South Korea has a strong vibrant nuclear industry – except it is not supported by its President

It is with great sadness that we see the Wolsong Unit 1 reactor start to defuel after being shut down prematurely as part of the South Korean government's plan to reduce reliance on nuclear energy.

This is part of the South Korean government's commitment to replace nuclear and coal with renewables supported by gas, hopefully one day coming by pipeline from Russia through North Korea. (Today all gas in South Korea comes as LNG and even an optimist would see energy security issues with this pipeline plan.)

We have a long history in South Korea. We were very active in the development of the contracts for Wolsong Units 2, 3 and 4 back in the early 1990s and worked to secure collaboration between South Korea and Canada for most of the next decade. This first big project success in Korea holds a special place in our hearts. And of even more importance, the lessons learned in South Korea are the backbone of our approach to nuclear power projects today and going forward.

In 2017, South Korea elected Moon Jae-in its President. As part of his platform he committed to reducing the share of nuclear over time. "*So far, our country's energy policy has been focused on low price and efficiency only, thus neglecting the safety of the people or the sustainability of the natural environment*," he said last year when Kori 1, Korea's oldest reactor, was retired. "*The new government shall consider the nuclear safety issue as a national security agenda*," he said

based on a fear of nuclear power following the accident at Fukushima in 2011 in neighbouring Japan.

Wolsong Nuclear Power Station, South Korea

Wolsong 1 is South Korea's second oldest reactor, so what's the big deal with retiring it? It is a CANDU and Korea has developed its own domesticated PWR as its main reactor type. Why should anyone care? First, its on-time construction as it went into operation in 1983 was a precursor of what was to come from this burgeoning technical and industrial powerhouse in the making. In the 1970s, four CANDU 6 type units were committed around the world. Two in Canada (in Quebec and in New Brunswick) and two abroad (Argentina and South Korea). Even though it was the last of the four committed, Wolsong 1 was the second to go into operation following a short 60-month construction schedule. This showed how Korea was developing its strong construction industry that focused on success. They also fully domesticated fuel production with only one CANDU unit in operation, another success story. It operated for 25 years at top capacity factors until it was shut down for refurbishment and life extension in 2009 returning to

service in 2011.

Once again, it was the most successful CANDU refurbishment project anywhere to date. And that is the rub. Although reported that it is South Korea's oldest operating reactor and only had a license until 2022, in reality, it was the newest of the units on the Wolsong site. A CANDU refurbishment is a complete overhaul of the reactor changing out the entire core so that the unit can operate another 30 years or more. This means that the Wolsong 1 reactor had the newest components when compared to Wolsong 2, 3 and 4 that came into service in 1997, 1998 and 1999 and should be operated into the 2040s.

In his recent article "Nuclear Energy Needs Truth, Not Truthiness" (truthiness is a term coined by comedian Stephen Colbert to describe the phenomenon – that basically one's desires, intuitions and fantasies are as true as reality and can substitute for them with no consequence), Jim Conca talks about the importance of the media being "*energetic advocates for, and defenders of, the actual, factual truth*" rather than succumbing to providing a "*false balance*" in their ongoing effort to report both sides of the story. Trying to match experts on one side with others who have no actual knowledge or expertise to support the other is foolish at best, and dangerous at worst. We need to listen to experts to know the actual truth.

Here is the truth about South Korea.

In 1960, a few years after the end of the Korean War, it was one of the poorest countries on earth. With a small population and little to no natural resources; even though a peninsula, it was more like an island with its unfriendly neighbour to the north. Based on sheer determination of its people, South Korea achieved an economic miracle, becoming an industrial giant, a software leader and an exporter of goods and services to the world. This was in part due to its ability to secure reliable and economic energy to fuel this

development. Today, South Korea produces 70 percent of its electricity from 24 nuclear reactors (27 percent) and thermal coal plants (42 percent). Liquefied natural gas (LNG) accounts for about 20 percent. Renewables are less than 10%. All its coal and gas are imported.

As for the nuclear sector, since it built Wolsong 1 on time and on budget three decades ago, Korea went on to develop a nuclear industry second to none. It fully domesticated its standard 1,000 MW design, the OPR1000 and then developed its larger standard APR1400 design on its own. In 2009, it became a full member of the tier one nuclear club with its first nuclear export to the UAE, a four-unit APR1400 project. Today the first of these units is complete and ready for operation with the remaining units on a path to completion on schedule. The UAE project is considered one of the major successes of the global nuclear industry in recent times, when other projects by more traditional vendors have not proved to be nearly as successful.

And what about the public? Last year, when President Moon proposed to stop construction of the in-progress Shin Kori units 5&6, he decided to make the decision with the help of a jury of the public to secure support for his energy plan. The Citizens' Jury announced on 20 October 2017 that it recommended construction of the two units should be resumed. The panel – comprising 471 randomly-selected citizens – voted 59.5% in favour of construction proceeding. More recently in August of this year, in a poll conducted by the Korean Nuclear Society, 71.6 percent of respondents supported the use of nuclear power in the country, far more than the 26 percent that said the country will be fine without it.

