THE

ABUNDANCE ENGINE

DAVID FRIEDBERG ON SCIENCE, SYSTEMS,
AND BUILDING A MORE ABUNDANT WORLD

COMPILED AND EDITED BY ALEX MONETON

SEPTEMBER 2026 · PRIVATE REVIEW EDITION

EDITOR'S NOTE

David,

Your conversations and writing share a progression: find a consequential problem, understand what is unknown, and build something that changes what is possible. This book brings those ideas together.

The chapters stay in your words, combining short observations with developed explanations and stories of building companies. Read them in order or begin with a question that matters to you.

Spoken passages retain the earlier edition's light transcript editing. This revision changes selection, order, paragraph breaks, and presentation. Separate sources remain separate quotations. Questions and qualifications remain where they affect meaning. The three diagrams are editorial illustrations of cited ideas.

Small source numbers lead to titles and dates at the back. Repeated sources share a number. A separate source companion preserves passage locations, context notes, review records, and the reasons for including or omitting material.

The research collection closed on 22 July 2026. September marks this editorial revision. Forecasts and company results remain attributed claims, and the earlier fact-checking and transcript-review questions remain open.

This independent private review edition has not been approved or endorsed by you and is not for distribution. I would welcome your corrections, additions, and decisions about what belongs here.

Alex Moneton

Contents

EDITOR'S NOTE 1

Part I — The Builder's Method **3**

FIND A CONSEQUENTIAL PROBLEM 4

LET REALITY CHANGE THE COMPANY 8

REMOVE THE UNKNOWN 18

Part II — The Production Thesis **28**

ABUNDANCE IS ENGINEERED 29

SCIENCE MUST BECOME A COMPANY 41

CAPITAL MUST MATCH THE CLOCK 55

Part III — The Frontiers **66**

BIOLOGY AS MACHINERY 67

ENERGY CHANGES THE FRONTIER 79

INTELLIGENCE AS LEVERAGE 88

Part IV — Civilization and Agency **101**

INSTITUTIONS, DIFFUSION, AND PRODUCTIVE FREEDOM . . 102

THE FRIEDBERG OPERATING SYSTEM 108

A LIFE SPENT BUILDING 117

INDEX OF IDEAS 118

Source index **120**

PART I

THE BUILDER'S METHOD

FIND A CONSEQUENTIAL PROBLEM

If you're thinking about doing something entrepreneurial, think about solving a really big problem.[1]

Doing a startup has about as much meaning as saying, 'I'm going to jump out of a plane.'[1]

So all the other investments kind of get shadowed by the performance of the one investment. And so I think life is a lot like that. You know, like life is always kind of iterating and iterating until it finds a successful thing and then it takes off. And I think that's a big part of how we should all live our lives, too, is when you find that outsized return opportunity, you've got to go all in because that's where all the value is going to be created and where all the opportunity lies.

So for me, I looked at Ohalo and I just sort of did the map. I mean, you know, the impact we could have across literally every crop grown on Earth and to increase yield by 50 to 100 percent on most crops. And we've tested this across many different crops and many different types of plants. And we see the results are consistently like mind-blowingly impressive. I said, there's just no way this business can't and shouldn't be the big thing of my life.

So I should commit myself to it and spend my time on it. So that was the thinking going into it.[2]

We measure success simply - alleviate our species of the anxiety of extinction.[3]

In 40 years, none of your failures will matter. And none of the small things that you succeeded doing will matter.[1]

CURIOSITY AND INDEPENDENT THOUGHT

I want to understand the secrets of the universe. I want to unlock and understand why things work the way they do.[1]

And it gave me a perspective that gave me a perspective that wasn't applicable in my personal endeavors to go and research using infrared telescopes, but gave me a set of tools and understandings that informed my ability to kind of do programming later because I used IDL at the time or to understand how these sensors worked, to understand how DNA sequencing worked, to understand how much of how data and information kind of manipulation with matrices worked. That was super useful to me later on in my career when working in software.

And I can give kind of a lot of different examples, but I just encourage everyone to not be kind of linear and unitrack in their work, in their research, in their exploration of interests, but to really kind of be intellectually curious and explore and try and do and learn in lots of different ways. You never know how things are going to kind of fit together later. That's always the big surprise. And that's been the case for me time and time again in my life is my ability to kind of take the next step often has been driven from some insight I drew from some experience I had that was totally unrelated to any track I'm on today from in the past and then realized some outcome.

So, yeah.[4]

Well, in lab classes, I got an A plus. In classes where you go to a lecture hall and they lecture you and then you take an exam at the end of the semester, I got like C minuses because it just wasn't a good fit for me to just be told stuff and then to be after repeat what I was told. But when I was set out to solving a problem like a lab and then you have to go figure out a way to solve the

problem on your own and you learn through that process, that was a good fit for me personally.

And I think I've seen that with other people where people that can frame the problem and then go and figure out a solution to that problem, those folks generally want to go do that active learning process. I get great joy out of constantly learning. I mean, I've never stopped trying to learn about new subjects, new areas of interest. And that's a key part of that learning process for me is getting your hands dirty to find the answer.[5]

More often than not, acting gives you the data you need to answer the question.[6]

It's hard to have like a single solution except to teach people how to think, right? We've almost kind of evolved societal norms to a point of telling people what truth is, and not helping people understand how to discover truth and how to think independently and how to come to a point of understanding through reason. Like there's no class called reason. When you go to school anymore, it's like, here's facts. Here's history. Here's science. You know, like, what is the path of reasoning?

And what is the path of thinking? And therefore, like, how do you equip yourself with the tools needed to, you know, kind of uncover the truth? And then there's also this whole weird thing with media, where media has become like a form of entertainment. And the concept of information is across the board been like, deeply altered to form an opinion in the viewer, as opposed to just provide them the facts and let them form their own opinion. And I think people need to be cognizant of that when they consume all media and just see if they can get to the source truth and facts rather than the opinions of the writer or communicator of those facts or certain facts, right?[2]

Anytime I've tried to predict social behavior, I've been generally wrong.[7]

One of our principles at TPB is dare to dream. So it's all about creating that audacious perspective, you know, how big can this be? How big should we be? And what happens when you set a big goal, like let's say I have to go climb to the top of a mountain and I can't see the path from here to the top of the mountain. There's a hundred permutations or a thousand permutations on how you might get up that mountain. And you don't know which path is going to work.

Most people that are smart have been successful. And most people that have been successful are not used to not succeeding. And so the orientation at that point is that success is all about doing something and getting an action that you expect out of what you just did. And so you want you are inclined naturally as a smart person, as a successful person to only do things that you know what you're going to get as an outcome. And guess what that does?

That limits your horizon.[8]

And complexity breeds fear because it breeds a higher chance of failure. You have to get each of these things right for something to work. So if I have to get 30 things done for the first time correctly, that is a much more scary task, a much more daunting task than choosing another thing to do with my time where I only have to get five things right. And I get, call it 20% of the return. I would probably follow the path where I only have to get five things right and get 20% of the return, then getting the 30 things right to achieve the bigger outcome.

And I think that that's a general way to frame why we've probably over-invested in software and under-invested in more complex, technically difficult opportunities on earth in the last decade or two. And I would say it goes back even further.[5]

> we tend to think about new technologies linearly.. their obvious application solving a problem directly in front of us. but more often than not, the value realized from new tech is its utilization across novel applications.[9]

Once you start to realize that whatever you're being told you can't do isn't really a limitation, then you're free.[10]

LET REALITY CHANGE THE COMPANY

I started the company in 2006 while working at Google. The idea was we could simulate the weather and use weather simulations to figure out the probability of any weather event occurring that we could then use to insure or sell insurance to business owners that lose money due to the weather. So a golf course or a car wash or a ski resort or even a farmer, they see their profit fluctuate based on whether it's raining, whether it's hot, whether it's cold, whether there's enough snow and so on.

So the idea was we would go and sell this weather insurance online. Business owners could plug in the weather events that mattered. They could buy the insurance. And I've probably been to every trade show you've ever heard of. I've been to the National Golf Course Owners Association. We sold through the National Car Wash Owners Association. We sold to ski resorts, hydroelectric plants, et cetera, et cetera. We started selling to farmers these insurance products probably as early as 2007, 2008. And we started to learn about agriculture and learn a lot about the needs of farmers.

And in doing that, we recognized that maybe agriculture was the best market for this weather insurance stuff we were building and selling. And we decided to focus the company exclusively on

agriculture around 2009. Remember, farmers put typically their entire life savings on the line every year. They're operating with very narrow margins. And their entire revenue stream is driven by the weather.[11]

The goal of the company and the goal of these pricing systems really isn't to do a better job of predicting the weather. It's to potentially open up a new market opportunity for customers that don't have access to weather protection today.[12]

The forecasting really isn't key. What's key is the fact that we can adjust pricing in real time based on what customers want.[12]

My last company, Climate Corp—we started out in 2006 and offered parametric weather insurance online. Our mission was to manage and adapt to climate change. You could buy weather insurance online, and we would underwrite the risk. The way you underwrite risk like this—and auto insurance and any kind of insurance—is you look at past data, build a statistical model that's represented by the past data and the frequency of certain things happening, and that's how you price the insurance. The problem now is the past data has absolutely no bearing on what's going on.

You have to create more fundamental, deterministic models of fires, which is something no one's really good at, because we've never seen this kind of environment before: hot year after hot year, dry year after dry year. There's no historical data to draw from to build the model. So all the insurers throw their hands in the air and say, 'We can't take on that risk. We don't know how to price it.'[13]

So the idea was, why don't we just focus on making products specifically for farmers? And in order to do that, we had to make it really simple and easy for them to understand. So to do that, we had to figure out the relationship between the weather and all the

variables in farming. So we started acquiring all these data sets, data sets that historically had not really been used. This was around 2009, 2010. At that time, we were known to be the largest users of Amazon's Elastic Compute Cloud because we were ingesting so much data to build these models that related all the variables of farming and the weather to predict outcome.

In fact, we did Federal Freedom of Information Act requests to the federal government in the U.S. to get hard drives and hard drives of data. We got historical satellite data and radar data and topographic data and elevation map data and soil profiling, farm reports, shape files. All of that data today is like the mainstay. And everyone kind of just pulls it off the Internet and they can get it in a couple of minutes. But we were shipping physical hard drives up to Amazon to load up on their servers so we could use that.

And that allowed us to build these predictive models that related all these variables and make a simple interface for farmers. There was a web app with a map and they could click on their field.[11]

Big learning was when Greg came on board and really made us diligent about this approach, just how little we knew and how little focus we had at the time in solving the right problems. And so in 2009, we started selling these specific products to farmers. We moved to 14,000 grids as opposed to 400 stations, because we realized no one cares about the rainfall 150. miles away, they want the rainfall to be measured at their location.[1]

Yeah, I mean, I'll tell you, I've worked a lot with farmers. It's funny because I never came from a farming background. I literally stumbled into agriculture after starting Climate Corp. We were originally selling weather insurance to farmers or sorry, to business owners. And we decided to focus on farmers in 2009. I started that company in 2006. I sold weather insurance to ski

resorts and golf courses and the U.S. Open for rain and car wash owners. And we eventually started selling to farmers.

And then we decided to focus the whole business on farming. So that's how we got to learn about agriculture and got involved. Now, farmers are prove it to me, guys. You know, they want to know that it's real. You can give them a pitch and they're like, show me the money. Show me that it's real. And what you see in agriculture is typically an adoption curve of new technologies that looks like a 10, 30, 90 curve, I tell people. It's like farmers are always willing to try stuff out on 10% of their acres, see if it works, whether it's a new tractor or a new kind of seed or some new application or a new kind of fertilizer or something.

And then if it works, they'll scale it up to 30%. And then if it works, it becomes standard across 90%. That's the way to kind of think about farmers. So when we talk to farmers about the benefits of what we're doing with our boosted breeding system, you know, the necessity with farmers is always, that's great. Thanks for the pitch, Silicon Valley guys. Now, show me the money. You know, let me try it out. I want to do a trial. It's called field trials and see if it works.

And if it works, then we'll start to adopt it and use it. So we're now moving from the space of having technology development to making products and now starting to do field trials and get product in market.[2]

Yeah. So if you're a farmer, your goal is to take care of your family, which means you want to be a good steward of your land. You want to take good care of your land and then you want to make income to support your family and make, if you can make $2 an acre instead of $1 an acre, that's what you want to do. So farmers are always aligned with things that are really important, economically speaking and sustainably speaking, which is making more food per acre, which means costs come down per unit of food per pound or per bushel.

And making sure they take care of their land through sustainable farming practices, because that's how they're going to earn a living next year. And so farmers will adopt technology if it increases what's called their productivity. Productivity is measured in output per acre, minus input. And so farmers want to look at things like yield, which is how many bushels per acre or pounds per acre or tons per acre of food are you making? And how much fertilizer or water or dollars did you have to put in to drive that out?

And that's the key measure. So our boosted system should drive productivity in a really impressive way for farmers. It should increase yield. It should use less water per unit of output. It should use less land per unit of output, less energy, less fertilizer, because the programming of the plant, now that it's got more genes to be more successful and we can put all these great traits together by breeding two really great plants together, goes up and the farmer will benefit and the cost of food should come down.[2]

Growers get an average of forty paychecks in their lifetime and each one needs to count. Growers with bad yields and good federal crop insurance coverage this season — but no Total Weather Insurance — are going to survive the year. But their low yields will have cost them an opportunity to capitalize on record commodity prices and really get ahead. Growers who bought TWI this year to complement their federal crop insurance locked in some of that profit potential that existed at the start of the season.[14]

DATA BECOMES A DECISION

And then once they click on their field, we would show them all this information and give them the price for insurance and relate all the variables based on what they were planting, when they were planting, what the relative maturity of their seed was, etc. And it turns out that a lot of the farmers were tracking the data we were providing every day in the insurance products. Soil moisture, growth stage, forecasted yield, forecasted harvest date. So the analytics that underlie our core insurance offering became super valuable to farmers on their own.

And that's when we set up Climate.com. And Climate.com became the standalone software product for farmers that allowed them to track, predict, and make better decisions on what they were doing on the farm. And that really is kind of, I think, the reason Monsanto bought the company and, you know, really kind of set, I think, the first big precedent for digitization of agriculture. Because it was easy to use and accessible and made all these services available to farmers. And it required lots of different data to do it and making it simple and intuitive and understandable.[11]

Farmers tell us that they can't get all the weather and agronomic data they want, organized in the way that makes it useful for them. We not only have the data they're looking for, but we have developed a service to present that information in an elegant and accessible experience. On Climate.com, we have taken the first steps in unleashing the power of our unique data and analyses, giving agricultural producers what they've never had before — valuable insights that will support their seasonal planning and daily decision-making.[15]

Farmers will adopt technology if it increases their productivity: output per acre, minus input.[2]

But I do remember a lot of meetings in the field where farmers almost got viscerally upset at the fact that, like, there was this concept of digital agronomy, and that software might make a recommendation when the farmer says, I've farmed this land for 30 years myself. I know this land better than anyone. There's no way my phone is going to tell me what to do better than I know. And by the way, that's like the innovator's dilemma in every business, especially with the digital age, with AI, whatever you want to call it, with any new technology, there's an evolution that occurs where you either are going to say, I have to figure out how to get leverage from this technology.

Or I'm going to say, there's no way that this technology can do what I do. And I'm not going to embrace it. And that's just the nature of how these things evolve.[16]

We simulate the weather for every field in the United States, and that's updated nearly daily.[17]

And that business is called Pattern Ag. It's called Earth Optics Now. And it's taken off. And it helps farmers make decisions about fertilizer and things that they could put in their soil to increase their yield, spend less. You know, regenerative agriculture is kind of a thing. But like how do you maintain the health of your soil and get the bacteria in the soil to make the stuff you want them to make? Yeah. To make your crops bigger. And then the other area we looked at was the human gut, which like there's hundreds of research papers going back probably to the 90s.

So in the 90s is kind of when DNA sequencing got cheap enough that we started to be able to like figure out what bacteria are in an environment. Because before that, we didn't really have the ability to do that. So DNA sequencing lets us look at the DNA of all the bacteria, and that tells us, hey, there's bacteria A, bacteria B, bacteria C. There's 10 of A, 20 of B, 30 of C. And as we

started to get all that data, and then we looked at the health and the other chemical markers in the blood, we could start to realize a lot of interesting stuff.

And so all these papers started to come out, you know, call it 30 plus years ago, and then 20 years ago, and then things have really taken off in the last decade.[10]

Reading the DNA in the soil was not possible, or economically feasible, before.[18]

Each season, farmers face a wide range of soil-related decisions that can help them improve the productivity of the finite land they farm. High quality, consistent soil analysis will ensure farmers, agronomists and ag retailers can offer and access improved decision support resources to increase on-farm efficiency. Essentially, with more accurate and consistent data inputs, the insights and recommendations we provide for farmers can be more precisely customized to their fields, helping them make better decisions for their farms.[19]

BUILDING THE DIGITAL FARM

So we were first contacted by Monsanto and I knew nothing about Monsanto. So I thought they were just this evil company in St. Louis that did terrible things to the world and to people. John Hammer, who now is a partner at DCVC Bio, he was working on the Monsanto Ventures team. And he had reached out. And he was trying to do this, Monsanto wants to come to Silicon Valley and engage with Silicon Valley conversations. So he, like, emailed our support team or something and said, hey, we'd like to meet you guys and get together.

And one of my guys said, hey, I said, well, why don't you go meet him? And he went and met John and met the team down there. And they were like, hey, they're serious. They may be

interested in having a real partnership. I'm like, oh, my gosh, these guys reach so many farmers. They could be a great distribution channel for us. So I started reading about Monsanto online. And, you know, not a lot of good stuff was being said about Monsanto online.

But I really started to understand the business a little bit better. And several of them came in and we kind of talked about what we do. And I think it really fit a need that they were acknowledging themselves in the market. Monsanto at that point had spent quite a bit of money on a service called FieldScript, where they were trying to do seed prescriptions for farmers as a service.[11]

Farmers around the world are challenged to make key decisions for their farms in the face of increasingly volatile weather, as well as a proliferation of information sources. Our team understands that the ability to turn data into actionable insight and farm management recommendations is vitally important for agriculture around the world and can greatly benefit farmers, regardless of farm size or their preferred farming methods. Monsanto shares this important vision for our business and we look forward to creating even greater experiences for our farmer customers.[20]

Look, I think at the time it was a transformative deal for agriculture. Like it was all about the digitization of agriculture. And it was kind of this milestone that Monsanto wanted to make sure that they had the best platform to do that. And we very quickly, you know, put in place a strategy to make sure that we captured as much of the market as we could. We got the 640 Labs acquisition done and had FieldView Drive distributed. So all the farm equipment could get connected because, you know, Deere and Agco and CNH, they didn't really want to partner with us because they saw how much of the data we were collecting and how valuable that was going to be and how useful that relationship is.

And everyone was nervous about having their relationship with farmers taken out by Monsanto. So we had to get the FieldView Drive going. And we really scaled this thing very quickly. And we had a great team and, you know, a lot of talent in data science and modeling, which, you know, nowadays, if we were a company, people would probably call us an AI company because you just put those two letters in front of everything. That's about using data to build predictive models now.

But, you know, we had a great team to do that work. We had good product people that could build intuitive products for farmers, good front ends. And so, you know, I think that was a seminal kind of acquisition.[11]

We're being aggressive in making this new technology service broadly available because we intend to be the operating system of choice for farmers, incorporating hardware, software and services in an integrated platform that helps them improve yields and use resources more efficiently. This price point makes the service significantly more accessible for farmers.[21]

And we've seen this many times in history when there have been great step changes in agricultural productivity, right? So the tractor was a really important one because it increased the productivity of a single person, what they could get out of their farm. Fertilizer use was really important during the 19th century. And then we ran out of fertilizer and we developed the Haber-Bosch process, which unlocked a new era of productivity where we took nitrogen out of the atmosphere to make fertilizer. And that's the mainstay today in agriculture.

