Scott Tinker (00:00):

Next on Energy Switch, we'll look at the domestic benefits, environmental challenges, and global picture for natural gas.

Naomi Boness (00:08):

I see gas as a very economical way to enable the deployment of more renewables and keep energy prices affordable.

Scott Tinker (00:17):

I do too.

Rachel Fakhry (00:18):

I think cleaning up the power sector in a manner that maintains resiliency, reliability, and affordability. We have to be very clear around how, if we were to move away from it, how and in which sector. Some sectors may not be able to do so.

Scott Tinker (00:31):

Coming up on Energy Switch, what is the future of natural gas?

Speaker (00:37):

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

Scott Tinker (00:48):

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 (01:19):

Over the last 20 years, hydraulic fracturing, or fracking, has expanded the natural gas supply and industry in the US, and made gas plentiful and affordable. That's allowed gas to substitute for coal and power generation, reducing carbon emissions while driving domestic industry.

Scott Tinker (01:37):

But natural gas is mostly methane, a potent greenhouse gas and has other environmental impacts. Here to talk about the pros and cons are: Dr. Naomi Boness is the managing director of the Natural Gas Institute at Stanford University. She's originally from the UK. With her is Rachel Fakhry. She's a policy analyst at the National Resources Defense Council, who is trained as an engineer also at Stanford and in her homeland of Lebanon.

Scott Tinker (02:07):

On this episode of Energy Switch, what's the future of natural gas? Let's get started.

Scott Tinker (02:13):

I'm Scott tinker. Welcome to the Energy Switch. Natural gas, domestic benefits. Talk about US here to begin with. What are some of the impacts?

Naomi Boness (02:21):

In 2020, the oil and gas industry was responsible for 12.3 million jobs in America. It also contributed something like 1.6 trillion dollars between 2012 and 2025 to the federal-

Scott Tinker (02:34):

How much?

Naomi Boness (02:35):

1.6 trillion dollars to the federal tax revenue. And obviously that's money that's used to support schools and hospitals and infrastructure. And it's obviously contributing a lot of money to the manufacturing industry. Billions of dollars from low cost fuels that enable manufacturing to happen at home, which in itself spurs economic growth, lots of benefits.

Scott Tinker (02:58):

You align with all that?

Rachel Fakhry (02:59):

It is undeniable. It has been a big economic engine, especially for the regions that are gas producing, including the Marcellus, Pennsylvania, Ohio, but also Texas, New Mexico area of course. Now the good news is if we were to move away from gas to meet climate goals, clean energy does offer also a lot of employment opportunities. In fact, I think it is estimated that for every million dollars of spending, clean technologies like electric vehicles and efficiency and solar panels, can create three times as much jobs as fossil fuels. However, it is critical that if we move away from gas to meet climate goals, we take care of our workers, of our communities who will be off gas. And it's not going to be easy.

Scott Tinker (03:44):

So how does gas power generation actually function in this system?

Naomi Boness (03:47):

Renewable energy, because the sun doesn't shine all the time and the wind doesn't blow all the time, requires energy storage. And in particular, there's two types of storage. One is short duration. So the daily cycle. And that we have pretty much got under control. But the longer seasonal storage, so associated with the change in the output of solar and wind from summer to winter, is a much more challenging issue.

Naomi Boness (04:15):

In the country right now, we have something like 22 gigawatts of hydro pumped storage and about one gigawatt of battery storage. And if we were to move to a scenario where we had something like 80% renewables, that requires 120 gigawatts of storage in order to ensure that we have electricity supply all of the time. And that's like 9 billion Tesla power walls, right? That's a lot of storage. So right now, studies out of MIT, for example, have shown that we have to reduce the cost of battery storage by about 90% in order to make it economically viable.

Naomi Boness (04:58):

Gas is an alternative that we've been using for a very long time to meet the storage demand. Natural gas combine cycle power plants are very efficient. You can ramp them up and down very easily. They have low fixed costs relative to nuclear. It's about half the price. And it offers this resilience, not just to seasonal changes, but also to the increasing amount of climate events that we're seeing.

Naomi Boness (05:25):

So I see gas as a very economical way to enable the deployment of more renewables and keep energy prices affordable. We're already in a place where with more renewables in places like California, where we have a lot of renewables, we pay twice the national average for our electricity.

