RATIONAL MIDDLE.

NET ZERO

FUELING OUR FUTURE

EPISODE TRANSCRIPT

Scott Lewis:

I think it's critical to reframe the way we look at energy sources these days. We can all agree that from a climate change perspective, we no longer want to consume carbon and put it up into the atmosphere the way that was acceptable over the last 100 years.

Alan Krupnick:

Of course, we have the renewables, wind and solar. Those prices have been coming down rapidly. It's a tremendous achievement, but it's not enough.

Scott Lewis:

We have to find and invest in new ways to fuel ourselves. So we're still going to want to fly places. We're still going to want to drive places, and we still have to get our goods from A to B. We have to solve that problem for heavy duty commercial manufacturing. That's what we haven't done yet.

Aura Cuellar:

In 2020, the United States used 93 quadrillion BTUs of energy. That is 93 with 15 zeros.

Pat Sapinsley:

If you look at all of the uses and all of the fuels and try to map out how we could replace the dirty fuels, there are pathways. Most of those pathways go through clean electrical generation. Electrifying everything is a terrific idea, but it will not help us when it comes to heavy duty transportation and industry.

Alan Krupnick:

Almost all of our transportation fleet is based on fossil fuels for trucks, buses, ships, jet fuel. That's all derived from oil.

Dr. Ramanan Krishnamoorti:

Where else do I get my emissions from? They come from industry. Things like where I make chemicals, where I make paints, where I make silicon chips, cement, where I make steel. We

don't have technologies right now today available that are at high enough technology readiness level that can electrify everything.

Alan Krupnick:

So what can pick up the slack? One way we can do it is to use sources of energy like biofuels.

Aura Cuellar:

Biofuels are renewable, liquid or gases, fuels made out of a broad range of sources. It could be a sugar cane or it can be biomass from forestry or agricultural waste where you can apply different technologies in order to make fuel that can be utilized across the different sectors.

Scott Lewis:

There's no change that is required. It's a drop in fuel. You wouldn't know when you go to a station, whether you're filling up with petroleum, diesel or renewable diesel. It makes it really easy. When you can change behavior by using sustainable, clean, burning fuels that reduce emissions by 70-85%. It's a huge win because the public doesn't have to make that choice.

Aura Cuellar:

At the same time, there are some dilemmas with biofuels such as those that come from utilizing sources that are also used for foods such as sugar cane or corn.

Scott Lewis:

And so we are working to develop where the next feed stocks are going to come from. This allows us to also develop things like lipids from algae as well as cover crops, regenerative crops. So this allows you to get an extra growing season in with non-food grade products that have a high lipid content so you can convert that into a sustainable aviation fuel and renewable diesel. I think we're going to steer away eventually from the traditional pools that we've got, and it's going to go into things like oil that is going to be made from municipal solid waste, woody biomass, things like that, that are effectively inexhaustible.

Dr. Bryan Willson:

We can also produce things like renewable natural gas.

Aura Cuellar:

Renewable natural gas is a low carbon fuel made out of organic sources that can come from landfills, food sources or cow manure.

Dr. Bryan Willson:

Basically any organic compound, anything that's been alive at one time, can ultimately be digested into methane in an anaerobic process. It's what happens in the gut of cows. It's what happens in landfills, what happens at waste treatment plants.

Aura Cuellar:

What is great about renewable natural gas is that it is a drop in fuel. It is completely exchangeable with natural gas.

Dr. Bryan Willson:

There's now a lot of effort to try to understand if we can scale that up and if we can produce renewable natural gas, renewable methane, then we can use the infrastructure that we already have to distribute that energy for some of those hard to replace large industrial sources.

Aura Cuellar:

What is also great is that you are using ways which would have emissions and you are turning it into a product that can reduce CO2 emissions depending on how the gas is produced.

Alan Krupnick:

But the perennial ride at the church waiting for her fiancé to show up is hydrogen. Although there's been promise for hydrogen for 30 or 40 years now, it's time may have finally arrived. And hydrogen when it's burned has no CO2 emissions. Some companies are thinking about hydrogen fuel cells being a key part of the future for decarbonizing the transportation fleet.

Dr. Bryan Willson:

It remains to be seen if 18 wheelers will go down the pathway of batteries or something like hydrogen. When you get to aircraft, our candidates there could be liquid hydrogen, but we can also create what we call e-fuels. We can basically take hydrogen, I can take CO2, and we can combine those and stitch those together to make long chain liquid fuels that have the density that we like for aircraft.

Alan Krupnick:

So the other approach is that hydrogen could be utilized as a storage medium for electricity. So you can make the hydrogen when you have all this excess wind and solar and then store it for those times when the wind isn't blowing and the sun is not out. The hydrogen is thought to be better for longer term storage, let's say a few days to a week, where the batteries are thought to be better for those kind of hour here, hour there needs.

Aura Cuellar:

Hydrogen is actually a colorless molecule. However, current industry we use different colors to describe how it is produced. Gray hydrogen is produced from fossil fuels, mainly natural gas. Blue hydrogen is also produced from natural gas, but combined with carbon capture, it reduces significantly the emissions. Green hydrogen is produced from renewable energy sources.

Dr. Bryan Willson:

Over 95% of our hydrogen is produced by the steam reforming of natural gas. That's because it's much cheaper than producing from renewables, although that's changing. The Department of Energy has established a hydrogen moonshot goal of getting to a cost of $1 per kilogram of hydrogen in one decade.

Alan Krupnick:

And so that would be a big win right there. And from that, you could imagine a huge market developing in hydrogen. It takes a while for a new fuel to break in and to have companies comfortable with it to utilize it, and at a price that makes it economic. This doesn't happen overnight.

Dr. Ramanan Krishnamoorti:

Transform that paradigm isn't like switching from incandescent bulbs to LED bulbs. It isn't that simple. It's going to be a lot more expensive in order for us to be able to make that transformation.

Scott Lewis:

There is a cost premium. You need to spend your way through it so that you can develop efficiencies, get to scale and make it part of the mainstream but there's a long cycle to that. In the same way that when computers came out in the early eighties, a personal computer would be $8000 or $10,000 and it was absurd. Except look at it now and because of the early adopters, we're able to embrace and engage that, the companies evolved and became much more economical.

Dr. Bryan Willson:

In order to zero out our carbon emissions, we need a lot of solutions and they have to be developed urgently. That means working at the university level on fundamental research, working in industry to get solutions to scale, but working in the middle, in the translational work of turning science to solutions to scale. That really requires a poll either from the markets or by policy.

Scott Lewis:

So we need to find a way, and he's a big proponent of getting the net zero as an unequivocal requirement of society and as quickly as possible. So the date that is put out there is 2050, and we just can't afford to wait. The technologies are out there, they're constantly searching for more investment, and they do take time. So that's one of the reasons why we need to start today. We can't wait another 20 years.

Dr. Bryan Willson:

And that sort of means that we're going to need to be in this place of building the plane while we're flying it for a little bit.

Aura Cuellar:

With the combination of deployment of so many new technologies, continue working in partnerships across all different sectors between the industry, the government, academia, without a doubt, we can get there.