Scott Tinker (00:00):

Next on Energy Switch, we'll look at climate impacts and how we should respond to them.

Michael Greenstone (00:05):

Part of that problem is the uncertainty. The basic economics and the basic human behavior points out, well, when there's lots of uncertainty, actually, that's a cause for action, not a cause for inaction.

Steve Koonin (00:16):

Whatever the world does about emissions, we know it will adapt to a changing climate. It's what we humans have done forever.

Scott Tinker (00:26):

Coming up on Energy Switch, how should we respond to climate change?

Speaker (00:32):

Funding for Energy Switch was provided in part by Microsoft and by the University of Texas at Austin.

Scott Tinker (00:44):

I'm Scott Tinker and I'm an energy scientist. I work in the field, lead research, speak around the world, write articles, and make films about energy. This show brings together leading experts on vital topics in energy and climate. They may have different perspectives, but my goal is to learn and illuminate and bring diverging views together towards solutions. Welcome to the Energy Switch.

Scott Tinker (01:14):

Addressing climate change is complicated. We need to understand the impacts today and predict the impacts tomorrow, then recognize the uncertainties of doing so, the timeframes required in contrasting global priorities in order to quantify the costs and benefits of reducing greenhouse gas emissions and adapting to climate change. My guests for this vital conversation are Dr. Michael Greenstone directs the Energy Policy Institute and the Becker Friedman Institute at the University of Chicago and was a Chief Economist for the Obama Administration. Dr. Steve Koonin, a physicist, is Director of NYU's Center for Urban Science and was the Department of Energy Undersecretary for Science also under Obama and Provost of Caltech.

Scott Tinker (02:02):

On this episode of Energy Switch, how should we respond to climate change? So let's dive right in, we're going to talk about the impacts of climate. Is the temperature rising? Michael, let's start with you.

Michael Greenstone (02:15):

I think there's incontrovertible evidence that the temperature's rising. You see it every day in our personal lives. You see it in the comparative historical record as well.

Steve Koonin (02:24):

So there is of course nuance to that as there is in all things in science. The temperature that's commonly talked about is the average temperature over the globe relative to what the normal is and it's risen by

about two degrees Fahrenheit over the last century, since 1900 or so. But that rise hasn't been steady. It went up pretty strongly from 1910 to 1940, then it actually went down for 30 years and then it's been going up since about 1980. So that fact that it's not a smooth rise tells you already it's a little more complicated than just greenhouse gases are warming the planet.

Scott Tinker (03:04):

Yeah, interesting, always nuance there. So that gets us into the trends over this century and how do they compare to human drivers. Carbon dioxide being one of the big human greenhouse gases, methane's another one. How do you see that?

Michael Greenstone (03:20):

Yeah, I think the evidence that greenhouse gases play a central role in increase in temperature is, I think Steve might not like this word, but it's consensus. And I think the climate community, the climate scientists, have been very clear that we don't know that perfectly, the relationship, but there's been a narrowing of the range of uncertainty, but there's no doubt that CO2 is causing increases in temperature. The latest review would suggest that it's probably, for doubling the CO2, maybe between two and five degrees and I think their most likely number is about three degrees, and that's all C.

Scott Tinker (04:02):

DDC. Yeah.

Michael Greenstone (04:02):

That's all C. But I just want to be clear, because I think Steve's very focused on the uncertainty. And I think the climate community, the climate scientists, have been very clear about that uncertainty and that's why they don't express, "Well, it's going to go up by three degrees C for sure," they give this range.

Scott Tinker (04:18):

There's not a CO2 temperature knob in the sense if I dial that in, I get that. But that's a pretty big range.

Michael Greenstone (04:25):

It's a pretty big range.

Scott Tinker (04:26):

And they're honest about it, and open.

Michael Greenstone (04:27):

Yeah, they're quite open about it.

Scott Tinker (04:28):

Not everybody's open about it, but the climate community.

Michael Greenstone (04:30):

No, yeah. Yeah.

Steve Koonin (04:33):

I think, I have two things. One is about the treatment of uncertainties. I think when you get back to the research papers and even the recent report, they're pretty explicit about the uncertainties. It's as you get further down the chain into the summary for policy makers and into the media and the political discussion that you lose that nuance. There are several factors that change the earth's temperature. Most obviously, as you mentioned, greenhouse gases, which exert a warming influence, but also aerosols that humans produce, which exert a cooling influence. The net effect of what we see is really not just CO2, but is that combination of aerosols and greenhouse gases.