And then plant breeding and hybridization of plants. So, you know, in the early 20th century, around 1914, a guy figured out how to hybridize two plants, which means that you can combine genes in a really smart way and the yield went up. And then Norman Borlaug in the 1960s, 1950s, 1960s started to leverage

plant breeding to unlock productivity gains in wheat and rice in places like India. He eventually won the Nobel Peace Prize and was, you know, posthumously acknowledged as potentially saving over a billion lives through plant breeding.

So, you know, all of these like important unlocks, technological unlocks in agriculture drove an increase in productivity units of output per unit of input or usually per unit of land. And that drove down price and it drove up accessibility of calories and food. Right now, globally, we have about 800 million people that are malnourished. That means they're living on less than 1200 calories a day for over a year, according to the UN.[2]

given the cycle of agriculture is truly rate limited by the circling of the earth around the sun. That's the big challenge in agriculture. Nearly any other industry can more rapidly kind of respond to capital investment to improve productivity. But agriculture has this annual investment cycle that makes things very hard on the ground. And as a result, you're never going to be able to deploy capital in to see the returns as fast as you can in other industries like an enterprise setting where you can make a decision every day, every week, every month, every quarter on new purchases, new technology, new systems that you're going to try in agriculture, you've got one cycle a year. So that makes it really hard.[22]

REMOVE THE UNKNOWN

Figure out what you don't know, and then know it.[1]

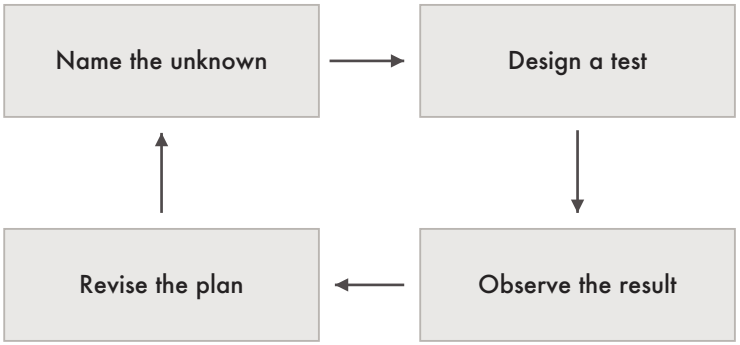
The problem is when you're trying to do something new, you cannot figure out, without trying and failing what is going to work. And so it becomes an extremely uncomfortable moment for

the person who has historically been more of an analyst than, a risk-taking action oriented, agent. And now you have to go into a situation where you're used to analyzing all the angles, making sure you know what you're going to do, making sure it's going to work. And then once you're comfortable doing it, because you know, you're going to have success.

Now you've got to dive in and do the thing that you don't know what's going to happen. You're going to take a risk. And that's why bias to action is so hard and so uncomfortable for successful people. and it's also why so many successful entrepreneurs do not come from the traditional backgrounds of repeated success. it's because they're willing to embrace failure and then you have to do failure and failure and failure over and over and over and over again. and eventually something works and then you pursue that path.

So, I think that one's very learnable.[23]

MAKE UNCERTAINTY TESTABLE



Editorial illustration of the learning loop described in these passages. Sources: 1, 23.

And it allowed them to test over 200 wing designs and they recorded the coefficients associated with each wing design in a

very detailed way that no one had done before. And that gave them the ability to systematically go out and build a better wing that they were then able to use to build a plane and eventually fly. And it was that grinding process. It wasn't a breakthrough. There wasn't some sort of moment of genius with the Wright brothers. There wasn't some discovery or penicillin thing that, you know, whatever, mythology.

These are what I call the sort of black swan outlier rock star motif equivalent events that occurred. These guys literally just took the principle of we need to get into the sky. That's a problem. We need to solve it.[1]

How do you succeed? You've got to grind.[1]

We could make this molecule to solve this cancer. We could do this thing and suddenly it turns out we're right. We could build this machine that could get us to the moon. Oh yeah, we're right. We could do that. Like all of these fundamental tools start to compound and we're in this kind of exponential curve right now that I think, and we can talk about some of the things that I think are most exciting, but that are really going to kind of transform the trajectory for humanity.

So I think that there's a risk of too much change too fast, which is perhaps the thing that breaks social order. And that's probably the phase that we're in right now. Like how much is the social order going to break? How hard is it going to be for people to adapt? How much of a dislocation will there be in social systems and economic systems and people's expectations when they shift too much and they have to kind of rethink what do I have to do?

They want to put a break on things. And I think that's kind of a moment that we're in the West right now. In the East, it's a little bit different. You go to China, they're very much embracing these technologies because there's so much more to gain than there is to

lose. In the West, we have so much more to lose than there is to gain.[24]

Let's figure out what they're doing and what we could do differently to get it done as fast as possible. OK, we can get it done in 12 months. When you break the problem down to every step in the process that's needed, rather than use the shorthand approximation that the way other people do it is the source of truth, and we say, let's figure out what are the steps, we can come up with a new way of doing things with shortened timelines, 24-hour cycles, etc., etc.

Suddenly we can get it done in a third of the time. So for me, first principles thinking is all about asking why and getting to the source of truth. What are the absolute facts, the data that you know is true, and then building the answer or the solution from there.[25]

> things are either deterministic or probabilistic. they either are or they may be. our biggest disagreements arise when we treat probabilistic things as deterministic. hard to overcome without effort.[26]

So if I knew the quantum state of every atom in the universe, I would be able to predict the future perfectly. And I had an extra universe model to run it. So it couldn't be in the universe. I think that a large part of skill is to figure out what you don't know, is to identify the risk, to identify the things you haven't identified, and to try and resolve an answer to them as quickly as possible. And as quickly as possible is the key.

So many people I know that are super smart are too analytical and not action-oriented enough in the sense that they kind of want to gather data before acting. More often than not, acting gives you the data you need to answer the question. So if I could move at an infinite speed, I could quickly resolve the perfect

business. Meaning I could run through a million different scenarios in one day. Like think about Groundhog Day, right? Like I could run my business over and over and over again, make it perfect.

So the faster I do it, so let's say it takes me a week to do that versus one day. So- the faster I can do it, the faster I can resolve to the perfect outcome. You know, number one is I think it's, I don't kind of view luck as being this passive thing that happens to me. I view luck as being the thing I didn't see happening because I didn't do the work to find it. And then I didn't act fast enough to either bring it to me, to bring the opportunity to me, or to resolve the challenge out of the path, out of the way.[6]

FAILURE AND REVISION

You're constantly failing until you're barely not.[27]

There was a lecture that a woman named Elizabeth Gilbert gave at TED that she gave a TED Talk years ago about how she had this great book called Eat, Pray, Love that had great success and accolades. And then she felt this extraordinary pressure on success because she had been successful before the expectation was she would be successful again and her next book would be just as good. I started a business at the end of 2006. I sold it for a little over a billion dollars at the end of 2013.

And I was 33 years old at the time. And I think it created an expectation or a belief that I was a great operator, that I was a great business builder, that I had some sort of superpower or some set of superpowers that allowed me to do that. And I think that that expectation leads to a great degree of pressure and expectation on myself that everything I do, everything I touch has to succeed. Because my mentality when I was building my business was I have to win.

There is no option for failure. There is no chance this business will die. I'm absolutely going to make sure it wins. I'm going to do everything. And I killed myself and we got it done. And I think that the pressure that that has to be repeated over and over again is particularly in this model where I'm building new businesses.[6]

A lack of experience with failure, I think, is usually the biggest predictor of net failure at the end of the day.[28]

You have to be comfortable with failure. You have to be comfortable with expectations not being met. I can't tell you how important it was early in my career. I had several cold-calling jobs where I cold-called college kids, I cold-called alumni, I cold-called CEOs. I had three different cold-calling jobs, getting rejection after rejection, failing in my life. I didn't get into any schools except for Berkeley. I did not do well in school. And then playing poker taught me a lot, because playing poker, you lose hands, you lose hands, you lose hands, you lose hands.

You have to make sure that you're making the right decisions, and over time the money will come to you; the positive EV will be there. Failure and persisting through failure was one of the most important traits I had to develop before I was even ready to start a company, because all that's happening every day is failure.[29]

Four out of five days, you're taking a step backwards. One out of five days, you take a five-step leap forward.[28]

The challenge with innovating at scale is that you have to get people in the mindset that failure is a process. It is part of that iterative process of grinding. The Wright brothers didn't consider themselves failures when the first 199 wing designs didn't work.[1]

That money afforded us the ability to make a lot of mistakes. And a lot of mistakes were really required.[1]

It really was just a chaotic mess trying to figure out. This whole notion of organized product-market-fit definition nowadays—that wasn't even in the realm of consciousness. It was like: we're just dialing for dollars, seeing what was out there, sort of grasping for straws.[27]

You've got to constantly be willing to let go of the past and embrace what makes the most sense going forward.[27]

You're going to have to constantly rewrite your story. … Some people call it pivoting. I think it's a little bit more existential than that.[28]

Every day that you exist, you are burning fuel. And you have unlimited opportunity to change course every day.[28]

I've come to the harsh realization over the last few years that you're going to have winners and you're going to have losers. You're going to have successes and you're going to have failures. The true alpha and the true beta will come out over time. A single data point does not a data set make. And so I would say that the hardest thing for me has been grappling with the kind of emotional complexity of winning and losing and not just being a winner.

That's been really difficult. every day. You know, I was talking with someone about this at length yesterday. And a lot of the pressure I would say is internal. I mean, when I really think about it objectively, my investors are very well distributed with billion dollars of assets invested across many different things. I'm just a little line in a portfolio for each of them. If I went to zero wouldn't

really move the needle for them. But for me, it's about me. Am I actually a success?

Or am I flash in the pan? Or am I, as everyone that's had entrepreneurial success or many people that I know have shared, am I a bit of an actor that happened to get lucky and happened to walk into the right thing at the right time? And, you know, I can convince myself either way on different days. There is a deep rooted psychological challenge that I think all successful entrepreneurs or investors have. And it's something that I think you probably grapple with for a long period of time.[6]

The problem is if you do that and you start selling to restaurants, you've now significantly minimized the opportunity to go into the consumer channel because you now have a customer and the customer is the restaurant. And the restaurant is going to say, I want this feature and I want this feature and I want this feature and I want you to do this for me. And all of a sudden, your whole team is going to be inundated with product and feature requests that focus on that much smaller, much narrower market.

And you're going to end up going deeper and deeper into that market. And you're going to lose out on the opportunity to go build for the big market, to go build for the 100x market that can actually change the world and improve the problems that we're trying to address with this business. And so, you know, I've seen this at many different businesses where taking on a lot of technical risk, taking on a moonshot project is often foregone and you end up trading into a much smaller pie and a much smaller opportunity.

And then you often miss out on that bigger opportunity. And so I think it's really important for entrepreneurs to continue to dream big and find aligned capital and aligned shareholders to let you dream big and shoot for those bigger, higher risk opportunities. Because if they work, they're 100x big.[8]

KNOW WHAT THE TEST CAN TELL YOU

We need to be careful with technology. Technology, like any other science, follows the scientific method. We learn things as we go. There's never a final answer, and there's never a final solution.[30]

Desertification is a process that takes time. And all of a sudden you wake up one day and you're living in a desert. I mean, imagine if all this beautiful forest land on just the western half of North America slowly burns off over the next decade. And there isn't enough moisture to revitalize that forest land and bring growth back. Those are the sorts of conditions that we're kind of facing. And it's not an overnight circumstance. It's that we are what we are seeing in this mega drought, which is a multi-decade process, is a reduction in moisture, a reduction as a result of vegetation, of life forms, of habitability, an increase of temperatures, which is a decrease of habitability, etc.

That is, you know, taking place over time. And it's been long predicted, but we are statistically in the midst of it and it is getting worse. And, you know, the data can kind of frame that conversation in a really scary way as you start to break out the data, which is what I tried to do when I put together that little tweet on there.[31]

I'm not sure that getting rid of the wet markets truly eliminates or eradicates the risk of a new viral outbreak. There are viruses everywhere. They are going to emerge. They are going to hit us. The issue isn't necessarily where the source of the virus is coming from. It's that we have to have better testing and diagnostics and preparedness and treatment plans, and an ability to motivate and mobilize ourselves to address pandemics like this in the future.[32]

But the truth is, I don't know because all of these tracks are intersecting with one another.[11]

Farmers are prove-it-to-me guys. They want to know that it's real.[2]

Eventually, you can inform; but make sure you take the time to first be informed.[33]

PART II

THE PRODUCTION THESIS

ABUNDANCE IS ENGINEERED

We live in a plentiful world.[3]

We haven't radically changed how we make things, we've simply scaled up making them.[3]

All the people were going to starve and die because we weren't going to be able to make enough food given how many people there were on earth. And then there was the nuclear bombs and there was nuclear energy and nuclear reactors were going to melt down and we're going to get. And then it was like chemicals in our water are all going to kill us. And then it was like, you know, on and on and on. There's always a climate change was like a good one, you know, for a while.

I think people are largely recognizing that climate change may be bad, but like it's not like we're all going to get wiped out in a day. Like, you know, all this sort of stuff. And and now it's AI. And I think AI is like the current kind of like existential threat du jour, right? Like what is it that is going to wipe us all? Now, another way to think about AI is it creates extraordinary possibilities. So like think about 10, 15 years ago, there were not a lot of people that could make money creating content on the internet, like making a podcast, doing Instagram, doing TikTok.

Think about how many people in Austin are living off of doing that. Yeah, how many that did not exist 15 years ago. That technology created opportunity for people to do things that they love doing instead of working in a factory that you wouldn't have loved doing or working in a farm in a field, plowing stuff by hand or, you know, working in a corporate cubicle that you didn't want to work in or pick your poison.[10]

Agriculture was humankind's first technology. We figured out that we could engineer the earth to make stuff for us.[11]

If a Martian came down to planet Earth and they look at the way we're doing things they would say, "that's a little bit crazy. Not only that, but it's crazy that you guys do things the way you do them given all the technology you have. You can do crazy shit as humans. You can like write DNA and you can like ferment things in these tanks and make whatever molecule you want. And you can pretty much print anything anywhere using different chemistry." It's ridiculous that the systems of production operate the way that they do.[34]

What if we could radically change how we produce the things we need? We can.[3]

And that's a good example of this principle of decentralizing production. You don't have one factory making a can of soda over and over again. You don't use all the CO2, plastic, aluminum, glass. You don't ship water around. It's much more efficient. It should be much lower cost. And it ends up making a better product for the consumer because it's personalized. Rather than buy the same soda that everyone else is buying, you can tweak the sugar and the vitamins and the color and the flavor and all the things that you want to tweak to make it much more what you would ideally choose.

And this principle of decentralization also is showing up in media. Julia, you're here doing a show that you're going to publish on YouTube. 30 years ago, almost all media was produced by a couple of studios, production houses. They had all the money and all the assets and all the resources and the distribution. Then the internet came along. And now technology distributed into our homes. So we all have a camera. We all have a Mac with a video camera on it. We've all got an iPhone.

And we've all got this ability to publish to each other. And so you no longer need to have, and most media consumed today, is made in this decentralized way. It's made by individuals making stuff on YouTube and TikTok. So the bulk of media consumed in the United States today is actually produced in a decentralized manner. And it's consumed in a decentralized manner. And I think that we'll see the same thing start to happen in the rest of the century with the production of all other goods that consumers consume.

It started, firstly, with digital goods, which is media. But I think it eventually finds its way into physical goods as we decentralize the production system and decentralize the creation systems. And so that's a big principle that I think we take for granted. We think that the industrialized world is all about centralized production. But I would argue that decentralized production is going to kind of sweep over everything this century.[23]

I think Star Trek, The Next Generation did a great job. One of the things about Star Trek, The Next Generation I always appreciated was the replicator, this idea that, like, if we can actually fully harness energy and just reorient molecules locally instead of running through all these physical, you know, humans started with mechanical engineering, you know, and then we did like chemical engineering. And now we do biochemical engineering, which is actually changing these really complex biomolecules to do more chemical manipulations for us.

Yeah. Machining molecules for us. And, you know, there's elements of physics where we're kind of doing interesting manipulation now on an atomic scale, right? Atomic layer deposition. It could be called chemical engineering, but it may be a little different. So much of that, I think, paints a picture that this trajectory maybe is reasonable, which is that in the future, we can kind of take carbon, hydrogen, oxygen, nitrogen, and maybe a few other kind of heavier elements and just reorient them locally

using some set of technologies to instantaneously make the things we want and that the only cost is energy.

And then if the cost of energy is free, well, holy shit, now humans live in this extraordinarily abundant universe and we can make anything we want and, you know, and go nuts and live our kind of abundant lifestyles. Yes. Star Trek had all these really great theories around what happens in that world, which is like the economy collapses. Does society collapse? Turns out in Star Trek, it doesn't. I'm not sure if that would really happen here.[4]

We can make carbohydrates, and we can make sugars. So I do think that there's this idea that if we were to go to Mars, if we were to try and colonize another planet, we would not be growing crops. We would use a system like this to synthesize the things that people want to eat from what the atmosphere is providing, from the gases that are all around us using a renewable power source. So I think we've got to get those energy costs down.

You know, average energy prices in the U.S. today are, call it, 11 to 15 cents a kilowatt hour. Once you get in that one to three cents a kilowatt hour price range, that's when you really have these breakthrough economics on being able to drive some of these different systems and have them work from a cost perspective locally, but they are really energy hungry. So you need to get cheap renewable energy sources, and then you can use these more efficient technologies to make the stuff that we want to consume.[11]

I just think about food as molecules. What does it matter where the molecules came from?[28]

So, you know, as I kind of think about how do we, you know, give humans more, right? I think a big part of how we should orient ourselves in terms of the ultimate quest for humanity should be around abundance. You know, how do humans get more?

Because that's how we're programmed. It's to always look for more. But how do we do that in a way that actually uses less?[35]

MAKE THE BETTER PRODUCT AFFORDABLE

The true cost of food isn't necessarily the dollar amount one spends on the food they're purchasing. It's that dollar amount plus the health cost to that person over time, plus the environmental cost that we all share over time.[30]

In order to eat healthy and environmentally conscious, you're paying a huge premium in dollars and time.[36]

I don't think those trade-offs are needed if you're smart about technology.[36]

So you really have to beat that price point, you have to get to parity and you have to make meat that's cheaper than meat and taste as good if you're going to have a shot at winning the 95% of the market. Because even if you grab the whole 5% of the market, you can make a good business.[35]

The idea that you can get people to quote, think green, be sustainable by, consuming less, by taking less in is a fallacy. It is not evolutionarily possible. And yes, for some percentage of the population, maybe you can discipline yourself to say, Hey, I don't want this, but generally 95% plus of people, they just want to have more stuff than they have today. If you've never eaten meat and you start to eat meat, you're like, Hey, I want more meat. And you know, the first time a child eats sugar, that kid wants more sugar.

And as soon as you were able to buy a nicer car, you want to upgrade the car. And so I would argue that our objective shouldn't be about in sustainability, shouldn't be about, Hey, can we get

people to consume less? It should be, can we get people to consume more? Can we give people 10 times, a hundred times, a thousand times more than they have today? And in doing so, it makes us solve the productivity problems and the productivity problems ultimately resolve the sustainability problems, which is, can you make a lot more with a lot less?

