Nuclear Energy Summit – Broadening the nuclear coalition

In our last two posts we looked at the pledge signed by more than 20 countries at COP28 in Dubai to triple the amount of nuclear globally by 2050 and the pledge made by more than 120 companies in the nuclear industry to meet this challenge. This month we comment on the first global Nuclear Energy Summit held in Brussels March 21, 2024.

The summit photo had Brussels' Atomium as its backdrop (Image: Klaus Iohannis/X)

This summit, organized by the IAEA together with Belgium, included senior government delegations from 32 countries, coming together for the sole purpose of discussing the future of nuclear energy and its role in supporting countries' climate and energy security goals.

The list of 32 countries includes 14 additions to those who signed the nuclear pledge at COP28 (not all COP28 signatories

participated in this event). This includes new countries with long histories of nuclear power like Argentina, India, Pakistan, and Slovakia, to those who are active nuclear newcomers (Bangladesh, Egypt, and Turkey) and those who are aspiring to bring nuclear power to their countries (Philippines, Saudi Arabia, and Serbia). The list also includes China, who has 55 operating nuclear plants and another 36 under construction, the world's most active nuclear program, and Kazakhstan, the world's largest supplier of uranium.

Just the fact that the summit was hosted by Belgium is important, given that it only recently abandoned its plan for a full nuclear phase out. And add Italy to the list of countries who have not been supportive of nuclear in the recent past.

The resulting declaration stated "*We, the leaders of countries operating nuclear power plants, or expanding or embarking on or exploring the option of nuclear power … reaffirm our strong commitment to nuclear energy as a key component of our global strategy to reduce greenhouse gas emissions from both power and industrial sectors, ensure energy security, enhance energy resilience, and promote long-term sustainable development and clean energy transition.*"

The declaration identified a range of topics where policies need to evolve (for a more complete description refer to the WNA release) including increased financing, workforce development. and support to nuclear newcomer countries. We will discuss each of these items in future posts. They are all critical to a healthy growing global nuclear sector. Why is this important? Because rather than continuously debate whether to pursue nuclear, the discussion has finally moved on to collaborating to create the necessary conditions for success.

In support of the government's declaration, global industry

associations released a joint statement noting their strong support to ensure governments can meet their nuclear ambitions. In addition, a group of 20 NGOs from around the globe issued a Declaration on the Future of Nuclear Energy jointly calling for the efficient and responsible expansion of nuclear energy.

This first nuclear summit shows the collation of countries, industry and NGOs supporting and actively promoting nuclear power is growing rapidly. It is unprecedented in the level of national leader support for nuclear since President Eisenhower's Atoms for Peace speech 70 years ago. The time has come for action, and the stage is set to put in place the necessary policies to enable the rapid scaling of nuclear in meeting all our climate and energy security needs. The future is bright. But the work ahead is hard. This is only the beginning.

[*Complete list of those signing the declaration: Argentina, Armenia, Bangladesh, Belgium, Bulgaria, Canada, China, Croatia, the Czech Republic, Egypt, Finland, France, Hungary, India, Italy, Japan, Kazakhstan, Netherlands, Pakistan, Philippines, Poland, Romania, Saudi Arabia, Serbia, Slovakia, Slovenia, South Korea, Sweden, Turkey, United Arab Emirates, UK, and the USA*]

Tripling the global nuclear fleet will require massive capacity building

In our last post we looked at the pledge signed by more than 20 countries at COP28 in Dubai to triple the amount of nuclear

globally by 2050. This month we consider the pledge made by more than 120 companies in the nuclear industry to meet this challenge and support a tripling of nuclear power by 2050. This is all part of the Net Zero Nuclear initiative started by the WNA (World Nuclear Association) and ENEC (Emirates Nuclear Energy Company) calling for unprecedented collaboration between government and industry leaders to at least triple global nuclear capacity to achieve carbon neutrality by 2050.

Some of the companies that have signed the industry pledge
Source: WNA photo COP28 December 2023

Tripling the global nuclear capacity is no small feat. Today there are 437 reactors in operation with a combined capacity of about 400 GW. Tripling means adding another 800 GW by 2050. In a combination of large nuclear and new Small Modular Reactors (SMRs), this would mean anywhere from 800 to 2500 or so new units being built around the world. Currently, there are 61 units representing about 68 GW under construction, only 7.6% of the way there. And two thirds of these units under construction are in or exported by China and Russia. In other words, the western nuclear industry has a long way to go to do their part in achieving this lofty goal. The question is then, how can we get there from here and why is this pledge so important?

Some say it is a pipe dream. We say the first step in solving any problem is to clearly define it. In this case, to express an ambition – and that was clearly set out at COP28.

Understanding the need, the question then becomes how the industry can scale to meet this demand? This requires a rapid increase in development of both the global supply chain and the human talent needed to deploy at this scale.

This is huge change for the industry. It is (except for China, Russia and possibly Korea) used to being in a global market with few new projects and too many suppliers. On top of that there have been many false starts on a renewal (or renaissance) in the past that did not work out. So, the industry has been reluctant to make the necessary investments to support the capacity building needed.

The first step is to firm up this new demand. This must be driven by government. And it has begun. Already since COP, France has announced its plans to build 14 new EPR2 units by 2050 and the UK has issued its nuclear plan on how it will meet its target of 24 GW by 2050. The UK document is clear in that capacity building and human workforce development is a critical part of this plan. Here in Canada work is underway to look at how to scale to meet 2050 growth projections as well. The US has a lot of work to do to determine how to deliver its ambition of 200 GW of new nuclear by 2050. And yes, where will the resources then come from for projects in Poland, Czechia, Estonia, Slovenia, Bulgaria, Saudi Arabia, South East Asian countries and the many possible nuclear newcomers in the global south?

The nature of global competition will also change. There will be enough work to support multiple vendors, both for traditional large nuclear and SMRs. To be successful, there must be a focus by each vendor on delivering fleets of their designs to be as efficient as possible. This can then support development of global supply chains with sufficient capacity and the human talent needed for delivery. The potential volume of work will encourage productivity improvements resulting in more on time and on budget delivery at lower total cost.

To meet the goals of net zero by 2050 and global energy security, the effort to build industry capacity is required now. All countries interested in new nuclear need to work on developing the people they will need to succeed. The ambition is clear – now is the time to act.