Steve Koonin (05:15):

That makes it particularly tough to disentangle things, and even tougher is the fact that the climate system has long term natural variations that extend over... We know about some, El Nino, for example, is the most familiar, couple years, every five or six years. But then there are things like the Atlantic Multi Decadal Oscillation or the Pacific Decadal Oscillation that run over 70 years and the models have a hard time reproducing those. So depending on where we are in those cycles, the warming may be enhanced by those or diminished by those, and we don't really know.

Scott Tinker (05:50):

When you say a hard time reproducing, it means that the existing models struggle to fully understand and model the past-

Steve Koonin (06:00):

Yeah, yeah.

Scott Tinker (06:01):

... given the... It's a bloody hard problem.

Steve Koonin (06:03):

Yes.

Scott Tinker (06:04):

It's multivariate non-linear.

Steve Koonin (06:05):

It's a chaotic system.

Michael Greenstone (06:06):

It's a terrible problem. You haven't even mentioned the oceans and the oceans play an important role.

Michael Greenstone (06:13):

But I think one thing, and I read Steve's book in the last week, it's a terrific book. But one thing that I don't think comes completely clear in the book is, there really seems to be little uncertainty about what the impact of greenhouse gases are on changing temperature. Again, there's this range. We don't know exactly where it's going to end and there's things that don't make sense with the models or contradict

the models. Steve has pointed out several of them. I think that there's probably many PhD dissertations that are going to be written as a followup to that, but I don't think it changes the central understanding.

Steve Koonin (06:47):

I would agree, but when society thinks about how it's going to respond to these, it's got to make some judgment about what the uncertainties are. If you're 99% sure that the planet's going to go to hell and become unlivable, then that's a very different discussion then, "Well, maybe two generations from now, we might see a little more storminess," okay? So the uncertainties are important in the policy discussion.

Michael Greenstone (07:17):

I think it's really clear what you should do, is it's a cost benefit problem. You should decide how much it's going to cost to reduce, let's say, US emissions by a billion tons of CO2. That would be not insubstantial reduction, not wild, either-

Scott Tinker (07:35):

About 20% [inaudible 00:07:35].

Michael Greenstone (07:35):

... about 20%. And then what are the benefits in terms of reduced climate damages. And I understand the way you're describing it-

Steve Koonin (07:42):

Even if the rest of the world doesn't do or does very little, even if emissions still keep going up?

Michael Greenstone (07:47):

Whatever the rest of the world does, doesn't have any impact on what our, like if we reduce by a billion tons, we reduce by a billion tons. That's terrific. And then we get, we and the rest of the world, gets benefits from it for the world.

Steve Koonin (07:59):

So even if we were to just do a little bit, you would say that would be worth it?

Michael Greenstone (08:02):

What I'm saying is, we would want to compare the cost and the benefits of that. And just jumping to the conclusion here, small reductions in emissions are even meaningful reductions in emissions in the United States, if done in an economically efficient way have benefits that vastly exceed the cost.

Scott Tinker (08:24):

Are there some things we can agree that are changing in the timeframes of industrial activity that matter to us?

Steve Koonin (08:33):

Yes. You know, if I just take the two from the latest IPCC report. So temperatures are going up, heat waves are becoming more common, although not in the US, but globally. We see more heavy precipitation events even if the average precipitation is not changing much. But when it rains, it rains more. Okay? But in terms of hurricanes, thunderstorms, severe winds, mid latitude storms, there are no trends detected.

Scott Tinker (09:06):

In counts. Numbers of these.

Steve Koonin (09:08):

In various metrics. The one that's been in the news for the last couple years are wildfires and wildfires are a very complicated phenomenon, at least in the Western US and in Australia. They involve how much forest is there. They involve are there people living there or not, both because of damages, but also people start these fires as well. And certainly a drying climate, the drought index for the West has gone down over the last 30 years. Now to what extent that's human influence or not, I think is still a bit debatable, but it's clear that a changing climate, for whatever reason, is playing a role in that phenomenon.

Scott Tinker (09:51):

Sure. Okay. So fires being a big one. Yep.