And there are tools to do that across nearly anything that we want to consume. And if we can do that, then you actually give people what they want while making things more sustainably. And so my argument is that we already have on this planet and in our knowledge banks as a species today, all the tools and all the abilities we need to make everything we want to consume with less. You don't have to not have steak. You don't have to not have eggs or milk or nice clothes.

You should be able to have it all. And you should be able to have it all at a lower cost. And technology allows us to do that. So I'm a big optimist in the tech technological sense that we have all the tools and we can, and should be driving towards building better systems to make all the things that people want. And that's a, that's a kind of big principle for me.[23]

Humans have prioritized the progression of individuals forward. People came out of poverty because of industrialization and the production of consumable goods that the population gets to consume. They get access to more calories, more foods. They get to have cars. They get to have houses. Making cement, making concrete—all of those things require industrial systems. And those industrial systems have a cost. There's the dollar economic cost, which we're rationalizing with great productivity. Then there's this whole cost that's externalized. That's the tension. If you're a wealthy nation—Western Europe or the United States—you get to stand up and say, 'Stop carbon.' But the rest of the world is like, 'I want to have a home.

I want to have a car. I want to progress as a person. I want to progress as a society.' How does more of the world get to progress while we are being cognizant of the long term? I see improvements in productivity: how many units we get out for every unit in, or every unit of carbon emitted. Better technology systems are rapidly changing how we make things and how people access goods and services. Because I'm a techno-optimist, I'm optimistic about where things are headed.

These things will pull people forward and make that happen faster without all the deleterious side effects we've unfortunately had in the absence of technology.[37]

I'll be declarative on this because a lot of people ask me. I started a company called the Climate Corporation. We talked a lot about climate change. I believe deeply in a lot of the climate science. But I also believe more deeply that innovation will solve a lot of the challenges that may arise. There's a whole series of solutions that are developing.[38]

I do think that there's a deflationary expectation that arises from this evolution of technology. And I do think that we've always been worried about what happens in the next cycle of human prosperity as new systems and new technologies replace the old. And every cycle, it's figured itself out. It used to be that what are all of the drivers of, or what are all of the horseback riders going to do when cars come to the streets? Oh my gosh, what are they all going to do?

They found, you know, the market evolved. You know, what are people going to do when factories automate? And unions fight against this, and they fight against it. And they don't want to see their union rep members lose their jobs. But the reality is eventually all factories will automate. All human labor will automate. And everyone that does work, or would have expected to work in those jobs. New jobs always emerge.[23]

Farmers want to be stewards of the land, but ultimately farmers are also running a business. If you can align the two—which is what this technology allows us to do—we can make food for less and have a lower impact on the environment as we produce the food.[30]

AN EXPANDING FRONTIER

You've got to be this eternal optimist. You have to be a realist about the problems and respond to them quickly.[27]

human civilization has always had big problems and big challenges. We also always seem to feel like we're existentially threatened. I think that's a big part of humanity is our kind of feeling of imminent doom that drives our progress and our innovation. And so I mean, like, obviously, right now, we have a lot going on in food and agriculture, which is one of the things we're gonna talk about today, because I'm running Ohalo, which is a company that's developed novel systems to totally transform genetics and agriculture.

And I think that's, you know, a real major kind of opportunity to improve the condition of humanity is to improve how we partner with nature and earth and grow things that we want to consume. And I think that's a big thing to address. Generally speaking, I think there's a lot of technologies that are moving us forward, moving humanity forward, and more so than probably the era right before the dark ages, we're also facing a lot of concern and a lot of pushback on science and on technology and on the interests.

And I always worry on are we on the cusp of a new enlightenment or on the cusp of a new dark ages? Because I do think that there's a lot of things that folks are willing to kind of accept that have no empirical truth or empirical evidence. And that has led us in some places to some really dark days in the

course of human history. And that means ignoring facts, ignoring science. And so I worry a lot about like, we've got so much opportunity right now in front of us with all the technology that humans have developed in just the last couple of decades, really, maybe two or three decades.

But at the same time, we're really challenged with accepting them and embracing. So that's where I think we're at.[2]

Every generation has these existential threats… there's always—and now it's AI.[24]

Generally speaking, techno-optimists are folks that believe that accelerating outcomes with AI, with automation, with bioengineering, manufacturing, semiconductors, quantum computing, nuclear energy, et cetera, will usher in this era of abundance by creating leverage, which is what technology gives us. Technology will make things cheaper, and it will be deflationary, and it will give everyone more, so it creates abundance. The challenge is that people who already have a lot worry more about exposure to the downside than they desire the upside. My personal view, obviously, is that I'm a very strong advocate for technology acceleration, because I think in nearly every case in human history, when a new technology has emerged, we've largely found ourselves assuming that the technology works in the framework of today or of yesteryear.

The automobile came along, and no one envisioned that everyone in the United States would own an automobile and therefore you would need to create all these new industries: mechanics, car dealerships, roads, all the people servicing and building roads, and all the other industry that emerged. It's very hard for us to sit here today and say, 'Okay, AI is going to destroy jobs. What is it going to create?' and be right. I think we're very likely going to be wrong, whatever estimations we give.

The area I think is most underestimated is the large technical projects that seem technically infeasible today that AI can unlock.[39]

But yeah, I mean, abundance is the name of the game, right? Like, if we really are moving a productivity curve, energy costs are coming down, we're able to make more stuff with AI. It's not that some people are going to get richer faster. That may happen, but I don't think that's the problem. I think what really functionally happens is everyone has more abundance. You can now, instead of working 60 hours a week or 100 hours a week when we all work, you know, when not we all, but like when Americans worked on farms, right?

The turn of the century, it was like 80% of people worked on a farm and now it's less than 1%. So we don't have to spend the 100 hour work week working on the farm. In fact, the guy working on the farm is in a John Deere automated tractor with air conditioning. He's on TikTok. While the thing drives itself, trust me, I work in the industry. It's awesome. They still work their asses off not to diminish it, but like it's a very different type of farming.

And yes, it is still backbreaking work, but there's a lot of automation. And so that created an abundance of food, an abundance of calories, an abundance of availability. And we dropped the number of people globally that live on less than 1200 calories a day for a year, which is how we define malnourished, you know, from billions of people down to 600 million.[24]

The velocity is greater, but the benefit will be faster. The Industrial Revolution ultimately drove lower-price products and broader availability of products through manufacturing. Prior to the Industrial Revolution, if you wanted to buy a table or clothes, they were handmade, artisanal. Suddenly, it unlocked the ability to mass-produce things in factories, and that dropped the cost and

increased the availability and abundance of things that everyone wanted access to but otherwise wouldn't have been able to afford. I think folks are underestimating the benefits that will come out of the AI revolution: availability of products, cost of goods, access to things.

The counterbalancing force is deflationary. Let's assume the cost of everything comes down by half. That's a huge relief on people's need to work sixty hours a week. Suddenly, you only need to work thirty hours a week and can have the same lifestyle, or perhaps even a better lifestyle than you have today. There's going to be this cost reduction and abundance that doesn't exist today. We're seeing restaurants install robotic systems to make food, and people say, 'Job loss, job loss.' The counter side is that the cost of your food drops.

Suddenly there's an incredible reduction—a deflationary effect—in the cost of food.[40]

I think the way to think about the opportunity is: if you're in a resource-expansive world, where you're increasing productivity and increasing production globally at an accelerating pace, perhaps there's less of a reason to have conflict. Perhaps there's a way that both societies, both countries, can increase the quality of life for their people without taking it away from the other side. In a world where you're more resource-constrained or resource-static, that becomes less possible. You have to fight and grab land and grab territory and grab resources from the other side.

In this moment, when we are seeing these extraordinary technology shifts unlocked by AI and automation and biotech—and what could be true abundance ahead of us—it seems like the perfect moment to say: maybe the world can be more multipolar. Everyone can participate in the expansion of the pie. How do we all share proportionally in growing the pie and

not find ourselves in a moment of conflict where we assume the pie is static?[41]

But at some point, you can't take care of everyone. And so the people you can't take care of become your competitors for resources. And that's how tribalism and, you know, nation states and all these things that create distinction between large groups of people arise. And in fact, when it comes down to it, even those nation state collectives may fall apart, as we've seen in civil wars in the past, when resources become scarce and folks want more than they have. And then they start competing within their nation state and things get ugly.

So that's, I think, a really fundamental psychological premise. And history has proven it time and time again. The only way out of these problems is by inventing cheaper and better alternatives. Like agriculture, we realized we could put seed in the ground. When we put a seed in the ground, a plant grew and then we could eat the plant a few months later. That was this kind of, you know, ingenious discovery and this ingenious invention. And then we started to develop irrigation and all these systems where we could engineer the natural ecosystem around us to make stuff for us.[42]

I think the fear of tomorrow is what makes everyone turn against each other. Because as soon as you're fearful about tomorrow, you have a reason to blame someone around you, and that's why we are all like this all the time. And I think it's very bad. It's very unhealthy. It goes to a dark place. And so I want us to all be optimistic about tomorrow and be realistic, but be optimistic about tomorrow so that we're not all at each other's throats all the time. That's why I think it matters.[43]

> a geometric line called "productivity" which would result in geometric scaling of all other lines except "resources" and

> population. arguably, resources could also climb as access to previously unusable resources emerges with productivity/technology gains[44]

We're all part of this long-term continuum of technological and productivity improvements driven by human ingenuity, which unlocks human potential.[45]

SCIENCE MUST BECOME A COMPANY

Science is about discovering new shit that no one even thought about as a possible engineering solution.[28]

Think about a funnel, the funnel being like, here's all the research that's going on in the world. And I would say that that funnel needs to be a big wide vacuum. And there just needs to be a lot of ingest going on there. Separately, the prioritization needs to arise from kind of understanding where there are big problems that need to be solved. Kind of first principles for me is always you got to solve problems. What problems do you solve? Well, let's solve the biggest ones.

Okay, well, what's the smartest way to solve those biggest problems with no knowns? Okay, well, what's the academic research showing us? You know, what's the technology showing us? What's cutting edge? What are things that other people haven't seen? What's non-obvious? And then that ability to answer that question is drawn from that wide funnel of science and academic research that we take in. And so we can start to answer those problem solving questions with a fundamental understanding of what's going on in science, a fundamental

understanding of what kind of new emerging technologies might be.

And then from a business model perspective, how can we apply them in such a way that can kind of solve this problem?[6]

No, so that's not where we participate. We spend a lot of time in markets, the life sciences, food, agriculture, human health, you know, markets that we start to know very well. We spend a lot of time with scientists and academics and researchers and engineers that are working on emerging technologies. And we read a lot of papers, a lot of scientific papers and journals. What we're trying to do is we're trying to identify scientific and engineering breakthroughs that can be applied to the markets in a non-obvious way.

To connect that dot, we try and bring the right people in to help build that business. So there'll be a research paper published, let's say, and some new discovery was made. We'll go find the best scientists we know with our concept on how can we take that discovery and build a new business or create a new business model. And that scientist and research team, we say, guys, can you run an R&D cycle with us? If this works, we're going to start a company.

And you can be the chief science officer or the CTO. And then sometimes we'll bring in a CEO on day one. Sometimes a CEO doesn't even show up for three years, depending on kind of, you know, the build cycle on the business. Because a lot of what we do is what people call deep tech. And so sometimes we'll just have R&D. Once the R&D de-risks the technology, we start a business.[6]

The Production Board uses science as our engine to pursue this mission.[3]

> An age of extraordinary discovery is underway.[46]

When I was 13 years old, I did a science-fair project on superconductors. I bought this superconductor from the back of Popular Science magazine, this old yttrium barium copper oxide. You could buy it for nothing. And I got liquid nitrogen at UCLA, and I did a demo at the science fair, and I did a poster board, and I had HyperCard on a Macintosh LC. And I showed everyone: this is the future. We're about to have room-temperature superconductors. It's about to happen, and we're going to have flying cars, and we're going to have limitless energy and limitless battery storage for energy, by the way, which is one of the big applications.

This was when I was 13 years old, 1993. Here we are, 30 years later, and everyone feels like this moment might be upon us. But it has been this thing that's always been elusive, that everyone's always thought was around the corner.[47]

Finding awesome scientists and trying to convince them to do this work is fun for me and a good use of my time.[48]

In a short period of physical space, you can create what would otherwise take a giant cyclotron in terms of energy to get these particles moving and then use them for kind of experimental applications, research application. And what's happened over the years, I think, is that the ability to kind of generate, you know, femtosecond scale or sub femtosecond scale sensing technology and control technology and responsiveness and then the compute infrastructure needed to actually quickly compute and respond and drive what the sensor is telling you and drive an action in the chamber has changed profoundly.

And so much of the science is not science, it's engineering. It's about the electronic componentry that can very rapidly and accurately and precisely sense and then very accurately, precisely control a strong enough magnetic field. And one kind of analogy I use when talking to people about fusion is it's like a giant balloon.

And if you put a pinprick in the balloon, all the air gets out. That's what happens with fusion—with a plasma. If you cannot control it, the plasma will just kind of, you know, go away and it'll evaporate.[4]

And so there's a guy working with us as a scientist in residence at TPB, which is a foundry. We run kind of R&D programs internally. And if we feel confident that the R&D yields an opportunity, we'll build a business around it. So in this particular case, we said, hey, Lance, why don't we read these papers, try and recreate these experiments and see if we can come up with a good orientation around is it really feasible that we can create thousands of beverages using just a few dozen compounds that they make economic sense, that we can put them in a flavor cartridge and turn this into a machine.[8]

We separately ran a chemistry program, analytical chemistry program, as well as a hardware program. And, you know, we had spreadsheet models that showed that the math could work and that we could actually make this device. And we had a bunch of different technical challenges on how do you actually dispense, right? You know, microliter and submicroliter volumes of these flavoring compounds into the water stream. You got to make sure you can do the whole thing in 15 seconds or 20 seconds, because otherwise consumers are going to get annoyed.

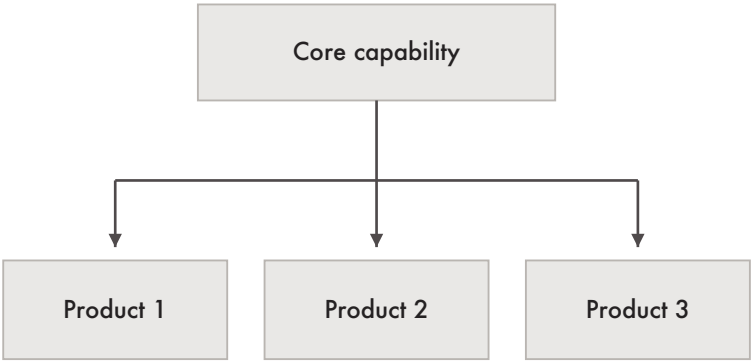
It's got to taste incredible. You can't, you got to have high precision. It's got to be cheap. You got to make it really cold. I mean, all the product that, you know, we had all these PRDs we were trying to iterate on. And then we yield our kind of estimated cost model. And then we had to prove the tech worked.[8]

A general framework for us is at least 10x improvement in the energy cost, time and or carbon footprint of an existing system, at least 10x. So if it's kind of an iterative thing, it's not that

interesting. And it has to have kind of the, you know, and this is an off overused term in Silicon Valley, but it has to have the makings of a platform, meaning that some core technology or capability can allow you to make and do lots of different things.

So it's not just a single point solution or a single product, but the platform, as it might be called, can be harnessed to make different products over time, each of which takes less money to make than the prior one because the platform scales, right? That's kind of the general framework for how to think about what a platform, you know, might be.[31]

A CAPABILITY THAT SUPPORTS MANY PRODUCTS



Editorial illustration. The platform is reused; later products build on the same capability. Sources: 31.

I think it's more a question of cost. Can you make the cost cheaper? Okay. I love and appreciate and am myself one with idealistic ideals. Okay. So we all want to have a farm in our backyard like Michael Pollan promotes, and we all want to make our own food, but it doesn't make sense when you have an apartment building with 40 floors, and you got to feed everyone in that apartment building and so on, which is the majority of the

urbanization, which is 60% of the population in the US and more in China, and it's happening in Africa too.

All technology starts out big, slow, expensive, and central. So think about a mainframe computer. It filled a room. It cost $15 million. It took forever to do something, and we would each be able to get the exact same thing out of it. Now we each have a supercomputer in our pocket. It's small. It's fast. It's cheap. It's more powerful, and it's personalized. I get my own version of stuff coming out of it. I think you could say the same about media production where it started with big studios, and now we're all YouTube creators, and we're all Instagram creators.

And you can see this across the books and publishing and so on and so forth. So much of, I think, technology ultimately kind of finds its way to the edge of the network, and I think we're seeing that in manufacturing, particularly in food manufacturing, because what happens is a lot of new technologies emerge that allow you to shrink, speed up, and distribute the technology.[11]

Across nearly every industry, we are seeing a tech competitor that is technology-led or technology-first kind of reinventing the operational model of traditional businesses. And it's having a dramatic impact. I mean, look at Airbnb and hotels and Uber and DoorDash. I mean, you can go through the category list. These aren't restaurants. These aren't hotel operators. These aren't, you know, taxi cab companies.[6]

Yeah, so for each of them, during the R&D phase, we're typically trying to demonstrate what we call a proof of concept or a prototype, which is like, is this technically feasible? You know, going back to that first principle point I made earlier about like, can you make a product? You know, in the software world, that seems like the simplest thing and you move right past it. Of course, anyone can write a website or an app or whatever. But in technically difficult businesses, in life sciences, in synthetic

biology, you know, the kinds of areas that we're operating in, you need to actually prove that the science or the engineering works.

So that's a proof of concept or prototype cycle. During that phase, we're just funding it. And, you know, usually there's a budget against it. So we'll say, here's how long we think it'll take. Here's how much we're going to fund against it. Here are the things we're trying to prove. Once we prove them, then we're going to start a business. Before we start a business, we build a milestone and budget plan. So we say like, look, here's how much it's going to take to achieve these outcomes in the business.

Here's what those outcomes are going to do from a value creation perspective. Like if we can do X, this business is going to be worth Y. If we can do, you know, A, this business is going to be worth B.[6]

I wouldn't say it was just a stroke of ingenuity because much like the Wright brothers and Thomas Edison, it was an iterative engineering project. It was all about trying and, and editing, experiments over and over and over hundreds and hundreds of attempts to eventually figure out how to synthesize nitrogen, ammonia. And that outcome saved the planet. And there are many examples like that.[49]

A PROCESS OF CORRECTION

Science is meant to be a process of skepticism, interrogation, and the search for objective truth, which means that you should be constantly questioning whether you are right or wrong. And I do think that that is a necessary part of the process of science. Science is not meant to be a dictatorial regime. And so I think that resetting the framework for how we operate some of the agencies and authorities that are supposed to be rooted in science—to have the necessary process of skepticism, review, and transparency—I think will reassert faith and reassert trust by the public in how these agencies are operating.

I hope that happens. I really do, because I do think that there are very good people in all these agencies who do very good work, and there's a lot of very important advances that have come out of the United States of America and have gone through processes through the federal government that have actually done really great things for Americans and for humanity. I don't want us to dismiss things as being whimsical bureaucracies that don't have any rooting in science. But I do think that it's important to have this degree of skepticism and process and have transparency.[50]

As you get more data, you use statistics to make predictions from that data about the future.[7]

The reliability plot of nearly any predictive model at some point, at some point in the history of the universe, will resolve to some S curve. And it will resolve to an S curve because the things that the model says will never happen with some degree of frequency. And the things that the model says will always happen, will happen with some degree of frequency, there is no such thing as 100% or 0% kind of predictive power. So that's, I think, like a really important general kind of orientation. I try and make sure I

remind myself of as often as I can, so I don't get in trouble being 100% convinced or 0% convinced of things.[4]

I think one way to summarize or sum up a bunch of the things we touched on today is don't use heuristics. There are things that humans have developed that have turned out to be net negative from a technology perspective. That doesn't mean all technology is bad. And this goes back to the point about being able to reason and understand through analysis or develop your own individual opinion. To identify that one thing is great and another thing, just because one thing isn't great doesn't mean that the other thing, the next thing can't be great.