Scott Tinker (05:49):

Yeah. Yeah. How do you see it?

Rachel Fakhry (05:50):

I think cleaning up the power sector in a manner that maintains resiliency, reliability, and affordability should be top of mind. Absolutely.

Rachel Fakhry (05:59):

However, I do want to caution against this sort of notion that natural gas is needed to integrate renewables because I think it could be understood in different ways. This is long lived infrastructure. So if we keep building pipelines, turbines today, we're stuck with the gas for a long time. Agreed that renewables need some form of flexibility and currently batteries can do a lot. However, the seasonal piece is still tricky. How can restore electricity for seasons at a time? Batteries can't do that or they can't do it affordably.

Rachel Fakhry (06:29):

So this is where I agree gas offers an interesting proposition. However, we also have to be cognizant that there is some interesting developments in this space on hydrogen, where you can produce hydrogen when you have excess renewables in the summer or in the shorter seasons and then store it for seasons and months at a time, and then burn the hydrogen turbines to produce power when you need it. So we should not close our minds to what is happening in the R&D space, but we're not there yet. We're not even close to being there yet.

Scott Tinker (06:58):

So gas and coal, why is it that at least in the US, we've seen such a strong substitution for coal?

Naomi Boness (07:07):

Well, I think in the early 2000s, we discovered this resource that we really didn't know existed up until that point. And that was the shale gas. And it created an energy revolution, particularly in the United States where we were able to, with new technologies like hydraulic fracturing and horizontal wells, exploit this resource. And the prices, the price of gas, dropped so much because of the increased volumes that it made it competitive with coal.

Naomi Boness (07:40):

So up until that point, coal had been something like 50% of the power gen, if not more in places. The industry was able very rapidly actually to switch from coal to gas, to repurpose existing facilities, and put in new facilities because the low gas prices combined with, at that time, new pollution standards from the EPA, made it cost competitive. With that came associated emissions reduction. 50% or more gas burns a lot cleaner than coal.

Scott Tinker (08:17):

How do you see that, Rachel?

Rachel Fakhry (08:19):

I think that's absolutely right. Cheap gas is the main reason why it replaced coal so extensively in the past 10 years or so. Of course there are other reasons as well. One of them being the regulations that the Obama administration put on coal plants. Secondary effect. But also the energy efficiency investments that we saw that really rendered the demand was more stagnant, which also hurt coal, and the rise of renewables. At the time, it was still renewables were still expensive. So it wasn't the main driver for sure. But it is helping now in also accelerating the move away from coal.

Scott Tinker (08:52):

And state policy too, for [inaudible 00:08:54]

Rachel Fakhry (08:54):

Absolutely. The RPS, absolutely. Undeniably gas has an advantage on coal. When you combust it, it's much cleaner. It makes about half the amount of carbon. However, when we take into account methane, the math becomes trickier. The methane leaks across the gas system have big bearing on the climate benefit, or lack thereof, of gas. In fact, the International Energy Agency put out this really fascinating graph that shows that at high methane leak rates for gas and assuming or accounting for the dramatic warming effect of methane in the short term, that gas can become worse than coal.

Scott Tinker (09:32):

For a purely climate impact.

Rachel Fakhry (09:33):

Right? This is chilling and also should give us pause around how we think about gas as this silver bullet to coal because it's cleaner. Whereas in many ways, it's either is not that much better or is equally bad. So we have to be careful about that.

Scott Tinker (09:50):

Or it could be better if we tighten down the-

Rachel Fakhry (09:52):

Could be better, of course. But it could be not better.

Scott Tinker (09:55):

What are the industrial benefits of the gas supply, US again, domestic? What are some of the industrial benefits that supply has had, other than power?

Naomi Boness (10:02):

Well, natural gas is used for a variety of different reasons within the industrial sector. So for process heating, for combined heat and power, and then as a feed stock. So it's the feed stock to many chemicals, to fertilizers, to hydrogen. And about a quarter of the total gas usage is in the industrial sector. And about 75% of the projected growth is going to come from the industrial sector. So really what low gas prices have done here is bring manufacturing of these chemicals, bulk chemicals in particular, back domestically. It's generated hundreds of thousands of jobs. And in turn, that spurs economic growth and low cost of goods to consumers.

