Fission Accomplished...Then What? International Security Implications of a Nuclear Energy Boom

[00:00:04] Speaker 3: Good morning. Thank you for joining us. This is the panel titled. Vision Accomplished. And then what? The International Security Implications of the Nuclear Energy Boom. My name is Lindsay Gehrig. I work at Pacific Northwest National Laboratory as a nonproliferation advisor in our National Security Directorate. And I'm just really thrilled to be here. This is such a timely and important topic. And I'm thrilled to be joined by four very distinguished panelists who will be joining me this morning. First, we have Ms. Joanna Bredenkamp, the Director of Global Nuclear Safeguards and Strategic Export Programs at Westinghouse, Ms. Sonia Fernandez Moreno, a Planning and Evaluation Officer at the Brazilian-Argentine Agency for Accounting and Control of Nuclear Material, also known as ABAC. We also have Mr. Sean Olbert, Vice President of Corporate Business Strategy at Centris Energy, and Dr. M. V. Ramana, Professor and Simon's Chair in Disarmament, Global and Human Security at the University of British Columbia. So the task before us is not small. One of the sort of central questions, one of the fundamental guestions we've been asked to unpack with you today is really as old as the nuclear dilemma itself, right, and what Eisenhower called the promise and the peril of nuclear technology. And that is, will this sort of resurgence of interest in civil nuclear capacity lead to a corresponding increase in nonproliferation risks? So I think we'll start with you, Joanna, if I may. Given your experience working in regulatory roles for the U.S. government, and now on safeguards for a major reactor vendor, what's your sense of the extent to which a significant expansion of nuclear power, including one that involves new technology and new users and new fuel types, will that raise proliferation risks? Your thoughts?

[00:02:16] Speaker 2: Well, the short answer is I think yes, but there are mitigations available for it. I think we're going into it with, or some of us are going into it with our eyes wide open and looking for some solutions leading up to it. But I think there are real risks associated with new end users, new entrants with different risk appetites than the nuclear industry has been wanting to accept. We are going into a time where we have a real need for expertise, not only at the regulatory level, but in the company levels. And that has the potential to stymie progress or just make those controls inconsequential because they can't be followed up on. I think also you have, with new locations, you have new requirements, an additional set of concerns for verification and regulatory entities. I think the short answer is yes, there are quite a few risks associated there. But with a lot of people thinking about how to address them and how new seats at the table for industry, for different participants, can mitigate those risks.

[00:03:38] Speaker 3: Okay, thank you. So Professor Ramana, I'd like to turn to you if I may. You've actually been rather critical of nuclear energy as a climate solution, and indeed your new book is very provocatively titled, that nuclear is not the solution. And there are, of course, several other supporting arguments in your book, but you do take the position at least in part because of the proliferation concerns. So I'm curious if you sort of agree or disagree with Joanna's sentiment, and if you might share your thoughts with us.

[00:04:08] Speaker 4: First, I'd like to thank the Carnegie Endowment for inviting me. Thank you very much, and thank you all for including me in this panel. I sort of agree that there is going to be an increased risk. I think that's fairly obvious, that

more nuclear power means more likelihood of nuclear weapons. I think there's no getting around that. It's not a one-to-one correspondence because we can't measure the probability of nuclear proliferation, because it changes very much with political circumstance, with security circumstances, all kinds of things. But I'd like to actually start by reminding people that this is the 20th anniversary of the 2005 Energy Policy Act passed by the George Bush administration. And that was the signal legislation to mark what was called the nuclear renaissance. And at that time, they were talking about, there were 30 reactor orders, 15 gigawatts was supposed to come online by 2021 in the United States alone. And of all of that, all those orders were canceled except for four reactors that went ahead, two in South Carolina, two in Georgia, and the two in South Carolina were canceled after \$9 billion was spent. And the two remaining in Georgia have been the most expensive power plants ever built in the United States. And this is a trend we have seen in many, many countries, in France, in the UK, and so on and so forth. So I'd like to begin by saying, I think there's a good reason to be skeptical that there's actually going to be a nuclear renaissance and large-scale buildup of nuclear plants. That's the good news. The bad news is what you said, which is that even a small nuclear plant, if a country were to acquire a limited amount of nuclear energy capacity, it'll still get a significant boost in terms of its capacity to build nuclear weapons. And a lot of the so-called mitigation measures are really focused on the technological risk, that is the possibility that fissile materials might be used from the nuclear power plant or from the enrichment apparatus. But there are many other factors that link nuclear energy to nuclear weapons. And one that I would like to sort of remind people of is something which was actually very well-articulated in an interview conducted by our own George Perkovich, who's not here, but he's somewhere there. And this was given to him by Munir Ahmed Khan, the chair of Pakistan's Atomic Energy Commission. I'd like to quote it in some detail, that's why I bought the book, not to show it off. And he said, the Pakistani higher education system is so poor, I have no place from which to draw talented scientists and engineers to work in our nuclear establishment. We don't have a training system for the kind of cadre we need. But if we can get France or somebody else to come and create a broad nuclear infrastructure and build these plants and these laboratories, I will train hundreds of my people in ways that otherwise they would never be able to be trained. And with that training and with the blueprints and other things that we'd get along the way, then we could set up separate plants that would not be under safeguards, that would not be built with direct foreign assistance, but I would now have the people who could do that. If I don't get that cooperation, I can't train the people to run a weapons program. I think that's a very significant factor, which is that when countries want to build nuclear plants, they might be thinking about it as an energy solution, they might be thinking about it as reducing emissions, but they also think about it as ways to train their people in high-tech sectors, which they otherwise would not be trained. And that is going to help them also. That's a very difficult thing to be mitigating at a technical level. I could go on, but I will sort of stop at this point.

