Achieving net zero requires building all low carbon technologies including lots of nuclear

In its 2022 report on the role of nuclear power in fighting climate change, “*Nuclear Power and Secure Energy Transitions*”, the International Energy Agency (IEA) says “***Nuclear energy can help make the energy sector’s journey away from unabated fossil fuels faster and more secure***.”

It goes on to clearly lay out why nuclear power is so important to a clean energy future noting that achieving net zero globally will be **harder** and **more expensive** with less nuclear.

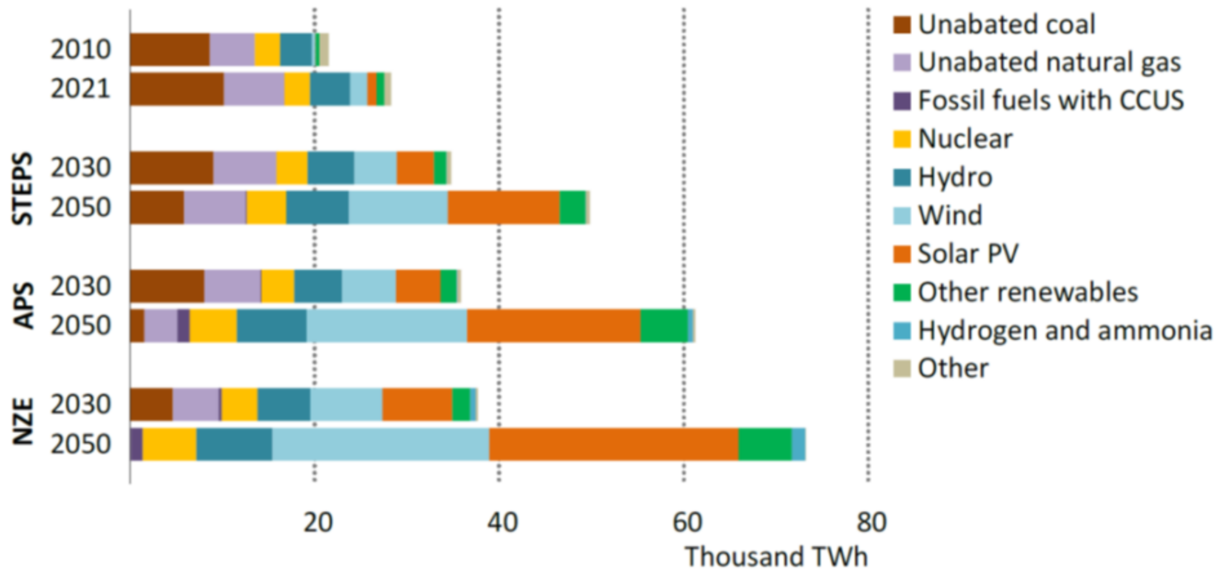
Source: Pexels.com

The report also notes there are challenges to further nuclear deployment emphasizing the importance of continuing to reduce costs and ensure projects are built to cost and schedule. These are indeed justifiable issues and there is no doubt the industry must perform for long term success.

While the IEA may say nuclear is important for net zero, this has not resulted in projections for a large new nuclear program. Rather, as is shown in the 2022 World Energy Outlook (WEO 2022) just released from the IEA, the role for nuclear remains modest. Yes, there is a doubling of nuclear capacity to 2050, but because of continued electricity demand growth the nuclear share falls from 10% of global electricity supply to only 8% in its Net Zero Scenario.

On the other hand, renewables are projected to account for the majority of capacity additions over the outlook period (to 2050). In the base STEPS scenario, wind and solar PV together set new deployment records every year to 2030 and then continue with increased annual growth through to 2050. For the IEA Net Zero scenario, wind grows by a factor of 12 and solar even faster with 27 times more solar in 2050 than in 2021. The assumption when it comes to renewables growth is that there are no limits. No concern about land use, or volume of critical materials required, or how storage technology will develop to support increasing the share of renewables from its current 28% of electricity supply to 88% of a larger global electricity system. Yet we know from experience in Germany, California and others where variable renewables have successfully achieved a relatively high share of electricity supply, that system reliability suffers, often requiring fossil fuel back up to support their intermittency.

Figure 6.7 ▷ Global electricity generation by source and scenario, 2010-2050



Electricity generation from unabated fossil fuels peak by 2030, as low-emissions sources ramp up and renewables dominate electricity supply in all scenarios by 2050

Note: Other renewables include bioenergy and renewable waste, geothermal, concentrating solar power and marine power.

Notes: STEPS (Stated Policy Scenario), APS (Announced Policy Scenario), NZE (Net Zero Scenario)
Source: IEA World Energy Outlook 2022

To be fair, we don't blame the IEA for their views. Based on recent experience in western countries with little ongoing nuclear new build and projects that have gone over budget and schedule, it may be difficult to see a path for more rapid nuclear growth. But that certainly doesn't mean there shouldn't be a challenging goal. Just look at China that has built over 50 GW of nuclear capacity in the last 20 years and has approved 10 new large reactors this year alone. In the west we have examples as the US built about 100 units and France built a fleet of 59 units in less than 30 years. Twenty years ago, there was little confidence in the ability of renewables to scale and here we are today, now assuming almost unlimited growth given their success. Just as with renewables, increasing the scale and pace of nuclear new build as we have achieved in the past is also possible given the political will.

There is an international study that considers a more balanced growth for all the clean technologies. UNECE (United Nation Economic Commission for Europe) has recently released its report "*Carbon Neutrality in the UNECE Region Technology Interplay under the Carbon Neutrality Concept*" which takes a fresh look at how to use a broad range of technology, both existing and new to meet its net zero challenge.