The World Pledges to Triple Nuclear Power at COP28

Earlier this year, we wrote a post stating that "*in 2022 the world acknowledged that net zero needs nuclear – in 2023 it will realize it needs a whole lot of it.*" Well, as 2023 draws to a close, it has! This month at COP28 in Dubai, more than 20 countries[1] (some with operating nuclear and some with ambitions for nuclear) got together and pledged to triple the amount of nuclear power globally by 2050.

Photo taken by Milt Caplan, December 2, 2023, Dubai

Why is this so important? For the first time at a COP meeting, there was a clear acknowledgement by governments that nuclear power is an essential part of the path to net zero. Of the countries represented at the announcement of the pledge were 8 presidents and several senior ministers, each who stood up and stated the importance of nuclear power to their countries' net zero ambitions. This is a far cry from COP meetings as recently as 3 years ago where the nuclear advocates were not welcome within the government sanctioned blue zone (the blue zone is the area restricted to government authorized delegates while the green zone is open to the public).

This year at COP28, there were multiple booths within the blue zone focused on nuclear – including the IAEA, nuclear for climate, net zero nuclear and others . At each one of these there were events and panels discussing a variety of issues as

they pertain to meeting this pledge. There was a high level of interest from attendees in learning more about this low carbon energy source.

This was followed up later in the week by a Net Zero Nuclear Industry Pledge from over 120 members of the nuclear energy industry agreeing to work towards at least a tripling of global nuclear capacity by 2050. We will discuss the importance of this industry commitment further in a future post.

As COP28 came to a close, more history was made in the official Global Stocktake – that the world must transition "*away from fossil fuels in energy systems, in a just, orderly and equitable manner….so as to achieve net zero by 2050 in keeping with the science*." It then noted this should be achieved by "*accelerating zero- and low-emission technologies, including, inter alia, renewables, **nuclear**, abatement and removal technologies such as carbon capture and utilization and storage, particularly in hard-to-abate sectors, and low-carbon hydrogen production.*" This is the first time a COP has noted that fossil fuel use must be reduced and the first time nuclear is part of the solution.

Being in attendance at this historic event was a wonderous experience. After years of hard work by so many, we are seeing a strong government commitment to nuclear power as an essential part of the climate story. This commitment now sets the stage for government to follow up with policies to implement the pledge. The political climate for nuclear has never been better. After all, **in 2022 the world acknowledged that net zero needs nuclear – in 2023 it fully accepted it needs a whole lot of it**. Now begins the real challenge – delivering on this ambitious commitment.

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[1] United States, Armenia, Bulgaria, Canada, Croatia, Czech

Republic, Finland, France, Ghana, Hungary, Jamaica, Japan, Republic of Korea, Moldova, Mongolia, Morocco, Netherlands, Poland, Romania, Slovakia, Slovenia, Sweden, Ukraine, United Arab Emirates, and United Kingdom.

How do we solve the world's big issues if we are not interested in truth?

Making good decisions on issues of importance like climate change requires access to evidenced-based, truthful information. And yet we currently live in a world where there has never been greater effort to control people through misinformation. Unfortunately, more and more people simply don't seem to care.

Likely of no surprise to anyone, we have once again seen evidence of the current lack of public interest in truthful fact-based reporting, this time here in Canada. As a result of a new Canadian law requiring companies like Google and Meta (Facebook/Instagram) to compensate traditional media for posting or linking to their content, Meta has banned all Canadian news media from its platforms. Google is contemplating the same but has not yet implemented any change.

Source: istockphoto.com

Some background on how we got here. The Canadian news media has long had a revenue model that included both advertising and subscription revenues. The issue is that big tech (Google, Apple, Facebook and Amazon) are now the main beneficiaries of online ad revenue estimated at $9.7 Billion in 2020 (with 90% of this revenue going to just two companies), while the news industry has lost just over half its revenues over the past decade. The Canadian government has responded with Bill C-18, the Online News Act, in which big tech would pay news companies for their content. The result, big tech has said no – that they would just ban this content instead.

For us, the issue is not who is right and who is wrong (as this can be the content of a much larger discussion); but rather the fact that since Facebook has banned Canadian news sources, **its users, for the most part, don’t seem to miss it**

or care. After a month of blocking news, analysis has confirmed that "Daily active users of Facebook and time spent on the app in Canada have stayed roughly unchanged since parent company Meta started blocking news."

This should be the headline. The lack of interest in genuine news to keep people informed should have people outraged. Yes, there were complaints by users who could not share important safety information when their local communities were impacted by wildfires. Access to credible, timely information was critical for those whose very homes were at risk. But in the end, even public safety was not enough to get Facebook users to fight back.

Of course, this comes as no surprise to anyone these days. The lack of interest in truth is an ongoing topic. There are different reasons why this is the case. For some younger people, they simply have no interest in news. From "it just makes me feel bad" and "it has nothing to do with me", we have a demographic with little interest in what is going on in the world at large. Then, there are those that have made up their minds on the issues they think are important and only want to see input from those they agree with. Often, these are the folks who do not trust the media and think they are heavily influenced by the other side (whoever that may be). After all, social media algorithms are structured to keep user's interest in staying on the apps by delivering information they want to see. The truth is not one of the criteria.

This is part of a larger issue where we no longer trust experts to provide us with useful information as input to our decision making. As we discussed 5 years ago, in his book "**The Death of Expertise**: **The Campaign Against Established Knowledge and Why it Matters**", Tom Nichols, makes the case that America has taken freedom and liberty to an unrealistic extreme – that there is a common belief that everyone is equal and thus, so are their opinions. Experts are no longer respected to the point where "*we actively resent them, with*

many people assuming that experts are wrong simply by virtue of being an expert." He goes on "*The issue is not indifference to established knowledge; it's the emergence of a positive hostility to such knowledge.*" In fact, those that disagree with these experts are often lauded for having the courage to stand up to corrupt elites.

The reality is that a free press is a necessary pillar of modern democracies and is essential to providing accurate impartial information on issues of importance. And experts, by the very definition of the word "expert", are needed to understand and progress complex issues like climate change.