[00:08:01] Speaker 3: Okay. Interesting. Does anyone on the panel have reactions? We'll unpack those in time. One of the things that struck me about your comment, too, is sort of thinking about the past and how plants have been built in the past, and I think one of the things we're looking at now, and again, with this sort of resurgence of interest and some comments that have been made, both by Mr. Magwood and others, about all of the advanced reactor technology under consideration. So I wonder, and we're going to just put a pin in this, but I wonder the extent to which

history does offer us lessons learned as we stare down a so-called new nuclear era or kind of a new era of renaissance, but as we think about these new nuclear reactors, including the human capital and associated supply chain challenges, I'd like to turn to you, Sean, in thinking about the new reactor designs, and they will, and to triple capacity or to whatever amount of capacity we see potentially increased, we're going to need more uranium, including the so-called high-assay, low-enriched uranium, or HALU, and I wonder your thoughts on whether or not the anticipated demands on the supply chain, both in terms of type and quantity, can be met without raising proliferation concerns.

[00:09:19] Speaker 1: Thanks, Lindsay. I think we all can agree that any enhanced strength and deployment of nuclear power around the world is going to create risks, however we define those risks. The real question in my mind is, how do you deal with those risks, and how do you deal with those challenges, and how do you mitigate those risks? If the framing of the question is, because there is an increased perceived risk, therefore we should not be doing these things, I think that will lead you in one direction. You had touched on in the question the tripling nuclear energy pledge that the United States and dozens of other countries had signed up to, and here in the United States, there is a bipartisan consensus on the need for the deployment of nuclear power for different reasons, but there is a consensus on the need to deploy that, and in the context of a tripling nuclear energy pledge, and we were talking about this before the start of the panel, just here in the United States alone, we're talking about 200 gigawatts of new nuclear energy deployed in less than 25 years. That's on top of the existing fleet, so 200,000 megawatt Westinghouse reactors need to be deployed in less than 25 years. Around the world, that's 1,200 to 1,400 gigawatts of new nuclear power that's going to need to be deployed in less than 25 years by those countries that have signed up to the pledge. Now, that's a reflection of the need for a lot more nuclear power, whether it be for energy security, climate change, whatever the need that you define for yourself. That's a reflection of the need for both accelerated and additional deployment of nuclear power. You're going to need a lot more fuel for that. Some of the advanced reactors that are being developed right now, whether they be for power generation or whether they be for process heat, whether they be for rural indigenous communities, Westinghouse is developing a reactor, a micro-reactor. They're going to need some of these high SALE fuels or HALU fuels that go to a little bit higher enrichment level. Those will convey with them additional risks of proliferation. I guess my answer to that is, and as I look around the room, I see many of my former government colleagues, certainly in the US government side, we like to tell people, because it's true that the United States has the highest nonproliferation standards in the world. The way that we get other countries to follow those norms and rules legally is through exports. If this deployment is going to happen and we're concerned about proliferation risks, the best thing that we can be doing is signing up partners overseas to buy from the United States, and by buying from the United States, they will be legally obligated to follow our legal requirements, whether they be for safety, security, nonproliferation. Then that gives us a tool to work with them to strengthen their safety cultures, their security cultures, and the like.

[00:12:33] Speaker 3: Thank you. I do want to unpack this notion of US competitiveness in the market and the ability for the US nuclear industry to provide that volume or something close to it, but first, I'd like to talk with you, Sonia, about this notion of nuclear technology being deployed in a country and a corresponding,

whether direct or indirect, increase in proliferation risk. You, of course, work for ABAC. Both Brazil and Argentina have uranium enrichment capacity and are not weapon states. What's your take on sort of the role of nuclear technology and how it can be safely, appropriately productively managed?

[00:13:18] Speaker 5: Thank you very much for the question, Lindsay, and for Carnegie to have me here. Well, first of all, I have some concerns on the linkage between balancing nuclear technology for peaceful applications as a component to reduce proliferation risks. I think pretty much that nuclear technology should be available to any state under, of course, very stringent standards of safety, security, and safeguards. I believe that this implies a concerted effort from weapon and nonweapon states in order to ensure that this increase, the tripling of these energy systems worldwide, happens in an environment that allow us to enjoy the benefits of nuclear energy, because in the end, if this is going to be a threat or is going to be an increase in the risk of proliferation that I personally don't see it, we have to think something else. We have the opportunity, the window of opportunity, to focus our analysis maybe to other areas of a weapons, a weaponization, or a weaponization program, rather than limiting, shutting the fuel cycle, even enrichment, even reprocessing. We all understand that these technologies put a state in a nearer position to obtain the nuclear material that is required for weapons. However, a civilian nuclear program is not really meant for that. So I just want to share with you at this point in time a couple of ideas, particularly one that is based on some discussions we had in the past on the focusing of the verification controls in the weaponization area in general, on the militarization area in general. Let's do the exercise in trying to find out some mechanisms that may allow us to be happy, safe, with this increase in the technology. Let's try to think in layers of instruments and controls, export controls, industry involvement, and let's try to see safeguards as a real technical tool that would allow us to give an effective conclusion on the nondiversion of nuclear energy for peaceful applications. For the time being, this is what I'm saying, but I think that there's a lot of potential here. Thank you.