South Korea is a small country and so far, efforts to increase the renewable footprint has also had issues. Solar power plants installed on mountains are causing landslides. Korean Experts say that the government should slow down its transition to renewable energies due to both environmental

concerns (such as the land slides) and energy inefficiencies. Nuclear remains the key low carbon energy source and with an electricity carbon intensity of about 540g/KWh due to its significant fossil generation, South Korea will not succeed in decarbonizing by trying to replace its nuclear fleet with renewables. Replacing coal with even more nuclear would be a far better approach.

Even though the nuclear phase out is intended to be long and slow, it is having an immediate effect on the industry. As one of the world's most successful nuclear industries, the South Korean nuclear community is demoralized. It is a sad thing to see. New graduates are already avoiding an industry that doesn't appear to have a long-term future, and I would expect that some of Korea's best and brightest will be getting job offers from the global industry which will be Korea's loss. Of course, it is also difficult to export a technology when the strategy at home is to phase it out. While the term of a South Korean president is 5 years, this is long enough for a lot of damage to be done.

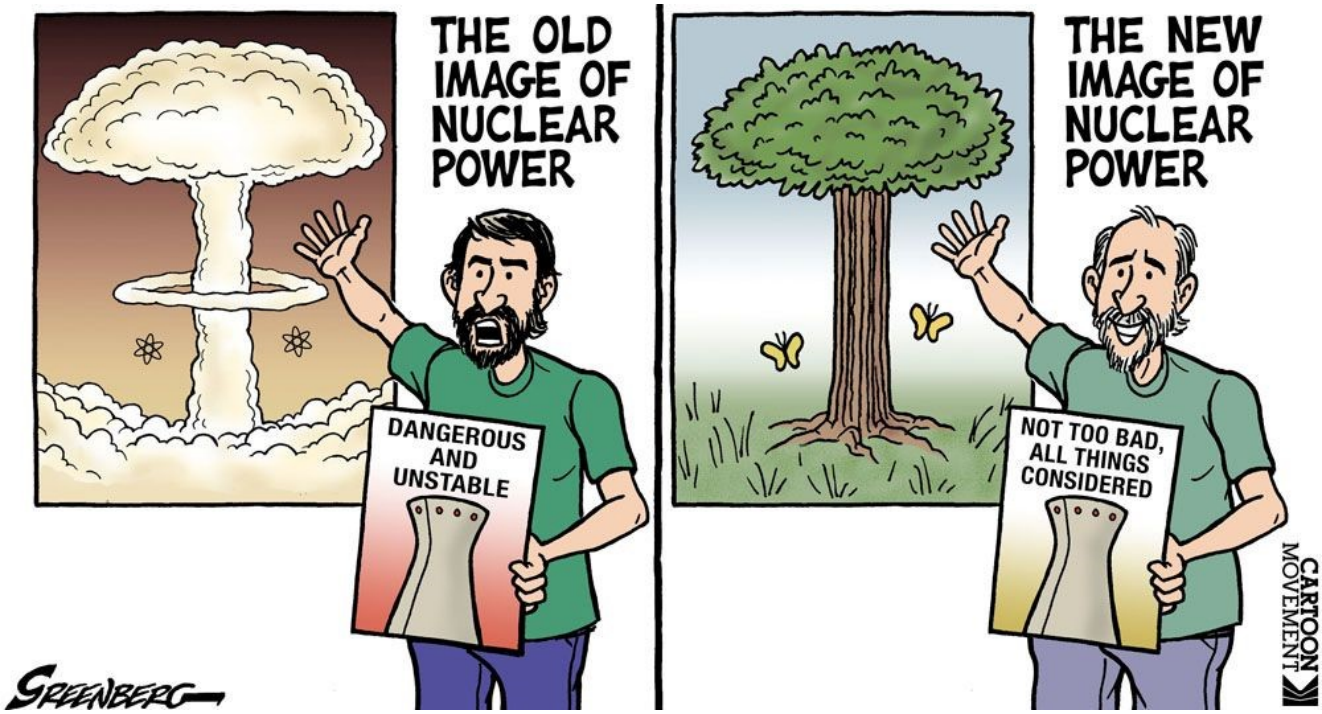
South Korea is truly an economic miracle and has developed one of the world's most successful nuclear industries. They have created a fleet of standardized plants that are built at low cost and to schedule. Their operating performance is excellent, and their people are among the world's best. This should be a point of great pride. It is hard to find any other country that has benefited from nuclear power more than South Korea. It is a shining example of what to do when building an industry. Even the Korean people see this to be true. Unfortunately, truthiness prevails as fear shapes the beliefs of its President. All we can say is ***President Moon, please listen to your nuclear experts. They are the very best there is***.

Let’s stop focusing on beliefs and really start communicating

How many discussions have you had today where either you or the other person thought carefully, and then said “here is what I believe….”? Believe is a strong word. It evokes personal values; and when something makes it to the level of a belief, it is often unshakeable.