While people are arguing about who pays to enable news organizations to survive and thrive, government should be more concerned about the public's access to verified credible sources as part of the response to any search for information.

In an interesting article from last week's New York climate week, Bill Gates mused, "Are we science people or are we idiots?" A bit harsh – maybe – but sadly, a good question.

The California Duck Curve gets deeper – the challenges of high levels of intermittent variable renewable energy

A recent article caught our eye – "*Stanford study warns against overnight charging of electric cars at home*" in

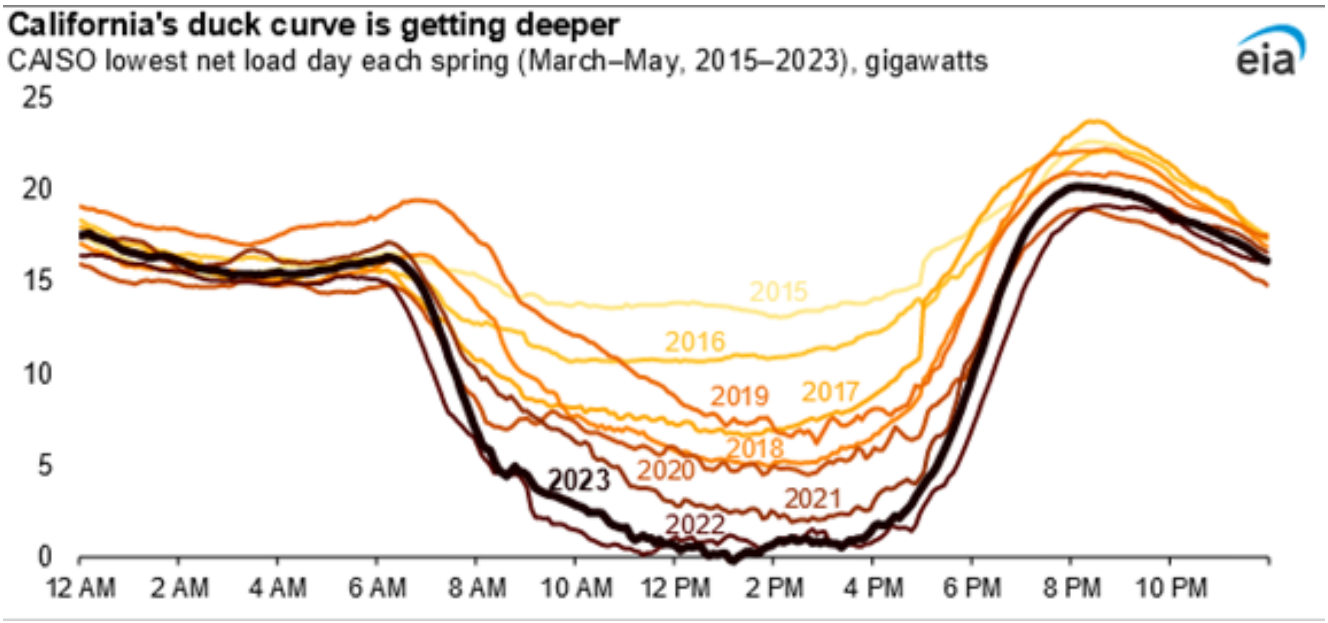
California. This study noted that most electric vehicle (EV) owners tend to charge their vehicles at home during the evening or overnight (which should come as no surprise to anyone), leading to significant costs for the electricity grid as California relies more and more on solar energy. It projects the rapid growth of EVs and their reliance on nighttime charging could lead to a 25% increase in peak electricity demand within a little over a decade. This study's solution, get people to shift towards daytime charging at public charging stations or workplaces. It goes on to explain that "*if more people charged their vehicles during the day at work or public charging stations, it could reduce greenhouse gas emissions (*presumably by avoiding gas usage at night*) and avoid the added costs of generating and storing electricity*".

Source: istockphoto.com

This is the beginning of an awareness of what happens when you rely too much on intermittent variable renewables for your electricity needs. It forces you to use the electricity when the sun shines (in this case) or the wind blows, which is not

necessarily when you actually need it.

California has had this issue for years. Due to a rapidly increasing amount of solar electricity, the net load on the system (total load less renewables) reduces rapidly in the morning when the sun comes up and solar power comes online, then increases again as the sun goes down and solar drops off. This has come to be known as the "Duck Curve", as the shape of the curve looks like a duck! What we see below is that the depth of the curve has continued to get deeper over the last eight years as California adds more and more solar power.



Source: https://cleantechnica.com/2023/07/07/california-duck-curve-getting-deeper-with-solar-growth/

Don't get us wrong, we like solar especially in sunny locations like California. Generally, solar plants produce about 15 to 20% of the time depending on location (based on the level of sunshine). Well, in very sunny California, the average capacity factor for solar is just over 28%. Excellent for this type of generation. This clearly has an important role to play in the generation mix.

But we also see that too much of a good thing can create new challenges. The cost to the system of being able to

accommodate this rapid change in load when the sun comes up and again when it goes down is large. Storage and other dispatchable sources of electricity (likely gas) are required to meet the needs the 70% of the time the sun is not shining. The duck curve also reduces the amount of time dispatchable conventional power plants operate, reducing their revenues, making them less economic to operate in the California market. If these plants are then retired without replacement, it becomes even harder to meet the needs of the system.

The other issue is grid stress. Grid operators need to drastically ramp up non solar generation as the sun sets, a very difficult thing to do. In the past, when we considered how big of a single generating plant a system could accommodate, we often used a simple rule of thumb that no unit should be larger than 10% of the entire system. Larger than that, the ability of the system to manage a unit outage would be compromised putting system reliability at risk. That is what solar has become in California. While you may think that there are many solar units in place, due to their intermittency, they operate on the system as one extremely large plant. They all come on at the same time when the sun comes up and they all go off at the same time when the sun goes down. What is the system to do?

We had a wonderful vacation in southern California this past July. Spent some time in Palm Springs where the temperatures were on the order of 45 to 47 degrees Celsius (~115 degrees Fahrenheit). I can assure you that we needed air conditioning as much at night as during the day.