Michael Greenstone (09:54):

Yeah. So one thing is, we're at the dawn of a super interesting era in economics where up until about a decade ago, what we knew about economic damages from climate change, people didn't have computers that were up to the task. And so now we can really begin to use data and a variety of exciting things are emerging from that. I think one that sits in my mind in a center place is the impacts of temperature on mortality are much more severe than personally I had realized, and I think, then the literature had realized before.

Scott Tinker (10:34):

Is that geographic, Michael, or-

Michael Greenstone (10:36):

Yeah. So let me try and unpack that. What is part of the reason that we didn't know that before? Part of the reason is that the only places that we had had data before were rich temperate climates, so Northern Europe and parts of the United States. And so, yeah, when temperature goes up a little bit, well, that's good because you get rid of some of the cold days that are dangerous and you're not really to the part of the temperature distribution that are causing impacts.

Michael Greenstone (11:01):

Now that we have data that covers most of the globe, a much richer and more nuanced picture is emerging. A paper that I wrote finds that by the end of the century, there would be about 74 additional deaths per a hundred thousand people. That sounds super wonky. If you want to put it in English, it's about as much mortality as we have from infectious diseases, pre COVID on the planet. And to your

question though, it is not equally distributed around the world. In places like Pakistan and Bangladesh and Ghana, it's expected it'll be like 200 per hundred thousand. So like-

Scott Tinker (11:38):

Equatorial.

Michael Greenstone (11:38):

Yeah, places that are already hot and poor are in the bullseye.

Scott Tinker (11:42):

Let's come to the social cost of carbon. This is something you've helped lead and even think through in the Obama Administration. What all goes into that?

Michael Greenstone (11:52):

Yeah. I like to refer to it as the most important number you've never heard of. And it's kind of audacious in its hopes and dreams. What it aims to do is to provide a monetary measure of the reduction in damages from mitigating or preventing one additional ton of CO2 from going in the air. And it should, in principle, encompass whatever the health effects are, whatever the crop yield effects are, whatever the labor supply effects are, whatever impacts there are on migration, on sea level rise, everything. Okay, so in that way, it's almost has-

Scott Tinker (12:30):

It should.

Michael Greenstone (12:31):

Yeah, it should, it almost has.

Scott Tinker (12:31):

It's hard.

Michael Greenstone (12:32):

It's very hard. There's lots of uncertainty around it and getting all of that exactly right is very challenging. But that led to a value of $51 per ton. The Biden Administration has adopted that on an interim basis while reviewing the changes in scientific understanding that have taken place in the last 10 years or so. My sense, my read of the literature, is it would be very difficult to come up with a number lower than $125. I think our understanding about the impacts of climate change have improved and they are pointing to bigger negative impacts than we had previously understood. And again, it is so useful that I refer to social cost carbon as the most important number you ever heard of because it provides this bright line of anything that we spend per ton that is less than that number, it's a good deal. The benefits are going to exceed the cost.

Steve Koonin (13:30):

When you say the impacts, presumably you mean net impacts because there are positive impacts from a rising CO2 and a rising temperature.

Michael Greenstone (13:41):

Absolutely.

Steve Koonin (13:42):

Agricultural yields are greatly enhanced by an extended growing season, but also by the fertilization of CO2. So you've got to take that into account. I don't know if people do that when they calculate [inaudible 00:13:55]-

Michael Greenstone (13:54):

It's all, the benefits-

Steve Koonin (13:56):

... so one number.

Michael Greenstone (13:57):

... and costs are there. And so, let me come back to mortality where the largest net costs are. There are enormous benefits from getting rid of very cold days and those are counted in there. And so, if you're in Oslo, or your favorite northern Canadian city, climate change is really going to be beneficial in terms of human health because it's going to get rid of these very deadly days. It's just that when you add it up across the globe, and even within the United States, the damages of the hot days outweigh the benefits.

Scott Tinker (14:28):

So you agree, curb CO2, Steve?

Steve Koonin (14:31):

All the things being equal, I would say yes. But in the end it's, again, a values discussion. You face a lot of problems in trying to cut down hard, hard enough to make a difference. One is that we have the developing world who need energy in order to improve their lot. We have the fact that fossil fuels are the most convenient and reliable way to do that. We also have, for the existing energy systems as we have in the US, what I'd like to say is that the recalcitrants of changing energy systems. The energy assets live a long time. They have to be operated reliably, which takes decades of experience improving the technologies and operating procedures. The assets have to be paid off over time and they all have to work together. The fuel for vehicles has to work with the vehicles and the fueling infrastructure, and so on. So the energy system historically doesn't like to change rapidly. The current discussion in the US is really too fast to be optimal.