This report finds "*there are achievable pathways for governments to design and implement a carbon-neutral energy system through technology interplay.*" In its carbon neutrality innovation scenario, UNECE considers the potential of three innovative low- and zero-carbon technologies: a new generation of nuclear power, CCUS, and hydrogen – to deliver on carbon neutrality. In this scenario nuclear grows to 3.4 times its current base in the region by 2050 (as opposed to 2x by IEA*) and reaches 27% of energy supply (compared to 8% by IEA*). It also notes challenges with all technologies. For example, it predicts 4,430 TWh of solar power in the region by 2050 (compared to the 27,000 TWh globally in the IEA net zero scenario) and notes this requires 7 million utility scale panels covering an area equal to 2.8 million football pitches equal to the entire surface area of Belgium.

There is little doubt the challenge of achieving net zero emissions in our energy systems by 2050 is enormous. Given the view to electrify everything, electricity use will at least double. To meet this growth, it has been generally accepted that nuclear power has a critical role to play, but the size of that role remains in question. Concerns about the industry's ability to deliver has limited its potential in many studies such as the IEA WEO 2022. However, UNECE has taken a different approach and explored a more rapid expansion of all low carbon technologies, rather than assuming wind and solar can do all the heavy lifting. This seems a more viable model. Get all technologies growing as fast as possible to ensure the primary goal of carbon neutrality is achieved. We only have one world, and we need to build all low carbon technologies as quickly as we can if we really want to reach our climate goals.

* *It should be noted the UNECE projects are limited to the UNECE region and the IEA projections are global.*

Keeping the lights on is of critical importance for a prosperous future

We previously talked about energy security and the impact on global energy markets resulting from the crisis in Ukraine. In that post we discussed energy security from the traditional perspective of risk of disruption in global energy flows as a result of geopolitical issues. Today we will expand upon the concept of energy security to go beyond the political and address the technical issues that impact our ability to deliver energy reliably to consumers. For society to truly prosper, we need strong **reliable** and **resilient** energy systems.

Source: pexels.com

System reliability – means a system (or grid) where electricity flows can be counted on to be available when required – i.e., customers need confidence that when they flip the switch, the lights come on, and stay on. Given that electricity supply and demand must be always in balance, our very reliable electricity grids are nothing short of an engineering marvel. Expert planners design systems where supply adjusts to changes in demand as needed, and that can tolerate most supply disruptions (outages – both planned and unplanned) without impacting customers. Some simple rules of thumb (actual system design is quite complex) suggest no single generating station should be larger than 10% of the capacity of the total system and grids should have 15% or more excess capacity to accommodate outages.

Somehow, over the past years, attention to this very important objective seems to have been diluted as the focus shifted to emissions reduction and market deregulation. Therefore, in some jurisdictions, system reliability has suffered due to a too rapid increase in intermittent variable renewable generation that needs dispatchable back up, and poorly designed electricity markets that focus on cost above all else with real time energy markets.

Renewables present two major challenges to system planners. First, their intermittency and reliance on weather complicate system design to ensure there is sufficient back up supply for when the sun doesn't shine, and the wind doesn't blow. We have seen, as stated in an article by Robert Bryce, where an excessive focus on renewables just doesn't make sense. For example, in hot climates like Texas, the times when you need the most energy are also going to be the times when you have the least wind. That's just how the weather works.

And the other, less talked about issue is that even though there may be large numbers of solar panels or wind turbines in operation within a given jurisdiction, they actually behave on the system as one very large super plant. Hence the famous "duck curve" in California where all solar panels come on at once when the sun rises in the morning and then all go off when the sun sets. This causes additional stresses for reliability planning as the system tries to respond to these large sudden changes in supply.

We talked about the issues with deregulated market pricing in a previous post noting that least cost does not necessarily mean most reliable. And now as we did then, we will recommend reading Meredith Angwin's book, "*Shorting the Grid*."

System resilience – which is related to how well the system can withstand external events that may cause it to go down such as extreme weather or other man made events. This concept took hold post 9/11 when the concern was how to harden power plants against potential terrorism. More recently the issue has been extreme weather such as hurricanes, tornadoes and wildfires that have forced systems down and damaged them to the point of disaster. The unfortunate thing is that the same jurisdictions we listed above, Texas and California are also suffering from these kinds of extreme weather events, that are challenging the ability of their systems to operate reliably.

This is where nuclear power can play an important role. Nuclear power's high energy density, low carbon emissions, highly reliable operations and built-in resilience can provide the stable energy source we need. It is one of the reasons law makers in California have provided overwhelming support for a bill to keep the Diablo Canyon nuclear plant operating at least another five years, once thought impossible.

Having reliable affordable access to abundant energy is one of the tenets of a prosperous society. Our lives are much better for it. A public threatened with losing this reliable access will not respond well. We have become so used to having a reliable grid that we now take it for granted. However, assuming it will always be, misunderstands how complex an electricity grid actually is. It's time to go back to basics and ensure that system reliability and resilience are the cornerstones of our energy systems. Given the need for a stable baseload 24/7 supply, nuclear power has an important role to play.

The World Nuclear University Summer Institute is back – and I am just so happy

I recently returned from making my modest contribution to the World Nuclear University (WNU) Summer Institute (SI) in Spain. I was so excited to be able to attend in person!! I wrote about this great program after the last summer institute in Romania back in 2019. At that time who knew we were about to enter a global pandemic that would make in person events impossible for the next two years?

It has been a dark time for us all. Crisis after crisis – pandemic, war, inflation and economic uncertainty, political upheaval. It has been easy to have a negative outlook. No sooner does it appear that one major world event is finally in the rear-view mirror than the next one takes hold.

WNU SI 2022

A reminder of what the WNU SI is as stated on its website. *"Built on a foundation of instruction from the world's leading nuclear experts, World Nuclear University's annual immersive,* *five-week leadership development programme brings together nuclear professionals from around the world to share knowledge and broaden horizons. Through a mix of taught lectures, mentored group work, industry-focused projects, and technical site visits, Summer Institute Fellows will improve their leadership capabilities and team effectiveness.*"

This year the SI included 70 fellows from 30 countries. These are young bright people who are not only expert in their own areas of the nuclear industry, but who are kind, hard working and most of all, respectful of each other. I saw people from different backgrounds and cultures helping each other learn as they make friends for a lifetime. Asking deep penetrating questions to the experts providing the lectures and working together with their mentors in groups to discuss interesting issues that make this industry what it is. The most important part of the WNU SI is community building – a strong global community of nuclear advocates who want to collaborate to build a better future for us all.