[00:16:04] Speaker 3: I agree. Thank you. So, Professor, what's your take on that? I mean, we sort of acknowledge that, sure, maybe more nuclear stuff could equal more risk, but we also have a long history of managing those risks and many, many programs dedicated to doing that. So if we acknowledge the risk, what's your take on, I guess, the risk-benefit calculus, if you will?

[00:16:26] Speaker 4: Yeah. It's a great question. I mean, if you don't try, of course, it's going to be worse, so it's better that we have some programs to try and control that risk. But also, we have to ask two questions, one which actually Sean raised, which is, should we do this at all? And my answer, as you can guess, is no, but let's, for the sake of the panel, assume the answer is yes, we have to keep doing this, regardless of what I think. I think the question is how well we understand these risks, and in order for us to be able to mitigate something, we need to be able to characterize all the possible pathways through which a country can get nuclear weapons. And one thing we can learn from history is that no two states have gone exactly the same route. Every country has its own path towards developing nuclear weapons. All of the nine nuclear weapon states right now, South Africa in its own state, Israel is different, India is different, and each of these countries have gone down a different path. So what does that tell us about what is the pathway that we're going to be able to control? Iran is a good example of a country that at least says it does not want nuclear weapons. The Supreme Leader has said that there is a fatwa

against nuclear weapons, and yet we are very, very concerned about Iran. So what is going to be the pathway for this? The other thing I want to sort of reflect on was something that Ambassador Grossi said about the situation in Zaporizhia, and he mentioned that the situation there is unprecedented. It is not something that had been anticipated. And I would submit that all of the proliferation cases that we have dealt with are in the same category. They're all unprecedented. And so I would be very doubtful that we can comfort ourselves by saying we can manage these risks through these programs.

[00:18:19] Speaker 3: Interesting. Thank you for that. Joanna, do you have any reactions?

[00:18:26] Speaker 2: I think we start down a difficult path when we say that the rising tide of technical knowledge will mean that weaponization is more attractive. I think there's more capability to weaponize. I think that the idea that energy is prosperity, and with bringing in this technical know-how and more energy, that there will be a rising tide for everybody, and there will be more incentive to participate in the global economy, and there will be more people looking at what you're doing because you have this nuclear energy. I think that it's more of an inclusive factor than that is really—does mitigate some of that risk of proliferation, if that makes sense to you.

[00:19:19] Speaker 3: I think that's right. I mean, and with this technology comes great responsibility. There was also a comment made earlier in response to—I believe it was Mr. Magwood was taking out the trash, and how do you know where your trash goes, and the world is watching. And then you add Grossi's comments as well with also that we have multilateral institutions to support the responsible use. I was struck by your comment, Sonia, as well about the imperative or the desire by many to have the nuclear community be more inclusive, and to offer the benefits of nuclear technology, and differentiating between civil nuclear programs and weapons programs, and how do we—but again, this is the great debate, right? It's the promise and the peril. How do we harness the power of the atom for good? And so as we think about risk, in your mind, Sonia, are there ways to kind of separate the technology from the weapons question, right? I mean, is there a way—and do we have the appropriate mechanisms, perhaps, to do so?

[00:20:21] Speaker 5: Yeah. Well, it is not a one-fit-all answer for that, and as you say, it's a debate that is taking years—more than 50 years, I think—and it's a dilemma, because connecting the knowledge to the use of nuclear energy for weapons is something which, in my opinion, is not right. Something is not good in that, because, again, you have a lot of experience, cumulative experience, in nonproliferation and in disarmament that would allow us to find new ways, new measures, and new instruments, and maybe new agreements and international organizations, or the same that we have today, entrusted with other roles that may provide the same level of confidence, or even more level of confidence, than limiting the technology. And the only way that limiting the technology for peaceful applications may work further in this increase of expansion in this nuclear blast zone could be really to include this prohibition of nuclear technology for psychological activities to all, and so maybe create an international consortium in charge, being responsible, of providing nuclear energy on the basis of nonproliferation and disarmament standards. If not, I think that we are going to go into a kind of deadlock,

and we are losing, again, an opportunity to progress really in nonproliferation and also in disarmament.