And I think that it's really important that we all kind of embrace the ability to be independently thoughtful. And if we are and if we were, I think we would all kind of find that a lot of technology is moving us forward in ways that like our grandparents, our parents would have never imagined. That's so incredible and so beautiful for the world. And we're headed in the right direction and we have these amazing tools and the human spirit drives incredible progress that over time is beneficial.

And we need to kind of get the fearful, you know, amygdala in our brains kind of turned off a little bit so we can use the front part of our brains and think and look at these things and be rational and don't embrace the dark ages, embrace the enlightenment. So that would be my summary of this moment.[2]

> this isn't a study. it's a computational analysis. anyone can pull the same data and theorize differently. and anyone can run experiments to prove/disprove the theories.[51]

> everything is a theory. skepticism is not anti-science. in fact, it is a cornerstone of science. denying data that discredits your own theory is not skepticism, it is ignorance.[52]

> science is a process of discovery, not absolutes. hypothesis->test->(dis)prove->new hypothesis.[53]

> i realize this can be frustrating but science is the best tool we have for seeking the truth. in this case, other scientists reviewed the methods & data and identified issues with how the data was resolved and what it conveyed. this is a healthy part of the process of discovery.[54]

THE CHANGING WORK OF A FOUNDER

Founder isn't really a role.[1]

I have a fundamental rubric for business value creation. It's super simple, but we could spend hours dissecting it. Number one is, can you make a product? Technical competency. Number two is, do customers want your product? Product market fit. Number three is, can you make a positive gross margin selling your product? Number four is, can you deploy marketing dollars to acquire customers in a positive way, meaning LTV greater than CAC? The next step is, can you actually increase that LTV to CAC or increase your unit economics as you scale?

And this is an important one that gets distorted in a lot of these cases. And finally is, can you become a platform? Meaning, can you be multiple product or bring partners on? So you get true leverage out of the network you've built between customers and suppliers in some form. Those step functions really do define value creation. The problem that you point out is that in a lot of cases, the assumption is you're gonna get to that next step of value creation with capital, and it's not necessarily true.

And then you're stuck where you completely fail on the next step of value creation and you actually create negative value for the business by putting too much capital in too fast. So I would argue, every business should raise as much capital as they

possibly can, provided it meets their dilution or ownership criteria. But at the end of the day, the deployment of that capital within the business, I believe, should be phased based on a recognition of are you stepping up value across my very simple business value creation rubric, but anyone can have their own before kind of assuming that you're gonna get there at scale.[6]

You have to build a better product for the consumer to change. … To really change what all people are eating, or what the 99 percent are eating, you have to have a better product. Better means cheaper and more preferable: tastier, more convenient.[30]

Automation was just a solution to the problems of cost and speed.[55]

The other ninety per cent care about taste, price, and speed—in that order.[55]

And then after the business kind of builds their first product or proves something, then we go hire a CEO. And so there's a sequencing depending on the technical challenge of the business. So our work is quite different. We're typically not bringing in people that we start businesses with that are otherwise trying to be entrepreneurs. The scientists, the academics, the engineers, the researchers that we primarily start businesses with... are not out there going up and down Sand Hill Road with PowerPoints with their crazy idea.

They're core principled people that have very strong interest in helping the world. They're very mission oriented and they're very deeply technical. And so we can help them build a business and we can kind of be effectively the founder of the business with them. And then over time, bring in the right management team and the right support staff and build out a whole company around it.[6]

Eric Schmidt came into Google through his relationship with John Doerr. John Doerr, as a mentor to Larry and Sergey and an investor in Google, suggested that they bring in a professional manager who could help them successfully scale the business. John had this relationship with Eric, and Larry and Sergey started to socialize with Eric. It was a very long process. They ultimately respected Eric because of his technical capabilities and technical background, which was quite distinct from the other candidates they had met during this process.

They were first-time founders. They had never worked anywhere. They had never had a job. They had never had experience. These first-time founders that haven't had any sort of work experience—and have no concept of organizational dynamics and the challenges that will arise as you try to build and scale a team to execute a mission—typically need to have some degree of counseling, mentorship, and support. Bringing in that degree of experience with someone who's ready and willing to partner with the founders—not necessarily direct them, but partner with them and help them learn, as Eric did—has been a really powerful enabling force.

The early days of Silicon Valley venture capital were framed around this concept where you find some smart technical founding team and then you bring in a professional manager, because so much of the origin of technology in Silicon Valley was about selling technology into an enterprise. There was a tried-and-true business model and business structure that made sense. The new era since the internet has been quite different. Every business model imaginable has been reinvented in Silicon Valley. Success, I think, has largely arisen in reinventing businesses, reinventing industries, through novel, independent-thinking leaders, not necessarily bringing in experienced managers to scale up a known business model.[56]

And the best entrepreneurs are willing and open and able to listen to all the advice around them and hear everyone and take it in. But ultimately can know themselves to make a decision and to reorient the business based on what they feel is the right thing to do, not to just be told what their investors or their board is telling them to do, which can sometimes be a path to ruin.[57]

Create leverage in your life. Find people. Give them ownership. Get out of the way.[28]

The founder is the person from whom the energy to drive, to innovate, and change the business comes.[5]

But at the end of the day, it really is the CEO that's driving the outcome of the business, not the board. I cannot control a company, I cannot direct a company, I cannot lead a company from the board. I cannot make the decisions, I cannot take the actions. I said to someone, it feels like when you're on the board, every day, you're waiting for shit to happen. But if you're the CEO, every day, you get to wake up and make shit happen.[58]

If you look at Airbnb, Uber, how Steve Jobs built Apple, what every one of these businesses has in common is that they were all built in a unique way. I think that's what makes great businesses: they identify their own unique path for how to operate a business, to scale, to achieve the mission of the organization. That's what's typically lacking in trained managers who use comparables and biases from their prior experience—what they've been trained and taught to use as a cookie-cutter model.

It doesn't create unique value; it makes your business look like the other, and ultimately commoditizes some aspect of the business to the point that its value goes down. To build something unique, where you're constantly finding the unique path that gives you an advantage, is what all these companies have in

common. Whether that path was made by an experienced hired person or a first-time founder, it's this ability to build a unique competency that makes them distinct as a group.[56]

Innovation is the only sustainable competitive advantage any company can have.[1]

Exceptional founders have nothing to worry about. But being a founder doesn't give you the privilege of being able to raise money. And so that's a fundamental truth that everyone's going to get hit in the head with at some point. You can't blame the market.[59]

Yeah, so our objective is not exits. Our objective is business value creation. So I think about absolute value creation across our portfolio of businesses. At any point, if the business value creation rate starts to diminish, meaning like each year or for the next couple of years, we don't think we're going to be able to get the value on this thing up by another 50%, 100%. Maybe we should turn it into cash and reinvest that cash in other projects. So, you know, we can kind of take a different point of view the way that we're structured, right?

We're not incentivized to have a liquidity that I don't make any carried interest, right? I don't take any money out if we sell a company. That money is just recycled. It's got to go into something else. So if a business is continuing to compound value, continuing to grow, continuing to make meaningful, you know, business advances, great. Let's keep owning it. And, you know, eventually maybe it goes public. Maybe it gets acquired when that kind of value accrual stops. But I think you may have noticed recently Sequoia kind of did this restructuring.

And I think it's for this very point, you know, a lot of the companies that Sequoia has invested in, tremendous, incredible businesses like DoorDash and others, right? They put money in,

thing goes public, the traditional model of distribute your shares, but so much of the value is created after they go public.[6]

If someone's willing to pay you to solve the problem and you can make money doing it means that you've created a tremendous amount of value.[6]

We've got a great technology. We've got a great platform. But we've got to build a great business now.[2]

CAPITAL MUST MATCH THE CLOCK

Well, when I started Climate Corp, I left Google in 2006 to start it. And I went around to a bunch of venture capital firms and none of them wanted to invest in it. You know, I had two VCs or a VC friend of mine who had kind of given me a small check. But he's like, let's go introduce you to other VCs and we'll raise a series A round so you can have some money to start this company. And I didn't really have the money because none of the VCs would invest in it.

You know, it was an idea and a PowerPoint or whatever. But I had to go raise money by kind of soliciting all my friends who had made a bunch of money from Google's IPO and networking my way to investors and eventually cobbled together a small seed round, which gave me enough capital to leave Google and start this business. And then, you know, the original concept for the business was we were going to simulate the weather and sell weather insurance online. This was in 2006.

So, you know, using data to create statistical simulations and have a website where people can buy weather insurance was a

little bit kind of out there. I ended up needing to go to a lot of trade shows to sell weather insurance. I mean, I've literally been to more trade shows than anyone you've met, passing out umbrellas, selling to the Golf Course Owners Association, the Car Wash Owners Association, many different farming conferences, travel association conferences, because all of these different industries were affected by the weather in different ways.

And I would just pitch this idea on, hey, you should ensure your business against rain or heat waves or drought or whatever, ski resorts. We sold to a lot of ski resorts, hydroelectric plants.[23]

Global agriculture production is more than $3 trillion per year, and it is at risk today from extreme weather conditions, as evidenced by the recent droughts in Russia and China and extensive flooding in Australia, which have decimated global commodity supplies. More than 90 percent of crop losses are due to unexpected weather and climate change is increasing the frequency of extreme weather events. Dedicated to addressing this global concern, WeatherBill is applying the use of our technology platform to become the first company to provide every farmer — from the developing world to the technologically sophisticated — with a simple and effective solution for removing weather-related risk from their financial profile, in order to support and ensure the sustainability of the global food supply.[60]

I mean, right now, I think the big challenge all entrepreneurs and investors are facing is these kind of gaps in capital that may keep certain projects that have a good technology shot from actually getting across to the other side of the chasm, right? So if you look at public biotech companies, about 45% of them are trading below cash now. What that is telling you is that most biotech companies, when they hit a successful outcome on a clinical trial or when they're close to, they go out and they raise more money

to keep funding the clinical trials and hopefully get the product across the finish line.

That's a good example of what's needed in a lot of ag tech that's going on right now in precision fermentation and cellular meat and some of these emerging categories we've been talking about. It's unique capital that as these businesses hit key technical milestones, they're able to get funded to get to the next technical milestone and get across the chasm. They're not profitable businesses on day one because they're big technology builds. And so in a market environment like this, where capital is saying, I would rather invest in things that are going to pay me 5% a year this year or next year versus making five times my money 10 years from now if it works or 10 times my money 10 years from now if it works, you're seeing all the money move the near term.[11]

And that's because of the way interest rates have been adjusted associated with problems with inflation and other macroeconomic conditions. So right now there's a real capital problem. These big projects that historically have been fundable are becoming less fundable. And as they become less fundable, the seed investors don't want to invest in them because they're afraid the A investors aren't going to be there, who are afraid the B investors won't be there. And no one wants to come and pick up the scraps of the company that's now getting priced in a down round.

And that's the other problem. So much of investors have been trained in the last 15 years to be momentum investors. You invest in stuff when it's going up. You don't invest in stuff when it's going down. In the last year, the index for growth stocks has declined by 70 to 80%. So everything is down 80%. So all private companies should be down 80%. So if you raise money at an A or a B valuation of 100, are you now worth 20?

And if you're worth 20 and you've raised 40 million of cash, you're now worth less than your preference stack. And that's the wall that everyone's starting to hit because the investors that

would do late stage investing are really nervous to fund a company that's now worth less than their preference stack. And you've got to go negotiate with the existing investors and recap and restructure.[11]

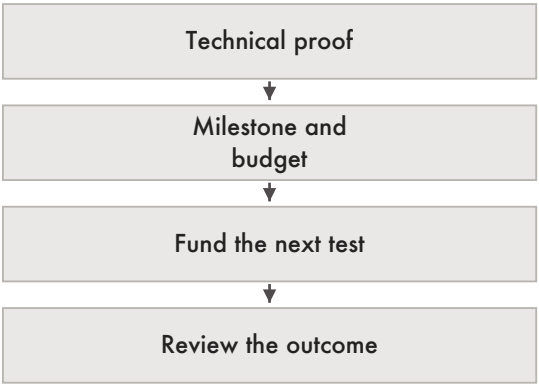
You have a sales cycle and an evaluation cycle once a year. … You still have to wait for the sales window. Then you have to wait a year for the results. … That's what makes it hard to deploy a lot of capital really fast into agriculture to drive technological innovation.[16]

And so we kind of ask ourselves the question, you know, how risky is that? How much time, how much money are we willing to put against hitting those milestones? And then we have a timeline and a set of goals and work with the team to help them achieve those milestones and those goals. At that point, like, let's say we put in $5 million into a business and we say, look, if we can get this thing built with that $5 million, this company's worth $150 million.

And so we can start to do the calculus on does it make sense to put that $5 million in versus like if it's going to take $15 million and you're only going to get to $175 million valuation, you're like, well, let's just do the $5, not the $15. And so you try and assess like what's it going to take to achieve different outcomes for the business over what period of time and what amount of capital. And that's how we start to make our kind of decisions.

And we typically take those milestones and we stage gate the capital. So, you know, we'll say like, look, we've got to achieve certain stages along the way to make sure that we're not just going to end up burning all the money away, right? This isn't like a VC where you give a founder a bunch of money and you hope that he does well with it or pivots away into something else.[6]

CAPITAL FOLLOWS EVIDENCE



Editorial illustration of staged funding. Each result informs the next commitment. Sources: 6.

You have to show that unit economics and growth can go hand in hand in order for the business to be valuable over the long run.[61]

That's the job of the investor: are you actually making money, or are you creating the artifice of making money—the artifice of growth by spending money?[61]

BUILD FOR THE DURATION

As a permanent capital holding company, we have the flexibility to deploy capital with a long time horizon.[3]

Why don't you just become an investor? So I set up a holding company. They invested some capital. I didn't want to run a fund. I didn't want to be a fund manager. And you have all these incentives around raising more capital and taking management fees and all that sort of stuff. So it was really simple. It was like, I'll put my businesses and investments in here. You guys put some

cash in. You guys own some shares. I own some shares. And then over time, just like any other business, we've sold more shares and raised more capital and used that to build some of our businesses that we operate today.[31]

We're a lot like companies. So we have a balance sheet. We raise some money from investors. We have shareholders. They all own shares in the company. I own shares in the company. And unlike a fund, it's not just committed capital. We actually take money. We put it in a checking account and we hold it there. And then we can use it to do whatever we want. We run R&D cycles, we start businesses, occasionally we'll make minority investments, but that capital is very flexible and it's primarily used for the building and operating of businesses that we're the majority owner in, but that we do set up as independent C-Corps.

So they are standalone companies. We are the majority owner in those companies, but we construct a board. The people that work at that company all have options and equity in that company. And in many cases later on, we'll bring in outside investors into those individual companies. So even though we are the original majority owner and holding company that owns those shares, that owns those businesses, we do kind of sell stakes in those businesses over time as they need additional growth capital.[6]

So we don't operate like a fund. We don't take a management fee out. We don't have an incentive to mark up investments and go raise our next fund. We're basically a balance sheet, right? We're a company that owns stakes in other companies. Most of those companies we start. So several minority investments we've made in businesses that are strategically aligned with the stuff we're doing. But generally, we start businesses. So we will spend a lot of time with scientists, with research teams, with academics trying to

identify new and emerging trends in science and technology that we think could enable some sort of breakthrough opportunity.

We also spend a lot of time in the markets we operate in. And then we really try and identify what's possible. And we ask ourselves, how can we reinvent a system of production on planet Earth, one of these systems that makes things that people consume, or provides health or therapeutic products to people? How can we reinvent that system using these emerging technical capabilities or emerging science?[62]

It stays on the balance sheet and we keep building.[48]

And I think there's, Harry, you'd know this more than I would, but I think that there's been a little bit of a trend lately in new managers of folks trying to find new managers that are going to be, I think, hungry and proving themselves in one way or another versus being on the ninth fund. Now, all that being said, that doesn't mean that you can't create a great business at scale. So the business you're creating as a craft in the early days, you know, hands on workshopping with CEOs, et cetera, versus like a company that a firm that now has 50 employees and is distributed across multiple funds with billions of dollars.

You know, the way that you would operate that larger fund is probably quite different. And it doesn't mean that you can't scale and succeed at scale. But I think that, you know, there is this natural incentive model to always raise more capital and make more fees.[6]

[Monsanto] used a lot of different third parties and it wasn't very sophisticated. It wasn't working very well. The business was fairly challenged. And I found that out after the fact that there had been all this money and effort that had gone into this program. And so, you know, they said, look, maybe we could work on this together. That sort of kicked off our conversations about maybe we could

be an investor, too, and put some capital in. And then we said, well, if you're going to do that, we're really big into gathering data and using all this data to make our models better.

Can you guys share all of your field trial data? Because no one has more field trial data than Monsanto. All the hybrids that they've produced, all the seed that they've produced, they know what the yields were, what fields those yields occurred at, what the dates were. We could match that with the weather and we could start to build better models using their data set. And we said, we want your, I think it was Gen 5 data set at the time. And they came back and said, well, if we're going to give you that data, we need to own the whole company.

And that's what really kind of kicked off the M&A conversations on, you know, what would it take to buy the whole company? And a year prior, we had raised a nice series C round from Founders Fund and business was, you know, kind of going well. We had this climate.com free offering for farmers and we're about to launch our paid analytics service. So, you know, things were looking really good. So it was like, well, in order to pull that off, we really have to do good for our last round investors and kind of had a hefty negotiation to get the deal done.

So that's kind of how the whole thing kind of came together.[11]

I've had both KV and FF as investors—lead investors in both Climate and at Ohalo now—so I know both firms really well. Founders Fund, they have this kind of mantra: they find great founders and just get out of the way, let them run. They don't want to be helpful. That's not their objective. They feel like if they have to be helpful, it's not the kind of founder. And then at Khosla, as you know, Vinod and the whole team there, especially at Climate and Ohalo, have always been extremely helpful: adding board members, introducing commercial partners, being very traditionally proactive, participatory VCs on the board.

Very different; both very valuable. When I had a board issue at Founders Fund and there were some board members that did not like my strategy, had issues with what I was doing with the company at Climate Corp at the time, Founders Fund actually stepped up and protected me. They got the rest of the board together to protect me in a way that was actually at a very crucial moment for the business.[63]

THE PRICE OF TECHNICAL RISK

What I'm talking about is the technical coordination of lots of technically difficult tasks that need to sync up. It's like getting a master lock with, like, ten digits, and you've got to figure out the combination of all ten digits. Once they're all correct, then the lock opens. And prior to that, if any one number is off, the lock doesn't open. These technically difficult businesses are some of the hardest, and they do require the most dogged personalities to persist and to realize an outcome from. But the truth is that if you get them, the moat is extraordinary, and they're usually going to create extraordinary leverage and value.[64]

Not every opportunity should be hedged away to make money. I think we have to accept that we need to take big risks that have high probability of failure and concentrate a large amount of capital in a few of those. And if we have a portfolio of those big bets, all it takes is a handful of them working that, you know, obviously it makes up for everything else. But I think it's really important from a return perspective. If you just look at the last 10 years that we need to expand our horizon away from software and, you know, applications and front end stuff that can make money very quickly and really try and take on more challenging, technically difficult businesses that can accelerate outcomes for humanity.