Now imagine what would happen without having the back up needed. Storage is part of the solution but requires a huge overbuild of daytime capacity to both meet the day’s energy needs while also filling storage for other times. And mostly current storage technology is good for hours, not days or weeks creating issues for when the weather is simply not cooperating (two weeks of continuous rain for example) or to

meet seasonal load changes. The result is a growing consensus that firm dispatchable capacity also needs to be an essential part of any clean energy solution.

The Diablo Canyon nuclear plant in California produces energy about 90% of the time, in other words each MW of capacity of California nuclear produces more than 3 times the amount of energy in a year than the equivalent capacity of solar. That is what builds a resilient system.

I don’t have an electric vehicle yet, but when I do, I will definitely feel better knowing I can leave home in the morning with a full charge.

Achieving Net Zero – A global problem requires global solutions

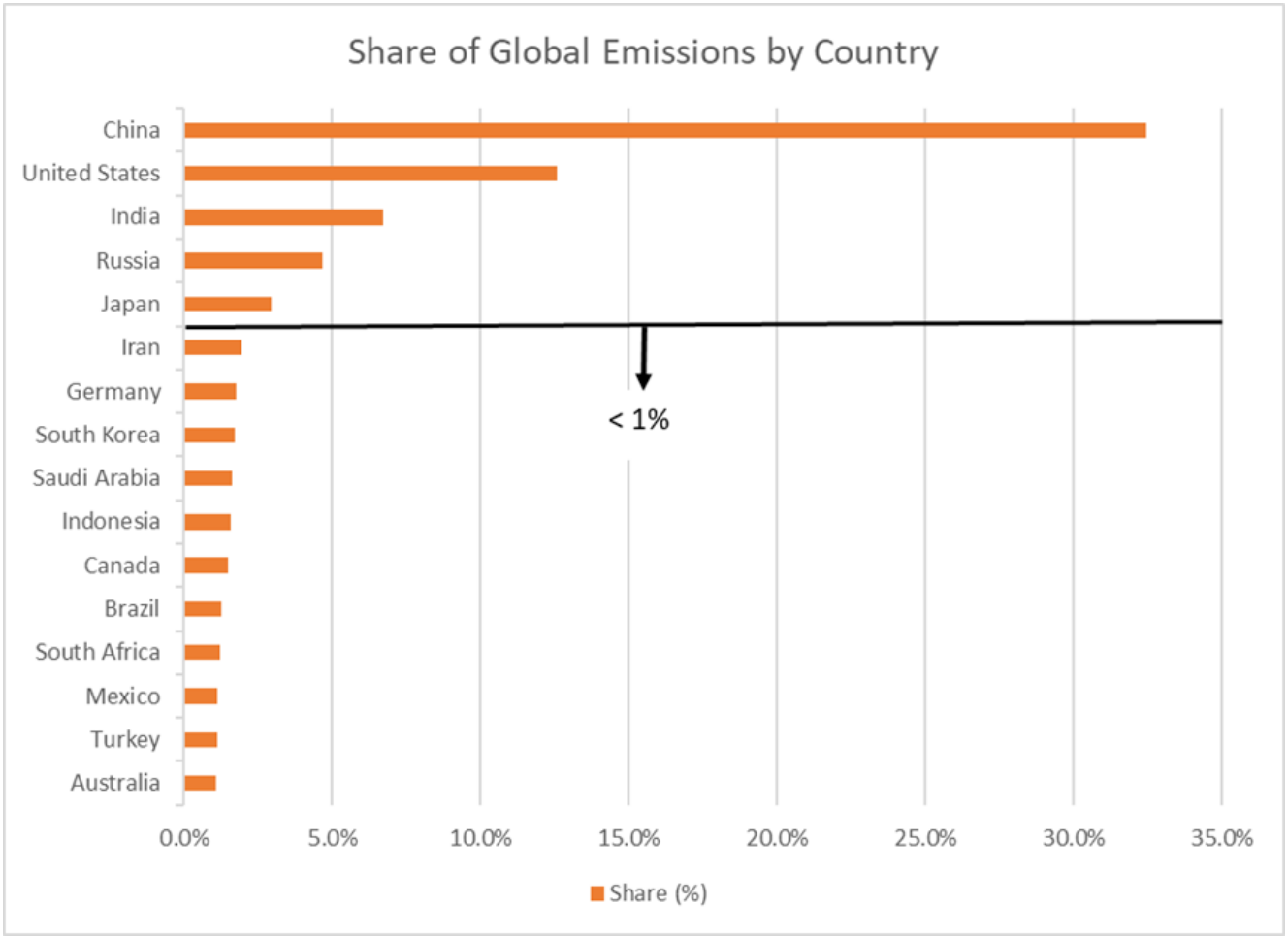
If you live in a relatively rich country (other than the United States), how often have you heard someone bemoaning government policies to cut carbon emissions say something like – “*since we only emit about 1% of global CO2, we could cut our emissions to zero, and it would make no difference. It is the large emitters like China and the United States who have to lead, not us.*”

Well, it is true that the United States and China account for about 45% of global emissions. But does that really mean that what the rest of us do doesn’t matter when it comes to combatting climate change?

Source: istockphoto.com

Global emissions are indeed concentrated in a very few countries. In fact, the top 5 emitters, China, United States, India, Russia, and Japan account for about 60% of global emissions (2020 data). China is by far the leader at about 32%. Continuing down the list, there are only 16 countries that emit more than 1% of global emissions with the remaining 195 or so countries in the world each emitting less than 1% of global CO2.