[00:22:05] Speaker 1: Can I add to that? One of the things that struck me about this conversation—excuse me—we're having this conversation in Washington, D.C. about the promise and the peril of civil nuclear energy, but we also need to keep in mind that this conversation is taking place around the world, and many of the countries that play in the nuclear space, their governments have made a strategic decision to act in this space, and we can go down the list—Russia, China, European allies. They have all made the decision, whether they own their industries or whether they're controlling their industries through policy, they have all made decisions to act in this space. We do things a little bit differently here in the United States. It's commercially led, but you had made a point earlier about competitiveness and stuff like that. Well, if we want to strengthen nonproliferation norms, if we want to help ensure that the promise of nuclear energy is done so in a way that mitigates the risk as much as possible, we also need to understand that we are attempting to accomplish that goal in a system that is dominated by foreign governments and that use this industry as a means to extend their strategic influence. Now, in that type of context, how do we then go about addressing this proliferation risk? I think that-I'm mindful of Ambassador Holgate in the front row. She would say it. The DG would say it. We need to be taking a more comprehensive approach to both addressing the need for additional deployment while also addressing some of the potential risks. We're going to need more resources in Vienna. We're going to need more safeguards experts. We're going to need more security officials. We're going to need more regulatory culture. We're going to need all of these things while also we're going to need to help support our domestic industries to get to that export point that I made before so that we get countries following our norms and it's backed up by the resources that they're going to need because otherwise, like the point that we used to make when we were in government, when we go into a new country, we want those handbooks written in English, not in Mandarin or not in Cyrillic.

[00:24:27] Speaker 2: If I could, John, please. I think that, yes, government has to lead the policy and provide a lot of the impetus for this, but I think really rethinking industry's role in nonproliferation and safeguards is really a timely discussion right now. Governments are no longer-well, in the West, governments no longer have a monopoly on the technology or the use of that technology. The people who are really in the middle of the development of the technology know the ins and outs, the potential pathways for misuse of that technology or industry, but yet industry is still tentatively invited to some tables to have the conversations. Industry is starting to be invited to things like this, to have discussions about why it matters, why disarmament matters, and there's really an appetite now in a lot of the Western companies, some of them, maybe mine, but are talking very loudly about what our role is and how we can help, how we can put the infrastructure in place that governments understand the new entrance needs, their understanding of export controls, of nonproliferation, of safeguards, provide a conduit for including those technical means there for those countries to understand what they're doing. Safeguards as a service, for example, is something that you get people cringing a little bit. Oh, that's verification. You have no role in it. Well, let me tell you how to use and misuse my technology so you can figure out exactly how you want to safeguard it. Let's do a Lego approach and figure this out together. I think that, and then it comes to export controls, and you come to the governments and you say, listen, I know there's all these rules. Can we do a risk-

informed analysis of this? Can we have some agreements together? Let me teach you about my technology so you understand it better and can make some better assessments of it from a licensing perspective. They say, well, let me know when you have a customer. No, no, I need to have these conversations very, very early. I need to have the conversations now. We have a global workforce. I have technology flows going way before I actually have a customer. Let's have these conversations now. I think that part of what's going to address some of your concerns is that it's not just governments talking to international institutions. It's companies whose analysis of their risk appetite weights as heavily economic as reputation futures, who are saying, I'm a partner in this. Let me help you help me help you type of scenario.

[00:27:02] Speaker 5: Thank you, Johanna. I very much agree with you, Johanna, and Dr. Ramana in that regard. I think that the increase of nuclear energy deployment is going to happen. Maybe not as high and huge as expected, but it's going to happen. And that required the establishment of a robust infrastructure in the countries to regulate and to ensure safety, security, and safeguards. And these do not happen overnight. That require human capital. That require organization, legal frameworks, international commitments of the states that will be embarking in nuclear energy systems. And a multilateral and multilayer approach, industry, export control, all the actors that may really help in establishing a coherent and holistic approach towards these famous three S's. And for that, the obligation of all the states and all the institutions to commit to reaching these standards. Human capital was one of the more concern issues for me when I heard Mr. Magwood today and yesterday Commissioner Hansen talking about how we are going to license new designs of reactors. Are we really licensing a new design, or we are just having a lot of experience in reactor designs that we are going to put into the system if we have a first-of-a-kind modular reactor that is going to be spread all over the world. So I think there is a lot of synergies that we need to have in terms of industry and export control. I just want to highlight the importance of the nuclear cooperation agreements, government to government. It was also mentioned yesterday. The suppliers states, or the suppliers, industries, government, states, are committed to implement safeguards and non-proliferation objectives, export controls. So they have the right to go into a state that will receive some technology, and they may inspect this reactor. So that is a very old idea in the former, maybe, I don't know if it is today valid, but in the nuclear cooperation agreements with the United States and recipient countries of nuclear technology from the United States. These clauses were really strong, and they were very effective, in my view, and add and complement things like safeguards. So why we couldn't think in terms of how the whole world is going to work.

[00:30:00] Speaker 3: So we have some consensus, it sounds like, supporting Joanna's notion of a greater role for industry in the conversation, Sonia and Sean both touching on the fact that increasing the capacity of the organizations who support human capital development. We also have some discussion around the longstanding, the 100-year hug that's been mentioned with respect to nuclear cooperation agreements and how important it is to embed high standards in those agreements. But Professor, do you agree? Are there some proliferation risks that simply can't be managed through those mechanisms? Or does it again come back to this risk-reward calculus? And if so, how would you suggest that we better or more effectively calculate the risks to inform these decisions?

