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Welcome to the Making Sense podcast, this is Sam Harris. OK, well, today I'm talking about some fundamental questions of human existence. But they are rarely thought of as such, there's not the mystery of being or the nature of consciousness or what happens after death. No, this is a conversation about a far more basic question than those, and it's the question of what we eat and how that affects the prospects of our survival here. It does it in two ways.

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How we produce food, in particular, how we produce protein affects climate change and pandemic risk very directly. And on both counts, the status quo really is unacceptable. So today I get into that topic with Bruce Friedrich and Liz Specked, both of whom work at the Good Food Institute. GFI is an international nonprofit that is reimagining the process of protein production. Bruce oversees GFI Global Strategy. He is also a TED fellow and a Y Combinator alum. He has published in The Wall Street Journal, USA Today, The Los Angeles Times, Wired and in many other places.

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He has a TED talk that some of you may have seen. And he's a graduate of Georgetown Law, Johns Hopkins and the London School of Economics. Liz is a scientist who works to identify and forecast areas of technological need within this field. She has a degree in chemical and biomolecular engineering from Johns Hopkins and a doctorate in biological sciences from the University of California, San Diego. As we were discussing such a pressing need here at what one hopes is the tail end of the covid pandemic.

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We're releasing this episode as a PSA outside the paywall, and we're also giving a significant donation to GFI through the Waking Up Foundation. As always, if you want to support the podcast and get access to full episodes in general, you can subscribe at Sam Harris Dog. And now, without further delay, I bring you Bruce Friedrich and Respect. I am here with Bruce Friedrich and respect Bruce and Liz, thanks for joining me. Thanks for having us.

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We're delighted to be here. So we have a lot to talk about. These are these can seem like unrelated issues, but they they intersect and in ways that will be immediately obvious to people, I think will probably focus on how global health concerns, especially with respect to things like pandemics and antibiotic resistance, coincide with a concern about climate change and how innovations in food production really seem like a silver bullet of sorts to help deal with both of these problems.

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That's not to say that it subsumes all of our efforts, but it will subsume some very important ones. And then I guess this all of this just relates to how we can intelligently solve problems in the world. And these are problems that we have thus far not been able to to marshal sufficient resources to solve for reasons that are at this point, somewhat inscrutable. But before we dive into that nexus of concerns, maybe you guys can just summarize how you come to focus on these problems.

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I'll start with you, Bruce. How did you come to focus in these areas? Well, I've been concerned about resource economics for a bunch of decades and have been concerned about the external costs of industrial meat production for quite a while as well. And about five years ago, I started thinking about whether we could use food technology to address the harms of industrial animal agriculture. And I think the answer to that question is absolutely yes. So these are some of the questions that will be diving into.

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But I started working on the Good Food Institute just a little over five years ago to answer what are really the two big questions in global food. And the first one is, how are we going to feed close to 10 billion people by 2050? And the second part of that is without lighting the world on fire and GFI and food technology and markets are kind of what we came up with as the solution to both those

questions and expanded it into global health.

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The other topics that we'll be talking a little bit more about subsequently and how big is the Good Food Institute at this point?

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How many employees do you have and what your annual budget?

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Our budget for 2020 one is 18 million dollars. We have eight million dollars spent in the United States on programs. We have about 65 full time scientists and lawyers and lobbyists and others on the team in the United States. And then we have about 45 across our international affiliates, which are in India, Israel, Brazil, Asia Pacific, out of Singapore and Europe. We have teams in both London and in Brussels and about eight million dollars for US operations, about five million dollars for international operations.

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And then we have a scientific granting program. We'll be spending about five million dollars this year on open access, science, plant based cultivation and fermentation focused on basically replicating the entire experience of meat eating that using plants or fermentation or cultivation. And Liz, where do you come in here?

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I came to the Good Food Institute straight out of academia, but I've long had a sort of altruistic and and for many years a ultimately global health or public health kind of bent to my work, really kind of trying to leverage technology as a means of having easily adaptable solutions to what are otherwise really sort of wicked societal problems.

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So I started in chemical engineering in my undergraduate work. I had the opportunity to go abroad for several summers to work in places like slum environments in India on global health issues, and just really saw sort of that nexus of societal intersection with with technological solutions and gravitated towards biotechnology as a means of trying to find solutions that are easy for people to adopt and easy to really scale and deploy globally. So I went to graduate school and molecular biology was working in an algae lab that did a little bit of biofuels work.

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This was sort of during the, you know, the rise and subsequent fall of the algae biofuels era.

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But what really drew me to that lab was that they were also using algae as an expression platform for producing oral edible vaccines for malaria.

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That, again, could be extremely low cost, extremely easy to deploy.

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You don't need quite cold chain or sophisticated health care infrastructure and so forth. I then went to do a postdoc in a biochemistry lab where my focus of my project was, you know, trying to develop a sensor system that could be used as sort of a remote diagnostic for low resource settings. So, again, this sort of bent towards, you know, how can we use relatively low hanging fruit in the biotech space to solve the issues that would have massive global impact has always been sort of the driver behind my interest in science and biotechnology.

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And a couple of years into my postdoc, I sort of went down a bit of a rabbit hole of learning about all

of these multifaceted implications of animal agriculture, specifically industrialized animal agriculture on our global health system, on the environment, just the sheer resource utilization, inefficiency of it. And, you know, for a long time I feel silly saying this in retrospect, but for a long time it really wasn't obvious to me that there was a biotech solution or a technology driven solution to these these multifaceted issues of animal agriculture.

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I considered this to be in the realm of, you know, public policy or consumer education or something like that. And it wasn't clear to me how I could use my background to really solve this issue that had almost overnight become my real passion project. The thing that I felt, you know, I have to spend my career working on this. And it was sort of a beautiful, you know, coincidence, honestly, that GFI was founded just a few months before I started kind of trolling around for career opportunities.

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And, you know, they had just posted a roll for their first couple of of senior scientist positions. And immediately upon seeing that and sort of reading about this theory of change, you know, it was that light bulb moment for me. Yes, this is eminently solvable. And, yes, we can use a technical technology approach to do it.