This is not the first time in the last year we see the future of this industry. We reported following the COP26 meetings in Glasgow last year how the young generation truly made a difference. Now we can see this generation working together to continue to hone their skills as they prepare themselves to be the industry's future leaders.

I want to thank all the fellows who welcomed me to this year's SI and took the time to listen, ask questions and generally build a long-lasting relationship. I am so proud to have been a small part of the WNU for the last 15 years and hope to continue well into the future. Most of all I am happy to know this industry attracts the world's best and brightest, those needed to make sure our shared future is a world with a sustainable environment and abundant clean economic and reliable energy. As this year's program comes to a close, we can be confident that the future is in very capable hands.

(Note: The “I” in this post is Milt Caplan.)

Deregulated electricity markets don’t support a viable energy transition

In the early 1990s, deregulating electricity generation seemed like a good idea. Led by the UK, many markets rushed to dismantle their vertically integrated electric utilities with the goal of creating competition to benefit their customers, the electricity using public.   The view was that utilities had become fat and lazy and since they were mostly able to pass on their costs through a regulated pricing system, they didn’t do their best to keep prices low. Competition would remove the fat.

Fast forward 30 years or so and much of the world has followed this path. There is a large relatively integrated European electricity market, the UK continues to operate its market and there are multiple states in the United States that operate this way. But is it working – and of more importance – is this the right path to support the transition to a low carbon energy system?

Source: iStockPhoto.com

To fully answer this question is a subject that requires a much longer discussion than is possible in a blog post. We will address some of the issues and explain why we believe large scale market redesign is required. For another excellent perspective we strongly recommend the book “*Shorting the Grid*” by Meredith Angwin that clearly explains how the current US deregulated model is failing the customer while reducing the reliability of the electric grid. Read it – please.

The original concept was sensible. Create competition in the electricity market to force electricity generation companies to become more efficient (In most cases transmission and distribution were not deregulated). It seemed to work in telecom. Why wouldn’t it work in electricity generation? And at the beginning it did work. Government owned electricity companies were sold off and broken up. New generating companies competed with existing companies and yes, the result was improved operations of the existing generation fleet.

The markets were mostly created as **energy** markets, where generators competed on marginal cost of production (variable operating and fuel costs) in basically real time markets to sell electricity. All that mattered was the price of electricity at any given moment. This was happening at about the same time as gas was ascending to be a major player in electricity generation both in the US and in the UK. Each generator would bid into the market at its marginal cost. The market would accept bids at the lowest cost available and continue to accept higher prices until the demand was met. The market price was the energy cost of the last generator who bid, and all participants received this price (the clearing price). When demand was high, the last bid accepted was usually gas generation which has the highest marginal cost of production and this price seemed to be enough to keep the other players with lower marginal costs but higher fixed costs content.

Then three things happened that started to change the equation.

First, at least in North America, the price of gas fell dramatically so that the only technology actually making money were gas generators. Their marginal cost had become very low given the low cost of gas and other forms of generation could no longer survive at that price. Hence the current situation where nuclear plants are closing before their end of life as they struggle to compete at very low gas prices. The US government has just launched a $6 Billion program to help save these plants. Market supporters may say – who cares? The market is the market. If gas plants are the lowest cost, then just run gas plants. And yes, that is certainly an option if a single source electricity system based on 100% gas is deemed acceptable. But if the objectives of the system are broadened to include diversity of generation for security purposes or to mitigate the risk of volatile fuel prices (yes, gas prices can and do go up), or to lower carbon emissions, then change is required.

Second, having an **energy** market only made it impossible to build new **capacity**. Since everyone was operating on marginal cost, there was no possibility to recover full costs – which is needed to support new plant investment. The solution was to create **capacity** markets. Payments would be made for capacity based on a bidding process so that low-cost capacity would be added to the system. Once again, in most jurisdictions, gas came to the rescue. The cost structure of a gas plant is just right for this type of market. The capital to build a plant is relatively low. Once the capacity is paid for, you only operate the plant when the energy is needed, at an energy cost that covers the marginal costs (which is primarily based on the cost of fuel).

The issue with this market structure is that gas generators were always price makers, and all other technologies were price takers. In other words, the business of electricity generation for all other technologies became a competition with gas. While these technologies made or lost money based on this competition, gas generators were always whole, no matter the price of gas. In effect, gas generation is pretty much a risk-free business in this market structure. Consumers are happy as long as gas prices are low – but will be very unhappy when prices rise.

Next, countries committed to decarbonization goals and started to support adding low carbon electricity, primarily intermittent variable solar and wind power on the system. To get these to work, subsidy was required both for price and to ensure the market takes the output of these resources when they produce, when the sun is shining and the wind blows.

To keep this story short, this structure made it near impossible for any other technology than gas or subsidized renewables to be built. Other projects were just too risky, especially those technologies like nuclear power where the bulk of the cost of energy is based on their capital investment. Even though a nuclear project is projected to be economic, once built, the price of the alternatives may change in the future so that the plant becomes unprofitable. Or in other words, no matter how successful and low cost the project, the risk of having to compete with daily changes in gas prices would be unmanageable. The solution was once again to contract outside of the market. Power purchase agreements, contracts for difference (Hinkley Point C) and other approaches were developed to support these types of projects. The result, more complexity, and complexity tends to increase costs. That is why we see the Sizewell C project in the UK moving to a Regulated Asset Base (RAB) model, to simplify the project structure and keep costs lower. (We will talk about this model in a future post.)

The reality is that data from the US DOE Energy Information Administration (EIA) show that customers do not benefit from these market structures. 2020 data shows that customers in deregulated states pay on average about 23% more for electricity than those in regulated ones. And while most states remain regulated (about 32 to 19), when you consider the actual amount of generation under both regimes, it is much closer to half of US generation is deregulated and half regulated.