[00:30:46] Speaker 4: I mean, I don't think we can calculate the risks. I think there are just too many uncertainties here. I mean, just to give a contemporary example, I'm coming here from Canada. For the first time in a very, very long time, there's actually discussion there about whether Canada should get nuclear weapons, thanks to reasons that I don't have to explain right here. It's not a serious discussion yet, but the fact that it's actually being aired, there are op-eds in the Globe and Mail and so on and so forth, tell you that things can change very rapidly. Who could have predicted this? What kind of calculus would actually tell you, oh, under certain circumstances, Canada might consider getting nuclear weapons, right? So that's one thing to remember. And the second thing to remember is that Canada can think about this, whether they're going to, I don't think they're going to do it, but nevertheless, the fact that they can think about it is precisely because they have a nuclear infrastructure. Another country in a very similar situation, Denmark, is not talking about it, right? They don't have nuclear power plants. So that, I think, is a very simple thing. The second thing I want to sort of reflect here is there's this word we that is being thrown around, and I don't think there's a common we here, right? There are different interests at play here, and all of them don't necessarily have the same interests. So of course, Russia and China have their interests, but also all of the countries that are buying nuclear power plants, or at least are in the supposed market for nuclear power plants, have their own interests, and they don't overlap, they don't align completely with the interests of, let's say, Westinghouse, right, or any other country. And I think there, something very central to be sort of remembered, there's a lot of talk about how we want nuclear power for prosperity, the promise of nuclear power. The promise of nuclear power has already been belied a long, long time ago. Remember, it was the energy source that was supposed to be too cheap to meter, and then the economists famously pointed out that it was too costly to matter, right? So developing countries, for developing countries, it is true, they need energy for development, right? Nuclear energy is the most expensive form of energy to be delivered there. So if they are investing in nuclear power, they are foregoing how much energy they could have produced for the same amount of limited capital that they have, right? So for them, they have to look around for what is the cheapest way. And coming back to the nuclear sector itself, one of the reasons why we see so many countries buying Russian nuclear plants is not because they have some profound geopolitical attraction to Russia. It is because Russia just gives them a better deal, right? And so that's something to remember. But also, I'll say one more thing about this question of developing countries, which is the case of India, where I grew up, and in India, the Atomic Energy Department, the Atomic Energy Commission, was set up with the idea of using atomic energy for peaceful purposes. because it was all seen that India just had got freedom, it needed a lot of energy, and they said this is going to happen. The Atomic Energy Commission evolved over a period of time, over a couple of decades, to one that wanted nuclear weapons, because that was one way for it to get much more political power, right? And this is something which we are going to see in multiple countries. Here in the United States, it's the same entity that oversees both nuclear weapons materials and nuclear power promotion, Department of Energy. This is seen around the world, right? So there are institutional interests also that come to play. And in the case of India as well, when Canada exported its first nuclear reactor to India, the NRX reactor, which became Cyrus, there was discussion in Canada about the possibility that India could separate plutonium from the NRX reactor. The NRX reactor was known to be a good producer of plutonium. And it was brushed aside because they said, we want to be able to sell reactors to India in Canada, and so the foreign, the people who are concerned about

proliferation were ruled out. We see the same kind of discussions happening today about Saudi Arabia, right? Saudi Arabia has made it very clear, MBS has made it very clear, why they are interested in nuclear power, and yet we want to sell them nuclear reactors. So these are things which I think we should be thinking about.

[00:34:58] Speaker 5: Sonia, it looks like you have a guestion. Yes. Just to add a note on that. I guess that I understood what John said and Dr. Ramana said on suppliers and reliable suppliers committed to non-proliferation standards rather than other possible suppliers not doing that. I guess that if that is the case, and again, I agree, it doesn't matter if Russia or whoever, we need to work internationally to engage all the suppliers in a commitment of requiring certain minimum standards to cooperate in providing nuclear facilities to other states. So we need to work on that. It's a loophole in the system. let's talk about it. And I have a very much more previous concern which has to do with the nuclear order as we have known it is on crisis. It has been challenged geopolitically. We are just discussing the possibility of the threat of using nuclear weapons. We are discussing geopolitical tensions that may lead us to a conflict of serious consequences. So we need to use this time to be prepared. This dialogue is very timely, it's very important to really build up on a system that may also try to address the challenges that we are facing today, not the ones that maybe we will face in 25 years, that I think somehow is much more easier to handle.

[00:36:36] Speaker 1: Lindsay, can I add something? This has been a very good conversation, and I'd be happy to continue having this kind of conversation. In my current role, I work for a publicly traded company. And the interest of a publicly traded company in the civil nuclear space is to sell. That's my job, that's what we're trying to do. We're trying to sell enriched uranium and enriched uranium products. And the reason why I raise that is because this conversation that is taking place has to take place, but it needs to, like Joanne said, incorporate industry into the conversation. But there needs to be a better understanding of the incentives that are driving industry, because they're not the same as government. The industries, what Joanne is trying to do at Westinghouse, is sell AP1000s and AP300s and eventually reactors. I'm trying to sell enriched uranium to power those reactors. Our incentives are different. We have an incentive and an obligation to comply with our legal, statutory, and regulatory obligations. Absolutely. And we uphold those obligations to the fullest. But our incentives are to do just that, to sell. Now, how do we take that private level, corporate level incentive to sell stuff in the United States and overseas, and do so in a way that it helps advance nonproliferation norms and national interests? I think we need to figure out the conversation there. One of the other things that, and I'm sorry I was taking notes on my phone, I've been writing down words, and one of the other words that came into my mind is uncertainty. There's a lot of uncertainty right now. We don't know whether this new, new, new nuclear renaissance is actually going to happen, what the pace is going to be, what the scale is going to be. We don't know all of that stuff. But uncertainty creates risk in the private sector, and it inhibits investment, and it inhibits moving forward with deployments. Regulatory uncertainty also does the same thing, whether it be designing a reactor in the United States, licensing in Canada, designing in Canada, licensing in the United States, all of those kinds of uncertainties. Those have effects on industry that we need to have a better understanding going in both directions and how that helps advance nonproliferation norms. Uncertainty in terms of designs. If Bill were sitting on this panel, he would talk about all the analysis that the NEA is