There was a time when we didn’t talk like this. We gave our opinion, or our view on a topic. This was developed through learning, by listening to (hopefully) an expert or reading relevant information. An opinion meant this is what we think at the moment, and that should we learn more, we may change or evolve our position. Now our views on almost every topic need to be elevated to the level of “belief”. And as we know, we don’t change our beliefs easily.

In our world of nuclear power, we know that many have strong views on whether this technology is worthy of being a path to a better world with clean economic abundant energy, or as others believe, is a path to our eventual demise. We have written before about the need to ramp up our communications and work hard to increase support for nuclear power. The facts are on our side, but negative beliefs stand in our way. We are happy to see even more young people come out with supportive communications, from Jarret Adams, to Eric Meyer at Generation Atomic and Bret Kugelmass with his podcast series, Titans of Nuclear; each using their own unique method to promote a nuclear future.



As it is the middle of summer, this is when we love to be a bit more philosophical. It is a time to do some deep thinking while enjoying the sunshine and sharing some more esoteric views based on our reading list so far this year. I have read a few books that I think are useful to both better understand the current environment for communications and provide some useful insights on how to better communicate going forward.

You may think these three books have nothing in common, but I see a common thread that should contribute to our thinking as we move forward. They are "**The Death of Expertise**: **The Campaign Against Established Knowledge and Why it Matters**" by Tom Nichols, "**Is Gwyneth Paltrow wrong about everything**: **When Celebrity Culture and Science Clash**" by Timothy Caulfield and finally, "**If I understood you, would I have this look on my face?: My Adventures in the Art and Science of Relating and Communicating**" by Alan Alda.

The first two books provide us with two different but complementary views of the environment we live in. Tom Nichols, in his excellent book, 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. In fact, he goes so far as to suggest that it is cool to be ignorant. Experts are no longer respected and in fact, he states that "*we actively resent them, with many people assuming that experts are wrong simply by virtue of being an expert*."

He talks about the changes to higher education, where young people think they are customers buying a service rather than students given an opportunity to learn. He talks about the changing news media, from provider of unbiased news to "infotainment" and notes that too many people approach the news not to seek information but rather confirmation of what they already know, avoiding sources they disagree with because they believe they are mistaken or even lying ("fake news").

This book is a must read, with more good quotes than I can use in a short blog post. But if I can summarize in one quote, it would be as follows. "*The death of expertise, however, is a different problem than the historical fact of low levels of information among laypeople. The issue is not indifference to established knowledge; it's the emergence of a positive hostility to such knowledge. This is the new American culture, and it represents the aggressive replacement of expert views or established knowledge with the insistence that every opinion on any matter is as good as every other.* " For everyone in the nuclear industry – sound familiar?

If we don't listen to experts, then who do we listen to? That is answered in the next book. In his fascinating book on celebrity culture and how it influences us, Timothy Caulfield explores the massive power that celebrities have over our decisions and beliefs. This ranges from using beauty products endorsed by your favourite celebrity (costly but not likely harmful), to using their favourite health care products (costly and may be harmful), to taking bad decisions that can negatively impact the health of our children like avoiding vaccines (definitely harmful).

In summary, we have replaced “experts” who we no longer believe in, with celebrities, who are the ones we look up to. We long for fame rather than accomplishment and dream of achieving it without necessarily working to get there. Anything to be like our idols. Unfortunately, the outcome is often nothing more than an empty wallet and little in terms of being able to take decisions that positively impact our lives.

This takes me to the third book of the bunch, Alan Alda’s book on how to better communicate science. Of course, if we shouldn’t listen to celebrities, then why listen to Alan Alda? It tuns out that he has been involved in communicating science to laypeople for over 20 years, having hosted a show by Scientific American and then starting the Alan Alda Center for communicating science at Stony Brook University. So, what does this book have to say that you may not have heard before? It makes a strong case for communicating, which means having a conversation noting that “*real conversation can’t happen if listening is just my waiting for you to finish talking*.” It talks about the importance of having empathy for your audience, consistent with many who talk about better communications; but he goes further, saying empathy is not enough; we need to be able to “relate” to our audience. Only then are you really communicating. The book then makes the case for using theatrical improvisation techniques as a means to break down barriers to learn to relate to others.

What can we learn from these books that we can apply to the nuclear industry? Our objective is to change the paradigm on nuclear power and raise awareness of the many benefits it brings to society. To do that let’s first work to improve our approach to communicating. We need to avoid trying to change others’ deeply held beliefs nor try to impose our own beliefs on others. This is a path to nowhere.

Rather, we need to focus on communicating, i.e. having an open and productive conversation with others while working hard to keep open minds. It is a willingness to consider new

information that is important for life long learning. Go beyond empathy and truly try to relate. Developing a relationship is hard work but hopefully the outcome will be that we both understand each other better and learn something new.

Moving the needle on public opinion on nuclear power is important and also very challenging. Hopefully some of these perspectives will help us think of new and better ways to have the conversation.

Afterword

For those of you that are interested, the following are a few more quotes from The Death of Expertise. Powerful stuff.