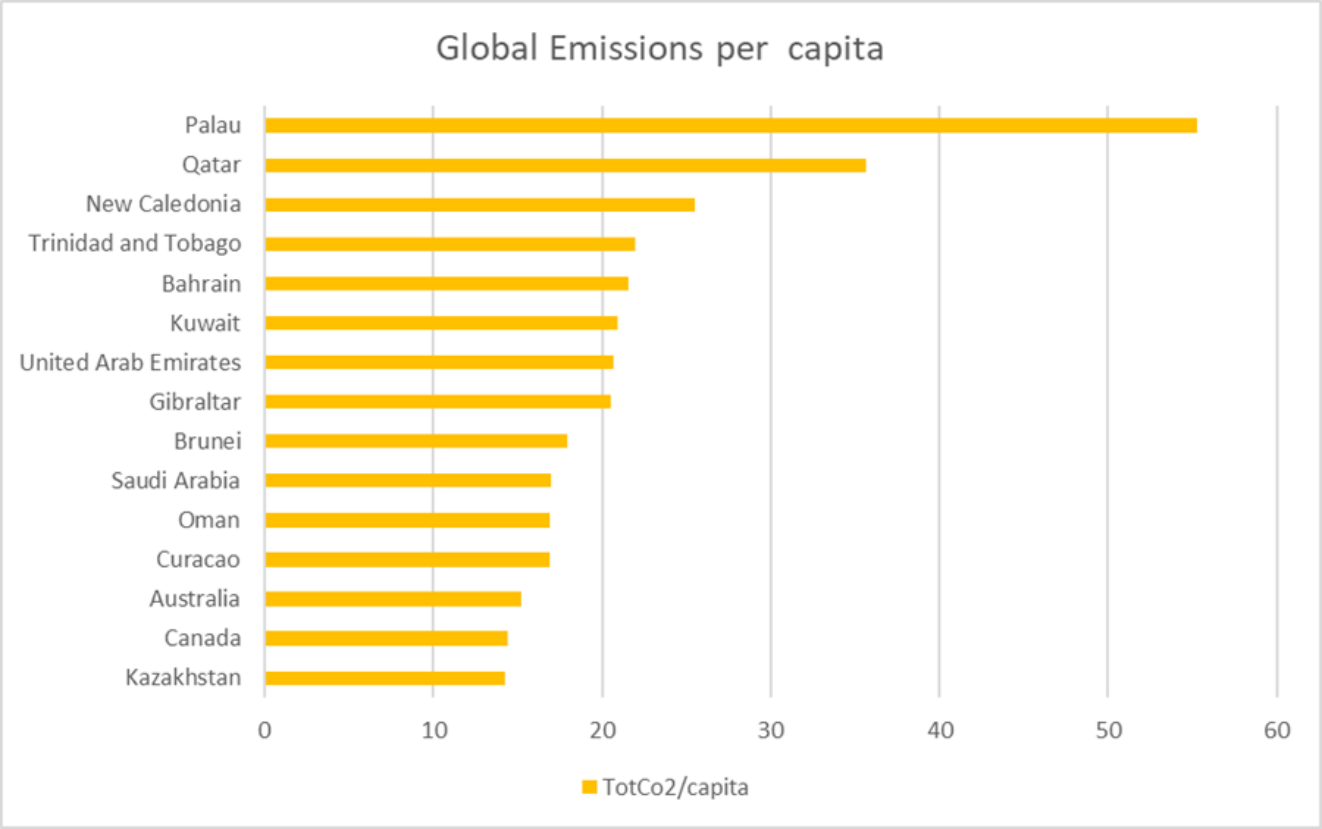
Does this then mean the rest of us need do nothing? Do we look to the top 5 emitting countries to do it all on the assumption that our efforts are just not worth the outcome? Of course not. At the simplest level, if we truly want to achieve net zero emissions, and assuming the biggest emitters do their part, then we can get 60% (assuming they go to zero) of the way there, but another 40% of emissions would remain. There would still be much more to do with each remaining country contributing a little bit. It is somewhat similar to replacing coal plants with gas fired plants. A big help, yes – they cut emissions in half, but then what?



Source: https://worldpopulationreview.com/country-rankings/carbon-footprint-by-country (Year 2020)

In any case, are emissions by country even the best metric when considering global policies to reduce carbon? What about individual emissions? It should come as no surprise that India and China are in the top 5 since about a quarter of the world's population lives in these two countries alone. Yet if we look at where individuals use the most energy (and are responsible for the most individual emissions) it is in the smaller population richer countries. In this case the top 5 are: Palau, Qatar, New Caledonia, Trinidad and Tobago, and Bahrain. Of the big country emitters, the US is 16th on an individual level, Russia 23rd, Japan 29th, China 35th and India is way down the list at 133rd. This means that those countries that emit the most may use less energy per person than others but simply have very large populations. Can we expect India to do the heavy lifting to reduce emissions when every Indian

used about 1/8 of the energy of the average American? Are small richer countries given a pass even though each resident emits a lot? Since access to affordable energy is directly related to quality of life, do poorer nations not have a right to a better life through using the same amount of energy of those in rich countries? (And of course, geography plays a part in energy use as does the current energy mix in each country, but this is beyond the scope of this discussion.)



Source: https://worldpopulationreview.com/country-rankings/carbon-footprint-by-country (Year 2020)

Of course. the largest emitters need to show leadership as they will have the largest impact. But we cannot expect them to reduce their emissions at a cost to their people's quality of life. And they cannot do it alone. Access to affordable low carbon energy including nuclear power is what is required for all the world's population to prosper. Climate change is a global problem that requires global solutions. And that means cooperation. So next time someone tells you that even if we in smaller emitting nations reduce our emissions to zero it will make no difference, disagree. We can choose to lead,

collaborate, or in some cases, even follow, but we cannot do nothing.

Nuclear project structures – it’s about managing risk

In our recent post on nuclear project financing, we noted the importance of reducing risk to investors to ensure projects can raise sufficient competitively priced capital needed to build them. Today we will discuss project structures. What are they and why are they important?

The project structure is how the project is organized contractually to build the plant and then sell the electricity to the market. Good structures help the project to succeed while poor ones end up with lawyers arguing where to lay blame rather than people delivering on their commitments.

Source: pexels.com

There are four major categories of participants in a large energy project.

- The customer – who needs the energy and pays for it to be reliably delivered to their home or business;
- The owner/operator (yes these can be separated, but we will keep them together for simplicity), who is responsible for building and operating a generating station to provide the energy to the customer;
- The contractor(s), who have technology, design, and construction capabilities to build the plant; and
- The investors, who provide the funding to support this construction and who will be repaid during plant operations when there are revenues from selling electricity.

When talking about contractual structures, the primary relationships are between the owner/operator and the customer (market structure); and between the owner/operator and the

contractor (project structure).

There are a whole range of contractual structures for both relationships. Some are simple and some are complex. None are perfect. Historically, electric utilities tended to be vertically integrated monopolistic companies, often owned by governments, who were charged with delivering electricity to customers at low cost. Utilities carried most project risks and passed them on to the customers. A government regulator was charged with setting rates for customers (while looking out for their best interests) based on the utility costs and performance.