doing in terms of their dashboard of all these different reactor designs, and I think there's 50 or 60 different reactor designs in there, evaluating on five different scales in various stages of development. Well, from a fuel seller, that doesn't help me. If there's 50 different designs out there, I don't know what designs could actually make it to market. If you don't know what to make it to market, you can't help design a safety and security and regulatory and safeguard structure for that. We need to minimize these uncertainties, and these are the issues that we deal with on an industry level that impact how government's going about helping us do what we need to do.

[00:39:47] Speaker 3: Thanks, Sean. I'm going to try to pull a few threads together here. I want to stay on this topic of incentives. If we know the behavior we seek to promote, we know what good behavior looks like, we know what responsible behavior looks like, how do we incentivize that? Are those incentive structures different for different countries, companies, the different nuclear stakeholders? Adding to the thread here is also the role of new nuclear members. Not necessarily member states, but we're talking about the wave of interest we're seeing from private companies in nuclear technology and these non-traditional end users who are also now seeking to become part of the nuclear community. How do we think about incentives with old and new players alike, with our varied perspectives? How do we incentivize the behaviors we seek? Sonia, you brought up something interesting, too, so I'm going to tack one more thing onto this sort of rant here, but this notion of having regional approaches. We're thinking about incentives, incentivizing behavior, multi-stakeholder perspectives, motivations. What is the role of regional approaches? Professor, you've talked about the economics and the timeliness of nuclear as well. Do regional approaches help as we think about incentives, economics, timeliness, and reducing uncertainty because you're sharing the risk among multiple parties? Let's start with you, Sonia, and then we'll go to you, Professor.

[00:41:26] Speaker 5: Yeah, very, very good comment, Lindsay. I think, really, that the regional approach is something that should be more fully taken into account since regional approach deals with geopolitics, history, culture, and provides a framework that may contribute to nonproliferation and safeguards by adding a level of confidence to the nonproliferation regime. That means I have the example of ABAC that was a regional system created to provide confidence between the states, Argentina and Brazil, on the peaceful nature of nuclear energy, and this system added a value to the safeguards, international safeguards, as well as to nonproliferation. However, after more than 30 years, at least in my perception, there is a lot more to be done in areas of the agency taking more fully that level of confidence into the implementation of its verification effort. That is something that needs further elaboration. I see other colleagues from my old times in Saxony here and in Vienna, and this is a conversation that takes ages how much the agency could rely on regional approaches in many facets, not only safeguards, maybe also in safety and security, to really deal with the current challenges and concerns we have. My point is, safeguards will continue to be the cornerstone of nonproliferation, is going to be the IAEA, they want to provide us confidence in the nonproliferation commitments, plus the possibility of incorporating further the assurances that provides regional approaches. And there are many regions now that are taking this lead, Asia-Pacific, Africa, we were talking about Africa this morning, so I think that there's plenty of opportunity also to explore regional approaches.

[00:43:47] Speaker 3: Thank you, Sonia. We'll go first to the professor and then Joanne, I'm curious, and for you as well, Sean, with the role or what the industry perspective might be on regionalizing some of this with respect to supply chain and other aspects of supply and demand. But first, professor, your thoughts on regional approaches, incentive structures, and sharing of risk and responsibility.

[00:44:08] Speaker 4: I'm actually going to turn the question slightly from what you said. Perfect. Because you talked about, what you started with was about talking about new nuclear players. And I want to include one other set of new nuclear players we're seeing today, especially in the nuclear reactor market in the United States that we should talk about, which is all of these new companies, very different from Westinghouse, from Silicon Valley. And they come with an ethos of moving fast and breaking things. And in the nuclear safety realm. I think there have been a disaster in terms of how they talk about how safety in general. And it leads to a very profoundly anti-regulatory environment, which I think is really bad for nuclear safety. And I think very similar things will happen in the context of proliferation as well. Because many of them seem to think that the reactors that they have designed. these are all tiny companies, one engineer, one CEO, one CFO, and a dog. And they just come up and say, oh, I made this reactor design. It's on a piece of paper. And it's so great that you don't have to test anything for this. And so the way you think about safety is also the way you think about proliferation. They think it's a nonproblem. And that, I think, is a huge issue. And these are the kind of players that have been incentivized by this talk about tripling of nuclear power, by this talk of all kinds of money coming in, and so on and so forth. And I think it's something which we should also be considering in our conversation.

[00:45:40] Speaker 3: Joanna, yeah, whether you want to go with the regional structures and incentives, the role of industry there, or on the most recent comments about new nuclear industry.