And so I would just encourage everyone to be much more risk seeking if we're going to have a venture landscape, if we're going

to have a venture capital market that's going to perform as an asset class and a startup ecosystem that's going to perform from a returns perspective. We have to have big outsized bets on big outsized ideas. So, you know, I would just encourage everyone to continue to be risk seeking.[5]

> probability of failure for high technical risk businesses will always be very high. but if successful, the payoffs will be worth the risk[65]

Yeah, I mean, look, I've spent the last seven years running the production board prior to this. And we've got a whole portfolio of other businesses. And, you know, I think that for me, when I saw the success that we had at Ohalo, and, you know, we started getting data quite some time ago. And as the data got more and more impressive, I was like, oh, my God, like, this is the business. I think that in life and in investing in early stage high risk stuff.

The whole point is to try and find that one power law returner, right? You know, the idea of the power law and venture investing is typically a handful of investments account for almost all of the returns. This is true across the entirety of startups. You know, if you look at the year that Uber was started, Uber probably accounts for 90% of the returns or 80, 70% of the returns generated from companies started that year. Out of thousands of companies started that year.

The same is true for the year that Google was started or the year that Amazon was started. So in venture, the only way you're really successful, meaning you're beating public markets from a return perspective, is if you have one of these massive outliers, one of these companies that's so significant that it returns many hundreds or thousands of times the capital you put in. And it basically makes multiples and multiples on the total fund.[2]

I've been talking with my management team a lot about AI first principles, and we're doing an offsite on this. There is, I would say, a once-in-a-generational opportunity to select companies that are going to accelerate growth because of the leverage they create by adopting these tools—not tech companies in the traditional sense, but across the entire economy. So much of the thesis is around traditional businesses being reinvented using AI. It's not just the few tech companies providing the fuel; there are fires that are going to take off in all these different markets, creating an opportunity for incredible market-value creation.

Traditionally, the market grows and differentiation among competitors is minimized once the market has matured. But every mature market can be completely disrupted. If you're smart about selecting management teams and companies, it seems to be an incredible opportunity to realize investment returns even in a mature equity market.[66]

> there are very few investors who are truly Constructivist - helping management make the right long-term decisions, rather than being Activist for strictly short-term arb.[67]

PART III

THE FRONTIERS

BIOLOGY AS MACHINERY

We're converting sunlight, water, CO2, and stuff in the soil—doing molecular conversion using these machines called plants. … They run off the power of the sun, so they're natural solar cells.[68]

So, you know, DNA is made up of four base pairs, right? We use these letters, A, C, T, and G. Everyone's learned that in high school biology, hopefully. But if you haven't, it's probably a good YouTube video. It does a better job explaining it than I do. And ultimately, what is DNA? DNA is organized into what are called genes. So a segment of DNA is called a gene. And that gene, all that it does is it codes, it's the code to make a protein, very simply.

So your whole, your DNA, your human genome is about three billion base pairs in length. So three billion of those A, C, T, and Gs split across a bunch of chromosomes. But that's the whole of the human genome. And it's chunked up into these genes. And each of these genes has a bunch of A, C, T, and Gs in a row that tell a little machine in your cell called the ribosome, which is also a protein, by the way, how to print a protein.[23]

The ribosome sucks in that RNA, and it reads three letter segments. And every three letters, it pulls down an amino acid. And it sticks an amino acid onto the last amino acid, and out comes a long chain of amino acids. And that beaded necklace is a protein. And what then happens, remember all molecules, each amino acid is a molecule, right? It's made up of a couple of hydrogen, carbon, oxygen, nitrogen molecules, sorry, atoms. And so there's different, think about them as little pieces of little magnets.

And they have different levels of attraction on different parts of them. So when you've got this necklace with these little amino acids on it, some of them attract to other amino acids and they

start to stick together. And the way they all stick together clumps them down and they all collapse into a little clumpy ball. And that clumpy machine, which is now stuck together, all these amino acids are now stuck together, is the shape of a protein. And protein is a physical machine.

The way that the amino acids move that machine defines the function of that machine, because sometimes they rotate, sometimes they're like a little jaw that opens and closes. And so proteins are little machines that do things in the body and in biology. A protein, for example, can be a catalyzer. So it can catalyze a chemical reaction, two molecules that are floating around in a cell that otherwise would not have come together to react. The protein can actually attract the one molecule on this side and the other molecule on this side and stick them together and force them to react.[23]

So historically, we've been able to edit the DNA. And so we can edit the code of biology. Now we may be able to actually edit the function of biology. So if I can translate protein, the physical protein structure, into what that protein does physically in a biological system, maybe I can actually resolve a number of ways that I can create a protein that can do a specific thing I want it to do. And that really opens up this whole new realm of biology that historically has been unattainable.

Because we know so little about biological interactions and how proteins interact with one another. I can create a protein that can bind to the very specific cancer cell I want it to bind to. Or I can create a protein that can very specifically pull some heavy element out of the environment. I can go pull all of the lithium out of the ocean and mine lithium with ocean water. I can create a protein that can break apart plastics in the environment. And I can create a protein that can, you know, do some specific access, for example, the inner membrane of a cell and ultimately access

the mitochondrial membrane in a cell and create new therapeutic delivery systems for drugs that don't exist today.

So we're now in a realm where the AI driven systems that were demonstrated with AlphaFold can be leveraged or harnessed to create all sorts of new things in biology that allow us to engineer the biology of ourselves and our physical universe in a way that was previously impossible or unimaginable. And that's why it's so exciting. So there's this whole new realm where we're going from editing the code to editing the function in biology.[23]

And each gene makes a unique protein. The proteins that then come out do a bunch of stuff. They're machines. They're molecular machines. And they're constantly doing all this stuff in your cell. And that's what makes every cell different, is what genes are on and what genes are off. And the complexity of this is astounding. If you were to think about a cell being the size of Manhattan. So imagine a cell is a city the size of Manhattan with 500 story tall buildings.

That's how big it would be. And every person is a protein. There's 10 billion people living in this 500 story tall building, island of Manhattan, going in between the buildings up and down all day long, building stuff together, never sleeping, always working, running into each other, having coffee, making stuff together, breaking stuff together, working 10 billion of us. Those are the proteins in the cell. In one cell. In one cell running around doing stuff for 80 years. That's one second in one cell.

That's how complex this is. So the proteins that are on or off matter a lot. And then they make stuff. So that's why the eye cell does totally different stuff than the brain cell or the heart cell.[24]

> we can already write genetic code to make proteins. now we are on the cusp of figuring out what code to write to create the proteins we need to achieve goals in the physical/nanoscale world. this could unlocks decades of human progress[69]

> this is a rosetta stone moment for biology. deepmind has translated the human genetic code into the physical machines (proteins) that run our body. 100s of new therapeutics will emerge as scientists map how molecules may interact with proteins to alter human health https://t.co/ZuiUFUuEd7[70]

CROPS AND THE BIOLOGICAL CLOCK

All we have to do is get the right machines in the soil to do the right things. That's what genomics unlocked—the understanding that all these machines are programmed by software called the genome.[68]

You know, we sold in 2013. And at the end of the day, you could kind of think about the genetics of a plant. That's like the software for the plant. And it's got all this code and the code makes proteins. And every protein it makes is made from a gene. And there's all these different genes. And every gene can be different. And every gene means it's got a different tool in the toolbox. The way biology works is a cell will call on a gene.

It'll express a gene when it needs a protein to do something. So if the weather is hot, there'll be a gene that will be expressed to help with hot weather. Or a gene will express if there's disease to fight off the disease or the virus. And so there's all these genes that nature has evolved over millions of years in plants and humans. And these genes work together. They can work independently. But they're all like tools in a toolbox. And they're turned on when the organism needs a tool to survive or to grow in a particular moment.

Now, as the weather changes, the more tools that a plant has to deal with frost, to deal with drought, to deal with a heat wave, to deal with too much rain, too little rain. Because when there's too much rain, there's fungus. When there's too little rain, it's got to grow deep roots. When it's cold, it's got to make bigger leaves.[2]

These are traits of the plant. And then what they try and do is they try and breed those traits together. So they cross one with the other. And it's totally random if it works, because you're getting a random half of the genes from the mother and a random half from the father. So you don't know if those genes are going to transfer. And so sometimes you could spend dozens of years, 100 plus years and not get the traits together that you want to get together in the plant.

And when you do get them together, sometimes you lose something else. And suddenly the plant is frail, and it falls apart. And it's so plant breeding has been this exercise of humanity. Some have some would say going back 1000s of years, that's allowed us to make all the crops that we grow on earth today. Everything from tomatoes to cucumbers to corn to potatoes to watermelons, it's all produced through plant breeding. And we've made them more resilient. And in many cases, we've tried to make them more delicious and more nutritious, use less water, all the things that are going to benefit the farm, benefit consumers.

And the challenge is you don't know which ones you're going to get. And so what boosted the idea that Judd and team had was we could turn off these reproductive circuits and the plant would give all its genes. So suddenly the offspring has all the mother's DNA and all the father's DNA and all the genes from both.[2]

So that's called vegetative propagation. Certain plants, certain crops, we do vegetative propagation. We chop up leftover crops from last year and we put it in the ground and grows. Potato is one of them. Strawberry is another one. You actually take all those vines from strawberry, you put them back in the ground, they'll grow new strawberry plants. And so there's a lot of crops that we actually propagate vegetatively. And that's because the seed that comes out of those crops are all different.

The genetics are different. So potatoes actually grow flowers on the top and every flower turns into a berry. And then they get

thousands of seed. Every one of those seed got a random half of the genes from the mother, a random half from the father. And so every seed is different. So if you were to try and take that seed and put it in the ground, every potato would be different. You get yellow potato, purple potato, red potato. It's crazy. You should do it at home sometime.

It's really fun. And you see all the crazy new potatoes you can make. And so potato farmers can't actually plant seed. So they take warehouses and they fill them up with potatoes and they've got conveyor belts and tractors and they spend all this money, all this time, all this fuel, moving potatoes back into the ground. And, you know, it works out to roughly 20% or more of their revenue that they're spending just moving old potatoes back into the ground.[2]

We generally have to improve genetic diversity. In doing so, there's natural resistance. The reason we have a TR4 problem in bananas is that the Cavendish bananas grown for the global export market are propagated as genetically near-identical clones. You take a plant, cut a clipping from it, put it in the ground for another plant, cut clippings from that, and keep multiplying it. Because of that genetic uniformity, this fungus has been exceptionally capable of adapting to infect the banana plant. If we had more genetic diversity and better genetics in banana programs around the world, we'd be able to radically improve resilience.[71]

That's a longer-term solution. But, at the end of the day, having crop genetics that can adapt to a more rapidly changing climate is going to be critical over the next couple of decades.[41]

If we didn't intervene in nature, we wouldn't have agriculture. We'd be sitting here waiting for food to drop off the tree. And when it falls to the ground, we'll eat it. We wait for the animal to

drop dead, and then we'll eat its carcass. That's how humans started. Our intervention in nature or our involvement in nature allowed us as a species to progress.[72]

On our website, we put a video out explaining boosted breeding, which is the name of the technology. And so boosted breeding means that we will, you know, boost two plants, a mother plant, a father plant. And then when we cross them together, the offspring has all the genes from the mother, all the genes from the father. And those boosted plants, which is what they're now called, the offspring, exhibit healthy, fast growth. You know, they're really impressive. And so we first started seeing these results in some small kind of model plants that you work with.

Like, you know, one's called Arabidopsis, where the leaves are bigger, but more importantly, the seed were much bigger. We saw seeds that were 40% or larger than either parent. The reason that's important is that tells us that the biomass accumulation in the plant is much better than either parent, because that's where a lot of the biomass goes, is into making seeds, which means that it should translate into large crops and make much bigger, you know, heartier plants with more biomass, making more calories, making more protein, all the things that you want a plant to do.[2]

What we do at Ohalo is we turn off meiosis in plants.[24]

Heterozygosity is the objective of Boosted Breeding, and making true seed is the outcome.[7]

Potatoes feed billions of people, but the genetics haven't meaningfully improved in decades. Boosted Breeding changes that.[73]

And so that data gave us this ability to be more predictive. So data made a prediction and I selected better plants. And it turns out my plant breeding got better and faster and I got more yield more quickly. And now we're using tools like whole genome sequencing and these AI models to make more complicated predictions, not just about the plants, but also the crosses I want to make between two plants and the combination of genes that the AI is saying will unlock this particular feature and doing it more quickly.

And then we can use AI to control the environment we're growing those plants in. We can use AI to control the conditions to accelerate the breeding outcomes. And then we can actually use a lot of lab-based tools and automation to accelerate a lot of the work and do it in the lab instead of in the field.[74]

I think in molecule engineering, cell engineering, system engineering… if you model transcription factors in organisms, AI is allowing us to think at a larger scale and be accurate and predictive at that scale, and then engineer an outcome with respect to our objective. If you can shorten the time to driving, testing, measuring and realizing outcomes from predicting and making changes in genome-driven systems, that value can compound and you can very quickly take entire markets and create extraordinary value.[59]

When we combine two parent plants, we know exactly what we're going to get in the offspring.[7]

You can spend many years and make very limited improvements in performance using traditional breeding techniques.[75]

You know what you're going to get when you make a cross.[75]

> sustainable ag can be better enabled by technology, not by its absence[76]

POTATO SEED AND BREEDING

Making seed and selling seed.[75]

We think about the whole supply chain.[75]

This is an open-access program. … We're bringing the seed to market for everyone.[75]

This is not a Boosted Breeding program.[75]

FROM THE LABORATORY TO HUMAN HEALTH

If you fast forward 50 years, Tyson Foods and these feedlots and cattle grazing, I mean, it's so fu**ing inefficient it's just unreal. It's mind blowing how much energy and money and CO2 is part of the system of producing meat and animal protein. And we have the tools to make animal proteins and fermenters, so if you could have a fermenter in your home, and it just prints meat when you want it, I think that would be pretty cool. Technically the science is there, the engineering isn't. And that's the thing: with a lot of these things, the science is proven, but a lot engineering work still to do. But it's, it's feasible. All these things are feasible.[34]

What humans have available to us today is this ability to use DNA as a programming language to get microorganisms to make the molecules we want to consume. And the energy efficiency of using a microorganism like a yeast cell or an E. coli cell is orders of magnitude better than using an animal, right? An animal has to grow and cluck and produce heat and water goes in and out all the time. It's really inefficient as a way to make protein. So it turns out you can take the DNA from a chicken and put it in a yeast cell.

And you put the yeast cell in a big fermenter tank, much like you would make beer or wine. And you feed sugar water into that fermenter tank, much like you would do for beer and wine. And instead of the yeast producing alcohol, in this case, the yeast can produce animal protein because you put the DNA in the yeast on how to make animal protein. And now that yeast becomes a little mini factory. And that's called biomanufacturing. And with that ability, we can make leather, we can make eggs, we can make cheese, we can make milk, all the proteins, all the materials, all the things that we use these old school industrial systems to make, we can program into microorganisms to make.[31]

I'm spending quite a bit of time at work on it, which is that starch-synthesis system that was demonstrated by those Chinese scientists. The system itself is likely not going to be the production system that saves the world. But the concept that we can take proteins that are expressed by different plants and put them together in a tank, and then that tank can convert molecules from one form to another by leveraging these proteins that just interact and move around in the tank, is really an incredible demonstration.

The demonstration is inspiring. We can take carbon out of the atmosphere and make food with a minimal amount of renewable electricity. And I think that's really a moment that will inspire a whole new realm of industrial synthetic-biology work, a lot of which I hope to build and participate in pretty heavily in the work that we do day to day.[77]

We started saying, like, hey, one idea we had was, like, let's measure the bacteria in people's poop, right? And use the microbiome that we read from the DNA in their poop to figure out what do they have in their gut. And then we'll give them a personalized probiotic recommendation back. And we very quickly kind of found, like, hey, that might be a little bit tough of

a business to make the scale because not everyone wants to scoop the poop and all the sort of stuff that goes on.

We get that pushback. … Then we started looking at, like, also the probiotic space. And the probiotic space, there's a whole bunch of research that shows that a lot of the probiotics that are on the store shelf are not really shelf stable. So what you're eating is a pill with nothing in it. There's literally nothing in that pill.[10]

No one chooses obesity. Obesity is a struggle, just like diabetes. No one chooses diabetes. Diabetes is a struggle. I've done some work, made some investments, been on the board of some companies that have been involved in trying to address the needs in this space. And one of the things that we've learned a lot about is how much of a social stigma it feels. People that are struggling with obesity and struggling with diabetes don't feel comfortable actively talking about it, because they hold a deep amount of shame about it.

They recognize that there's something deeply unhealthy about it, and they feel deep shame because they're often portrayed as having the choice and making the decisions that got them to this point. Generally, I would say that this is not something that should be stigmatized in an open way. It should be treated with compassion, but it should be spoken about openly. There is a challenge and a struggle that people have, and we need to help.[78]

A team of scientists in Italy collected samples from patients who had plaque removed from the carotid artery. A total of 304 patients agreed to have the plaque submitted for analysis. The team studied it to see how much plastic was found in that plaque, using measurement techniques including electron microscopy and mass spectrometry. These microplastics and nanoplastics were accumulating in the human body. They then did follow-up roughly thirty-four months later. The patients who had plastic in

their plaque had roughly four and a half times the risk of heart attack, stroke, or death from any cause.

This was published in the New England Journal of Medicine. It indicates that there is this cumulative problem likely associated with adverse health outcomes. We're just starting to uncover these effects. These plastics were mostly PET, which is what we use to make plastic bottles, and PVC, or polyvinyl chloride, which is used in a lot of plastic plumbing and piping. Tiny bits of these materials end up in our water and food supply; we consume them, they accumulate in bodies, and they may be driving inflammatory responses and adverse health outcomes.[79]

What we see is that when you go off the GLP-1 agonist drugs, you gain some amount of the weight back. This is pretty well documented, and I think that it speaks to the why. It also introduces an opportunity. There are molecules that can turn certain genes on or off, that can be identified and utilized to change that epigenetic memory. This could arise from things like increased exercise. When you do significant amounts of cardiovascular exercise, there are certain genes that are expressed that trigger other genes to switch on or off.

We can start to identify those particular molecules and produce either supplements or additional drugs or combination therapies that can both knock the weight off and keep it off by changing the epigenetic memory in those cells. It introduces a whole new class of opportunity for folks to explore.[80]

They coated the gene-editing system with lipid nanoparticles, which helped it get into the cells. It got absorbed by the liver. It went into the cells, found its way to the site on the DNA, and converted the A to G. As a result, those liver cells became functional to make the protein that breaks down the ammonia in the child's blood. They did the first dose just to make sure the

child would handle it. It worked; the child didn't have any adverse effects.

They then did the second dose and were able to take the child off some of the medicines and compounds they were giving the child to break down ammonia in the blood. Then they gave the third dose, and they're monitoring. This is the first time that we've seen this kind of custom CRISPR gene editing for a genetic mutation applied to a patient in vivo, in the blood, for a specific target, for a specific treatment.[81]

> patients w genetic diseases that cause blood disorders had blood cells removed & DNA errors repaired w CRISPR (takes minutes, high hit rate) & returned. remarkable results. genetic repair throughout body w clinical improvement. era of scalable repair of genetic disease is upon us https://t.co/2WdJZ1IGwb[82]

ENERGY CHANGES THE FRONTIER

There's a lot that could happen on Earth too. So like, I think there's a lot. There's a couple of other big drivers. I think one is dropping energy cost to zero. And I think fusion will have a big role in that this century. So people don't want to talk about fusion because everyone's all about solar all the time and Elon loves solar and blah, blah. So everyone pooh-poohs fusion. I'll talk about it in a second, but the cost, if you get the cost of energy down to one cent a kilowatt hour, it absolutely expands every economy.