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Well, I think I discovered the two of you independently, so if memory serves, Bruce, you reached out to me and I found you through the the Effective Altruism Network, your foundation, the Good Food Institute, is in high esteem among effective altruists. Founders Pledge recommends it as a charity. And Founders Pledge is also advising my foundation, the Waking Up Foundation, at this point. But, Liz, I noticed you on Twitter as a an especially sane voice on covid just when the pandemic was kicking off.

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I think you put together a threat or two which which many people found very valuable. And so, yeah, when Bruce when you reached out when I saw the association between the two of you, it seemed like there was a lot to talk about. You know, I don't know if this is too pessimistic for you, but, you know, I've drawn a lesson from covid that is. Really pretty gloomy with respect to the prospects of our marshalling a political response to climate change, the idea that we are ever going to convince ourselves that this is a an emergency that we need to respond to, given that we couldn't convince ourselves to respond to covid even when Italians were shrieking from their excuse that this wave of contagion was coming, even when it was hitting New York and the rest of the country couldn't seem to care or take it seriously.

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I just don't know how we break the spell of misinformation and hyper partisanship in response to a threat that really strikes me as at least an order of magnitude more difficult to get your mind around. You know, pandemics can be hypothetical until they arrive, but climate change seems to just persist in this in this zone of hypothesis, even if most of the science is fairly settled and I just don't see people responding to it. So it seems that we need to find a way around this which solves the problems without actually having to convince people that these problems are anything like an existential threat that must be responded to like an emergency.

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I mean, which is to say that I think we just have to build the cars and produce the technology and produce the food that people want and take whatever friction we can find out of that system of gratifying people's desires as opposed to convincing them that the house is on fire. I don't know if you think I'm being too pessimistic about the political avenues here, but that's a lesson I feel like I've learned from the last year under covid. I don't know, I mean, listening to you, Sam, it feels to me like your indictment, and I think it's absolutely right.

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And it's the observation that led to the founding of GFI is that convincing individuals to change is

going to be very, very difficult. So what we know about meat is just one example and we can dive a little bit more into this. But we know that it is an extraordinarily inefficient way of producing food. We know that it is the most likely cause of the next pandemic. We know that more than 70 percent of antibiotics are being fed to farm animals, which is driving antibiotic resistance, which could lead to the end of modern medicine.

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And we know that it packs a mega CLIMA wallop relative to alternatives and these things. People may not know the intricacies, but people are basically aware of these issues. And yet per capita meat consumption goes up and up and up. Even in the United States, 20 19 was the highest per capita meat consumption in recorded history. And globally, the U.N. says we're going to have to produce 70 to 100 percent more meat by 2050. So that's a pretty thorough indictment of behavior change.

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But I think if you look at your question with regard to climate and you look at U.S. funding for climate solutions politically, EU funding for climate solutions politically, what China is doing in terms of addressing climate issues, it certainly may not be enough, but it is billions and billions and billions of dollars spent on renewable energy and climate mitigation and other strategies for addressing climate that don't require that individuals make big changes. So switching to an electric car and incentivizing that switch or switching to renewable energy as the price comes down and governments incentivizing that switch, that's really what GFI was designed to focus on.

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We think science and markets are the way to go, but science and markets left to their own devices, just like science and markets left to their own devices with renewable energy are going to be a very slow road. So most fundamentally, GFI exists to lift this entire space. And a big part of that is helping entrepreneurs be more successful, helping investors be more successful, helping big food, recognize this as an opportunity rather than a threat. And really, our organizational battle cry is that governments should be putting resources into both open access R&D to create meat from these in these alternative ways.

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And it's got to be meat that eventually tastes the same or better and costs the same or less further. To your point, it has to give consumers everything that they like about meat and it has to cost less. And we're very optimistic that governments will get on board with this theory of change. And then that gets past the sort of behavioral modification that I think your your pessimism around that is, is it's pretty on point.

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You guys take an interesting angle here with respect to the dietary focus, because this is not a vegetarian or vegan argument, per say. I mean, obviously, the ethics here are virtuous in that direction. Right? So it is it is a matter of reducing animal suffering and ending the current practices of factory farming. But you aren't emphasizing the ethical case. It seems to me you're emphasizing more the pragmatic case that given the role that the meat production plays in climate change and raising pandemic risk, we have to make these changes.

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And the changes are producing plant based meat and producing cultured or otherwise known as clean meat, which is real meat. But just it's it's cell based rather than derived from a, you know, slaughtering animal after an animal in an abattoir. It sounds like that is a conscious decision. Is it a practical one or is it just that you think it's much more effective to talk about the pragmatics here? Or is there is there more behind this angle you're taking?

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I mean, I think it's primarily observational. So Daniel Kahneman talks about Systems one and systems to thinking, as you know, and it just seems super clear that food is systems, one thinking and some people will change their diets on the basis of ethical considerations. And one of the really interesting

observations, I think, is that a lot of people will change their vocations based on systems to thinking. So education is how somebody like, um, Cavaletti or Pat Brown or Ethan Brown forms their company.

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But education as a method of sort of radical Diatta. Rechange just absolutely has not worked, and if education worked, we wouldn't see the, you know, the the charts, the color charts of obesity where they keep having to get all new colors because people just keep getting more and more overweight and more and more obese. There just seems to be something about human physiology and physiological needs where food is concerned that people, you know, everybody cares about cost, everybody cares about taste.

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And for the vast majority of people, that's kind of where it ends. So when we're thinking about solutions that work globally, even in countries where education levels around external costs for meat are very, very high. And a lot of people know nevertheless, most people don't change their diets. But we also need a solution that works in rural China and we need a solution that works literally everywhere. And GFI has operations in Israel not because we care what the Israelis eat.

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We have operations in Israel because it is so advanced technologically and as a country. It's very interested in producing all of its own food, food security. So Israel and Singapore are the two countries that are most advanced and both plant based and cultivated meat for that reason. So we operate in those places because the science that's discovered in Singapore or Israel can change the way that meat is made literally everywhere. So we're big fans of education, mostly to educate policymakers, to educate environmental and global health NGOs, to educate scientists, because this is a great vocation for people who want to address global health, address food security, address climate change.