[00:45:48] Speaker 2: Well, you're right about the new nuclear industries. I call them the paper tigers, the CFO, the web designer, and the engineer, who have some really good ideas and are going forward and attracting a lot of money. They're the new shiny thing. But additional new actors are the money coming in for them, the IT for data centers. They're looking for the shiny thing and throwing money at them. And they have a very different risk appetite than the nuclear industry traditionally. And I think it's important that we are re-supporting, re-looking at our nuclear safety culture and ensuring that the industry understands it fully. And I think understanding the importance of it is not just to double, triple check yourself to make sure everybody's on the same page, but to make sure that things are done correctly. I think that's a really big risk. And if those coupled together make a mistake, that's going to impact all of industry and the future of this renaissance, re-renaissance, or renaissance, right? But there's the second part of incentivization and regionalization. I think it's very appetizing from the perspective of industry. If regulators were to get together and decide on some way to evaluate and some way to recognize each other's evaluations to reduce some of the time that is invested in every country to ensure you're compliant, that would be tremendously valuable and beneficial to industry. So perhaps, and it's maybe a little bit too far out there, but some way to provide some sort of a bona fides to companies that perhaps operate in many different regions, many different countries who have shown their ability to comply with the regulations in a certain way, that have shown their processes and procedures, their nuclear safety culture, transparently to be recognized in some form

or fashion. Companies that have, for example, a safeguards by design program, being able to open that up to verification entities, to the IAEA, and have them say, yes, we agree. That is meeting the objectives of what we want. We can work with this. Those types of things would incentivize companies to carry that message of nonproliferation, those standards forward in a meaningful way.

[00:48:22] Speaker 3: Thank you, Joanna. You pulled on some of the comments I'm seeing in the chat here with respect to incentives. Is there bona fides? Is there a credential, perhaps, that could be developed and adhered to? And also sort of the role of safeguards and security by design in that. So that very much resonates with some of the feedback from the audience. So thank you for that. I guess I wonder the extent to which the renaissance or the re-renaissance, if we're now calling it that, is different from the last time. Does history teach us anything? Or has the world, and technology, and geopolitics, have they sufficiently evolved that there might be some lessons learned from the past, but what we're talking about now, in this moment in time, and the massive, seemingly insatiable demand for energy, the new players, technology companies and otherwise, also really hard to abate, hard to decarbonize sectors looking at nuclear technology to reach their climate or other related goals. Is the sort of interest that we're seeing now, coupled with new technology, mean that we're staring down a fundamentally different calculus? The world has evolved in certain ways. Has the non-proliferation regime sufficiently or commensurately evolved as well?

[00:49:51] Speaker 1: I think the operative word that you use there is moment. This is a moment in time, and moments pass. The nuclear industry has a long tradition of fits and starts, and promises underwhelmed. The insatiable demand for energy is a fact, and it's only going to increase. We made reference earlier to non-traditional customers like Meta, Facebook, Google, AI, and the like. Their demand for energy is now. With all of the challenges that we're facing on the commercial side, whether it be technology development, whether it be infrastructure, human capital, all of these kinds of things, the demand by these non-traditional customers, let alone traditional customers, is now. If nuclear's not going to be there to meet the challenge, they're going to address the demand for energy through other means, whether it be LNG or something like that. That demand's going to be met. We all, I think it's fair to say in talking about incentives, we all have incentives, shared incentives, to try to tackle these challenges that we face in an expeditious way in order to intersect that demand that we see right now. I think certainly from a commercial perspective, but I also think from a national security, from an energy securities perspective, if those tripling nuclear energy pledges just amount to words on a page, we will have failed. We need to do this, and we need to get these answers done guickly.

[00:51:36] Speaker 3: To your point about meeting the bottom line in an industry perspective, Microsoft and others need energy. They need a lot of it. They need it now. If nuclear's the solution, there were some comments, I believe, Joyce Connery and others earlier about if nuclear doesn't meet the moment, move on and find other things. Is it attractive, I imagine so, from an industry perspective to have such eager and willing off-takers of the nuclear energy capacity? What is the risk-benefit award that we've talked about? Joanna, you look eager to respond. The move fast and break it, that mentality, but they're also bringing demand and capital to the equation. How do you think about that, Joanna?

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[00:52:30] Speaker 2: From my perspective, it's like the discussions you have with a country that's like, we need energy. We want a reactor. Tell me what I need to do. It's getting to know each other, getting to know the atmosphere you're working in, the industry you're working in, and getting them to understand why we do things the way we do, how we do things, for them to really appreciate the value associated with it. Like I say, when people say, why does it take so long to sign a contract? You've been talking to Poland since you were in grade school. We're dating for a while. We're engaged right now. We might get married, but we're going to be together and have grandkids together if this works out. We really want to invest our time in knowing each other better. I think with this data center kind of meta, all of the IT industry throwing money really at the nuclear industry and saying, we want it now, move faster. This moment needs to have some strategic thought and some real discussions with each other about what exactly you want, how we can provide it in a way that meets both of our objectives. There's a disaster waiting to happen in that you might not even get to a proliferation or an actual accident, but just a failure. This was a bad idea, public divorces, those types of things. I think we're in a moment right now that's a very tricky moment that requires a lot of very strategic discussions with each other. I think that you see a lot of shiny, loud things in the press, but hopefully, and it isn't all that you're seeing, and that you'll actually see some really substantive type of discussions and relationships in the future.