Poor project performance and a belief that competition would incent better results led to a shift to deregulated markets in many jurisdictions in the early 1990s whereby the utilities would be broken up and generators would have to compete to sell their electricity to the market. (We wrote a previous post on why these deregulated markets do not work well for building new low carbon generation.)

Being forced to take on more risk by their customers, owners wanted more certainty of outcomes and believed contractors, as the experts in performing the work, were in the best position to take on these risks. Wanting this work, contractors agreed to take on more project risk, for a price. This provided a sense of security to the owners that their risk was limited, and that they could rest easy, knowing it would be up to others to ensure successful project delivery.

Unfortunately, this has been proven to be nothing more than an illusion. In reality, the contractor’s ability to take on additional risk is limited and when project costs increase, they will generally make a claim for a change in scope requiring additional funds. This often results in contractual disputes that slow down project progress and negatively impact company relationships. In the end, there is no escaping the project risks for the owner, as it is their project and their

money. After all, there is no scenario where the contractor fails, and the project succeeds.

The lesson is that when developing project structures, the objective is to manage risk while incentivising the behaviours from the project stakeholders necessary for project success; not to decide who suffers the most in the case of failure. Because for **long term commercial success**, there is one truth. All costs must be borne by the customer. There is no one else (unless government provides a subsidy in which case taxpayers are involved which is a different discussion – we will talk about the potential role of government in mitigating risk in a future post). When the investors state that they do not want to be exposed to excessive risk, what they mean is that they want a credit worthy borrower who can reliably replay loans and deliver a return on equity. And while ensuring they are contractually protected from risk is important, the best way forward is to confidently deliver projects to cost and schedule.

This is changing the way that projects are structured to more collaborative models whereby all parties' objectives are aligned, and everyone sinks or swims together. Good project contracting is important in defining the project, but on its own is insufficient to ensure good project outcomes. Successful project delivery results from good project planning, doing enough work upfront to set a realistic cost and schedule; and excellent project management, supported by a high level of transparency together with a strong set of project metrics to enable informed rapid decision making to keep the cost and schedule under control. Continuously improving the ability to deliver successful projects to cost and schedule will ensure that nuclear power can meet its full potential on the road to a Net Zero future.

In 2022 the world acknowledged that net zero needs nuclear – in 2023 it will realize it needs a whole lot of it

Early last month, Vogtle Unit 3, the first new nuclear plant to be built in the United States in decades, went critical, meaning it started to nuclear fission and move down the path to producing its first electricity and becoming operational. This was great news as the project has had a troubled history of delays and cost overruns. Once fully operational the Vogtle site will have four operating units and be the largest nuclear operating site in America.

But this was not the most important nuclear news coming out of the US this past month. On March 21 the US Department of Energy released its "*Pathways to Commercial Liftoff*", a set of reports to strengthen engagement between the public and private sectors to accelerate the commercialization and deployment of key clean energy technologies. This included a report on "*Pathways to Commercial Liftoff: Advanced Nuclear*" in which the DOE estimated a need for an additional 200 GW of advanced nuclear by 2050 on the path to net zero. This is a huge change from the past (equivalent to tripling the current fleet) when most felt that nuclear would struggle to play an important role in the country's future.

Source: istockphoto.com

And the US is not the only country to set huge nuclear ambitions. In December of 2022 in Canada, the Ontario Independent Electricity Operator issued a report, ”Pathways to Decarbonization”, in which it suggested Ontario may need another 18 GW of new nuclear to complement its current 14 GW fleet.

In the UK, the government has set a target of 24 GW of nuclear by 2050 delivering about 25% of UK demand. In France, work is underway to deliver 6 new EPR units followed by another 8 by 2050 for a total of about 22 GW of new nuclear.

Meanwhile South Korea, after suffering an administration that wanted to phase out nuclear energy, is planning to expand its nuclear fleet in its *10th Basic Plan for Electricity Supply and Demand (2022 – 2036).* The plan includes 6 new 1.4 GW units coming into service and nuclear reaching 34.6% of electricity generation by 2036 as coal use declines. And even in Japan, 12 years after the accident at Fukushima caused by

the Great Tohoku earthquake and tsunami, has adopted a plan to extend the lifespan of nuclear reactors, replace the old and even build new ones as part of its commitment to fighting climate change.

This commitment to large new nuclear fleets is not only by countries that have nuclear power, but even those just planning their first plants. For example, Poland, Europe's largest coal burning country, is planning at least 9 GW of new large nuclear plus a range of small nuclear power plants by 2040.

Why is this important? In the last year more and more governments have accepted that nuclear power must be part of any climate plan that achieves net zero targets by 2050. Nuclear was accepted (albeit marginally) in the European taxonomy as a low carbon technology, the UK is defining nuclear as green, and many other governments have noted there is no path to net zero without nuclear.

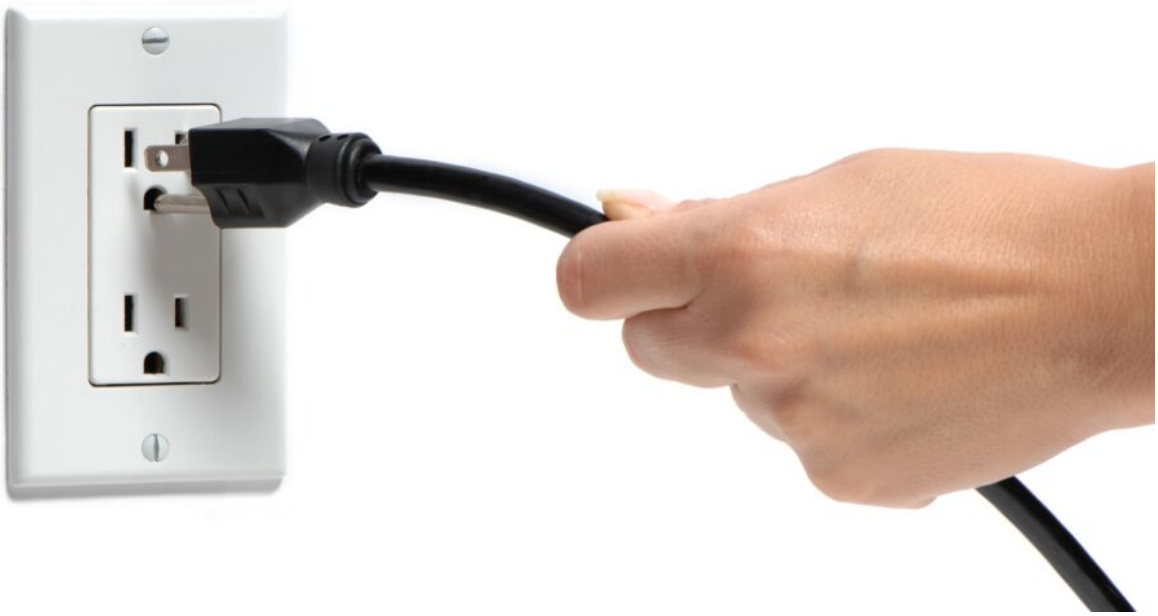
And then there is the war in Ukraine increasing concerns about energy security to a level not seen in many years. This is hastening the movement away from fossil dependence which further supports the energy security strengths of nuclear power.