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This is a great vocation. But for the vast majority of people sitting down to eat, it's really going to distill to how does it taste and can I afford it?

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I'll chime in on the consumer front as well.

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You know, if you look at what's really driving the tipping point of interest in alternative proteins where there was virtually no new activity going on, you know, just a blip on the radar in terms of new product launches or investments or what have you until about 2015, 2016. And ever since then, you can look at any of those those metrics, investment product launches, new start ups, et cetera. And you'll see a very rapid uptick in in the years in the past five years or so.

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And that shift is really driven not by increasing numbers of vegetarians or vegans. Those are still small, single digit. What that's driven by is a huge swell in the number of folks who identify as so-called flexitarian or reduce Italians, people who are looking for different protein sources for certain meals of the day or of the week. If you look at data from beyond meat or impossible foods, they're both finding that over 90 percent of consumers purchasing their products are also consuming or purchasing meat products in the same shopping cart or in the same meal.

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So this you know, the reason this this space has become of interest to the sort of global food giants and to investors and entrepreneurial folks is because we've seen we've seen a huge broadening in that consumer base that is now interested in these products. It is no longer relegated to these sort of niche consumer categories, like vegetarians or vegans that historically were kind of driving activity in alternative protein products.

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And correspondingly, we've seen obviously a huge revolution in the sort of quality of those products with respect to how well they recapitulate that consumer experience from a flavor perspective, from an olfactory perspective, from a texture perspective and so forth.

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And just to build on that so that it's sort of an interesting theory of change that we have it GFI, because right now the plant based products do cost more than animal based products. So we need flexitarian and people who are looking to reduce their meat intake because we need people who are willing to pay a little bit more.

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But the theory is that because these products are so much more efficient, so chicken is the most efficient animal at turning crops into meat. And according to the World Resource Resources Institute, it takes nine calories in the form of soy or oats or whatever you're going to feed to the chicken. It takes nine calories into the chicken to get one calorie back out. That is extraordinarily inefficient. And that means nine times as much land, nine times as much water, nine times as many pesticides and herbicides as we get better at bio mimicking the entire meat experience.

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And a lot of people listening are going to be thinking, well, I've had veggie burgers and they're not very good. This is not that. This is people who are literally focused on making products. That you will not be able to distinguish from animal meat, but using plants and then, as you said, Sam, with cultivated meat, it is literally the exact same product just made through cultivation, which is similarly three times as efficient as chicken in terms of input output.

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So as the scales up, as the factories are built, as we move in the case of cultivated meat to food grade ingredients, the hypothesis is, and we're very optimistic about this, that plant based meat and cultivated meat can taste the same or better and cost the same or less. And that's why this should be seen as a massive opportunity for big meat companies like JBS and Tyson and Smithfield and also for big food companies like a.T.M and Nestlé. And so far, we've been really gratified by the degree to which the companies are seeing this as an opportunity.

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Yeah, there's an interesting psychology here and there's a few threads to pick up on him. And one is the flexitarian Reduce Attarian approach is interesting because it doesn't tend to get much ethical standing, certainly not among vegetarians or vegans. But it is worth acknowledging that, you know, if you're someone who. Reduces your your meat intake by half. Let's say you're someone who used to eat meat twice a week and now you go to once a week, you have made precisely the same contribution to this project that someone who eats meat once a week does when they go to zero and become a vegan or vegetarian.

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It's the same reduction and yet it doesn't have the ethical purity of changing your status as an eater. And it is very interesting to know that most of the people who are buying these alternative protein products are also still eating meat. They haven't radically changed their lives, but they're showing that they either want to or just are interested in eating differently and could easily be incentivized to just eat in a truly benign way if the products simply arrived in the stores. Yeah, I think that's exactly right.

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I mean, that's that's the theory of change is just making it easier and easier for people to make decisions that align with their values. But we do, I think, have to meet people halfway. Liz was talking about five years ago being sort of the real advent of these products, ramping up and getting more successful. That is also the point at which the companies started thinking about their mission differently. They started thinking about the fact that they really did need to make products that didn't require sacrifice, because the easier you make it for people to switch, the more likely they are to

switch.

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And eventually, once you have products that that literally give consumers everything they like about meat that cost less. Our expectation is that you'll see basically just a transformation of how meat is made. So in the same way that we moved from phones that require cords to cell phones, where the same way we moved from analog photography to digital photography, we just give consumers everything they like about in those cases and communication or taking pictures. But we do it in a better way.

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And if it also costs less, that dynamic should should really make a significant impact. And eventually, the idea that meat requires live animals just becomes a thing of history.

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Where are we with the cultured meat cell-based meat in terms of its actual availability to consumers? If I had, as you know, Ouma Feleti on the podcast a couple of years ago and full disclosure, I actually invested in his company after that podcast because I was just so. Taken with the prospect of this becoming an available technology, I mean, it wasn't even so much a bet on its likelihood to succeed, it was more just an aspirational investment. But where are we with Kleenmaid specifically?

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We have now seen the the first commercial sale of cultivated meat just a few weeks ago in Singapore by the company, just which has been in this space alongside their plant based work for several years now.

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I think we're likely to see over the next year or two to twenty four months, quite a sort of follow on effect of first more more governments approving this product. It is a new to market product. And in some cases, that regulatory path is is still being sort of sussed out.

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But, you know, there are multiple companies that are sort of at that point of ready to move into true large scale commercial scale production in the next few years. So there are several companies building out pilot scale facilities right now, and we're starting to see these first commercial sales.

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OK, so let's start with our farming practices and how I mean, why are we talking about finding other ways to produce protein at this point? Why is this a problem we need to solve? If people have been eating meat for as long as there have been people and we've been growing it in one form or another for thousands of years, we've lived in proximity to animals. All this time we've been dimly aware of how this causes various pathogens to enter the human population and have grown more acutely aware of that of late.

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But still, why is this not sustainable? Why is this a slow moving emergency that is now not moving slow enough for anyone's comfort? And how does this connect to the question of climate change? Just how big? I guess I'm looking for some picture of how big our problem is. Sure.