Back to the point of this post. If you want to ensure grid stability, the markets need to change. If you want to encourage diversity of generation, the markets need to change. But most of all, a completely new structure has to be developed because the low carbon options (wind, solar, nuclear, hydro) have relatively high fixed costs and near zero marginal costs making an energy cost based market unworkable. For these forms of generation, a market structure based on recovering fixed costs is required.

If we really want to work towards net zero carbon emissions, now is the time to re-imagine how we are going to generate electricity and pay for it. One thing is certain. The existing deregulated model in place in many jurisdictions will not take us where we need to go and the longer we take to accept that, the longer it will be to reach our carbon goals.

The nuclear industry approach to managing waste is a model for all

This month, as we continue our short series on energy economics, our focus is the nuclear industry's commitment to safely managing its wastes. More specifically how this commitment ensures the cost of managing waste is included in nuclear power economics and how funds are set aside to pay for it.

As we have noted before, almost every article on nuclear energy, including the supportive ones will comment on the *enduring problem of nuclear waste.* This waste "problem" is often presented as insurmountable. Yet, the world is full of toxic wastes from human activities. Everything from mining to chemical processes to simple garbage thrown out from everyday household products are cause for concern.

Caption: If all your energy was produced from nuclear power for your entire life, the resulting waste would fit into a pop can Source: iStockPhoto.com

Every form of electricity generation creates waste products. Even renewable sources of electricity like solar and wind contain toxic substances in their panels and turbines and result in a need to manage their waste. The International Renewable Energy Agency (IRENA)'s official projections assert that "*large amounts of annual waste are anticipated by the early 2030s*" and could total 78 million tonnes by the year 2050.

You would be led to believe that nuclear waste is the worst of the worst (In this case waste is referring the used fuel coming out of the reactor). But is it? The reality is nuclear waste is in a solid form, the volumes are relatively small, are easily contained and well managed. There has never been a fatality due to the storage of nuclear waste.

From an economic perspective, it has long been required by regulation to accommodate the cost of managing waste and the cost of decommissioning the nuclear plant at its end of life into the cost of electricity production. In other words, every operating plant is required to charge a fee for every MWh produced to create a fund to pay for waste management. In most jurisdictions this fund is required to be segregated and funded (rather than just an item on the owner's balance sheet) so that in case the owner is no longer solvent when the plant reaches end of life, the fund will be there to pay for waste management and decommissioning.

In the International Energy Agency's (IEA) Projected Cost of Electricity report, the assumed cost of managing used fuel waste is $2.33 / MWh. The fee for decommissioning is even smaller in the $0.1 / MWh range. This compares to about $7.00 / MWh as the fuel cost and a total Levelized Cost of Electricity (LCOE) of about $70 / MWh (or 7 cents/kWh). Therefore, accounting for the cost of managing waste and decommissioning requires adding about 3% to the cost of electricity throughout the unit's operating life. One reason this is relatively small is once again due to the high energy density of nuclear fuel. Or in other words, a very small amount of fuel produces a very large amount of energy. Each jurisdiction has its own method for calculating the amount of money to put aside. Here in Canada, the cost to manage waste is updated every five years and then the amount collected in the cost of electricity is adjusted to ensure the fund remains adequate to pay for final disposal.

If only other forms of energy managed their wastes so responsibly. We have issues in western Canada with oil rigs abandoned with no one to clean them up. Coal burning pollutes with much of its waste being airborne particulates that cause significant harm to our health. And as solar panels and wind turbines reach their end of lives there is going to be a large volume of waste that will need to be safely managed.

The nuclear industry has always focused its efforts on ensuring it provides reliable economic electricity while minimizing any impact to the environment. This approach has the industry taking full responsibility to manage its waste. Rather than being concerned about nuclear waste, this model of ensuring that fully funded plans are in place to safely manage waste should be a standard applied to all forms of energy production. This is the path to a sustainable future.

The war in Ukraine has raised concerns about global energy security as well as the safety of nuclear reactors under siege. On the one hand, the safety concerns have stoked fear; and on the other, energy security issues support discussions of increasing the use of nuclear power as an option to reduce dependence upon imported fossil fuels. We will comment on these issues in future posts.

2021 – The year the nuclear energy narrative started to change

This past year, as COP26 came and went, and the climate discussion turned from emission reductions to net zero targets; more and more governments have come to accept that nuclear power should, and in fact must, play an important role in meeting their aggressive climate goals.

China is leading the way with plans to build 150 new units over the next 15 years. Other countries with plans for new nuclear include Poland, Czech Republic, Hungary, Finland, Slovenia, Romania, the UK and the Netherlands, just to name a few. In France, President Macron has stated "*We are going, for the first time in decades, to relaunch the construction of nuclear reactors in our country and continue to develop* *renewable energies.*” The US, the UK and Canada are leading the way in the development and deployment of Small Modular Reactors (SMRs). And Belarus and the UAE started up their first nuclear plants this year becoming the newest members of the nuclear family.

Source: pexels.com

We have reliable assessments this year that make the environmental benefits of nuclear power unambiguously clear from a range of multilateral global organizations.

- In March 2021 the European Joint Research Centre (JRC) issued its report on whether nuclear meets the EU Taxonomy requirements and stated – *“there is no science-based evidence that nuclear energy does more harm to human health or to the environment than other electricity production technologies already included in the EU Taxonomy as activities supporting climate change mitigation “*.
- An October 2021 study (**Life Cycle Assessment of**

> **Electricity Generation Options)** from the United Nations Economic Commission for Europe (UNECE) looking at a broad range of energy technologies concluded that nuclear technology has the lowest lifecycle carbon intensity of any electricity source, ranging from 5.1-6.4g CO2 per kWh. It also found nuclear has the lowest lifecycle land use, as well as the lowest lifecycle mineral and metal requirements of all the clean technologies.