"There is a cult of ignorance in the United States, and there always has been. The strain of anti-intellectualism has been a constant thread winding its way throughout political and cultural life, nurtured by the false notion that democracy means that "my ignorance is just as good as your knowledge.""

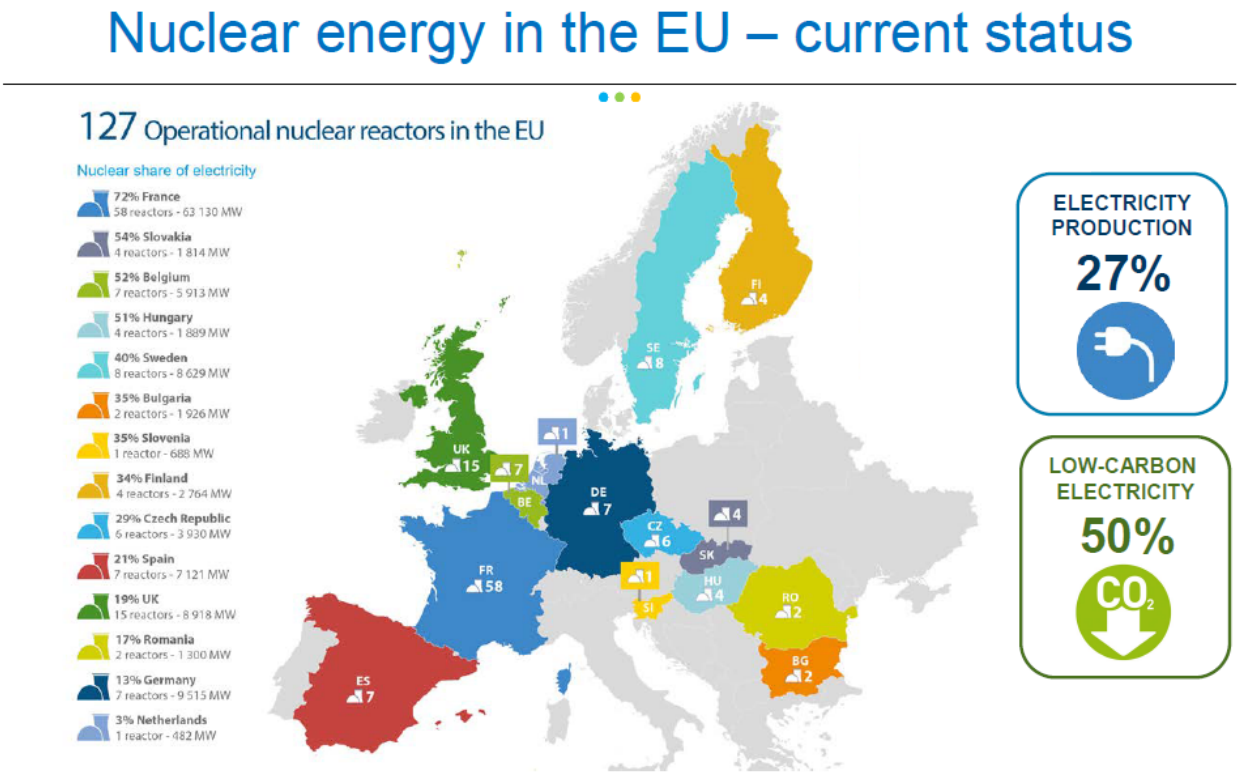
"These are dangerous times. Never have so many people had so much access to so much knowledge and yet have been so resistant to learning anything. In the United States and other developed nations, otherwise intelligent people denigrate intellectual achievement and reject the advice of experts. Not only do increasing numbers of laypeople lack basic knowledge, they reject fundamental rules of evidence and refuse to learn how to make a logical argument. In doing so, they risk throwing away centuries of accumulated knowledge and undermining the practices and habits that allow us to develop new knowledge."

"Rather, Americans now think of democracy as a state of actual equality, in which every opinion is as good as any other on almost any subject under the sun. Feelings are more important than facts: if people think vaccines are harmful, or if they believe that half of the US budget is going to foreign aid,

then it is "undemocratic" and "elitist" to contradict them."

The road to a low carbon Europe is nuclear power

There are more nuclear plants in the European (EU) than anywhere else. Yet a broad range of nuclear policies across the European nations is having a large impact on its future. Currently there are 127 nuclear plants in operation in the EU (plus another 5 in Switzerland). Of the 14 EU countries with nuclear power, a quarter generate more than 50% of their electricity with nuclear power and more than half generate more than 30%. In total, nuclear in the EU, generates 27% of its electricity and accounts for fully half of the EU's low-carbon electricity.



Source: Foratom presentation "Keeping Europe lights on – a role for nuclear", WNFC, Madrid April 2018

Nuclear power has provided decades of low carbon, reliable and very economic energy to the people of Europe playing an important role in fueling the European economy. It provides over 800,000 jobs at over 3,000 companies and provides security of supply needed by a region that mostly imports its fossil fuels (although some countries are coal rich). Most gas and oil come from Russia and Norway. It is not by accident that the lowest carbon emitters are the largest users of nuclear power.