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So I mentioned a minute ago that the most efficient animal at turning crops into meat is the chicken, and it takes nine calories fed to a chicken to get one calorie back out. And it's even worse for pork and beef. And so you're talking about many times as much land. But it's not just that you're growing all of those crops and you're shipping them to a feed mill and you're operating the feed mill and then you're shipping the feed to the Animal Farm and you're operating the Animal Farm, and then you're shipping the animals to the slaughterhouse and you're operating the slaughterhouse.

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And the United Nations crunched the numbers on all of this inefficiency. And they said that animal agriculture is responsible for about fourteen point five percent of all human caused climate change globally. If you think about it in a meal by meal basis, you're looking at chicken is the least climate change inducing meat. And yet chicken causes 40 times as much climate change per calorie of protein when compared to legumes like soy and like peas. So we are going to have to produce 70 to 100 percent more meat by 2050.

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And it is just a huge problem for the climate. So Bill Gates in his new book talks about plant based meat and cultivated meat. And in both his book and on his tour, he was talking about how food and AG is a critical pillar of addressing and mitigating climate change. But he was sort of scratching his head wondering what next steps could be. And he is now super enthusiastic about plant based and cultivated meat. As part of the solution at GFI, we spent about a year working with Breakthrough Energy, which is his umbrella organization, on how we can best accelerate this transition toward plant based meat and cultivated meat.

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And we're delighted that Breakthrough Energy adopted GFI recommendations that governments should be incentivizing these alternative proteins, open access to R&D that the entire industry can build on. And then government should also be incentivizing private companies to transition their factories, to build factories and to shift in this direction.

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I'll also mention that we don't want to be too reductive when speaking about environmental impacts. Obviously, climate implications are huge and front and centre. But there are also a number of other implications for biodiversity and local ecosystems that are incredibly damaging, resulting from industrialised animal agriculture. One of the biggest externalities of this industrialised intensified system is the enormous.

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Quantities of animal waste being produced that we've seen instances where in hurricanes, for example, on the East Coast, these lagoons of animal waste are overflowing their their fences and flowing into local waterways. There are huge zones of eutrophication or so-called ocean dead zones at the outlet of virtually every river that has run off from agricultural basins.

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That's contributed to in part by fertilizer on fields, but to a very large degree from runoff from animal waste, from these large scale animal facilities. The other thing we should probably address, and I don't know if you want to address, I mean, you actually did sort of not at it, Sam, but the global health implications are pretty colossal in terms of how we produce meat. Right now. We are ushering in an age of antibiotic resistance, where, according to the former president of the World Health Organization, Dr.

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Margaret Chan, she says it's the end of modern medicine if antibiotics stop working. And about 70 percent of all of the antibiotics that are produced globally are fed to farm animals. If one of your listeners get sick or if one of us gets sick, we'll go on a course of antibiotics that will be quite short. But farm animals are fed antibiotics for their entire lives, and it's leading to antibiotic resistance. The UK government released a report. They said the threat to the human race from antibiotic resistance is greater than the threat from climate change.

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So if listeners want to scare Google, the end of working antibiotics, if you want an even bigger scare ad the word China to that Google search. There was a truly chilling cover story in the New York Times magazine maybe 18 months ago called Pig Zero that addresses this issue. So the way that we are raising animals right now requires all of these subtherapeutic drugs. If you shift to plant based meat

production or cultivated meat production, no antibiotics required. So it's another really big benefit of shifting in this direction and another reason that that governments should really be incentivizing these technologies.

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Yeah, I am.

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I must say, I'm a fan of slightly changing the subject when talking about the problem of climate change to get around the the abstraction of it and to connect with things that people can be more easily led to care about or acknowledge they already care about. So, for instance, often when we're talking about climate change, I feel like we could do more work when focusing on just the benefits and the pleasure, the sheer pleasure of breathing clean air. I mean, just when you think of just how much nicer it is to live in a city where the air is actually clean and imagine what it would be like to live in a city like Los Angeles when there was basically no air pollution.

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Right. If we're all driving electric cars and the Port of Los Angeles were not being inundated with diesel fumes, it would just be a different life in the city. And we experienced it. One of them, one of the epiphanies we had when covid was first changing life everywhere in the first lockdown, and we noticed the reduction in air pollution. It was a vision of a possible future where we could breathe clean air. And then you connect that to all of the.

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The health effects of bad air and the tens of thousands of people who are killed outright by it in any major city over the course of a year, when you when you look at emphysema and asthma and lung cancer and all the all the other pulmonary and cardiovascular knock on effects of people essentially smoking cigarettes when they didn't consent to smoke them, it's just very easy to see that kind of ancillary benefit being so enormous that we will seem retrospectively insane not to have made these changes earlier.

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And it will seem as crazy as we seem now. When you look back at what it was like to fly on airplanes that had smoking sections, how did we ever get ourselves into that situation to consent to be put on a sealed tube with a few hundred other people and let them smoke for the next 10 hours on a flight to Europe? It's just sheer masochism. And yet it was our common practice. And I got to think the spell is going to break here as decisively as that.

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And we will we will not recognize ourselves in retrospect.

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I think it's probably a pretty relatable experience for anyone who's driven cross-country or across states that have, you know, animal farming operations to know that you're coming up on an industrial animal farm and literally have to hold your nose for several miles.

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And I think, you know, some of those sort of societal implications and worker implications have been laid bare in this pandemic as well as as folks have sort of taken a peek behind the curtain of how conventional meat meat is produced and the conditions on processing lines and so forth. There really are health implications for the communities that surround these farms and for the workers who are working in these these processing plants.

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And it's probably worth just taking a moment and stepping back and thinking about the fact that everything we're talking about right now is domestic. We could also be talking about insane weather events that are created by climate change. But if we look outside of the United States and at

developing economies in particular, I mean, that's where it becomes a huge problem, that it takes nine calories fed to a chicken to get one calorie back out. We're literally burning down the Amazon rainforest in order to grow soy, to ship that soy to Europe, to feed to agricultural animals.