Rachel Fakhry (10:54):

I think Naomi laid it out pretty well. It is undeniable that gas has been a good support for the industrial sector in the US. And again, we have to be very, very clear-eyed around, if you were to move away from it, how and in which sectors. Some sectors may not be able to do.

Scott Tinker (11:10):

So we've talked about the benefits. Let's take a look at the environmental impacts of natural gas. How do you see some of the big impacts of fracking?

Naomi Boness (11:18):

There have been concerns around things like water pollution, but over 27 peer reviewed publications have shown that it really isn't a source of major water pollution. There have been earthquakes associated with operations, but it's actually not in the most part due to hydraulic fracturing. It's actually the injection of waste water.

Scott Tinker (11:42):

We've seen a few cases of earthquakes from the fracking itself in Texas with our network now. I mean, yep. You could feel it at the surface.

Naomi Boness (11:50):

And we need to be mindful of the amount of fluid that we're injecting into the subsurface such that we don't cause these larger earthquakes.

Scott Tinker (11:58):

Okay. So water and earthquakes, you talk about. What else? What are some other concerns?

Rachel Fakhry (12:03):

I would add air pollution is a big concern. Two of the main air pollutants that fracking emits include particulate matter, which is very health damaging, but also-

Scott Tinker (12:11):

And from what? The particulates-

Rachel Fakhry (12:13):

My understanding is that the dust from the drilling is-

Scott Tinker (12:15):

Oh, I gotcha. The operations themselves.

Rachel Fakhry (12:18):

Absolutely. And then the methane leaks from these operations, which is a precursor to smog. Smog is itself a strong air pollutant. And it's understandable that communities who live around fracking operations may want to oppose them. To have also a lot of pollution coming from all the diesel trucks and the activity of course can be addressed with hopefully cleaner resources at some point. But I think we need to be cognizant around the air pollution impacts and potential earthquake impacts that we still don't know how to mitigate well, before we, again, proceed with large scale continuation and new wells to frack.

Scott Tinker (12:54):

Methane, we've talked about, it can leak. Is this a problem?

Naomi Boness (12:57):

So we've got half a million gas wells, another million oil wells that leak a little bit of methane too. And then we've got 2.6 million miles of pipelines with connection points and valves. Methane leaks from the system from these connection points, unintended. The industry, I think, is very motivated to mitigate those methane emissions. There's a lot of big research programs right now looking at different types of detection technologies. How do we quantify these methane emissions? How do we accurately detect them, and then put operations in place to mitigate them? But it's a complex business.

Rachel Fakhry (13:41):

I completely agree with everything Naomi said. This is an important issue. Frame of reference is, there is scientific instances that reducing methane in this decade is the single most effective tool to slow down the rate of global warming. So this already, I think, needs to hover over any methane conversation around how important of a lever this is in us actually being able to address the climate crisis. The IEA, the International Energy Agency found that to achieve the net zero greenhouse gas goal globally, methane from fossil fuels have to be reduced by 75% in next 10 years, by 2030.

Scott Tinker (14:15):

The leaking? Methane leakage?

Rachel Fakhry (14:16):

Yes. So 70% from total operations. Some of it will come from just reducing the use of fossil fuels generally, so organically. But the other part, the largest part, will come from targeted applications or targeted measurements, and monitoring and addressing methane leaks on the system. And gladly, we are seeing this become more part of the conversation. Of course, you have the US and the EU, who have made this pledge to reduce emissions in this decade by third. Incoming regulations are certainly going to be important.

Rachel Fakhry (14:46):

Just want to talk a little bit about the measurement piece of it. And I think Naomi laid it out well, it's a very complex system. It's very vast. And the scale is pretty challenging. The methane inventories that we have are not based on direct measurements of methane, largely. They're based on calculations where you know what equipment you have on the system. You know roughly the emissions rate of each equipment. You make calculations and you get to that level. And these inventories have been shown to significantly underestimate the amount of methane that is actually in the atmosphere and being emitted.