You would think that there is nowhere on earth where nuclear has a brighter future. But you would be wrong. There has always been a strong anti-nuclear presence in Europe, more in some countries than others. Countries like Austria and Italy are anti-nuclear to their core, while other nuclear power houses such as Sweden, Belgium, Spain and of course, Germany, have continuously had to address strong anti-nuclear sentiment. These anti-nuclear forces are primarily based on ideology. They are the greens that have since the 1970s simply believed that nuclear energy is dangerous and needs to be stopped. But there are also countries like the UK, Finland and Hungary that have relatively high support for nuclear and are either building new plants or are planning to.

Greens have been successful in convincing the public that if you support the environment, then you must be against nuclear power. This belief was re-enforced by the Chernobyl accident in the Ukraine 30 years ago, and then again following the Fukushima nuclear accident in Japan in 2011. Couple this with a strong belief that renewables, primarily in the form of solar and wind energy can simply replace nuclear, then the solution seems simple – who would say they don't like sun and wind?

Some European nuclear countries, where greens have had

influence in government, have been fighting to sustain their programs for decades. Anti-nuclear supporters have succeeded in getting government to impose special taxes on nuclear to make it costlier while at the same time subsidizing renewables. Under pressure from the Greens, some governments have agreed to long term nuclear phase outs. These deals were made (Sweden, Germany, Belgium) at the time as a compromise to enable continued operations in the short term, with nuclear supporters maintaining hope that in the long term it would become obvious that the phase out would not be practical. Unfortunately, as the time for these phase outs is now approaching, the opposite rings true. These policies have been in place for a long time and the public have simply accepted that new renewable technology will be there to replace the aging nuclear fleet when its time comes.

With nuclear closures on the horizon, governments have had to take action with mixed results. Sweden has made progress to maintain their fleet having allowed plants to run longer and eliminating its nuclear tax, while Belgium has confirmed its phase out for 2025, and Spain is still working on its plan going forward.

Even France, Europe's largest nuclear country, has not been immune to anti-nuclear thinking. Its previous government mandated a maximum nuclear capacity to ensure the share of nuclear doe not increase and then a planned reduction of the nuclear share from about 75% down to 50% within 15 years. In the short term this means that for the soon to be completed new plant at Flamanville to come into service, an existing plant has to be shutdown; the country's oldest at Fessenheim. The new government has taken a more pragmatic stance and has deferred the target date while undertaking a review of its nuclear reduction plan. Let's face it, it is literally crazy to shut down an excellent operating asset at Fessenhiem for no reason other than it is politically mandated. The French regulator has said that these plants are safe to operate for

another decade. This is an expensive political give –and needs to be seen for what it is, a plan by those opposed to nuclear to exert pressure to close plants, demonstrate there are viable alternatives, and over time push for a complete phase out.

Of course, the biggest change has been in Germany, Europe's technology powerhouse. After finally starting to reconsider the timing of its planned nuclear phase out, the Fukushima accident happened, and the Greens pushed for immediate closure, even sooner than was originally planned. And they succeeded. As part of its Energiewende, nuclear plants have started to close, and the share of nuclear energy has dropped significantly with a total shutdown only a few years away. In December of last year, one of Germany's top economists, Prof. Dr. Hans-Werner Sinn, made news when he published a paper stating it is unrealistic to believe that Germany can power itself with only wind and sun due to their immense supply volatility. He concludes that 30% renewable is a viable target although this can increase through cooperation with neighbouring countries.

To those of us outside of Germany, their strong commitment to quickly removing nuclear from the mix is a complete mystery. Fear of nuclear in Germany has put the shutdown of nuclear ahead of reducing carbon emissions. No German has ever been hurt by a nuclear plant and German industry has benefited from abundant economic nuclear energy for a generation. With the highest energy carbon intensity in Europe, Germany recently accepted that it cannot meet its 2020 commitments as carbon emissions reductions have ground to a halt in the few years since nuclear started shutting down. Shutting coal plants instead of nuclear would have shown Germany as a carbon reduction leader, but for some reason they chose to continue to damage the environment by opening new coal mines and building new coal plants, as they prioritize nuclear shutdowns over carbon reductions. The German Energiewende is a good

albeit expensive experiment, and the results to date should make others think twice about going down this path.

The fight for nuclear power in Europe has been long and hard. In some countries nuclear supporters have been worn down and sometimes wonder if they are fighting a losing battle. But they must always remember that European anti-nuclear sentiment is rooted in an ideology that is out of step with the current need to combat climate change. In reality, nuclear power has made Europe better in every way by delivering economic reliable electricity, while providing energy security of supply and preserving the environment by reducing the use of fossil fuels.

Even with the new build plans currently in place, Europe will need another 80 GW of nuclear by 2050 just to maintain the status quo. And that is not good enough. Rather than accept the political views of those that oppose; bold new plans should be made to increase the nuclear footprint in Europe including the very challenging task of changing views in anti-nuclear countries. If decarbonization is a goal, then there must be a realization that nuclear has been a great success in Europe and represents the best path forward to secure a low carbon economic energy future for all Europeans. A strong Europe needs nuclear power.