Given the evidence supporting nuclear as an environmental champion, why is it such a struggle for people to think about nuclear power in a positive way? I was listening to one of the great podcasts from Dr. Chris Kiefer (Decouple podcast), (who also went above and beyond in his efforts at COP26) where he spoke to Angelique Oung earlier this year, an energy reporter and supporter of nuclear energy from Taiwan. She said it best when she said, "*Before I started reporting on this issue, it (being against nuclear) is just the default position in our society. I never thought that much about it, it was just nuclear is scary, nuclear bad, nuclear old fashion, nuclear is expensive – never had reason to challenge those beliefs.*"

And there is the challenge. We have discussed this before. There is a narrative of fear that goes along with nuclear energy that is part of our collective psyche. Almost every article on nuclear energy, including the supportive ones include something like "*The spectre of Chernobyl and Fukushima, along with the enduring problem of nuclear waste, kept energy generated by splitting atoms on the sidelines, even if that energy was virtually carbon free.*"; or "*Nuclear power can go horribly wrong and is notorious for cost overruns, but it is gaining high-profile champions*."

Nothing demonstrates this point more than when the Director General of the IAEA, Rafael Grossi, was being interviewed at COP26 and was explaining the benefits of nuclear energy. He mentioned that nobody died from radiation at the Fukushima accident in Japan – and some in the audience responded with laughter. Grossi replied "*I don't know why you're laughing, it's a fact. Thousands of people died because of the tsunami but there were no deaths attributable to exposure to radiation. People died also because of the evacuation, it was very traumatic*," he continued. "*We're taking this very seriously. This is not a laughable matter*."

And then something unexpected happened. Following the interview, journalist Gillian Tett decided to do her homework and learn more. As she stated, "*For me, the incident acted as a (somewhat uncomfortable) reminder of the need for all of us, journalists most certainly included, to periodically question our own assumptions.*" What she was found was published in an article in the Financial Times "**What I got wrong about nuclear power – A debate with the head of the International Atomic Energy Agency challenged my preconceptions**." This reassessment led her to conclude "*With my preconceptions about the radiation impact in Fukushima shifting, I am now doubly convinced it is time to have a wider debate about nuclear power.*"

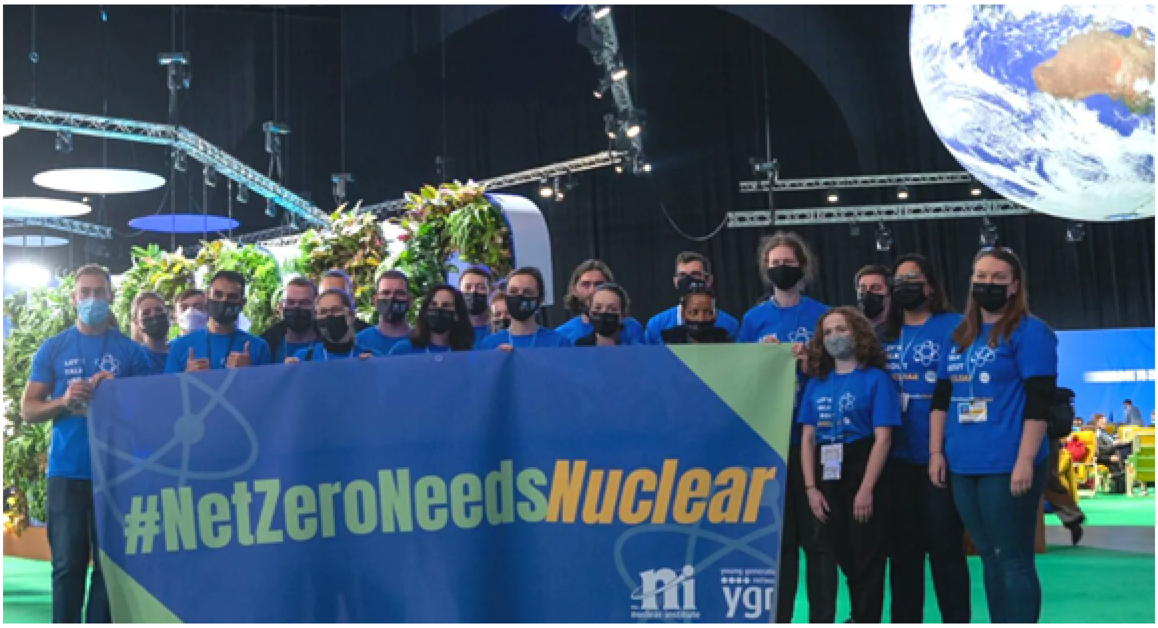
Going back to the critical comment made by Angelique, she "*never had reason to challenge those beliefs*." Until now. The challenge of achieving net zero carbon emissions is massive and requires new thinking. Young people are more focused on climate issues than any generation before them. They are ready to question the entrenched beliefs of others and make up their own minds about how to solve this climate crisis. For many, being willing to take a fresh look at the nuclear option was the first step on the journey to changing their minds about this technology. As this support continues to grow, governments are becoming more willing to include nuclear in their climate plans than ever before. Who knows? 2022 may well be the year that realistic comprehensive climate plans including all low carbon technologies start to show a truly viable path to a decarbonized world.

Thank you for reading our blog. Wishing you all a very happy holidays and looking forward to more discussion in 2022.

At COP26 – the nuclear young generation showed the world the future of nuclear

The role of nuclear power in supporting global decarbonization was discussed more at this COP than at any previous one. We have seen articles with headlines like "**Nuclear Was the Quiet Hero of COP26**" talking about the gains made in getting people to listen to the arguments in support of nuclear power. World Nuclear Association Director General Sama Bilbao y León was in attendance and noted, "*There has been a change in how nuclear is perceived at this COP*."

While there were many hard-working people who deserve thanks for their efforts in advancing the discussion on the merits of nuclear power, it is the energy and commitment of the nuclear young generation that really stood out.