Like, everything blows up. … In the U.S., we're paying 15 to 40 cents a kilowatt hour for off the grid. But nuclear power, you know, best case scenario is about five cents a kilowatt hour. And that's amortized. When you take the cost of everything you got to

build and amortize it out and then your runtime cost, five to 10 cents, but they're going to sell it at like 15. So like, imagine if you could take power cost down to one hundredth of what it is today.

The cost to make anything drops because now you've got robots. Robots can make stuff quickly and with no marginal cost because the electricity is what runs the robots. So you could have a swarm of a hundred robots build you a mansion. How much would that cost? Like a 10,000 square foot crazy house. The cost of energy is nothing. So maybe having a crazy house could cost close to nothing.[24]

And that electricity that's free, we can use that to desalinate water from the oceans and terraform the earth and turn deserts into rainforests if we wanted to or create incredible advances in how we as a species live and thrive together with the other living organisms on this planet. And so I'm really excited about thinking about what's possible as the cost of energy goes down. Everyone's worried about the cost of energy going up because we're thinking in yesteryear's models of, you know, burning oil.

But in the future, I think that the cost of energy can and should go down as these sorts of new technologies come to bear on earth. And that's where we really transform as a species. Another reason why I'm so optimistic. By the way, with zero cost energy, go suck all the carbon out of the atmosphere. It costs you nothing to do it. So we can very quickly resolve all the issues we have on our planet. And you combine that with automation and robots and industrial and, you know, automated systems of production.

And humans can start to speak their intent on the earth and say, here's the thing I want. And then the AI and the automated machine goes and makes the thing you want with free energy. And so there is this really interesting utopian, you know, kind of model that emerges as these systems come online that I think is really compelling to think about and makes me less worried and much more excited.[23]

Nuclear energy is fission where you're taking heavy, heavy elements like uranium, breaking them apart. They're radioactive. It's the opposite. And you're getting energy out. You're doing the opposite. You're taking the heavier stuff and grabbing the energy when the heavier stuff becomes lighter, releasing that energy that it took to make it.[24]

Now, what stars do is they're at such a high energy that the atoms in the star bang into each other at such a high rate that they fuse and create new elements and the protons stick together, form a new nucleus, and now you've got a heavier element. It is such an energy intensive action that it is infeasible today to do this on earth. What's happening now is we have this new technology called plasma fusion that has been in development for decades.

And by the way, every year everyone's like, hey, it's a decade away. So take this with a grain of salt. But there will come a time when humans will master the ability to do plasma fusion systems on earth. And our objective with plasma fusions is we create a condition that's like the sun, where you take hydrogen and you compress it and you make it so energetic and it's moving at such a high energy that those hydrogen atoms slam into each other.

And when they slam into each other, they fuse and they form heavier elements and they also release energy.[23]

Fusion is how the sun makes energy. So every time proton and proton get together, they release some energy and that's the light that we get from the sun. Constant fusion. So the challenge has always been can we do fusion on Earth? Can we just jam protons together and capture that energy? So the technology to do it is you basically spin, you know, these protons around in a plasma at 100 million degrees Celsius. Some people are using these like donut-shaped toroidals. Some people are now using these sort of weird what are called stellarators.

They've got crazy shapes. And much of the design of these systems on how do you get these protons to move fast enough and the problem is when the protons get close and close together they push each other apart. So you've got to use a magnetic field to squeeze these protons together so that they get closer and closer and then get them to fuse.[24]

The problem is as they get closer the protons make their own magnetic field that pushes back and fucks up the magnetic field that you're trying to use to squeeze them together. And so it's this dynamical equilibrium problem. They just keep breaking and breaking and breaking and you cannot get a stable plasma at that density. AI seems to be solving that problem because they're now using AI to train the control of the magnetic fields in a way that's working. And they're now able to hold these magnetic fields for 30 minutes at a time out of China now or you know started out it went from like 17 seconds to a few seconds a few longer to a few minutes to 30 minutes in literally like the last two and a half three years.

Like that's how quickly they're ramping up in the ability to make this happen. There's about 70 startups doing this.[24]

And the first principles of physics say this is possible. This should happen. So a couple of years ago, three years ago, there was about seven venture-funded fusion companies. As of the end of last year—or Q2, Q3 of last year— the count was 47. And I was speaking with an investor last week who told me that the count is now up to 70. So there are 70 fusion companies that are pursuing different models of fusion energy production. As you know, there's kind of the tokamak systems, there's stellarator systems, and now there's these kind of pulse plasma systems like Helion and others, all of which have different physics underlying kind of how they're supposed to get the plasma to a hot enough and

dense enough state to trigger kind of a sustainable or sustaining kind of fusion reaction regime.

In terms of, like, the tokamaks, it feels to me like so much of what's driving the advances here and enabling them is similar to what I talked about with DNA sequencing, which is all these underlying digital technologies that in aggregate are enabling a cost down where suddenly the potential goes up and the possibilities or the probability of success goes up. So as you know, like, so much of, like, experimental, like, beam physics, I used to work in the Center for Beam Physics at Lawrence Berkeley Labs for two years when I was an undergrad.

And they had, like, this was back in 1999, this plasma wakefield accelerator.[4]

That's what is so exciting to everyone because that's sort of a breakthrough. It doesn't just solve all of our energy needs and replace all the carbon emitting stuff. It creates entirely new industries that are not even possible or feasible today.[42]

SYSTEMS THAT MAKE ABUNDANCE USEFUL

I think we've just got to generally increase energy production on Earth. So we've increased energy production by about 20-fold in the last 100 years on Earth. I think in the next 100 years, we can and should increase energy production by over 100-fold. So we can't just kind of replace old systems and get some renewables. This doesn't solve the core driver. And the core driver is human consumption and consumption needs. We're replacing labor with machines. You know, we're moving around stuff more.

There's so much about the evolution of humans that's driven, as we talked about earlier, by this notion of desire. I have to consume more this year than I did last year to feel happy. If I don't consume more next year, I'm not going to feel like I'm getting happier or I'm happy anymore. I'm unhappy when I'm

consuming less this year than I did last year. I have less. So I'm consuming less and I'm unhappy. So the core driver of human civilization is this kind of consumptive pattern, which ultimately drives up energy consumption, which means we need to make more energy to make things more abundant, make them more affordable, make them more accessible.[4]

On a net basis, the risks associated with nuclear power are far outweighed by the benefits. It is a clean power source. And in fact, we could do a lot of desalination with nuclear power using existing desal techniques and technologies and the free and available power that comes out of these nuclear systems, these nuclear power stations. So we've overregulated and chased ourselves away from a very clean and stable power supply, which could drive a more available water supply. And we're choosing to not do it.[31]

> 6) longer-term, infrastructure spending should not go to rural broadband and roads. we need systems of energy production, materials, and food production that are distributed, low-carbon, and create jobs for americans while increasing power/water/food/clean air/temp security (fin)[83]

There's a theory about sulfur dioxide that has now been restricted in shipping and cargo vessels that go across the oceans. Sulfur dioxide reflects sunlight. As it goes up into the atmosphere coming out of these ships, it blocks and reflects light, so that would make the oceans cooler. A lot of folks have said that, over the last couple of decades, we've dampened the warming that's happened on Earth because of all the sulfur dioxide we've been putting into the atmosphere. But because sulfur dioxide causes acid rain, environmentalists have been pushing for years to restrict sulfur dioxide.

The problem is that, by restricting sulfur dioxide, you may have this other side effect: a more rapid increase in warming of the surface and of the oceans. These are complex systems, and we should be delicate with them.[37]

All technology can be good, can be bad. When cars came around, they were good—they get us places faster. They're bad in that people crash them and die. When nuclear fission came about, it was good in the sense that suddenly we had practically unlimited, very cheap energy. It's bad in the sense that you can make nuclear bombs and wipe out cities.[10]

There is a deep arrogance to technologists. That arrogance always leads to these existential conclusions.[45]

Factories in China are purpose-built: they're built to make a thing, and then they have to get retooled if you want to make another thing. It's very hard to replace China as a source of production for a lot of what we consume in this country. You could decouple from China and basically recreate that same production system here in the United States, but that wouldn't be possible. We don't have enough people to work. We don't have the ability to do that. The cost of everything would go up substantially.

Or we could invent new systems of production, which we have the ability to do: three-dimensional printing, biomanufacturing—all these other interesting ways of making stuff that could replace the old factories that are run in China. Through automation, three-dimensional printing, and biomanufacturing, you can change the methods of doing this stuff. If we could do that, then we could decouple from China. The reality is, I don't know how we continue to consume things at the percentage of wallet share that comes from China without rebuilding how we make stuff.[84]

There are two sides of the equation when it comes to rare earths. One is mining the ore. The Mountain Pass site, near the border of California and Nevada, is now MP Materials. They've got a rare-earth ore called bastnäsite. That's the ore you get out of the ground. Then you have to process that ore to get the elements you want to use in manufacturing. I went a little deep on the processing steps because I got interested in why we don't do more of this in the United States.

There is a lot of nasty output from this process. You're using very strong acids to do leaching. You do processing, extraction, refinement; all the material gets separated from the rock. It's dirty. There are byproducts and waste, environmental exposure, and human-personnel exposure. With automation and improved systems, we could process this ore more safely. It's a series of understood steps of chemistry and mechanical separation. If we decided this was strategic, we could unlock both new discoveries and new refinement systems in the United States and become more competitive with China if we put the will behind it.[85]

AN ENGINEERING FRONTIER

If you think back, what humans have figured out how to do over time is we figured out how to take a combination of elements and kind of physically manipulate them. And this was kind of the initial thing. So the bronze age was when humans figured out that we could heat up certain metals and then meld them together and then make a new kind of metal, a new kind of material. Or we figured out that we could take cotton and, you know, turn it into thread and then make clothing out of it.

And so we manipulated matter mechanically. Okay. And that means we applied heat and physical manipulation to turn the physical stuff around us into the things that we could then use and consume.[23]

We are entering the era of decentralized manufacturing.[86]

You could ship all those robots to the Moon, and they could get to work and create an entirely new manufacturing frontier for our civilization, for humanity. That frontier can manufacture precious metals and other goods and ship them back. You could manufacture semiconductors on the Moon. All that's missing is the robots. So moving the robots to the Moon, or setting up the materials for robots to build themselves on the Moon, is kind of the first phase of this transition—you know, asking about twenty years from now.

I think that this may not be, and it certainly won't be, limited to just SpaceX. But SpaceX is demonstrating its capacity at being effectively the railroads—what the railroads were to the West and to the frontier in the West in the last generation, SpaceX will be to the Moon and ultimately to Mars. And there's going to be an extraordinary abundance of production that's going to come out of the Moon.[87]

And I think it's just such a profound way to think about our place in the universe. Not only will we be editing genomes and changing life forms on earth today, we could theoretically be engineering individual atoms and changing the elemental composition of our local area of space. And, and, you know, the human ingenuity and the tools we have could allow us to just take this chunk of molecules we have sitting around us that we call planet earth and convert it into anything the heck we want, right?[49]

> for these reasons, and others (driven by various other science/eng advances), i am optimistic about mankind's ability to survive and thrive through the end of this century and well into the next, at which point, it appears far more than we can imagine today may become possible..[88]

INTELLIGENCE AS LEVERAGE

I would reframe this as being some binary condition. We talk about general intelligence and superintelligence as being on a spectrum of leverage toward complexity. I can do a simple task: instead of writing a letter, putting it in an envelope, and having some guy carry it to my mom so she gets it the next day, I can digitally get her that message instantly over email. That creates an incredible amount of leverage and solves a lot of the complexity of getting her that communication from me.

So if I, as a human, said, 'I would like to harness fusion power, similar to what the sun uses to make energy, and I want to do that on Earth,' that is a scientific problem, a discovery problem, an engineering problem. The idea of superintelligence is that it could give us immense leverage in solving that complex problem that we otherwise may be challenged to solve over decades or hundreds of years—or think about one day solving a problem that would take humans thousands of years to solve.

I don't think humans are limited in our ability to solve problems. I think we're limited in terms of time. Digital intelligence gives us leverage on time so that we can now tackle ever more complex tasks. The amount of time isn't just an incremental one year or two years, but becomes a hundred years or maybe a thousand years. I don't view it as some species or race that independently persists in its own intentions, but as a tool that provides leverage in a way that is orders of magnitude greater than the leverage we got from yesterday's digital tools.

Functionally, leverage into complexity is where this becomes super compelling for humans.[89]

And you realize how much that person that's like living in a hut, doesn't have furniture, sits on the floor, would benefit from having access to the internet on a mobile phone. The mobile phone and the AI could create an unlock for that person like you

and I could not imagine. For you and I, we could spend five minutes or have an assistant of ours search stuff on the internet for us. But for that individual with nothing, this would be an incredible unlock for them and a benefit for humanity.

So what we generally see is this aversion to new technologies mostly being held by the privileged wealthy class, those who don't need it, and quickly adopted, eagerly adopted by those who will progress because of it.[25]

The profitability focus at young companies, particularly in an age of AI copilot tools for software development—from what I've seen, it's pretty incredible. Single-person efforts can yield what historically required more people to do using copilot tools and AI. Software development is accelerated; new products and entire companies can be built by a single individual at very low cost, building totally customized software. From what I've seen, it's not widely adopted. These capabilities are starting to be. But just imagine once the majority of people are using these copiloting tools to write software and start to learn how to use these tools. It's really going to increase productivity globally as it finds its way into every business, and everyone can become an entrepreneur.[90]

One of the things that I think AI unlocks is the ability to do really complex projects. People think about AI as like, hey, I'm going to replace labor. Like the accountant's job is going to go away and we're all kind of swirling our heads around. What are we going to do with the accountant's jobs going away? And, you know, we could use the automobile and the horse buggy driver analogy. People were worried about the horse buggy jobs going away and who's going to breed the horses, who's going to take care of the horses, all the horse tables are going to go away.

And then when the car came around, there was auto mechanics and there were the highway system and then motels popped up and then gas stations popped up and then coffee houses popped

up on the highways and new towns emerged on the highways because you could get to them and suddenly the automobile unlocked industries we didn't contemplate, right? It's several degrees away, several steps away from the initial problem that you're thinking about which is the horse companies dying and the horse jobs going away.

So I think that's kind of like an important thing to note and before I get to the moon, I'll just say this one point. I think physical AI or robotics is really going to be an unlock for people. People think it's like the companies, the corporations will have all the robots and the corporations will replace all the people.[24]

And the other thing about AI is it unlocks complex projects that we can't do today as a species. Like if I were to tell you like, hey, let's go to the Mars, everyone would be like, how do you do that? That's like a trillion dollars, like $10 trillion. That's crazy. But AI could make that project like a couple million dollars, you know, or like AI could let us very quickly with robots build a really cool city in the ocean, floating in the city, a floating city in the ocean where people could like fly to on flying cars and like live there.

Like there's all this crazy shit that's going to happen that would not have been possible before. It's going to be possible now because of AI.[10]

You have to figure out the exact trajectory, get it perfectly right, get a launch off Earth, and intercept this thing at the exact moment you need to push it off course or detonate something nearby to redirect it. It's technically very complicated, very hard to pull off. This is why we have planetary-defense funding at NASA to track these objects. I have a thesis that AI, more than anything, unlocks deeply complicated projects for humans that would otherwise be infeasible in the pre-AI era.

AI can unlock large-scale projects that would require millions of people to do things in a coordinated way. It could play a role in

planetary-defense concepts in the future, where you can build a complete project model in software for how you would address the problem and then go execute it with automation.[71]

But why can't everyone have a robot? Meaning, why can't someone put a robot in their garage and this robot can do anything? It works 24 hours a day. That robot's now your employee and you can say to the robot in the garage, hey, I want to make a bicycle shop. I want to make custom bicycles that are really cool. They're like Chrome and people can, you know, kind of tweak them online and make all these different versions of bicycles and then the robot will build the bicycle.

So people, so you can stand up a Shopify store or an Etsy store or whatever, sell bicycles and your robot will make them for you. You don't even have to know how to make bicycles. The robot will order all the parts, it'll order all the machinery it needs, it'll run the robot bike shop in your garage, it'll make bikes, it'll package them up and ship them out for you. When you think about it in that context, which is that this diffusion of technology enables everyone to get value from it, so everyone will have a robot, everyone will be able to have a small business.

It's like imagine back in the day, 20, 30 years ago, if you told people, hey, everyone can have an Etsy store, now all of the knitting you're doing at home you can sell and you can make 50 grand a year, no one would have believed you. But now you can do that.[24]

I'm not sure that giving people a choice of an algorithm is going to work. Consumers want to have stuff that incites emotion. There's a reason horror movies do well, and romantic comedies, and adventure films: they're all emotive. The more emotive something is, the more likely you are to want something like that again. When something is emotionally inciting, you want more of

it, and you get more of it. The crazy thing about social media, or digital media, is that the feedback cycle is much faster.

It used to be that you put out a book and wouldn't get the results on how the book sold, how many people liked it, and how many people read it until a year later. With movies, you get results in a weekend. With social media, you get results instantly. With a feed, the next content is dynamically selected for you based on your reaction to the content prior to it. You get this immediate feedback loop that tunes and lines up the next thing.

Now you're getting hundreds of iterations an hour.[56]

There are a lot of solutions that will emerge within verticals, and I think you can distinguish them. You could see stuff like, for example, a chatbot that replaces, 'Help me figure out whether my credit-card charges are correct or not,' instead of having a customer-service agent helping you resolve that, or, 'Help me return my item.' There are very specific, verticalized applications that can plug in and ultimately replace what was manual and human-driven before. I think you can think about it in that same way: these are known knowns.

They don't require necessarily human physical labor or human responsiveness. If ninety-five percent of the work can be handled, it will get handled by some verticalized solution. Physical labor versus nonphysical labor is one way to think about the distinction: is there some change in the physical world? Driving is absolutely a change in the physical world. You have to move physically through space, so that is a very distinct class. All the stuff that's like communication, imagery, static imagery, audio, and then visual video—there's some stacking that happens there.

Some will be siloed, and some will merge, and you'll have these unique combination models. As they start to work together, I think we'll see them completely rewrite some of these verticals, like movie production, music production, or advertising.[91]

We're living in a reality where AI is clunky. It takes some putting together. It's a little more complicated than we thought.[92]

MODELS, DATA, AND COMPETITION

Yeah. All technology shifts go through a phase of diffusion, meaning they have to start somewhere. It's not like we turn on a switch and suddenly everyone can build an Etsy store or a Shopify store. Like that's not how the internet started with everyone suddenly benefiting from being able to be an entrepreneur online. It took a couple of generations of technology diffusion before the idea of Shopify and the high speed internet all over the country got everywhere and people could actually stand up a Shopify store and run it.

The first people on the internet, the first businesses that stood up did very well. And so the technology started centrally, but then, you know, initially people were like, oh my God, Cisco is going to dominate the world, right? Like Cisco's got the switches that make the internet switch. That's the technology that's going to, those guys that own Cisco, those guys are going to run the world. This is not fair. Like they're going to control everything. This is crazy. Nowadays, it's Nvidia to some degree.