If we want to breathe clean air – shutting nuclear plants early is insanity

People are dying – lots of people, each and every day. As stated in a study published by Lancet on October 19,”

Pollution *is the largest environmental cause of disease and premature death in the world today. Diseases caused by pollution were responsible for an estimated 9 million premature deaths in 2015—16% of all deaths worldwide—three times more deaths than from AIDS, tuberculosis, and malaria combined and 15 times more than from all wars and other forms of violence.*" And to make matters even worse, it continues, "*In the most severely affected countries, pollution-related disease is responsible for more than one death in four.*" (Note: James Conca wrote an excellent article following the release of the lancet paper).

Earlier this month authorities in New Delhi took a decision to spray water over the capital to fight toxic dust in the air. It's hard to imagine having to take such extreme action just so people can breathe.

And yet, we seem to want to make it worse, not better, by supporting the early shut down of safe, reliable, and of most importance, CLEAN, nuclear power plants. Nothing can be more foolish than removing low carbon, non-polluting generating plants from the generation mix when the replacements are almost always dirtier fossil fueled generation. These nuclear plants still have years of useful life left and are operating safely as clearly evidenced by the regulators who are giving them licenses to operate in their respective countries.

This is sometimes based on local economics such as in the United States, where low cost gas is making nuclear uneconomic in some de-regulated states. But of more importance, it is more often a result of made-in-the-past anti-nuclear sentiment. In Germany, shutting nuclear early is accepted as more important than reducing carbon emissions even as new dirty lignite mines are opened to replace them. In Japan the slow return to service of nuclear plants following the 2011 accident at Fukushima is not only causing an increase in fossil usage but there are now plans to build more than 20 new coal plants. The previous French government decided to close

its oldest two nuclear units early, even though they are licensed for another 10 years, and set a target to reduce the share of nuclear going forward when there is no clear option to replace them. In Korea, even though a large public review approved the completion of two partially built plants, the Korean government has cancelled further new build plans, and of more importance, is against extending the lives of existing operating units wanting to replace them with a combination of renewables and gas. They are also on the verge of closing Wolsong 1, their oldest operating plant even though its recent complete refurbishment has made it operable for another 30 years and frankly, makes its components the newest of the four operating CANDU type units on that site. In the United States, California has decided not to extend the life of Diablo Canyon, claiming it can replace these units with renewables and demand management. In Belgium, there are plans to retire their units without life extension, etc, etc, and the list goes on.

As for the argument on economics, let's remember that nuclear plants have very low operating costs due to the low cost of fuel. However, in some jurisdictions, mostly in the US, low gas prices and subsidized renewables make these plants less economic for now. Since in all cases, they would be replaced by fossil generation (with some renewable component), the replacements will increase both pollution and carbon emissions and if we include the cost to build new plants, then even with low fossil fuel prices, this new fossil generation will not be more economic than existing nuclear.

Many governments have started to see the reality of the situation. That is why the fight is on and in many countries efforts are underway to save these reliable non-emitting plants. In the US, a number of states including New York, Illinois and Connecticut are working to keep plants open and there is a federal initiative to support nuclear plants as a result of their "resilience" (a topic for another day). In

Sweden there is support for extending the lives of existing units and recently the French government has decided to slow its plans to reduce its share of nuclear.

This is why I am proud to live in Canada where the commitment to our existing nuclear fleet is strong. The new 2017 Long Term Energy Plan in Ontario supports the decision made in 2015 to refurbish 10 more reactors and to maintain nuclear as the back bone of the system for the foreseeable future. A just released review by the Ontario Financial Accountability Office concluded "*Two of the primary benefits of nuclear generation are that it is both relatively low-cost and emits very low amounts of greenhouse gases. There are alternative generation portfolios which the Province could use to replace nuclear generation. However, currently none of the alternative generation portfolios could provide the same supply of low emissions baseload electricity generation at a comparable price to the Base Case Plan*".

So, it appears that we Canadians are indeed sensible people. We understand that our existing fleet of nuclear plants are reliable, low cost and low emitting. And it is this good sense that will keep our air clean. This needs to be an example to others so they can also see that removing existing well operating plants from service early to appease a big green lobby is a crazy risky proposition. After all, what can be more important than being able to breathe?

Advocating for nuclear power

– the time is right

We live in strange times. Globally, populism is growing in response to a deep-seated anger with so-called liberal elites. Experts are no longer respected over louder voices that support peoples' strongly held views. There are no facts, only beliefs.

While most of the world continues to support the Paris agreement on climate, there is a reluctance by some to include nuclear power in the tool-kit to help meet this global challenge. There is wide spread belief that Germany is going down the right path as it eliminates nuclear from its mix and drastically increases its use of renewables. The only problem is that fossil fuel use is also increasing and emissions are not going down. This has not stopped other countries like France, which has one of the lowest emissions in Europe due to their nuclear fleet, setting out a policy to reduce reliance on nuclear. And now Korea seems to be going down the same path even though it would probably be hard to find another country that has benefited more through successfully implementing its nuclear program.