[00:54:23] Speaker 3: Professor, your reactions?

[00:54:24] Speaker 4: Yeah. Yeah. I completely agree. I think there's a lot of shiny stuff going on. I actually do disagree slightly on the idea that they are actually throwing money. They are throwing money, but not the kind of money that is needed for nuclear power. I've not read any of the contracts, none of them are public, but I'm sure that Google and Amazon and all of them have very smart lawyers who put all kinds of conditionalities there about buying power. If you think about the amounts they have disclosed in public, they are in the few hundreds of millions of dollars at best. The last SMR project that was talked about in the United States, which went quite far, the UAMS project, ended up costing \$9.3 billion. This is before the construction started. Even before that, NuScale has spent about \$1.8 billion on R&D, and they have not yet gotten the full license to actually start construction. So there's a huge amount of money that's required, and the kind of money that Amazon or Google are supposed to be talking about is sort of peanuts compared to what is actually required. It's good for publicity. They get a lot of publicity out of talking about this, but in terms of getting an actual nuclear power plant, nothing. And this is, of course, for them, this is pocket change, given the kind of revenues that they have. So if they want, they can easily invest \$50 billion and say, okay, build me a plant. But they're not doing that. So it's, I think, wrong to think about this as actually throwing money at the scale that is required.

[00:55:52] Speaker 3: Thank you. We have just a few minutes left. We've covered a lot of ground. We've talked about new nuclear newcomers in a different sense. We've talked about incentives, standards, the role of perhaps regional approaches of multilateral organizations. How can we approach this re-Renaissance, this moment, responsibly? I'd appreciate each of your reactions on that with just a few minutes left. Sonia, do you want to begin? Thank you. What do we do here? Sonia, tell us.

[00:56:28] Speaker 5: What do we do? I would say that we have to work harder. We have to be very open-minded and be really critic on the current nonproliferation and

disarmament status in order to identify lessons learned, as you said in previous blossoms, like the newcomers, Brea Fukushima. And now this possibility, which is, I think, unprecedented in the way that if climate change is going to state and the response to climate change impact and net zero will be solved by nuclear energy, that triple of nuclear energy or this increase in nuclear energy will take place. So we need to work on that basis. Of course, a lot of uncertainties, as John said, but let's work on the basis of that very seriously, analyze what we have learned from the past. We have a lot of initiatives like multinational fuel approaches, incentives for states to get nuclear energy with a certain environment of benefits. So my word would be unprecedented time require unprecedented strategic thinking. So dialogues like this needs to be reproduced and continue in order to find solutions and proposals to tackle with this.

[00:57:55] Speaker 3: Thank you, Sonia. Sean, how do we responsibly meet the moment?

[00:57:59] Speaker 1: Real quickly. I think we have to lead and I think we have to lead through action. Not to preview Ellie's talk this afternoon, but I think the conversation about U.S.-Saudi civil nuclear cooperation discussions is a perfect reflection of the challenges and the opportunities that we face as a nation in addressing this challenge. There are market opportunities. There are nonproliferation issues that need to be addressed. In the context of a strategic issue that other countries view strategically. And we need to be thinking about how can we renew our leadership. We tell ourselves that we lead in this field, but everybody else is buying from Russia and everybody else is buying from everyone but us. Westinghouse accepted. But we need to renew this leadership role that we had in the past and we need to do so through action.

[00:58:58] Speaker 3: Thank you, Sean. Joanna? I'm going to pass it. Professor, how do we responsibly meet the moment? And your answer may include not nuclear.

[00:59:14] Speaker 4: So it's very bad for a panel to be disagreeing with themselves. It looks very disagreeable, but if I have to be honest and be consistent with all that I have said, yes, I think we should not expand nuclear power. That's just a bad idea. We should just give up. Better now than later.

[00:59:30] Speaker 2: So I'm going to take some of my time back and say we shouldn't give up. I think there's a real opportunity here, but there is so much uncertainty and there's so much risk. So anywhere we can mitigate risk for industry is really where we need governments to focus. There's risk in that we are dealing with regulators who don't quite understand nuclear technology, let alone what it means to regulate a nuclear reactor. We're dealing with uncertainty in what exactly the market's going to look like, who's exactly going to buy. We're dealing with uncertainty if our deployment models, which are new and fancy, talking about products instead of construction, what that's going to mean in the context of export control safeguards, regulation, operation, remote access, those types of things. So there is a lot of uncertainty, and so discussions to really get to the core of what is actually possible and what actually needs to be looked at instead of this universe. We're going to have 100 different reactors in 1,000 different places, and everybody's going to share all the technology, and all the regulators are going to recognize each

other's licenses. That's never going to happen. So let's really have those practical conversations.

[01:00:48] Speaker 3: Well, thank you. I think no one asked my opinion, but if I had to comment on what's responsible here, I think actually this panel has really reflected it. It's healthy dissent. It's substantive dialogue, and it's looking at the hard questions and having conversations like this one. So I'd really like to thank you each for joining us. I hope you'll join me in thanking this panel. Plenty of thought-provoking fodder here to head into lunch, and thank you again for joining us. Thank you. Thank you.