Rachel Fakhry (15:22):

And one of the main reasons why these methodologies are so crude in a way is because, one, it is difficult to measure methane leakage. You have a very vast system. They can come from anywhere. There's high variation between processes, equipment, regions. And there's something called super emitter, which are the small sources that will emit inordinate amount of methane, such that if you sample overlooks one of these super emitters, your whole inventory is skewed.

Naomi Boness (15:49):

I'd like to add on to this. As Rachel said, Stanford uncovered the idea of these super emitters. And this is actually really great news. So 50% of the methane leaks are coming from just a few sources. That's great because if we now use technology like airplanes, and satellites potentially, we can see those leaks very clearly and they're easy to fix.

Rachel Fakhry (16:16):

I do want to add one perspective for this debate, which is what keeps me up at night when it comes to methane. Yes, we know that we can do better. We know we can reduce it significantly at little to no cost. However, my question mark is how far can we go? What is the extent to which we can reduce methane? We know we can reduce it significantly, but will we ever get to a place where it's near zero? We don't know.

Rachel Fakhry (16:46):

So this has direct bearing on what I think is the risk profile of, again, investing more and more and more in gas, is we don't know if we're going to get to a place where methane is near zero. I think a lot of the arguments around the large scale future role of gas are premised on this hope that gas will be something it's currently not. And that to me is inherently very risky.

Scott Tinker (17:11):

Interesting. Let's look at the global picture of natural gas now a little bit. And does the rest of the world have some shale gas?

Naomi Boness (17:17):

Well, China has the largest shale gas resource. And they have really struggled to commercialize it. Complex geology terrain. In the United States, our shale gas is all on the flat, makes it much easier for putting in well pads and roads. And China has not had that luxury. The UK had some success with shale gas, but shut down operations primarily due to anti-fracking campaigns. And then Europe. The majority

of European shale gas reserves are in densely populated areas, and places like France have put a complete ban on shale gas.

Scott Tinker (18:02):

So what role is gas playing, particularly in Russian and European relations?

Rachel Fakhry (18:06):

Geopolitically, it's a very powerful tool. Gas between Russia and the European Union, which is playing out now with the energy crisis that Europe's going through. Of course, and Russia trying to weaponize the gas shortages to get some additional pipelines from its country to Europe to solidify the dependence. My understanding is it's not shale. It's more conventional production.

Scott Tinker (18:29):

It is. Yeah.

Rachel Fakhry (18:30):

So shale is not at play there, but it is certainly currently a very powerful geopolitical tool for Russia.

Scott Tinker (18:36):

And start thinking about that and moving it in pipelines on land or on boats, Asia's importing a lot of LNG. They need a lot of power. What's the LNG trade look like globally, especially in Asia? How do you see that?

Naomi Boness (18:51):

So right now, of the 360 million tons that's being exported globally, Asia accounts for about 75% of that.

Scott Tinker (19:01):

Importing it?

Naomi Boness (19:02):

Importing it, right.

Scott Tinker (19:03):

Okay. Where India goes matters to the climate.

Rachel Fakhry (19:06):

Yeah.

Scott Tinker (19:08):

How do you see gas in India?

Naomi Boness (19:10):

Part of their national strategy is to continue to increase the amount of gas that they are using in the country and putting in infrastructure associated with that. And most of that gas is being imported from the Middle East.

Rachel Fakhry (19:24):

They don't seem to have a lot of interest in exploring their own resource for, I think, several reasons. Imports will likely make up 70% of their gas use in the next 10 years or so. I think this also falls under this idea of system wide. Of what is the most optimal mix of resources for India to grow its economy?

Rachel Fakhry (19:46):

Is it immediately engaging or investing in gas importing terminals that will make it dependent on foreign gas for the foreseeable future? Or is it a more holistic approach to it, whereby it keeps investing into its solar resource? This needs to be the priority of the country with a broader evaluation of how and where gas could play a role.

Rachel Fakhry (20:11):

Cooking, excellent example. Cooking is a big issue in India. But it needs to be part of a broader framework, which it currently is not. Currently, we are seeing this rush to build a lot of LNG terminals without a prerequisite of this system wide view of how to meet, optimally, the demand of this population, in the most affordable manner that also is commensurate with the climate crisis. So we have to be very careful around how we expand gas resources.