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That is the sort of thing that is sort of the real world outcome of this inefficiency. And you think about, you know, it's almost tautological, but in the United States and developed economies, we will do a pretty acceptable job of acclimate acclimating to bad climate events. The people who get hit the worst or the people who contributed the least. It's the developing economies where people are going to be displaced. Entire cities are going to be wiped out, and it's the economies that are least able to deal with these impacts.

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What do you do with the argument that in the developing world they require more or less the same career we had with building their economies based on an industrial a 19th century style industrial revolution? Now that we have grown as wealthy as we have, we are demanding that the rest of the world that has not yet caught up to us clean up their act when only now, as you know, at the tail end of our development, do we have the courage of our scruples here.

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What's our obligation to help the developing world kind of bypass? The the industrial mistakes we've made for self-preservation alone should dictate that we figure out how to do this. But how do you view that dialogue and trying to persuade China and India and Africa to not follow all the missteps we in in the utterly developed world have made?

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And I think at least on the meat front, you can look at cellular technology and cell phones and the concept of of leapfrogging.

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So making meat from plants and cultivating meat for themselves. What I think we can't do for the reasons that you just underlined is go to them and say you need to eat less meat. You need to not adopt practices of industrial animal agriculture, look at the adverse harm to the climate or antibiotic resistance or whatever else. But we can go and say, let us help you switch to renewable energy is one climate solution that is win win. And in the case of me, we can help you figure out how, in the case of India to turn Millet's into palatable products that Indian consumers will be enthusiastic about.

[00:40:21.590]
We can do that with plant based meat. We can also do that with cultivated meat. And we've been deeply gratified. We operate in India and. By India, the Modi government in India was the first to fund the Center for Cellular and Molecular Biology and India cultivated Meet Open Access R&D. The Chemical Technology Institute in India is also very enthusiastic, and the entire food industry in India has been a phenomenal partner as well as other companies in India. So and then China wants to be the global leader on addressing climate change.

[00:41:00.570]
China should be all in on these alternative ways of producing meat as well. We haven't even talked about pandemics to any significant degree yet. But as you know, Sam, we kind of lucked out. covid-19 could have been significantly more deadly. It could have been significantly more transmissible. Scientists say the next pandemic is inevitable. And according to the U.N. Environment Program, the most likely cause of the next pandemic is the consumption of animal meat, followed by intensification of agriculture.

[00:41:35.970]
So with plant based meat, uncultivated meat, the chances that your food contributes to antibiotic resistance or the next pandemic falls from very, very likely to zero. It eliminates those problems and that is in the best interest of governments in developing economies. But it is particularly in the best

interest of governments in developed economies to incentivize this, to make it something that is not a sacrifice for these other countries. And this leapfrogging concept also speaks to the urgency here, you know, the vast majority of the increase in demand for meat and animal protein will come from these emerging economies.

[00:42:18.300]
And they don't currently have one of the biggest challenges that the developed world is facing right now in this protein transition, which is to say that they don't have the inertia of sunk assets into all of this infrastructure that underlies industrial animal agriculture.

[00:42:35.160]
So the opportunity to, you know, go straight to production methods that are more efficient, that are cleaner, that are safer, that are more resilient and not have to expend all of those resources in building these incredibly damaging systems that then, you know, the folks who invested in that are incentivized to keep that status quo in in operation as long as possible. Yeah, yeah, well, on that point in the developed world, what sort of partners have the established agribusinesses been?

[00:43:10.110]
And I got to think that and I know this was, um, of a lady's opinion when we spoke, you have to figure out how to bring them in as partners so that they don't view these alternatives as a a mere subtraction from their potential market. What's that dialogue been like and how hopeful are you that the titans of the world are going to recognize that they should be in this game rather than resisting it?

[00:43:35.700]
We have been deeply gratified by the response of both the biggest food and the biggest meat companies in the world. So Prie covid GFI had an annual conference and we had JBS and Tyson at our conference, the two largest meat companies in the world speaking from the dais, talking about how they want to be protein companies. They want to supply the world with high quality protein as profitably as possible. So literally, all of the world's largest food companies and all of the world's largest meat companies have gone into their own plant based meat brands.

[00:44:14.700]
So JBS, Tyson and Smithfield have their own brands. Cargill is supplying KFC in China, which is pretty exciting. Tyson and Cargill, which are the two largest U.S. based meat companies, have each invested in this company. They've invested in Memphis meats. And kudos, kudos to Ouma for seeing the value and being so enthusiastic about inviting them in because, yeah, we want them to see this as opportunity. We their supply chains are robust. They know what consumers want from meat.

[00:44:49.410]
They are trusted brands. So we are just very, very excited about having Nestlé, a.T.M, JBS, Tyson, and as far as we can tell, they are all taking this concept very, very seriously. It's a little toe in the water at the moment, but there has not been resistance. And it does seem to us that there has been real enthusiasm and we're delighted by that.

[00:45:11.520]
Hmm. It's interesting to consider how few minds actually need to change to utterly transform our practices here globally, because as we've pointed out, it's not a matter of successfully getting through to all the individuals to modify their day to day choices. We simply have to deliver more compelling choices and they will just grab what they want. So when electric cars become better than gas cars by every metric and also cheaper, there will be no more friction in the system. You know, there'll be a few people who are nostalgic for the the rumble of an internal combustion engine.

[00:45:52.560]
But for the most part, people won't will want faster, safer, cheaper cars. And that's what they'll get. And the I think we're more than halfway to already transforming the basis of that decision. The final piece is probably price, but how many people's minds do you think would have to change at the, you know, the decision making level in government, in these companies to essentially rewrite the rules of

the industry here? We're certainly not talking about millions of people.

[00:46:27.600]
We might be talking about 10000 people. Mm hmm. I think you're absolutely right.

[00:46:32.670]
I wanted to to squeeze in one of my favorite quotes ever, which is if we could make meat without the animal, why wouldn't we? And the reason that's one of my favorites is because that was said by the CEO of Tyson Foods, Tom Hayes, in about twenty eighteen, which just really speaks to the incentives when you approach this from a really pragmatic perspective, you know, for for a meat company that controls enormous market share of total global meat production, to be, you know, that candid that the animal is almost the most inconvenient part of their whole process.