NIYGN at COP26

The Nuclear Young Generation consists of groups of young people in 50+ country/continental chapters around the world that come together as the International Youth Nuclear Congress. For COP26 they were organized by the Nuclear Institute Young Generation Network (NI YGN). Their small team was supported by about 80 volunteers from countries around the world.

Their efforts to advocate for nuclear power and influence world leaders and policy makers were well received. Their message was heard in numerous talks and panel sessions right across the conference.

What was amazing is the way in which these young people engaged. There were no old men in white lab coats giving monotonous lectures on the how nuclear power works. Rather there were symbols like Melty the polar bear and Bella the 3 metres tall inflatable gummy bear who represents the amount of uranium that could power all of Glasgow’s electricity for 16 months.

Their voices were heard. And they made a difference. They even organized a flash mob to get attention to their slogan for the event – Net Zero needs nuclear. Antinuclear activists and aligned politicians have called this video cringe worthy.

Yet in their criticism they also widely shared the video giving it even more attention.

As stated in one of the articles coming out of COP26, "*Nuclear is losing its stigma, in other words, it's been invited to the cool kids' table.*" And these cool kids are smart passionate young people who are well on their way to being the future leaders of a strong global industry that is playing a major role in solving climate change. From those of us that are not as young as we once were, but remain passionate about nuclear power, and are still young at heart – thank you. The future is in good hands.

Preparing for COP26 – a little less conversation – a little more action

In advance of COP26, the next important global meeting to discuss climate change, the International Energy Agency (IEA) released it World Energy Outlook 2021 (and for the first time is offering it for free). And while it notes "*a new energy economy is emerging*", it is telling us what we all know – "that *this clean energy progress is still far too slow to put global emissions into sustained decline towards net zero, highlighting the need for an unmistakeable signal of ambition and action from government leaders at COP26.*"

Source: Unsplash.com

If you are anything like us, as this pandemic has continued, your normal day is probably something like this – check email, join a Zoom, WebEx or Teams meeting – then the next one after that and so on – and sprinkle in a good number of fascinating webinars through the week to keep you glued to your seat.

After a year and a half of this routine, one thing has become clear. We talk a lot. Really a lot. We all have great ideas on how to do better, how to improve the climate, and in our case, how and why nuclear power should play a bigger role. Or as so eloquently put by Greta Thunberg – "*Build back better. Blah, blah, blah. Green economy. Blah blah blah. Net zero by 2050. Blah, blah, blah*".

Yes, we have learned some things from all this talk; that reaching our global climate goals by 2050 is extremely difficult. Even with massive growth in renewables and extraordinary efforts in improving efficiencies, the goal is eluding us. We know nuclear, one of the only scalable baseload low carbon options, must be part of the solution.

Yet we are still fighting to get nuclear accepted within the EU taxonomy (the decision to include nuclear was just delayed once again). We are still fighting the early shutdown of perfectly good operating plants even though they are most often replaced by increasing use of fossil fuel. In many markets we have projects ready to go but securing government approvals seems to be a never-ending task.

Every year we talk without action is one less year we have to reach our goals by 2050. Thinking we can do everything we need at the last minute is a plan to fail. Tackling climate change is hard. And making hard decisions is not easy for governments. We have seen in the last year governments around the world delay hard decisions needed to defeat the covid pandemic. Or try to choose balance and compromise. In all of these cases, the result was more suffering and death than we would have had if decisions were taken more quickly.

Independent of politics, climate change is about science. And math. Between now and 2050 carbon emissions will either rise or fall. And if we all are convinced the right thing to do is to make them fall, and fall dramatically, then we need to take the hard decisions required to make this a reality.

Nuclear power can play a critical role in helping us all achieve our climate goals. The WEO 2021 and many other forecasts suggest that the amount of nuclear will double between now and 2050. But we can do more. The global nuclear industry has set a target of reaching 25% of global electricity generation by 2050 (WNA Harmony goal). This would require increasing the amount of nuclear by a factor of 5. The time has come to make things happen. Solar and wind are growling rapidly. Nuclear needs to do the same and this requires commitment.

We need governments to declare that nuclear is a clean low carbon energy source that must contribute to achieving global climate goals and then step up and make strong commitments to making this happen. There have been many recent announcements demonstrating that progress is being made. But more is needed. Governments need to:

- Stop the early phaseout of safely operating plants and provide the necessary supports to keep them operating
- Accept nuclear into the EU taxonomy
- Approve new projects that are ready to go – Sizewell C in the UK, the 6 new EPRs in France, new build in India etc. Only China is consistently approving new build at a rate of many units per year.
- Advance the development of new projects in the planning phase such as in Ukraine, Poland and Romania with a focus on getting these projects built sooner rather than later; and
- Approve first of a kind SMR projects to launch these programs in the US, Canada and elsewhere and quickly move on to deploying a global fleet.

And of course, it is not all about government. Goals can only be reached if the industry performs. The industry has done a superb job of keeping the existing fleet operating safely, economically and at high capacity factors, even as they age.

However, the experience on new build has been mixed. Countries with vibrant programs like Russia, China and Korea have built new plants quickly and efficiently. Other projects, especially those with first of a kind designs and in markets where there have not been new builds for a long time have struggled. The industry must work together to learn the lessons required and deliver a large new global nuclear fleet on time and on budget. This is possible but not guaranteed. What will make it happen is orders and lots of them. This will drive efficiencies and create even more innovation just at it has done for renewables.

The most likely outcome of COP26 will be meetings and new targets and pledges. We will all then go back to our daily routines of talking and meeting. But if we truly want to reach the stated climate goals, the time for talk is over – it is now the time to do, and do more than we ever have before. As Elvis Presley sang so many years ago – A little less conversation, a little more action.

For a little Elvis press play!