It's Google. But like eventually, every technology commoditizes. That's what's so amazing about technology. Is it like, it's always diffusing. Like this new innovation finds its way out. Like we've already seen in just the last couple of weeks, this insane shift in AI where people don't have to run models in the cloud anymore. They can run models on their desktop at home.[24]

The value of that model is time-bound because at some point a better model is going to come around.[45]

There's currently a natural market force for two things. One is more open source, and second is a fragmentation of the AI stack.[45]

LLMs and these sorts of tools can become the dominant operating system on that hardware, and you can totally rethink the modality of how you use computing through applications. Today we have an app store and we download apps and use them, and that all becomes in-stream in an LLM or chat-type interface that can be accessed in a bunch of different ways. So for me, there's a really bigger thing that's happening that's not just about making smarter tools and increasing productivity, but a real revolution in computing itself that seems to be emergent. It's a wholesale rewriting of computing—computing interfaces, human-computer interaction—that's going to rethink everything. And it seems to be pretty substantial.[93]

Fundamentally, if all of the tens of billions of dollars you as a life sciences company have invested in experiments and product development, and you've generated all of this proprietary data along the way, that data is a true asset of your organization. It's an asset that you've spent billions of dollars developing. And by handing it over to a model company to then combine with other people's data, you are effectively commoditizing the asset that you have, the one kind of core differentiation that you have.[92]

That data is a true asset of your organization. It's an asset that you've spent billions of dollars developing.[92]

> we dont think data is valuable - free and open is best. value comes from insight derived fm models built on data[94]

There's this Evo 2 model that was published at the Arc Institute. That model ingested DNA data—trillions and trillions of base pairs—and looked at patterns in DNA. It had no context for what the DNA represented, no context for the concept of genes, none of the structured understanding of what that DNA does or what it is. They fed in BRCA variants, and it identified variants associated

with pathogenic outcomes without being explicitly trained on breast-cancer labels. That's a great example where there's a lack of understanding at the human level about what really drives some of the patterns in nature—the emergent phenomena these AI models are starting to identify.[95]

If I asked who won the internet race, there were businesses built out of the U.S., businesses built out of China, businesses built out of India and Europe that all created value for shareholders, created value for consumers, and changed the world. I think the same is going to happen in AI. I don't think there's a finish line in AI. AI is a new paradigm of work, a new paradigm of productivity, a new paradigm of business, of the economy, of livelihoods—of pretty much everything.

Every interaction humans have with ourselves and the world around us will have, in its substrate, AI. As a result, I think it's going to be this continuous process of improvement. There are different models, and you can look at the performance metrics of models, but you can get yourself spun up into a tizzy over which model is ahead of the others and which one is going to get to the finish line first. At the end of the day, the abundance and economic prosperity that will arise from the continuous performance improvements that come out of AI and AI development will benefit all nation-states and could lead to a less resource-constrained world, where we're all fighting less over limited resources and nation-state definitions around who has access to what—perhaps more abundance, which means more peace and less of this resource-driven world.[40]

In order to compete in a world of commoditizing knowledge and commoditizing capabilities, you have to leverage the core differentiating assets that you have.[92]

And it says so much about human creativity, that human creativity is largely driven in the same way as AI is, which is sensing, synthesis, and then output or prediction. And that human creativity arguably can be achieved through AI. So then the question is, what does the human become if that happens? And I would argue that the human becomes the narrator. We then get to narrate the world we want to have around us. And the AI can resolve the creative content for us.

And the automation can resolve the physical work that needs to be done to make that possible. And then humans can go through a phase of extraordinary exploration and consumption, and just narration of what it is we want around us. And so the human as narrator is really hard to see today. And it's really hard to talk about and to define. But I think having humans kind of clearly state their intent in the world, and see that intent made manifest for them is a really powerful evolutionary state for us.[23]

Let me paint a picture for this that I've been thinking a lot about, because I'm thinking about what is the artist and what is culture in this context. I do think that there's a future where AI can dynamically, on the fly, create media for us. So I can dynamically create a movie and I can tell the movie-creation system, maybe it's my Apple TV: hey, I want to see the story of Star Wars. I want to see it from the Emperor's point of view and what he's watching the whole time and how he's remotely monitoring.

And then it just renders it and I watch it. And then people are like, oh, that's so depressing because there's no culture. That's not actually true, because what you could do is the artist that creates the fundamental core of that cultural moment can define what is variable and what is not. And the artist will then get a whole set of tools that they don't have available to them today. So the artist could say, don't allow musical rendering. Don't allow black-and-white film.

Never show the Emperor's point of view. Allow creation of new characters. Don't allow creation of racist characters. And they're creating constraints and boundaries and a primary storyline from which other storylines can shoot off or other perspectives can be realized. But the cultural story still exists. They could say the story of Star Wars is always that Luke is saved by Darth Vader and he kills the Emperor, and that always is core to the end of the story. You always have to start with Luke.

And you could be really clear about what has to be and not be. And then whatever the artist says is core, that becomes the shared experience that we all have culturally. And then how you watch it, how you read it, how you render it, how you experience and enjoy it is different than me. And so I actually think it doesn't diminish the idea of culture and shared media. It does, in fact, give the artist more tools, more creativity, and just creates this incredibly beautiful way to bring people together with shared notions.

By the way, when people go to church and read the Bible, they're not all hearing the same sermon. When you go to a gospel church in the South, it's not the same experience as going to a Catholic church in San Francisco. And even though they might all follow the same story that's described in the Bible, their experience, their rendering, their point of view on it is quite different. But they all share that Christianity as a common ethos. And I think that that's what this sort of AI-driven media landscape allows us to do: it gives artists broad creative potential, and then it gives consumers broad creative rendering experiences, which is going to be really beautiful.[74]

I do think you're going to see a lot of this real-time generative video that's going to take as its input news feeds, develop some understanding, and then present it back to you in whatever visual format you want. You'll have your own personal newscaster presenting you the stuff that's interesting and be like, 'No, tell me

less about the Middle East. Tell me more about Wall Street. Tell me more about tech.' You can basically interact with it and curate your own personal news feed, whether that's through video, through text, or through audio.

You can have it presented to you any way you want. I'm really excited for the day that happens, so I don't have to doom-scroll through Twitter all the time to get news, and I can have a personally curated newscaster.[96]

I think what we will see over time is that, for a lot of AI that is like a celebrity, the value of it will arise from the celebrity's endorsement, not actually using the celebrity's features. I know everyone wants to point to this idea of likeness, but I think there's something about the authentic aspect of having the celebrity actually endorse and provide their signature or their stamp on it. Restaurants are a good example. Some celebrity chef says, 'I was involved in making this menu.' That's a lot different than mimicking the celebrity chef's menu from their restaurant and putting their name and brand on it.[97]

There's a lot of value in human interaction that's going to get a premium in the future.[92]

Human in the loop will be the premium.[92]

> Everyone will enjoy their own personalized movie, music, book, news article, video game experience.[98]

> "content" and "media" may end as terms, as we simply enjoy personalized experiences, not productize or distribute uniform consumables. centralized production for many is replaced by decentralized production for each individual human. should be fun.[99]

I think another lens to look at what's going on is the incredible deflation of how much it costs to successfully run a business. You don't have to pay a premium price for SaaS products anymore, meaning that that piece of the business can suddenly get much cheaper. AI is delivering on its deflationary promise. The problem with economic deflation is that when it occurs, it means some business is seeing its revenue go down. And if that segment of the economy is levered—if it has debt sitting on top of that piece of the economy, where it's supposed to always, always grow—suddenly that debt gets impaired, and that can have an economic ripple effect that is adverse.

But if the deflation isn't coming from cost-cutting or economic contraction, the deflationary forces ultimately lead to economic expansion, because other parts of the economy will now grow. If I can suddenly cut, call it, 50 percent of my SaaS budget and reinvest that capital in other ways of growing my business instead of managing my expenses, all of a sudden my enterprise will grow, and the economy will grow.[100]

I think it's the output that needs to be adjudicated in some manner. I'm not trying to be naive here. I recognize there have to be guardrails and there have to be stage gates put into these systems. But limiting the systems themselves is denying us both the economic opportunity, the job-creation opportunity, and also the world-changing opportunity that these tools can enable. So I think that we're going about it the wrong way by trying to create these gates all the way up front on the technology being available.[101]

> in the same vein, and to directly address your original example, instead of working for a video game company, AI will now let artists create their own video games and run their own studios. they don't need to be employed by someone else's studio or big company. AI gives them all the tools they need. if a studio "replaces artists" with AI, those artists will now be able to

> compete with the studio, eroding the studio's profits away, while increasing the quality and quantity of video games in the market. consumers win and artists make more money. these economic miracles play out every day in free markets, unburdened by the government's intervention. as soon as the govt creates "taxes on automation", it shackles workers to old jobs. automation IS opportunity. it is leverage for the individual, not just profiteering for the corporation.[102]

PART IV

CIVILIZATION AND AGENCY

INSTITUTIONS, DIFFUSION, AND PRODUCTIVE FREEDOM

Productivity is the best measure, I would say, of technology's advance—of how technology advances social systems.[24]

Anyone that is productive, meaning they create more value than they take in, grows the economy and more jobs get created.[92]

So much of, I think, technology ultimately kind of finds its way to the edge of the network.[11]

All technology starts out big, slow, expensive, and central.[11]

All technology shifts go through a phase of diffusion, meaning they have to start somewhere.[24]

Eventually, every technology commoditizes. That's what's so amazing about technology: it's always diffusing. This new innovation finds its way out.[24]

The application of data science in agriculture is relatively new, and with the development of new technologies comes some level of uncertainty about its potential implications. In our experience, farmers are more likely to embrace new technologies that will drive the evolution of agricultural production when they have certainty about the use, privacy and control of the data they personally generate on their own farms.[103]

There’s an underlying view that technology creates leverage for a small group of people, which creates power imbalances, and nothing represents that more than AI. A small number of people

who control, profit from, and benefit from AI are going to get outsized returns relative to the broader population. Ultimately, technologies commoditize and diffuse, but the time to diffusion here may be extremely asymmetric for society. The questions—'When does this benefit me? How does it benefit me?'—can't be answered today. The economic benefit accruing to the few today becomes the narrative.

It becomes the story, and it becomes this power system where a few people take from the many. There's something deeply disturbing for the average person about that. They don't understand how it works, why it works, what it will do for them, or when it will do it. All they're being told is that some people are making trillions of dollars. I think it's pretty obvious why this has received such a backlash.[104]

I don't worry. So I'm extremely techno-optimistic. I see myriad solutions to all of the problems we face as a species today. So from a fundamental threat perspective, I'm less worried about the long range outcome for civilization and our species and our planet. We have the opportunity to kind of resolve energy, resolve carbon, resolve human health. I mean, many of these challenges are resolvable based on first principles analysis of science as it sits today. What's going to be challenging is the next couple of decades as our species kind of meanders our way to those outcomes.

There's more kind of, I think, social issues than there are technical, technological issues to try and resolve as, you know, we kind of realize that, hey, maybe, you know, the United States doesn't have primacy in the century. What is the right governing structure for a people? Is it an old school model of democracy or socialism or maybe a new school model of decentralized governance? Right. So what is money going to be? And so these are going to cause like really challenging social issues that we're going to resolve.

Meanwhile, there's this wonderful substrate of society called science and science continues to plug away and solve problems. And then all of a sudden, you know, we pop up 40 years later and we're all living to 200 years old and we're all flying around in cars and we all have nuclear fusion reactors in our backyard. But, you know, we've just gone through probably decades of strife as we try and resolve these big shifts that are underway right now, these big social shifts.[6]

All of these legal efforts and government efforts to try and stall and stop technology, historically, it's never worked. Like, it's just not going to work. Except when you have a limited resource like uranium, you know, for like nuclear fuel or something like that. But for like something like this, which is self-replicating, it's software, it can go anywhere, it can be anywhere, it can fill any space, it's knowledge work. It's going to be very hard to stop it. So the real question, and this is going to be transitory for now, but the real question is going to be which of the humans that are folding t-shirts today are going to have the spark in their brain that's going to say, I should buy five robots and run my own t-shirt folding business.

That's this challenge that I think humanity faces in this next evolution. We can talk about transhumanism too, which I think is going to be a forced adaptation, but particularly it's about agency. Taking ownership for how do you engage the future versus waiting for someone to tell you what to do next.[24]

RULES THAT CAN LEARN

You're allowed in Nevada to play roulette. It's got a negative expected value for individuals, but the individual generally doesn't have the capacity to recognize that every dollar they're spending at the roulette table is likely going to be taken away from them. There's a five-percent edge for the house on that game. And so we make the argument in some cases that people don't have the capacity to understand risk, but in other cases it's okay for them not to have the capacity to take risk. I think there is this notion of what some people call regulatory capture: some degree of profiteering has created some set of laws that manifestly capture that system in a certain way.[105]

The way the statutes were written, there's a definition on the size of a model, which in and of itself is very quickly changing. We've seen significant reductions in model size that actually improve performance of the model for specific applications. It's very likely we end up seeing more smaller, targeted models used in specific applications instead of one massive general-purpose model—or networks of smaller models, which is where I think the industry is going. If that's where things go, then this statute doesn't even matter.

It makes no sense anymore. That shows you how quickly things are changing. They go and get experts' opinions. In a couple of months, those experts come back: 'Here's the size of a model you need to regulate.' Then the legislators run, write the code, and pass the statute. All of a sudden, it doesn't even make sense anymore. I don't think we really know where this technology is all falling out, and it's very difficult to have the government reach in too quickly to identify what they should and shouldn't allow to happen.[37]

So the SRO concept would be that experts could be brought in from industry that know how to assess models for things like

cyber risk, for things like bio risk, for things like weapons risk, social manipulation, et cetera. That independent body can get voted on, can get changed over time. And because they actually have expertise in running software evals and running tests like this, they can operate at a faster pace than setting up a new government agency. So it's kind of a very elegant solution.

The industry recognizes that there needs to be some degree of oversight and checkpoints here, and I think that this could actually solve that problem. That's why I think everyone's kind of climbing on board with it: it doesn't actually hand stuff over to the government. It says, hey, we're going to get the right people to take a look at these things, and the government is going to have oversight ultimately.[106]

My concern is that there's going to be lots of push for things like roads and stuff that doesn't create ongoing jobs; that so much money is going to go into basically a disguised stimulus package, versus the ideal kind of infrastructure program set is to enable industry. If you go back and think about the Manhattan Project and the Apollo mission, those were very expensive government programs that had a very specific mandate. But because there were big investments in difficult problems, they unlocked a lot of industry that followed that initial development cycle.

I think that is kind of a good guideline for us to think about what we might hope for an infrastructure bill to do: create unlock for industry, as opposed to plowing money into short-term service contracts where it doesn't really change the industry very much.[107]

Over time, we have benefited from lower costs of nearly everything, and that we do have this ubiquitous access to things that we didn't have 30, 40, 50 years ago. Just think about how much it used to cost to go to the movies to watch two hours of film, and today we can watch six hours for free on our phones.

The same is true with physical stuff, the same is true with a lot of services, and on an inflation-adjusted basis and a wallet share basis, food prices are down significantly over the last 50 years, and so there's a lot of technology that has actually been extraordinarily deflationary.[23]

> i am a big believer in market forces. normally, i think if you reduce regulation and enable markets to act freely they will resolve to the best outcome. however, i don't think market forces work well when the collective interest outweighs individual interest.[108]

> "free markets" drive progress - sellers compete with each other because buyers demand lower prices. "captured markets", where the government is the primary financier on the buy-side (usually at the political urging of some group of sellers), distort prices higher because the opposite is true - no matter how expensive something gets, the government will provide funding to buy it, if legislated to do so. this only yields anti-progress. and is true in pharma and healthcare (medicare has no price negotiation incentive), education (federal student loans are handed out indiscriminately regardless of quality or performance or relative cost of education), and housing (tax credits and the federal housing loan programs, which assume home prices will always go up). while the moral and policy intentions of these programs are sound - they provide supportive access to those in need - they are inevitably and universally inflationary which eventually makes the services LESS accessible to those in need.[109]

> capitalism is incentivized to root out and exploit failure. that's what makes it better... things that don't work go away and those that do better take over[110]

> is succeeding after making good choices, sacrificing personally, and working hard really "privilege"? is it oppressive that everyone doesn't get to the same place? perhaps the real oppression is the loss of individual liberties when naively egalitarian philosophies mutate into marxism, denying opportunities for individual sacrifice, effort, and achievement to be rewarded. framed as privilege v equality misses the mark.. equality of opportunity and equality of outcome are v different things.[111]

It's really important that we all embrace the ability to be independently thoughtful.[2]

THE FRIEDBERG OPERATING SYSTEM

You can't count the chips that you've already put in the pot. You've just got to look at the hand you have in front of you.[27]

Having a premise—know what it is you're trying to do and whether it's the right thing. The strategy is to know what you don't know. The tactic is to grind. And there are plenty of places for you to innovate.[1]

You can't let the fact that you spent a lot of time doing something drive the decision of what's best going forward.[27]

The velocity of decision-making at an early-stage company is far more important than the accuracy of decision-making.[28]

You try and put numbers to things, and then you use those ranges to make decisions, as opposed to 'my opinion matters.'[28]

I am much more oriented towards trying to figure out the questions I'm trying to answer and then sourcing all objective truth that I can identify to try and answer those questions.[6]

What are the things I should be saying no to? What are the things I should be focusing on? The more focus I get, the better things seem to work.[10]

And there were things that worked well that I took with me and kind of went beyond. So I think that's one thing is just like take some time to get different experiences and see different things and build your own perspective on what's good and what's bad, like how to do things well, how to not do things well. Before jumping into just like, because I'll see people try and do a startup for five years and they didn't learn anything. The startup fails.

And it's like they didn't learn anything because they didn't iterate enough. They didn't change enough. They didn't take different learnings in. They just kept trying to do the same thing over and over again. It's like, well, what were you guys doing? Yeah. So I think that's one thing. The other one is just this point about iteration. Like you've got to constantly be like if things aren't working, you have to change what's going on frequently until you find something that does work.

The rate at which you change things is more a predictor of success than like doing the right thing. Yeah. And then I think the final thing is just curiosity. Like the most successful people in the world by far are the most curious. It has to have other things too. But like every day, like I want to learn new shit. Yeah. Like that for me is one of my drivers. Like I just like learning new things. And so I'm constantly trying to learn new things.

And then you never know why something serendipitously might happen.[10]

The most successful people in the world by far are the most curious. … Every day, I want to learn new shit. I just like learning new things, and so I'm constantly trying to learn new things. You never know why something serendipitously might happen.[10]

The other one was just grit or determination. I mean, I cannot tell you how many no's I got, how many rejections I got, how many times we failed, how many times our customers hated what we gave them. We went through, pissed off customers all the way through the lawsuits from customers, all the way through to every investor in Silicon Valley I've been rejected by countless times, even still to this day, I get rejected by them. And I think that the simple model of success in life is you do something, you succeed, you consider yourself successful.

But then when you get knocked down, it's very hard to think about yourself still being successful or having the potential to be successful. If you're model, you're learned model is success. And so getting knocked down over and over again, particularly early in my career or early in those days, I think prepared me well for being equipped to have the grit needed to persist and continue to push even in the face of things not working. And I think that's another critical success factor for nearly every business that's starting out in this kind of startup phase.

So those are two really important takeaways on entrepreneurship for me that arose and I still really try and apply those as principles in every business I look at investing in today. I really look at how gritty the team can be and what informs me that they have that grit ability and how much of a bias to action they have and how quickly they can and will iterate their business to success because no business plan is executed perfectly. Every business plan is a plan until you get punched in the face.

And then you have to iterate. And so one's ability to quickly and rapidly iterate I think is key.[23]

BUILD WITH OTHER PEOPLE

Coachability goes hand in hand with intellectual curiosity. People who are intellectually curious generally are very humble because they're constantly seeking things they don't know, and they recognize that they don't know a lot of things. In that same mentality, they are willing to recognize that other individuals can have good points of view that inform their perspective, and they're willing to change their perspective. That's a really key thing. Across successful founder-CEOs, one of the more common threads is this intellectual curiosity, which translates into coachability, which translates into adaptability and being willing to take advice.