[00:47:09.960]
If they can meet the make the meat without the animal, why wouldn't they? It becomes quite easy to sort of identify what those incentives and what those drivers are for. As you say, a relatively small number of of key decision makers.

[00:47:24.420]
And I sort of feel like there might be just like one person in China who, if they got really absolutely behind this, could steer billions of dollars into it.

[00:47:33.660]
Or if John Kerry got really into this or Joe Biden, for that matter, in the United States.

[00:47:39.090]
And there is tremendous incentive for them to do that. I mean, you think about electric cars, which you were just talking about, Sam, and GM has said by 2035 they're going to be 100 percent electric. Ford has said they'll be 100 percent electric by 2035 in Europe. And that means they're all going to go to China because China has ninety three of these giga. Batteries for lithium ion batteries, and they're going to have 140 by 2030. The U.S. has four of these giga factories and we're expected to have 10 by 2030.

[00:48:10.810]
So if that happens to meet, if China goes all in on reconstructing meat from plants and cultivating meat directly from cells, they become the global supplier of meat as well. So there should be a sort of space race among governments to reconstitute meat from plants, to cultivate meat directly from cells, because it is how we take the likelihood that our food causes the next pandemic or leads to antibiotic resistance from significant to zero. It's a huge part of the climate solution.

[00:48:44.470]
And the countries that decide to take this on, I mean, they're going to have bragging rights until the end of time, but it'll also be spectacularly good for their economies. So we certainly want the corporations, but getting governments really behind this and lifting up these entire sectors, you know, could be very, very few people who could make a massive difference.

[00:49:05.830]
That's one of the the silver linings of having a totalitarian approach to government. You really only have to change a couple of minds and then everything changes. So before we close here, I want to revisit an issue I raised with with humor in my original podcast on this topic, because I feel like people's intuitions are probably in the process of change in here. But at the time when this notion of clean meat was first floated, there was a concern that that there was a kind of ick factor around the concept.

[00:49:37.750]
And this is, I've always thought, somewhat counterintuitive or paradoxical. You tell people that a single cell has been removed from the the finest producer of steak you can find on Earth. And then

then steak has been amplified on the basis of that single cell. So all of the disorder and suffering has been bypassed. You know, literally a single cell has been removed from an otherwise happy animal and that's started the process. And now you have meat that is getting grown in perfectly clean vats by people and in white lab coats.

[00:50:19.570]
And when you pitch this to people there, at least there was a kind of ick factor where they thought that's that's not something I really want to eat. Right. And yet what's so strange about this is what they're telling you is that if you could only add all the blood and chaos and misery of a slaughterhouse to the picture, then they would get hungry all of a sudden. Then they feel like eating that steak that had to be reclaimed from the murder of terrified animals and somehow rendered antiseptic enough to consume.

[00:50:53.640]
Add to the picture the DNA viruses that now everyone has good reason to to worry about. How do you guys view the psychology here of it? Have we have we actually just blown past this initial reservation in people? And do you think we're just there really won't be any problem in adoption or do you think people are still stuck with this? I guess it's the kind of uncanny valley of food intuitions. What do you guys think about the psychology here?

[00:51:22.210]
I think people eat meat right now. Not really very thoughtfully so human beings, I mean, again, our programming is to be wary of new foods because for however many thousands of years, a new food might kill you.

[00:51:39.780]
I think once you have the two products side by side and one of them has basically no chance that it is contaminated with bacteria, if it's seafood, no chance that it's contaminated with dioxins or mercury, if it's other animal products, no chance that it has any kind of antibiotic residues. It's just a safer product. Live streaming production on the Internet, very, very boring, very, very quickly, but kind of the opposite of passing laws to make it illegal to find out what's happening on these farms and in these slaughterhouses.

[00:52:16.800]
So I think it's natural that people, when they first hear about it, might not be super enthusiastic. But as the products come to market, I think people will be very enthusiastic, especially as it starts reaching price parity and assuming that it tastes the same or better. I will just say that the initial consumer surveys that are done, even when it's referred to as like in vitro meat or lab grown meat, you still have somewhere on the order of 35 to 70 plus percent of people who say they're happy to eat it.

[00:52:52.290]
You have a significant portion who say they are happy to pay more for it. That alone is a colossal, colossal market. But I think we go back to what dictates consumer choices is how does it taste and what does it cost? So and we'll have lots and lots of early adopters. And as the the products scale up and the price comes down, I think, you know, just about everybody will go in this direction.

[00:53:18.330]
And familiarity goes a huge way towards this.

[00:53:21.330]
I don't know if you've seen the charts of people's reservations about getting a covid vaccine prior to the the approval of those vaccines.

[00:53:31.410]
And then afterwards, the curve drops almost immediately. Once the vaccines were approved and people started hearing about friends and family members who had gotten them, I think the exact same kind of psychology applies here that people may say they have reservations about something

just because it's new and unfamiliar. But as soon as you know a friend who went to a restaurant and was able to try this really cool new product, I think a lot of that evaporates right away. And as Bruce mentioned, you know, we largely have not really seen that ick factor to a substantial degree in the last few years, even of these consumer surveys of this product before it's on market.

[00:54:12.930]
Yeah, Bruce's side by side comparison does suggest a diabolical commercial that could be shot. Just, you know, how one mistake was made versus how the other was made and all of it, culminating with the taste, are not being able to tell the difference. Yeah, I do think we will rewrite our intuitions on this front. And I mean, just shining a light on how strange they are, you know, to take vaccines as an analogy. We're currently living in a country where something like half of the population is quite sanguine about getting coronavirus right.

[00:54:51.570]
They think that's no big deal. And yet they're afraid to get vaccinated for coronavirus. That's how upside down it is for I don't know if it's half, but it has to be tens of millions of people. I know some of these people personally. I know people who have taken basically no precautions to avoid getting covid but are highly vaccine resistant. And these people are not uneducated either. So it's this sort of an imperative to shine a light on how discordant these beliefs are or should be.