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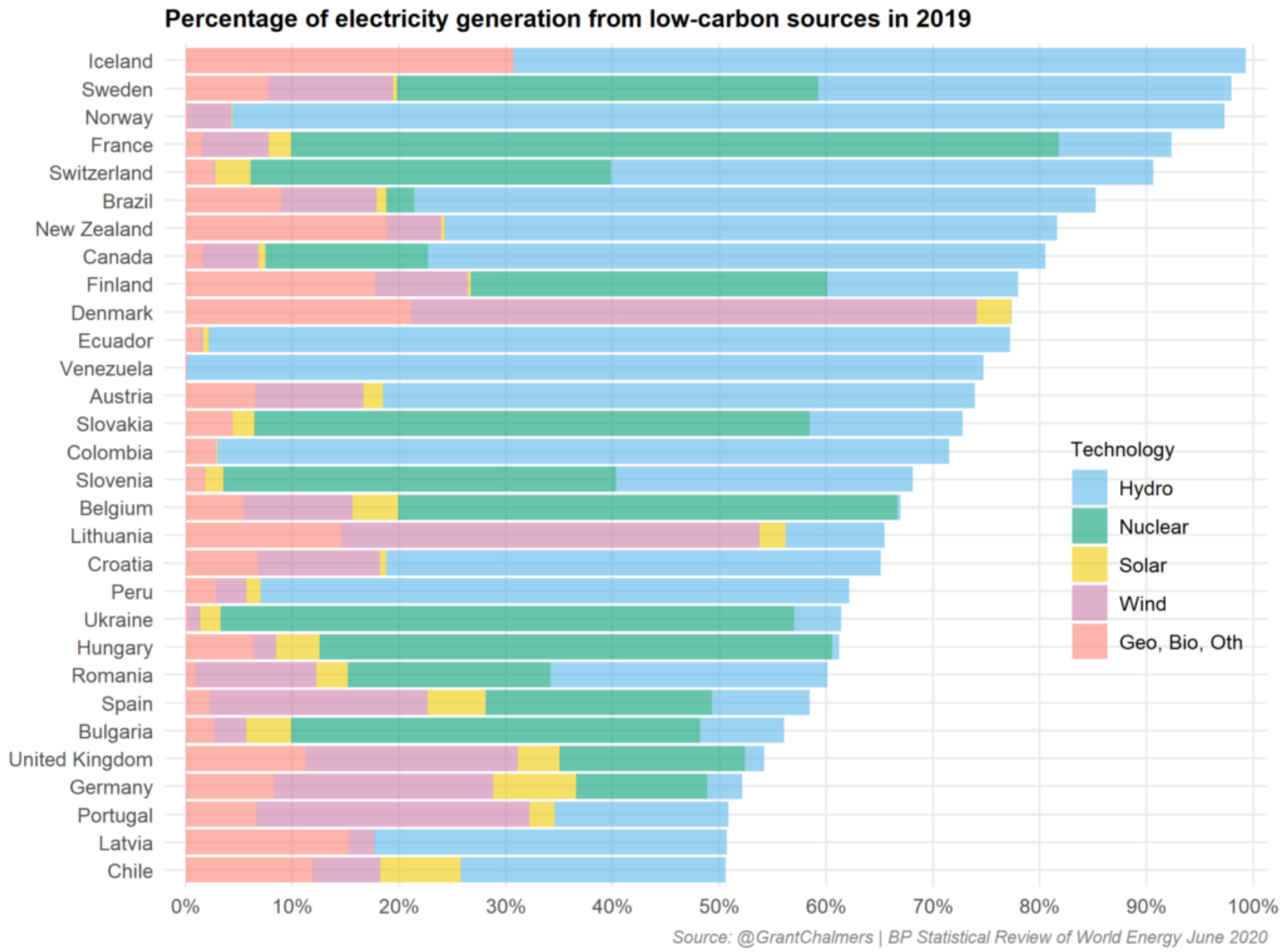
Welcome nuclear newcomer countries to the nuclear family

So far in 2021 two new countries have started producing nuclear energy for the first time. The UAE has put the first unit of its 4-unit Barakah plant into service with the second one following close behind. In Belarus, it is the same story, as the first unit of the Ostrovets station entered service and the second is going through its start up.

We know that the countries that have the lowest carbon emissions rely on either hydro or nuclear power (or both) as the backbone of their electricity systems. And these countries have achieved this low carbon footprint in reasonable time frames. So, a country like the UAE who has almost 100% fossil fuelled electricity will quickly decarbonize as the four-unit Barakah plant comes into service at which time nuclear will be 25% of their mix. Their further investments in renewables will help them meet their carbon targets.



Often when considering the future of nuclear power, the case of Germany comes up. Here we have a high-tech industrialized country who has decided to not only meet its climate goals without nuclear power but has put phasing it out as a higher priority than reducing emissions. This is often given as the example to demonstrate that nuclear has no future in a clean energy world.

Nothing could be more wrong. These decisions tend to be purely for ideological reasons. Germany who has invested heavily in renewables while at the same time phasing out nuclear power has struggled to meet its carbon objectives. Belgium announced it would build new gas plants to replace its nuclear fleet given its commitment to a nuclear phase out. Frankly, these countries have every right to meet their carbon targets as they see fit. But if they are so certain that renewables can do it alone, then they should just do it and remove nuclear when it is no longer needed. But this is not the case. Each of these countries has had to rely more on fossil fuel when nuclear is removed from their systems even as they invest heavily in new renewables.

Given the urgency of decarbonizing the world, the solution is clear. Countries that rely on fossil fuel for their energy should pursue both hydro and nuclear for their baseload needs and supplement with renewables to fully decarbonize their systems. Unfortunately, hydro is limited by geography but nuclear can be implemented almost anywhere. This means nuclear is an important option and countries planning to decarbonize are taking note.

According to the IAEA there are up to 30 countries looking into nuclear power for the first time.