Your board is a tool, not a governance structure sitting over you. The less you are like that, the more likely you are to feel like your board is an umbrella sitting over you, telling you what you can't do.[112]

I have criteria around raw horsepower, skills or experience, and then motivation. And I have systems for how we try and assess those, and then matching our principles is kind of the fourth bucket of things. Horsepower you can test. Skills is based on experience and fits the role and the need. But motivation is one that there's a lot of question marks around. Has this person demonstrated that they've had not just a desire, but an action that they've taken that has pushed them beyond the limits of the systems that they've operated in?

That's what I would typically look for, regardless of the schooling background or the education background: some demonstration of that, because that's necessary in business

building. That's my framework for hiring. We call it smarts or horsepower, skills, motivation, and principles.[113]

And the third is narrative. And narrative, I think the biggest distinction between the human species and all other species on earth is our ability to story tell. And our ability to story tell is really about creating a mental image of something that doesn't exist in front of you here and now today. And that is what allows people to work in cooperation. We're going to build a building. So you describe the building and everyone works together to make that mental image a reality.

Or here's what the world will look like if we do X, Y, and Z. And that statement inspires people to do X, Y, and Z. Story telling is the basis of emotional context development for all experiences we have as humans. It comes from how we communicate and what we communicate to one another to create mental models in the listener. And I think storytelling is the most powerful tool we have as a species.[23]

Number two is bias to action. I've seen way too many people that come from an analytical background that like to analyze and think about options and think about uncertainty and hedge their way into nothing. And having a bias to jump in and take risk and be ready for that failure is important. Those two go hand in hand. But the third is narrative. Narrative is so important, which is, can you tell your story? Do people know your story? And that really attracts, firstly, employees, attracts capital, and attracts customers.

And you have a friend, Elon, who's probably the best in the world at narratives. Steve Jobs is arguably one of the best in the world at narratives. But it's so important. And so I've really come to this understanding that it's not just about putting out the product. It's not just about making the business work. It really is about being able to articulate your narrative, to get the best

people to work with you on it, to get the customers to be aware of it, and to get the capital that you need to execute against your business.[62]

In 2003, I was kind of working at this job that I worked at for under a year. And I taught myself programming and PHP, MySQL, setting up a Linux server, Apache server. Like, I built the whole stack and JavaScript. And I built this kind of web service, this app called Kodongo, which is like a question and answer research service. And it was like, I was working till four in the morning every night, then at 8 a.m. I'd be in the office again.

And I would get home and I would work on it all night. And I, you know, and I kept, I read all the books on computer programming, wrote the whole thing myself, built a payment gateway integration, set up an AdWords account, bought ads. This was back in 2003.[4]

We've done a couple of these lunchtime seminars where we actually did one where we then followed it with a hackathon. So every employee at the company came and we did a sit-down, taught them how to use Cursor, and then said: pick a business problem that you're dealing with at work, whether you work in the lab, whether you work in the greenhouse, or whether you work at a desk, and come up with an app, a web app. And then you're going to create and deploy that web app by tonight.

And then everyone kind of went through that exercise. So that was a good set of experiences for people. The other one is, I really like this idea of challenging people when they ask for headcount about why they can't use AI to do the things that they are asking for the individual to do. That, I think, needs to be built in culturally, into organizations to help managers, help leaders, and even help individuals figure out: hey, wait a second, I never thought about using AI to solve this problem, like designing a greenhouse or designing a new lab layout.

And then the other thing we're doing now is these AI-first offsites. So I'm doing one with my reports, my leadership team. We're going to go through systematizing how we are going to work with individuals in the organization to try and make the organization more AI-first. What are we going to ask of people? How are we going to demand outputs from them? What are the things that we're expecting of folks? And so we're trying to build from the top down. I need to make sure everyone in leadership is using these tools and then figure out the methods for making sure that they're passing that through the organization.

So it's like dissemination of any management process. You've got to start at the top. First of all, you've got to make sure that you as a leader are the right person to lead in this effort. And then you can get your team to take those processes and distill them throughout the organization, make sure you have the right levels of checks and accountability and performance standards and so on. ... So rather than just say, hey, we're AI-first, and then it's like, okay, no one knows what that means, go to an offsite with your management team and say: what does it mean to be AI-first?

For example, when anyone asks for headcount, ask them: why can't AI do the job? How have you tried to use AI to do the job or to get the things done you're trying to get done that you need to hire someone to do? Maybe every job description that needs to get approved by leadership, the first paragraph is: why aren't you using AI? And then they can make the request for the job. Those are the sorts of business processes that you need to build that really institutionalize this notion of AI-first culturally.[74]

If you can deliver value for your customer … and charge them roughly one third of the incremental profit … they're usually going to say yes. … For every three bucks of profit, you get two and I get one. … It's a great thing about the seed business. It's a great thing about enterprise software. It's the exact same business model.[16]

PURPOSE BEYOND THE SCOREBOARD

Human happiness, I don't think is defined by the absolute condition of the human. Human happiness, I've talked about this in the past before. Human happiness is defined by the relative change in one's condition. And so what happens is over time, there's a great book on this called The Happiness Hypothesis. And this researcher from, I think UVA, people are happier as their income levels go up until they make about 60 grand a year. This was as of a few years ago. So it's probably higher now.

After that, income is no longer a predictor of happiness. It's the change in income from one year to the next. So if your income's going up 10% a year, you're happy. If your income's going up 20% a year, you're happier. If your income's going up 30% a year, you're way happier, and so on. This creates the unhappiness cycle, which is when you look beyond where you are today, you end up seeing that next strata, you end up seeing that next level, and you're unhappy because you're not there yet. right?

This is just how human brains are wired. And it's how we survived as a species and got ourselves this notion of desire drives us to go and colonize the world and eat everything and kill everything. You know, fundamentally, it also causes, you know, deep rooted unhappiness without us finding our next line of sight and then shooting for it.[6]

So as a result, I think of that degree of cognizance, there are certainly physical manifest things that I care about and want in the world, security for my kids, all that sort of stuff, but I'm much more interested in solving fundamental problems, understanding where things are headed for us as a species, for our planet, for our understanding of science and engineering and the principles of the universe. Those are very intriguing things for me, and I find intellectually rewarding. More rewarding for me, and I try and make sure that that's where I get my great rewards from, than making more money.

And so I think for me it's just been a little bit of a mindset and kind of understanding that. It's unfortunate because I do see a lot of people caught up in the Joneses cycle, which is what does the other guy have that I don't have? And it's a big part of the problem in the United States today, and globally, the pace of technology adoption increased wealth disparity globally. Wealth disparity, the difference between call it the top decile and the bottom quartile has increased, whereas the absolute condition of everyone has moved forward.

So while everyone's better off, most people are unhappy because they see certain people have done better than they have. It's a hard thing to kind of break from. We're never going to break it as a species. It's going to take a couple hundred years. It's just something to be cognizant of in framing one's own life that you're never going to find reward from just constantly trying to climb the ladder.[6]

When the mindset becomes one of selflessness, it becomes one of service to others.[6]

The hardest thing for me has been grappling with the emotional complexity of winning and losing and not just being a winner.[6]

> humans are definitely motivated by immediacy, in time and space. the less immediate the less important. but urgent and important are distinct and different. eventually the important becomes urgent. maybe we learn that lesson this year. maybe climate change is next.[114]

A LIFE SPENT BUILDING

Yeah, I did my undergrad degree in astrophysics at UC Berkeley. I was in the Bay Area during the dot-com boom. You know, I was working in a government lab, getting bored to death doing mathematical models. Meanwhile, I was reading the Wall Street Journal and seeing kids in my dorm make a million dollars on some dot-com startup they had built. And it seemed like a better place to make an impact in the world was to go across the Bay and live in San Francisco and work in tech.

So when I graduated in 2001, I interviewed and got a job in technology investment banking. I'd never taken a finance business or accounting class in my life. I'd only been a physics major. I played a lot of poker in college, so I guess that helped me get the job. And ultimately, the investment banking job led to me being exposed to hundreds of technology companies. And then I started working at Google in early 2004 and left Google at the end of 06 to start my company, The Climate Corporation.[6]

And I thought this is what I want to do. Rather than sit in the dark room and be part of a cog in a machine that was going to take forever to output some theory that may or may not be disproven 50 years later, I wanted to be able to go out and do something that was impactful and would have lasting change in the world and I could control my own destiny and I could make that happen in the time that I live on this earth.[1]

INDEX OF IDEAS

A short guide to the reading themes.

Agency · Find a Consequential Problem, A Life Spent Building

Agriculture · Let Reality Change the Company, Biology as Machinery

Artificial intelligence · Intelligence as Leverage

Capital and time · Capital Must Match the Clock

Climate Corporation · Let Reality Change the Company

Compounding · Capital Must Match the Clock

Curiosity · Find a Consequential Problem, The Friedberg Operating System

Customer needs · Let Reality Change the Company

Data · Let Reality Change the Company, Intelligence as Leverage

Decentralized production · Abundance Is Engineered, Energy Changes the Frontier

Experiments · Remove the Unknown, Science Must Become a Company

Failure · Remove the Unknown, The Friedberg Operating System

Founder and CEO roles · Science Must Become a Company

Fusion · Energy Changes the Frontier

Genetics and breeding · Biology as Machinery

Hiring · The Friedberg Operating System

Institutions and regulation · Institutions, Diffusion, and Productive Freedom

Iteration · Remove the Unknown, The Friedberg Operating System

Milestones · Capital Must Match the Clock

Ohalo · Biology as Machinery

Platforms · Science Must Become a Company

Productivity · Abundance Is Engineered, Institutions, Diffusion, and Productive Freedom

Purpose · Find a Consequential Problem, A Life Spent Building

Scientific method · Science Must Become a Company

Storytelling · The Friedberg Operating System

Technical risk · Capital Must Match the Clock

The Production Board · Science Must Become a Company, Capital Must Match the Clock

Trust and adoption · Institutions, Diffusion, and Productive Freedom

Uncertainty · Remove the Unknown

WeatherBill · Let Reality Change the Company

Source index

1. Entrepreneurship Gives Life Meaning. 2011-10-05.
2. The Julia La Roche Show, episode 171. 2024-05-21.
3. Philosophy: A letter from CEO and founder Dave Friedberg ("Reimagining Earth"). 2020-04-09.
4. David Friedberg is All-In on Science. 2023-02-10.
5. David Friedberg on How To Build a Billion Dollar Startup Limited Partner E31. 2024-01-08.
6. 20VC interview with David Friedberg. 2022-03-14.
7. Food for Thought: One-On-One with David Friedberg — Spud Smart. 2025-01-16.
8. How to Think Big with David Friedberg Founder of Cana. 2022-03-03.
9. X post. 2022-02-12.
10. Dave Friedberg on Optimizing Your Gut Microbiome, the Power of Fiber and the Mindset for Success. 2026-03-19.
11. Agtech Reflections and Projections with David Friedberg and Louisa Burwood-Taylor. 2023-11-08.
12. WeatherBill on Bloomberg TV. 2007-02-02.
13. All-In Podcast, episode 45. 2021-09-04.
14. The Climate Corporation Launches Total Weather Insurance 2013. 2012-10-09. Company statement.
15. Climate.com Provides Farmers with Weather and Crop Insights Customized for Each Field. 2012-10-09. Company statement.
16. Fireside Chat with David Friedberg at World Agri-Tech. 2026-01-15.
17. Value of Weather Simulations. 2014-03-03.
18. LinkedIn post praising Pattern Ag corn service ('amazing service offering with extraordinary ROI for corn'). 2023-04.
19. The Climate Corporation Announces Acquisition of Soil Analysis Business Line of Solum Inc.. 2014-02-20. Company statement.

20. Monsanto to Acquire The Climate Corporation, Combination to Provide Farmers with Broad Suite of Tools Offering Greater On-Farm Insights. 2013-10-02. Company statement.

21. The Climate Corporation newsroom (Monsanto subsidiary; Internet Archive capture). 2014-08-26. Company statement.

22. Ignore the Downturn Transformative Tech Will Always Make Returns. 2025-03-11.

23. David Friedberg On Reimagining The World Through Decentralization. 2022-09-29.

24. Modern Wisdom, episode 1084. 2026-04-13.

25. America Is About To Crash Into A Brick Wall Impact Theory. 2024-07-02.

26. X post. 2020-10-27.

27. Founder Stories: Why Leading A Company Is Like Playing Poker. 2013-06-05.

28. David Friedberg: Astrophysics, Eatsa, and Everything In Between (Richard Newton Lecture Series). 2017-02-21.

29. All-In Podcast, episode 170. 2024-03-15.

30. Food For Tomorrow 2015 — Keystone: Technology As A Solution In Food Production. 2015-10-21.

31. The Production Board's Dave Friedberg Technology Will Save the Day Hopefully. 2021-08-20.

32. All-In Podcast, episode 1. 2020-03-19.

33. Why the Climate Corporation Sold Itself to Monsanto (Friedberg's letter to employees). 2013-11-03.

34. Talking 23andMe For Farms, Bioreactors-as-a-Service & Other Crazy FoodTech Ideas With Dave Friedberg. 2020-06-25.

35. The Production Board and the All In Podcasts Sultan of Science. 2023-05-15.

36. The Future of Food with David Friedberg (speaker spotlight, quoted statements). 2017-01-19.

37. DOJ targets Nvidia, Meme stock comeback, Trump fundraiser in SF, Apple/OpenAI, Texas stock market. 2024-06-07.

38. Doug Burgum, Secretary of the Interior | All-In DC. 2025-05-06.

39. JD Vance's AI Speech, Techno-Optimists vs Doomers, Tariffs, AI Court Cases with Naval Ravikant. 2025-02-15.

40. AI Doom vs Boom, EA Cult Returns, BBB Upside, US Steel and Golden Votes. 2025-05-31.

41. Trump-Xi Summit, Benioff: "Not My First SaaSpocalypse," OpenAI vs Apple, Multi-Sensory AI, El Niño. 2026-05-15.

42. Can Technology Solve Our Climate Crisis. 2023-02-15.

43. A Conversation With Spotifys New Co CEO. 2026-03-13.

44. X post. 2023-05-22.

45. World's First Trillionaire, Anthropic Fable Banned, The New Oligarchs, Iran Peace Deal. 2026-06-19.

46. X post. 2021-07-16.

47. All-In Podcast, episode 140. 2023-08-04.

48. Early Google exec got Larry Page's backing to build a start-up factory focused on saving the planet. 2021-07-30.

49. Anything Is Possible with Dave Friedberg Where It Happens. 2022-03-03.

50. Trump wins! How it happened and what's next. 2024-11-08.

51. X post. 2020-03-29.

52. X post. 2020-10-26.

53. X post. 2021-07-16.

54. X post. 2021-07-16.

55. Quinoa Is the New Big Mac. 2016-12-17.

56. "Founder Mode," DOJ alleges Russian podcast op, Kamala flips proposals, Tech loses Section 230?. 2024-09-06.

57. The Founding Story of The Climate Corporation and Reimagining Earth. 2023-05-01.

58. David Friedberg on Joining Ohalo Genetics as CEO Gene Editing Technology and AgTech Trends. 2024-06-04.

59. Khosla, Friedberg strike positive note amid agrifoodtech funding winter. 2024-03-19.

60. WeatherBill Raises $42 Million to Expand Its Technology Platform. 2011-02-28. Company statement.

61. 'I think there's definitely a significant correction ahead' (market crash / de-globalization). 2022-03-14.

62. David Friedberg Cana the First Molecular Beverage Printer TWiS E1365. 2022-01-21.

63. Trump's Cabinet, Google's Quantum Chip, Apple's iOS Flop, TikTok Ban, State of VC with Keith Rabois. 2024-12-13.

64. All-In Podcast, episode 167. 2024-02-23.

65. X post. 2022-01-21.

66. Fed Hesitates on Tariffs, The New Mag 7, Death of VC, Google's Value in a Post-Search World. 2025-05-09.

67. X post. 2023-04-01.

68. David Friedberg explains his new genetics startup Ohalo. 2024-02-06.

69. X post. 2020-11-30.

70. X post. 2021-07-22.

71. The Stablecoin Future, Milei's Memecoin, DOGE for the DoD, Grok 3, Why Stripe Stays Private. 2025-02-21.

72. A Scientific Breakthrough That Could Transform How We Produce Food. 2024-06.

73. Ohalo and Allied Potato announce strategic partnership. 2026-05-28. Company statement.

74. David Friedberg on AI-First Startups and the Future of Biology Business and Creativity. 2025-05-22.

75. Ohalo CEO on 'boosted' breeding: 'Yields are through the roof' (interview at World Agri-Tech). 2025-03-12.

76. X post. 2014-02-27.

77. All-In Podcast, episode 60. 2021-12-24.

78. All-In Podcast, episode 139. 2023-07-27.

79. All-In Podcast, episode 169. 2024-03-08.

80. DOGE unveils a roadmap, Unlocking GDP Growth, WW3 escalation, Fat cell memory. 2024-11-23.

81. Bond crisis looming? GOP abandons DOGE, Google disrupts Search with AI, OpenAI buys Jony Ive's IO. 2025-05-24.

82. X post. 2020-12-05.

83. X post. 2021-07-08.

84. All-In Podcast, episode 3. 2020-05-21.

85. National Guard in SF? US vs China on Rare Earths, Trump-Xi Meeting, Price Floors, AI's PR Crisis. 2025-10-17.

86. Introducing Cana: A molecular beverage printer in every home helps us take a giant step towards decentralized manufacturing. 2022-01-21.

87. SpaceX IPO, Iran War Fallout, Quantum Bitcoin Hack, The Space Opportunity. 2026-04-03.

88. X post. 2022-02-12.

89. Trump vs Powell, Solving the Debt Crisis, The $10T AGI Prize, GENIUS Act Becomes Law. 2025-07-19.

90. All-In Podcast, episode 159. 2023-12-29.

91. All-In Podcast, episode 106. 2022-12-03.

92. AI Sovereignty Wars, Palantir-Nvidia Deal, SCOTUS Birthright Ruling, Newsom's CA Budget Lie. 2026-07-03.

93. All-In Podcast, episode 147. 2023-09-29.

94. X post. 2014-01-16.

95. Trump AI Speech & Action Plan, DC Summit Recap, Hot GDP Print, Trade Deals, Altman Warns No Privacy. 2025-08-01.

96. All-In Podcast, episode 160. 2024-01-06.

97. Scarlett Johansson vs OpenAI, Nvidia's trillion-dollar problem, the "vibecession," plastic in our balls. 2024-05-24.

98. X post. 2022-12-09.

99. X post. 2022-12-09.

100. SpaceX-Cursor Deal, SaaS Debt Bomb, New Apple CEO, SPLC Indictment, Colon Cancer Spike. 2026-04-24.

101. Anthropic's Fable Backlash, Nationalizing AI, Inflation Heats Up & California's Broken Elections. 2026-06-13.

102. X post. 2025-11-15.

103. The Climate Corporation Makes Landmark Data Access and Privacy Commitments to Farmers. 2014-01-31. Company statement.

104. SpaceX's $2T Case, Nvidia's Shock Selloff, America Turns on AI, Trump Pulls AI Order, Bond Crisis?. 2026-05-22.

105. All-In Podcast, episode 13. 2020-11-25.

106. Can the AI Industry Regulate Itself? Stripe Wants PayPal, China Catches Up, NY Bans Datacenters. 2026-07-18.

107. All-In Podcast, episode 27. 2021-03-27.

108. X post. 2021-01-09.

109. X post. 2024-05-12.

110. X post. 2025-01-11.

111. X post. 2025-08-24.

112. All-In Podcast, episode 75. 2022-04-09.

113. All-In Podcast, episode 157. 2023-12-16.

114. X post. 2020-03-27.