[00:55:30.630]
In the case of a cold vaccine, this is basically someone expressing a preference for taking into their body whatever it is that naturally came out of a bat so as to second and kill millions of people to the thing we have consciously engineered. That is a well understood not to be a complete virus that can sickened you and whatever side effects one gets from getting a vaccine. At this point, this experiment has been run on millions and millions of people. And we know people are not being sent to the hospital and dying based on their reaction to the vaccine, whereas they are to the disease proper.

[00:56:11.550]
And it's still it's a hard conversation to have with people. So I it's fascinating how clear the path to daylight should be on so many questions and how difficult it is to actually get people to walk in the. The only reasonable direction, I think one salient point here that's different is that this transition towards alternative proteins is currently and should remain entirely apolitical or bipartisan.

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And we've seen support from sort of libertarian leaning folks who recognize this as, yeah, this is just a free, open market solution to an inefficiency, as well as folks who are kind of driven by some of those those larger societal implications.

[00:56:58.610]
Yeah. And I mean, you look at somebody like Sonny Perdue, who was Donald Trump secretary of agriculture, or Scott Gottlieb, who was Donald Trump's FDA commissioner. And further to Liz's point, they were both all in on alternative proteins.

[00:57:12.440]
So I think socializing at what Liz says is absolutely true. It's just also the case that if you're thinking about meat with cultivated meat and I guess I will also just take a step back and say this is a fairly small thing. The term that GFI is using is cultivated. It allows us to talk about cultivating meat and doing it in cultivators.

[00:57:32.480]
And it's a familiar term that we think is also helpful. Not a big thing. As I mentioned, even the polls that talk about in vitro meat or lab grown meat, the numbers are pretty good. And when it's explored why people might not want to eat cultivated meat, their answers oftentimes are things that we can disabuse them of fairly quickly. So it's going to cost too much or it's not going to taste good enough for whatever else. But once we actually do have the product available, it is literally the exact same product.

[00:58:05.010]
In the case of cultivated meat and with plant based meat, it's made up of things that people are used to consuming. The reason that people are resistant to plant based meat is generally they you know, maybe they had a bad experience with a veggie burger or something. So, again, we can we can educate people and move them in the right direction.

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I think with both these products also, there must be two markets here. Obviously, there's the market of people who eat meat and want things to taste the way they used to taste under the the odious regime. And if you can give them that, then they'll be happy. But then there must be vegetarians and vegans who don't want their meat substitutes to be too realistic. Right. Isn't there a preference that has now grown up for millions of people that it's what you want, a veggie burger to taste great, but you actually don't want it to taste exactly like a burger?

[00:58:58.140]
Yeah, I mean, I think at least at GFI, it's it's a little bit of a laugh line, but it's also true when vegetarians or vegans say, well, I don't want to eat that, it's like we really don't care what you want to eat or don't want to eat. The value to all of the positive qualities of a shift to plant based and cultivated meat is zero. If you're eating that instead of beans and rice or whatever vegetarians and vegans are eating.

[00:59:26.090]
So we are pretty laser focused at GFI on something like 98 percent of Americans who continue to eat meat. I mean, it's a sort of funny thing that something like six percent of the public self identifies as vegetarian. But when the Vegetarian Resource Group asks people, what did you eat in the last month, a significant portion of those have eaten your chicken in the last month.

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The arithmetic doesn't work.

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I think you're absolutely right, Sam, that some people don't want the taste exactly the same. But for those people, they have a range of products that they can consume instead for the positive benefit of this shift.

[01:00:05.540]
What we're really trying to do is that Holy Grail. It needs to satisfy meat eaters. It needs to taste the same or better. And then eventually, as it scales up, it needs to cost the same or less.

[01:00:17.360]
OK, so is there anything that people can do at this point to help again, we're trying to change the minds of decision makers here, but what can people do to effectively change the timeline over which this is bound to happen at this point? Well, I will start by saying that the Good Food Institute operates as sort of a think tank and open access resource hub. So we operate across three programmatic areas, our policy department, and we are hiring in our policy department.

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But people can get involved in lobbying their members of Congress to support the work that GFI is doing and others are doing to incentivize the shift and also to fund open access research. We operate in terms of industry engagement, so we work with the really big meat and food companies. If somebody works at one of those companies, you have a huge lever to try to help make change. We also work with entrepreneurs and investors and encourage people to check out all of the resources that we have on our website at GFI Drug for Entrepreneurs and Investors.

[01:01:32.760]
We work with scientists and I'll let Liz talk a little bit about what people can do if they're they're interested in getting involved and they have scientific acumen.

[01:01:41.600]
Yeah. One of the big biggest bottlenecks we hear over and over for what's hampering the growth of the alternative protein industry is a gap around technical talent. A lot of folks from sort of adjacent technical fields, whether it's tissue engineering or biochemistry or bioprocessing design, have relevant skill sets. But this may not be on folks radar, as you know, an up and coming sort of career vocational calling. So that's that's a big area where we support with resources to help folks plug into this industry.

[01:02:16.970]
We do a lot of work on campuses. As Bruce mentioned before, we are funding grants to get new researchers and new investigators pivoting some of their research focus towards the biggest, highest impact knowledge gaps in research questions in this field.

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So almost at any career stage, there's there's sort of an inlet to figure out, you know, how that technical talent can go to serve some of these needs. And and I do just want to reiterate how utterly tractable this field is. There is a great need for research and research funding, but this is not rocket science. If you look at the improvement in the quality of products and the breadth of products that has happened in the last few years, that's really been on a complete shoestring budget.

[01:03:07.400]
So there's immense capability here. You know, as we've we've touched on a couple of times, we don't batted an eye at the hundreds of billions of dollars going into renewable energy R&D every single year. But in our tallying, the total public funding that we estimate has gone towards alternative proteins across all time, across all governments is on the order of tens of millions, not trillions or hundreds of billions. So, you know, there's just immense potential here for allocating more resources, more talent, more attention towards this field and having that manifest as a really outsized impact on the world.