Does this mean that nuclear power is getting ready to move over and cede the future of energy supply to a fully renewable world? Not even close. With 58 units under construction there are now more new nuclear units coming into service each year than in the last 20 years. The UAE is nearing completion of its first units, a four-unit station as it becomes the newest entry into the nuclear club.

On the other hand, in the USA units are struggling to stay in service in de-regulated states and one of two new build projects has been stopped in the face of Westinghouse bankruptcy.

In the midst of all of this apparent chaos, there is a bright

light. People are standing up saying – don't close my nuclear plants. People are recognizing that removing large low carbon emitting stations from the energy mix is no way to improve the climate. And most of all these people are ready and willing to fight. In the more than 35 years we have been in the nuclear industry I don't remember a time when there were strong vocal pro-nuclear NGOs. Yes, that's right – there are those who are not directly in the nuclear industry who have taken up the fight for nuclear. Not because they have any great passion for the technology, but because (as we discussed in May), they see nuclear plants as the ultimate solution to important issues. They want to save the environment. They want plentiful economic energy and they know that nuclear is an important part of the solution.

More vocal pro-nuclear NGOs today than we have had in 35 years

These organizations include a growing list of environmentalists such as Environmental Progress, Energy for

Humanity, Bright New World and Mothers for Nuclear – to name a few (this list is not meant to be exhaustive so if your organization is advocating for nuclear power, please comment with your name and a link). What they have in common is an understanding that nuclear power is not the evil that some think it is and that in fact it can help to make the world a better place. And of more importance they are willing to advocate for it.

The way I look at it, there are two types of advocacy. First there is the broader objective of securing public support; and then there is the more targeted advocacy that fights in the trenches to get political support for specific projects and actions. It is this second approach that I want to focus on here. These pro-nuclear groups consist of many who have spent their lives advocating for what they believe in; and therefore, bring a knowledge of how to influence decision makers and raise the profile of their cause. I have talked before about Meredith Angwin's wonderful book on how to be a nuclear advocate. It's a "how to" on getting out there and taking action. Or take the case of the nuclear bus – old fashion grass roots activism.

As was once explained to me, it is always easier to be against something than to be a supporter. It is anger about things that people believe is wrong in the world that ignites passion and brings them to the streets; supporters often stay at home and discuss these projects with their friends over a glass of wine. That is in part why there is so much passion about stopping the closure of existing nuclear plants. It is easier to be against closing them with the impacts to emissions and our communities than to argue in support of building something new. This is the beginning.

Because after all, it is a numbers game. 200 anti-project protesters can get a lot of press even though there may be 2000 who support the project but who stayed home. It's about getting people out – politicians want to do the will of the

people and they need to see this will. Supporting continued operations of a plant or even a new build is much easier if the preponderance of the people speaking at public hearings are in favour of the project.

The word we use today is “social license”. But what does this really mean? If it means securing significant local support for something then it is a laudable goal. However, most anti-nuclear (or anti-anything) groups take it to the extreme and mean that they have to agree with proceeding; which is something they will never do. As stated so eloquently by Rex Murphy in his piece on the efforts of the new NDP government desire to develop oil in Alberta – “*Notley [the Premier] missed the central point of social licence: its preconditions can never be met, and are not meant to be. It is an obstructionist tactic, designed to forestall and delay*.”

So why are countries ignoring the potential benefits of nuclear power as they strive to feed their energy hungry citizens with low carbon economic energy? There are many reasons as we and others have discussed before. We certainly believe that the overriding issue is fear. But we can also see that when people become supporters based on nuclear power being a solution to issues of importance to them, they do their homework and are able to resolve their fear. So we need to ask ourselves are people really that afraid, or is this also a remnant of the past where environmentally conscious groups were synonymous with being anti-nuclear? Are we seeing the last vestiges of a generation that fears nuclear power at all costs? Do we now have the opportunity to start to change the minds of a new generation that is willing to stand up and advocate for nuclear power? It may well be.

One thing is for sure, we all need to get out there and advocate for what we believe in. The time for talk is over – it is time to act. We need to organize and be sure to be out there every opportunity we can to support the decisions that we believe are necessary to achieve our goals.

So,

- if you believe that climate change is a threat and that fossil fuel use is the main culprit; or
- if you believe that access to economic reliable energy is essential for progress and is critical to lift people out of poverty; or
- if you believe that high quality jobs and technological innovation is good for our communities and our economies; or
- if you want a future for your children and grandchildren with abundant plentiful reliable economic and low carbon energy to support them as they create their own future;

Then the answer is clear – and that answer is nuclear power.

This is a call to action. We all need to work together to advocate for what we know is right. We have been involved in this industry for close to 40 years and still are passionate supporters – because we truly believe we can leave the world a better place than when we started.