Scott Tinker (15:36):

And I think a lot of big industries that are going to have to do this would agree. And so we get down the road, what are the levers we can throw? What are some of the big things that will have an impact in the timeframes, at the scales that we can deploy globally?

Michael Greenstone (15:53):

In some respects, I think it's actually, to think of it the climate challenge is you got the microscope a little too close to the piece of paper. I actually think the right thing is the global energy challenge. I think of it

as a stool that has three legs. The first leg is how do we get access to inexpensive and reliable sources of energy. Every society wants that. It unlocks, it increases living standards that we take for granted here. The second is, can it be done without causing air pollution that causes people to lead shorter and sicker lives, and that's from regular air pollution. And then the third is, how do we avoid disruptive climate change while also satisfying these first two goals? And the painful part of the energy challenge is that you can name policies or actions that improve one or two of those goals, but it's almost impossible to name one that hits all three at once. And so that's why there's trade offs.

Steve Koonin (16:53):

So let's talk about the decarbonization strategy a little bit. The strategy is to basically electrify everything. And so we're going to electrify transport, we're going to electrify residential heating and we are then going to, or perhaps coincidentally, decarbonize the electrical system. So everything becomes electricity except maybe for airplanes, which we can do with biofuels, or heavy ships. But the real question is, can you create a grid that is simultaneously affordable, reliable, and clean. And as we've been discussing, that's really hard. The technical levers for doing that, I believe are, first of all, fission. Right now, it's the only reliable emissions free source of electricity that we have.

Scott Tinker (17:44):

And it's scalable.

Steve Koonin (17:45):

And it's scalable. We have already scaled it. The problem is with nuclear right now is that we've been building them big and each one is different in the US. If we build them small and standardize small modular reactors, when I was in the government, I was promoting that. I think there's a lot of potential for that.

Scott Tinker (18:06):

How about, talked about carbon capture a little bit. I think we agree that's a piece of this puzzle.

Michael Greenstone (18:13):

I think we should be throwing everything we can at trying to understand how it works.

Steve Koonin (18:18):

Yeah. We should certainly try to bring the cost down. Right now the costs for direct capture are $500 a ton and people are trying to get to a hundred optimistically.

Scott Tinker (18:28):

Which would get us [inaudible 00:18:29] planes.

Steve Koonin (18:29):

It starts to get-

Michael Greenstone (18:30):

If you guys carbon capture at a hundred dollars a ton, you're scaled. But the scale thing is an enormous problem.

Scott Tinker (18:36):

It's a big deal. How about, we haven't talked about, what about energy efficiency? What about doing more with less? How do we get that translated into our worlds?

Michael Greenstone (18:48):

I have run some real experiments, randomized control trials, in the residential sector in the United States, where some households were given energy efficiency investments, others weren't. And the surprising finding was that the rate, the realized rate of return, was much lower than what was promised and that a lot of these weren't very good investments. It does fit this idea that economists love to believe which is there's not free money laying around.

Steve Koonin (19:17):

Well, actually, Mr. Jevons realized in the 19th century that improvements in efficiency don't necessarily translate into reduced energy use because if it's more efficient, you'll use more of it. And also if you save some money through energy costs, you're going to go spend the money on something else that uses energy, like take an airplane trip or something like that.

Scott Tinker (19:39):

So kind of a rebound built into all that.

Steve Koonin (19:41):

So you got to be careful.

Scott Tinker (19:44):

These are all these different responses and we've talked about the cost and benefits, and the challenges. One of the concerns I hear consistently is, how do I know that that kind of investment's going to have a payout? What do we say?

Michael Greenstone (19:56):

Oh, I think the best answer is, we can run experiments. In India, I've been running an experiment with the Gujarat, state of Gujarat's, pollution control board, where industries were randomly assigned to face cap and trade market for regulation versus the standard command and control. The results are very striking. The cap and trade approach is much more effective.

Scott Tinker (20:22):

Really. That's interesting.

Michael Greenstone (20:24):

And so I think, yeah, we're facing an era, we're going to have to make big changes. And I don't think we should have the hubris to think that every idea we have is going to work, and we can run tests.