[01:03:50.660]
And I will just toss out, Sam, for people who just want to put their toe in the water. GFI has a couple of different monthly seminars. We have a Business of Alternative Proteins seminar. It's a webinar and a Science of Proteins webinar. Every single month we have some newsletters which people can sign up for, which are sort of everything that's happening in alternative proteins. And we do have job openings in the United States as well as I think maybe in all of our global affiliates, certainly in most of them.

[01:04:19.280]
So folks can find all of that information. Just on our website, which is GFI dot o r g. We are also philanthropically funded. So this is extremely high impact, extremely neglected and extremely tractable. And we certainly invite anybody who would like to join our family of supporters. That's great.

[01:04:39.290]
Actually, Liz, I want to spell that out a little bit more because it seems to me that we should make it crystal clear many people go into science without any clear concept of what they're going to do and how they're going to put it to use. They're interested in it and they're just kind of meandering through their undergraduate years, following their interests. But they haven't actually connected with a a more vocational sense of how they're going to do good in the world.

[01:05:10.250]
And so I'd like to tap into this idealism a little bit more, because what we really want to engineer here is a. Kind of gold rush, you know, both purely material, I mean, we let's leverage people's greed for material success, but also a kind of moral gold rush. And we want people to feel inspired by solving a massive problem and reducing suffering and existential risk. And this topic really does sit at the crossroads of all of that.

[01:05:44.640]

If you were starting college today, what courses of study would be obviously relevant to making a contribution in this area? At risk of feeling like I'm dodging your question, it really is true that any STEM discipline has a role to play.

[01:06:02.570]
Here are these these approaches are so interdisciplinary that that's actually been one of the challenges from a technical talent training perspective is finding folks who would have, say, a stem cell or tissue engineering background, who also understand the biochemistry of flavor in food or the biomechanics of texture. Those are typically biomaterials folks or food scientists who would have that kind of expertise.

[01:06:31.540]
So what we've started to see at some universities is students who who have the opportunity to sort of create a major and pull coursework and and lab work in some cases from multiple areas to really understand those intersections, which I think is where there's the greatest potential for these sort of innovative leaps.

[01:06:55.250]
We have seen tremendous traction with our student group chapters on campuses. We have 11 chapters so far with plans to scale those. And those students have been extraordinarily influential as this this voice on campus to advocate for more coursework in this area, to go out and connect directly with faculty members, to implore them to consider applications of their research area towards addressing these challenges.

[01:07:24.830]
And I think there is, you know, among this sort of up and coming generation of scientists, a real appetite for making sure that, you know, they're not just doing research for research sake, but that it's truly tapping into something that that is a passion project for them and and the sort of sense of disillusionment with maybe a kind of older paradigms in academia of finding your Neshin, just publishing relentlessly in that sort of, you know, obscure corner of of the knowledge sphere, but rather kind of taking this this holistic approach and and saying we can we can have it.

[01:08:04.520]
All right. We can explore really fascinating kind of fundamental biochemistry and biology and and engineering questions, but do it in the context of also addressing these massive societal and global issues.

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How much of this is needing to get people to do doctorate research in the relevant areas? And how much can be more along the lines of what we've seen in computer science, where, you know, you can come out of an undergraduate computer science background and quite clearly make the relevant contributions to the software industry. And obviously the people can be self-taught in those areas. It's so modular. But is this the kind of thing that with the right undergraduate curriculum, we could help engineer a functionally unlimited supply of relevant talent?

[01:09:00.050]
I've certainly seen my fair share of incredibly impressive folks who are passionate about this field and don't have, you know, endless letters and credentials after their name. And I think, you know, I'm glad you mentioned computational science because I think that's an area that has a huge role to play in alternative proteins that hasn't been quite so recognized yet. You know, the degree to which we can automate and accelerate R&D through, you know, simulating experiments rather than having to conduct that work empirically.

[01:09:33.410]
There's massive potential there for acceleration. And certainly, as you know, startup companies in this space become more mature. They'll need talent at sort of every tier of training. You know, when you're a startup, first formulating your your R&D strategy and so forth, you're typically just hiring folks mostly

at the PhD level.

[01:09:56.060]
But once this starts to move more and more into commercial operation, you'll need technicians to kind of maintain your cell banks.

[01:10:04.550]
You'll need folks who who are keeping the system running but don't need to be those sort of highly credentialed, highly trained and skilled innovators.

[01:10:15.830]
And just further to something that that is not at.

[01:10:18.160]
At a minute ago, the GFI University focus is pretty single mindedly on STEM and some of the undergrad students that are taking very seriously alternative proteins on their campuses are making just a massive impact from sort of the bottom to the top in terms of their outreach to professors and getting even graduate level courses considered and working with professors on research centers.

[01:10:47.120]
So we need people in private industry, but we also, just like there are climate centers at universities all over the world, there should be alternative protein research centers at universities all over the world. And that does not require an advanced degree to be a champion of that concept.

[01:11:07.310]
Seems like they could be incentivized financially to I mean, if a university like Stanford created the relevant department and that department could have equity in whatever enterprises were spun out of its curriculum, it just seems like you could marry the academics and the business case there and get people moving. Absolutely.

[01:11:32.630]
And those models do exist and have been pioneered in other fields.

[01:11:36.620]
And I think that's really, you know, a beautiful sort of trifecta of players in those types of research institutes, as if you have government funding, university involvement and industry partners and they all have the appropriate incentives to be involved. It's it's value creation or job creation from the government perspective. It's training opportunities from the university perspective and really, you know, the ability to establish a center of excellence. And then, as you note, these industry partners get sort of first look at new technologies coming out of that space, as well as an opportunity to help guide those research focus areas based on what they're seeing as the true pain points in in the industry.

[01:12:26.120]
Well, it's exciting stuff.

[01:12:27.470]
So I just want to thank you both for taking the time to explain all of this to my audience and for the work you're doing. And I recommend people go to the the Good Food Institute site and get more information and support your necessary work.

[01:12:43.160]
And I will certainly do that myself. So both of you, thank you for your time. Thank you very much. Thank you.