The World Nuclear Association (WNA) has just this month updated it biannual Nuclear Fuel Report. In this report the industry surveys companies around the globe to develop its scenarios. This year's update sees an expansion of the market with new countries embarking down the path of deploying nuclear power. In the reference scenario there are 9 new countries including Bangladesh, Egypt, Ghana, Indonesia, Kenya, Poland, Saudi Arabia, Turkey and Uzbekistan. Of these countries, Bangladesh, Egypt and Turkey have their first plants under construction. The Upper Scenario adds an additional 7 countries: Chile, Jordan, Kazakhstan, Nigeria, Philippines, Thailand and Vietnam. And there are others who are starting to consider nuclear for their future.

All of these projections do not take into consideration the increased demand on energy systems as the goal becomes net zero carbon emissions. Once those pledged to meet net zero by 2050 start to develop their plans, and with the new nuclear options such as SMRs entering the market, we expect to see many more countries taking a hard look at implementing nuclear as part of their future energy systems.

So, for those countries that are truly committed to decarbonizing their energy systems and want to deploy nuclear as part of their solution – welcome to the nuclear family – you are on the path to abundant, reliable, and economic low carbon energy.

It’s time to rethink the South Korean nuclear phase out policy

President Moon Jae-in of South Korea followed through on his campaign pledge to reduce Korea’s reliance on nuclear power only a month after his inauguration in May 2017. He quickly announced Korea would stop building new reactors and not life extend those in operation. The objective was to replace nuclear with other clean energy options over time. This policy was developed following the 2011 Fukushima accident in Japan and a 2016 movie (Pandora) which fictionalized a similar accident in Korea. Now, with the next presidential election coming up in March of 2022, this policy is becoming an election issue – as it should.

We first wrote about Korea’s current anti-nuclear policy three years ago when they decided to shut down the Wolsong 1 reactor and decommission it. So far Korea has only closed two reactors. Kori unit 1, the nation’s oldest PWR, was closed rather than life extended in 2017; and Wolsong 1. The narrative is that Wolsong 1 was closed only 3 years before its end of life. Although that would have been when its licence expired, it was far from its end of life. Just a few years earlier, in 2011, Wolsong 1 had been refurbished, a life extending process for pressurized heavy water (CANDU) plants, where the key nuclear components are all replaced allowing for another 30 years operation. There is no doubt this unit was sacrificed to support the phase out policy and should be operating today, together with Wolsong units 2, 3 and 4, providing clean carbon free energy to the Korean grid.


The skyscrapers of Seoul light up as evening comes on in South Korea. Source: iStockphoto.com

In December 2020 Korea issued its Ninth Basic Plan for Electricity Supply and Demand for the years 2020-2034. This plan suggests that supply will increase by just over 50% while reducing dependence upon coal and nuclear power. 30 coal plants will reach their end of life by 2034 reducing the share of coal in the system from 40 to 15%. Unfortunately, 24 of these coal plants will be converted to gas. While we know that gas produces less carbon emissions than coal, entrenching fossil generation for the long term is not a path to net zero emissions. Today Korea’s electricity sector emits over 500 g/kWh and has a long way to go to decarbonize.

The goal is to increase renewables from its current 6.5% to about 42 percent of capacity. Nuclear will be reduced from its current 25% to just over 10%. It is always important to remember that plant capacity is not the right metric for comparison since renewable sources of energy such as solar and wind produce much less energy than equivalent sized coal and nuclear plants due to the limited time the wind blows and the sun shines. This means more plants are needed to produce the same amount of electricity.

And these plants all require land, and lots of it. This creates further challenges as Korea is a small mountainous country with limited space to implement large scale renewable solutions. The most promising source of renewables is offshore wind. In February, plans to invest $43.2 Billion in the world's **largest** single offshore wind project with a capacity of 8.2GW (today Korea has only 1.67 GW of wind capacity) by 2030 were reported. This is a technically challenging project and claims this would produce the energy equivalent to the output of six (1.4 GW) nuclear reactors is somewhat deceptive because as stated above, a nuclear plant will produce more than double the energy as a similar sized wind turbine, i.e., 4 GW of nuclear would produce more energy in a year than 8 GW of wind.

Korea is a global industrial powerhouse and as the world's 9th largest energy consumer in 2019 needs access to economic reliable energy to fuel its dynamic economy. This is not easy as South Korea has little to no domestic energy resources and is one of the world's top five importers of liquefied natural gas (LNG), coal, and oil.

Trying to decarbonize without nuclear power means that Korea will lock in fossil use (gas) for decades to come. In addition to increasing risk to their energy security, recent reports are suggesting the era of cheap gas is coming to an end. Spurred by increasing global demand, LNG prices in Asia have increased about six-fold in the last year.

Korea once made a bold decision to implement nuclear power in a big way to reduce its dependence on foreign supplied fossil fuel and provide large amounts of low carbon economic and reliable energy to fuel its growing economy. Through dedication and hard work, it went from an importer of nuclear technology to becoming self sufficient and then exporting the technology; its export to the UAE is a source of great pride.

This also resulted in a very high level of both technology and human development. Nuclear power creates high quality jobs for thousands of Koreans. This expertise is valued all over the world. Unfortunately, it doesn't take long for negative policies to start to degrade this expertise. Young people will not choose nuclear as a career if government policy is to phase it out even if there are still years of operations that require trained experts. And for those more experienced, there is a whole world out there that would value their excellent Korean qualifications.

The International Energy Agency (IEA) has stated that net zero emissions cannot be reached without nuclear continuing to play a critical role. Governments around the world are becoming more vocal in their agreement. In Canada and the United States, both governments have stated unequivocally that nuclear is needed to reach these goals. In Europe a group of 87 parliamentarians have signed a letter supporting nuclear to be included in the EU taxonomy as a sustainable clean generating option. China and Russia are pursuing large nuclear expansions and Japan continues to declare that nuclear must be part of its energy mix.

Nuclear power in Korea has been an unqualified success and is the example to be used for other nations wisely choosing to deploy nuclear as part of their climate and energy infrastructure. Korea needs nuclear to maintain its industrial base and meet its climate goals. And the world needs Korean nuclear experience and expertise. The time is right for a discussion with the Korean people on the nuclear phase out policy – and an election is a good time to have it.