So, if 2022 was the year that governments around the world finally embraced nuclear power as a necessary part of the path to net zero, 2023 will be the year they start to accept this means building a whole lot of it, expanding the global nuclear fleet at a pace and scale not seen before. What does this mean for the global nuclear industry as it readies itself for this massive increase in demand? This is a topic for another day.

Closing perfectly good nuclear plants before their end of life – it's a sin!

In March, Kuosheng Unit 2 became the latest nuclear unit to be retired following the expiry of its 40-year operating licence in accordance with Taiwan's nuclear phase-out policy. This is the fourth unit to be shut down in Taiwan leaving just two more operating units at Maanshan. When their licences expire in 2024 and 2025, the island's phase out will be complete, taking its once 20% nuclear share down to zero. And as has been the case with most other nuclear plant closures around the world, its output will be replaced with fossil fuels, adding carbon emissions at a time when we are all trying to reduce them. Taipower has reassured its customers there are numerous new gas-fired power generation projects and even new coal-powered units being brought online this year to make up for the energy lost as a result of its unnecessary nuclear phase out.

Of course, Taiwan is not the first to go down this path. Over the last few years, there have been a number of plants that were closed before their time. In the US, it was primarily due to competition from low-cost gas in deregulated markets. In Europe and Asia, it was simply a result of government anti nuclear policies. Today as we pass the 12th anniversary of the Great Tohoku earthquake and tsunami in Japan, that also triggered the Fukushima nuclear plant accident, things are changing rapidly.



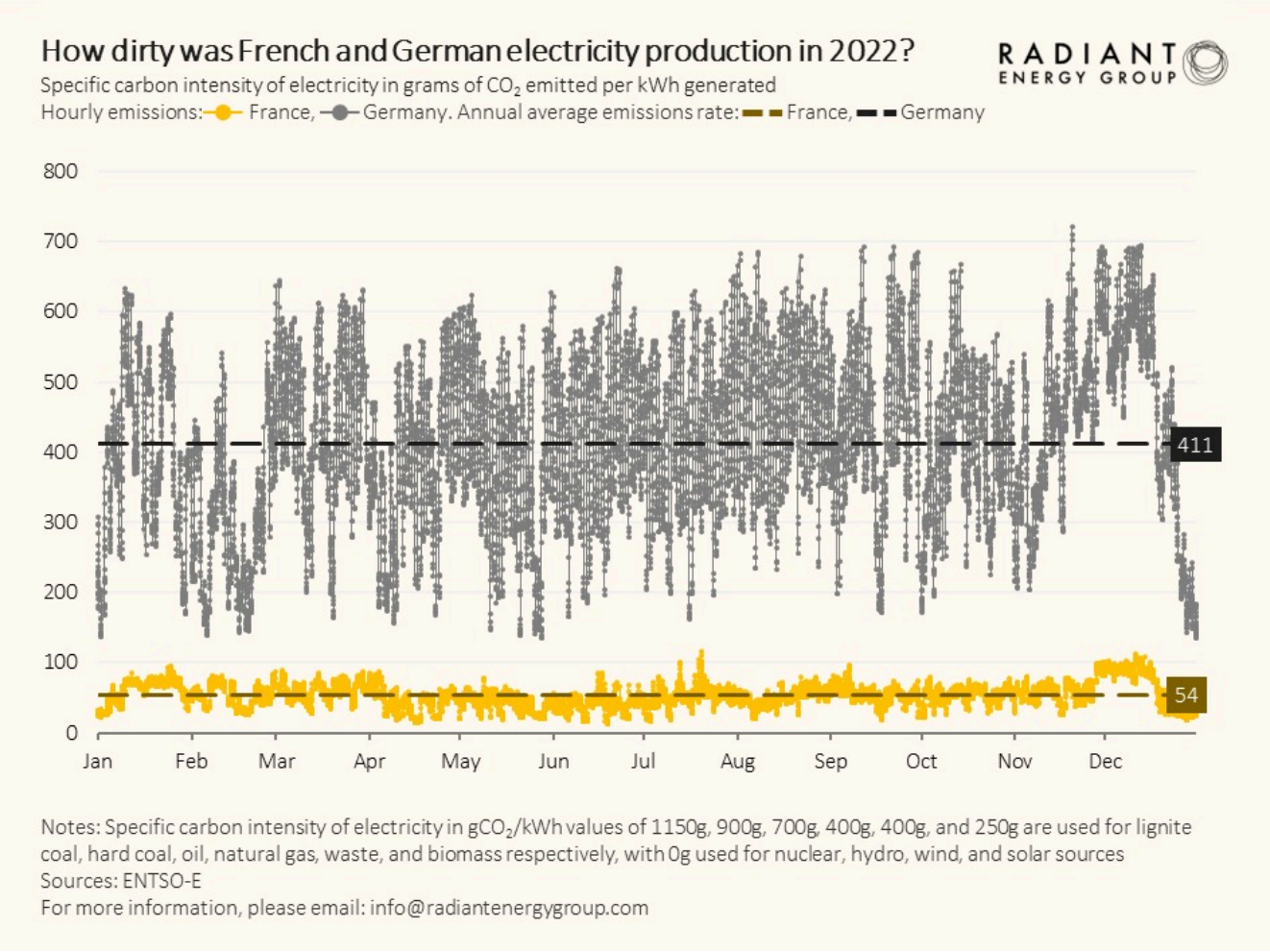
Source: istockphoto.com

Why? There are two urgent drivers to the revisiting of nuclear power. First and foremost, is the energy crisis in place in Europe due to the war in Ukraine. When energy security is at risk, people respond, and respond quickly. And then there is climate change. With more and more countries setting net zero goals, it has become crystal clear that nuclear must be part of the mix. We have never been more optimistic about the future of nuclear power playing an essential role in a decarbonizing world.