Naomi Boness (20:37):

I think India has done a remarkable job putting in renewable resources. They're on track for 44% of their energy mix to be supplied by renewables. And that far exceeds what we're doing in the States. In order to ensure reliability, and reliability is really what spurs economic growth and prosperity, India cannot afford to put in the battery storage that would enable more renewables. It would take a quarter of their GDP. That's just not feasible. So the increasing energy demand has to be met with something. So if 44% of it is renewables, if we cut off financing or don't enable gas to make up the difference, their only other option is coal. I believe that India is doing what they can. But I will say, I think it is the height of hypocrisy for us to impose Western decarbonization standards on these developing countries.

Rachel Fakhry (21:43):

I see as the exact opposite. I think it would be a disservice to not impose the same level of rigor that we impose on our own investment plans. In the US, every utility has to undergo an extensive process of demonstrating to investors and to customers that what they're investing in is the most affordable, clean set of resources for the next 30 years. I think to not demand the same rigor of developing countries, I'm from a developing country, that would be a disservice. Gas will play a role, but I would hate to see these countries being forced to rely on imports for the next 30 years, whereas they have clean local resources they can utilize, empower their own domestic resources, empower their own local workforces in a way that is affordable. So I disagree with that.

Scott Tinker (22:30):

That's interesting.

Naomi Boness (22:30):

I think that the Indian government has put out national strategies that really demonstrate that they have looked at it with rigor.

Rachel Fakhry (22:40):

And to be clear, this is not a dig at Indian government, who must be doing things very, very well. But I do think that Western standards, it's funny coming from a nonwestern person, are actually necessary. In the case of developing world, we need rigor. We need to show affordability, reliability, and cleanliness. We need to show that it's the optimal investment plan for a country, as opposed to address, here's an LNG or terminal, import our gas for the next 30 years. And say thank you because we're helping you decarbonize.

Naomi Boness (23:09):

Yeah, I don't think that they are building LNG terminals because they feel it's being forced upon them. An LNG terminal is incredibly expensive. And so for them to undertake that kind of investment tells you what the alternative, which is energy storage batteries primarily, cost in comparison. So it's actually the affordable alternative that's on the table right now.

Rachel Fakhry (23:37):

An example from my country where LNG terminals are now being considered, the first thing comes to my mind is show me the numbers. Show me where this is actually good for my country, for the affordability of resources, versus a much smaller reliance on gas, much bigger reliance on domestic resources.

Scott Tinker (23:57):

Do you either you want to do a quick wrap, just your thoughts on gas. Give you both a chance to do that.

Rachel Fakhry (24:00):

You know, I do think this is our last chess move in a way, and we have to be very prudent with it. I think this is the overarching umbrella. I would like to leave today with is let's be prudent. Clean energy has gotten to places we never would've imagined 10 years ago. Let's prioritize that. It is much less risky than other approaches. When it comes to gas, the world will likely need gas in some form, but let's be targeted with it. Let's ensure it's proceeded with rigorous assessments that take into account the clean energy revolution and the climate crisis that we're in. Let's be prudent, let's be targeted, and let's prioritize clean energy.

Scott Tinker (24:39):

And clean being solar and wind?

Rachel Fakhry (24:40):

Solar and wind. Yeah.

Scott Tinker (24:41):

Okay.

Naomi Boness (24:42):

It's very clear that we need to curb the amount of CO2 that we're putting into the atmosphere, and we're all playing on the same team. At the end of the day, we want a clean and sustainable environment for our children and grandchildren. Natural gas is an amazing, abundant, and low cost option. It's much cleaner than coal, which continues to be priority one, in my opinion, for reducing emissions. And it acts as an enabler, providing the storage and reliability to the clean energy technologies of tomorrow.

Scott Tinker (25:22):

Here's my takeaway from our conversation. Natural gas consumption for power generation, heating, and industrial uses, is growing in every global region and will likely continue. But that may depend on international trade. As fracking industries will develop inconsistently in other countries, this growth would come with challenges: CO2 emissions from combustion, and direct leakage of methane which is a greenhouse gas.

Scott Tinker (25:47):

The IEA found that 50% of methane leak reduction could be cost neutral. The cost of the gas saved covers the work done. Good reason to make progress on reducing leaks so that the lower carbon potential of natural gas could come with the smallest environmental costs.

Speaker 4 (26:36):

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