Scott Tinker (20:36):

Have the courage and give them-

Michael Greenstone (20:38):

The humility.

Scott Tinker (20:39):

... the leaders to be able to say, "That didn't work. Let's try something else." Right now they're held to some standard that-

Michael Greenstone (20:47):

The gotcha. Steve probably can tell terrible war stories about Solyndra which was... That program was designed to have firms fail.

Steve Koonin (20:57):

Right. That's what I said on TV and I got bashed for it.

Scott Tinker (21:00):

Let's talk a little bit about adaptation because we've agreed this is going to take some time and so, what do we do? What are some of the better adaptation strategies, and again, cost benefits to those?

Steve Koonin (21:13):

Let me first speak generally about adaptation. Whatever the world does about emissions, we know it will adapt to a changing climate and there are several reasons why I believe that that will be the dominant response over the next 30 or 40 years. It's autonomous. It's what we humans have done forever. It's politically saleable. It does not involve having to convince most of the world, or even a given country, to reduce its emissions because of something that's going to happen two generations from now and half a world away. And it's effective. I mean, people adapt their societies. We move from all the way up in Hudson Bay, all the way down to Ecuador, and those are quite viable societies. They have different characteristics, of course. So I think that's what, again, without trying to be normative about what society should do, I think that's what society will do.

Scott Tinker (22:15):

How do you see it, Michael?

Michael Greenstone (22:16):

Oh yeah. Adaptation is not free, it's costly. Anyone who's been to Houston in the middle of the summer or Montreal in the middle of the winter knows there are very expensive investments made to make those places habitable. And those are resources that you could spend on your kids, a whole variety of things. And so I think what government can do is balance what people are going to do to protect themselves with reducing CO2 emissions and try and search for the optimal combination of adaptation in mitigation.

Scott Tinker (22:49):

Some of both are good. It gives you a little bit more flexibility, optionality.

Steve Koonin (22:55):

You know, there are simple things, like don't build or keep rebuilding in places that are prone to flooding, even though the land might be wonderfully arable.

Michael Greenstone (23:05):

Yeah. And actually, I believe the Biden Administration just made this major change in how flood insurance is priced, which I think was really, probably has not received enough attention. It used to be, under the National Flood Insurance Program, that coastal communities, which tend to be richer communities, were being subsidized by inland people and they were paying below market flood insurance. And I think that is now going away. To Steve's point, it'll begin to reshape the country. You will not see vulnerable developments built there because it'll just be too expensive. There's going to be a temptation to blunt the message that markets are trying to send, that's the subsidized coastal people or people who are at risk from wildfires, to subsidize them so their current lifestyles can continue. It's a very appealing and strong force, but ultimately, it limits the adaptation that's going to have to take place in the end.

Scott Tinker (24:07):

Anything that either of you would like to add that we haven't covered?

Steve Koonin (24:11):

This is a knotty problem. It involves humans, technology, the environment, and we need to really think it through and do it well. If we don't do it well, we will create more damage than we might get from the climate.

Michael Greenstone (24:29):

I would just say part of that problem is the uncertainty, and there's uncertainty throughout it, and I think for too long that uncertainty has been a cause for inaction. And I think the basic economics and the basic human behavior points out when there's lots of uncertainty, actually that's a cause for action, not a cause for inaction.

Scott Tinker (24:51):

Uncertain doesn't mean unsolvable and unaddressable. I think addressing the uncertainty is so important. I worry, myself, that we take these binary kind of soundbites and people take positions. And to me, if we could really bring these things together, like we've just done, and address these in investment ways, I think we'll be able to get a lot closer to solutions that are better for everyone.

Scott Tinker (25:18):

Climate modeling is not precise, but shows that human activity is increasing global temperatures with varying impacts. IPCC reports suggest heat waves and heavy rain events are increasing, but they're less conclusive on storms and wildfires. Calculating the societal cost of carbon emissions is also very difficult, but offers a way to evaluate the price of different CO_2 reduction strategies against the value of their expected benefits. Ideally, we could find solutions that provide affordable energy while reducing

environmental impacts. In the end, we'll need to compare the cost of mitigation against adaptation and their likely benefits. How much we choose to spend will be influenced by other global priorities.

Scott Tinker (26:36):

Funding for Energy Switch was provided in part by Microsoft and by the University of Texas at Austin.