As we have said many times before, deciding not to continue to use nuclear power is the right of every sovereign nation. However, if you believe you have better options, build them, then shut down the old plants. What we have seen is the opposite. Closing nuclear plants in Germany, emissions go up, close Indian Point in New York, emissions go up, close San Onofre in California, emissions go up. Belgium plans to close its nuclear fleet and replace it with gas, emissions will go up. And so on and so on and so on.

It took an energy crisis in Europe for the penny to drop. Closing perfectly good plants that emit zero carbon without having something better to replace them is folly.

Progress has been made. After seeing about 10% of its operating units close, the US started saving units through state legislated support, and now is ensuring nuclear remains an essential part of its carbon reduction strategy with provisions in the recent federal Inflation Reduction Act (IRA). Even when it was generally thought to be too late to save Diablo Canyon in California, common sense prevailed. Belgium has agreed to run its two newest plants another decade and is considering minor extensions for its older units. Korea has recovered from its period of anti nuclear policies and is once again moving full steam ahead. Japan, a decade after the Fukushima accident is recommitting to nuclear power. Even Germany is contemplating extending its final units' lifetimes, even if only by a very little bit.



We now have enough experience with the early movers who have hoped to decarbonize with renewables alone. Germany has spent two decades and over $500 Billion dollars and made little

progress on its emissions reduction goals. Its huge investment in renewables has not been sufficient to overcome the impact of shutting down most of its nuclear fleet. The chart above shows that in 2022, France, with its mostly nuclear fleet emitted about 8 times less carbon than Germany. The evidence is in. Trying to decarbonize with renewables alone is simply not feasible.

But the worst offences remain shutting down perfectly good operating plants before their time. There are 437 nuclear units in operation around the world producing about 10% of the world's electricity. Yet they also represent the second largest source of global low carbon generation after hydro. Add to that, as stated in the IEA/NEA Projected Cost of Electricity 2020, life extending nuclear plants is the single lowest cost option of any type of electricity generation. No surprise. If something is capital intensive, as nuclear power is, then it makes sense to maximize use of the asset once you have the capital behind you.

So, for all those countries thinking about closing well operating zero emissions nuclear plants before their time, remember what the Pet Shop Boys have said many years ago – It's a Sin!

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Financing nuclear power – some basics

We often hear that financing is a major issue for nuclear projects that creates significant impediments to new projects moving forward. There are myriads of thoughts and ideas on how to fix this, from various clever project contractual structures to identifying new non-traditional sources of funds. But other than stating "financing nuclear projects is difficult", what are the issues? After all, we can't solve a problem if we don't fully understand it. For this post, we are not going to talk about solving problems. Rather in the first of a series of posts on financing, let's start by understanding some of the basics.

Source: pexels.com

The reality is there is lots of money in the world looking for good places to invest. So, the question becomes – are nuclear projects attractive to investors? To answer that question,

let’s not think about financing as an input to developing a project, let’s consider it as an outcome. In other words, if we successfully structure a project, getting the risk profile right, with an appropriate revenue stream; then our nuclear project should attract the necessary funds to proceed.

Fundamentally attracting investment is all about managing risk. Investors want to put their money into investments where they understand the risk and are then appropriately compensated for taking on this risk.

What are some of the key risks related to a new nuclear project?

1. Size – these projects are generally very big and require large volumes of funds. Projects in excess of $10 billion are common.
2. Duration – nuclear plants take a relatively long time to build (6 to 10 years) meaning there is more risk of things going wrong before the plant is completed and the asset starts to generate revenue.
3. Credit worthiness of the owner/operator – Only the largest companies have the capacity to raise the volume of funds required on their balance sheet. Even the largest nuclear utilities often seek out partners to raise all the funds necessary for large nuclear new build.
4. Project performance – there is a history of large infrastructure projects (not just nuclear plants) struggling to be completed on time and on budget – with numerous examples of projects taking years longer and being completed at much more than the original planned costs and schedule.
5. Political risk / bias – there are many governments and other nongovernmental actors that work to ensure nuclear is unable to raise capital on ideological grounds.
6. ESG – there is growing interest in ensuring capital

flows to environmentally sustainable and ethically run projects. There are those that do not think nuclear is ESG compliant.
7. Operating performance – as a mature industry there is good experience with plant operations and as such, nuclear operators are generally able to raise the funding needed for ongoing operations.

What does this all mean? There is much work to do to successfully finance new nuclear projects that can include:

1. Reducing the size and duration of the project – this is one of the primary goals of Small Modular Reactors (SMRs) – to reduce project risk by making them smaller and faster.
2. Structuring the project to reduce the risk to investors – we hear of many ideas for project structure that allocate less risk to investors, moving the risk to industry, government, or the customer, depending upon the model.
3. Ensuring the environmental attributes are recognized and that governments support nuclear as a sustainable option for the future – being excluded from the sustainable finance market greatly reduces the funds available – the long battle to get nuclear into the European taxonomy is testament to how those opposed try to ensure funding is made unavailable to nuclear projects.
4. Developing knowledge and capability in the financial community to be able to understand and assess nuclear projects.

Most of all, it is about project performance. If investors know that the project is likely to deliver on its financial projections, there will be interest to participate. This does not solve everything, as managing political risk and raising large volumes of funds will always create challenges.

What we do know, is that more and more countries agree that nuclear is needed to achieve their net zero 2050 goals and to address energy security issues. This is resulting in a renewed interest for new nuclear that will literally require trillions of dollars to deliver in the decades ahead. We will talk further about some of the solutions above and their impact in more detail in later posts.