthy and we should never ever take it for granted. The four of you really are embodiments of what we had in mind when Senator Bob Dole and Senator Birch Bayh passed this law back in 1980.

Joe Allen (01:25:08):

We put the incentives in place, there was no guarantee of success, but we just had a feeling that if we build a system like that and got out of the way, that the results would more than justify it and they actually have. So again, anybody interested in supporting us and working with us, you'll find a link to a membership application on our website, which is www.bayhdolecoalition.org. I hope everyone has a great rest of the day. Thank you for joining us and thank you again to our panelists and good luck with your companies. It's really exciting seeing what you're doing and it's folks like yourself that light up the world. So thank you very much. And we'll see you down the road.

Bob Mumgaard (01:25:49):

Thanks.

Peter Stern (01:25:49):

Thank you. We need the luck.