Energy policy cannot be based on fantasy – the truth may yet prevail

Over the last week or so, the internet has been abuzz with articles on the recent paper published in the Proceedings of the National Academy of Sciences, "***Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar***", by 21 prominent scientists taking issue with Mark Jacobson's earlier study claiming that 100% renewables is

feasible in the USA by 2050. Given the strong desire to believe in this utopian future; and how many prominent people have referenced this Jacobson paper to support their energy views, it is somewhat surprising how much press the opposing view elicited. That being said, most of the articles had titles like, "*A bitter scientific debate just erupted over the future of America's power grid*" or "*Fisticuffs Over the Route to a Clean-Energy Future*" making it seem like this is about scientific debate, when it is actually about a paper that has been proven to be false.

As stated by this paper's authors, *"In this paper, we evaluate that study [the Jacobson study] and find significant shortcomings in the analysis. In particular, we point out that this work used invalid modeling tools, contained modeling errors, and made implausible and inadequately supported assumptions. Policy makers should treat with caution any visions of a rapid, reliable, and low-cost transition to entire energy systems that relies almost exclusively on wind, solar, and hydroelectric power."* These are pretty strong statements for an academic paper.

Of course, for most of us in the industry this study is

telling us what we already knew, that 100% reliance on intermittent low-density energy sources is not going to meet the needs of an energy hungry world. We suggest you read a few of the articles and of most importance, the actual paper. We would also recommend you read the article by James Conca "*Debunking The Unscientific Fantasy Of 100% Renewables*" which takes aim at the issue of bad science.

But the world is passionately in love with renewables. What can be better or more natural than wind and solar? It makes you feel good – there are no problems that can't be overcome with these wondrous technologies. They definitely don't cost too much [but they need subsidies], or have environmental or waste issues [solar waste is increasing] and of course their intermittency is a modest problem to be resolved by smart people [by building more gas to back them up]. On the other hand, fossil fuels emit carbon and while nuclear plants are low carbon, they are dangerous – everybody knows that. And in this era of fake news and alternate facts, why would anyone want to change this glorious view of the future?

Of course, the option that does tick all the boxes for a low carbon energy revolution is nuclear power. And we are starting to see this position being more widely accepted. As the dream of a renewables only future fades, the merits of nuclear are once again coming to the forefront. That is why the US government is taking action to save its operating nuclear plants that are struggling in de-regulated markets, the UK is strongly supporting new build, Canada is refurbishing its aging nuclear fleet and China is rapidly expanding its share of nuclear production.

Countries like Germany that are committed to phasing out nuclear for a 100% renewable future are further proof that this approach to decarbonization is flawed as they add coal production to make up for their nuclear shortfall. Now Korea seems to be following this approach as their new president is committed to getting rid of both coal and nuclear (70% of

their current system) for a renewable future. We only hope this analysis of Jacobson's paper is a wake-up call that is heeded in these markets that now seem to be following an unrealistic romantic world view rather than a realistic one.

Once again, I have to quote Michael Shellenberger. In his proposal for Atomic Humanism his first principle is – "*nuclear is special. Only nuclear can lift all humans out of poverty while saving the natural environment. Nothing else – not coal, not solar, not geo-engineering – can do that. How does the special child, who is bullied for her specialness, survive? By pretending she's ordinary. As good as – but no better than! – coal, natural gas or renewables*."

And it is this pretending that needs to stop. There is no longer a need to be defensive when supporting the nuclear option. Or as stated by the Department of Energy in the USA. *"… we're particularly proud of the contributions being made by the nation's nuclear power plants. Nuclear is, in short, a clean, constant, and downright cool energy resource. Unfortunately, many people may not understand how remarkable this unique energy source truly is, or the role that it plays in our energy portfolio and Americans' daily lives.*"

We are at a crossroad. The time has come to strongly support the best technology that can reliably meet the energy hunger of the world and we need to make it known to policy makers everywhere. Making energy policy on a hope and a dream is no way to plan our energy future. Nuclear power is the only true path to a low carbon future with the vast amount of energy needed to fuel the world that is both economic and reliable – and yes safe. If we work hard to support the facts, the truth may yet prevail. Or as stated by Michael Shellenberger – Nuclear is special – let's say it loud and let's say it proud!

A strategy for nuclear communications – listen

Not a day goes by when we don't read something about the public acceptance problem in the nuclear industry. A recent article preaching the end of the nuclear era had a pretty strong statement that sums up like this – "*Nuclear looks ever more like a 20th-century dinosaur, unloved by investors, the public, and policymakers alike*." While I don't believe this is actually the case, I am sure that many in the public would not find much to fault with it. And that is the challenge we face.

For more than 30 years we have been hearing that the public just don't understand the nuclear message – that we need to better educate them – and that while we are all smart folks we are very bad at communicating. Yawn……

As an industry, we pride ourselves on maintaining detailed OPEX from around the world and learning lessons to foster continuous operations improvement. Yet, while there has actually been a lot of recent good work on communicating with the public, in this non-technical area we are much slower in leaning the lessons we need to learn.

Beliefs about nuclear power are well entrenched in society. Most of the concerns come from its weapons origin and a significant fear of radiation that will not just go away with a simple explanation or better education.

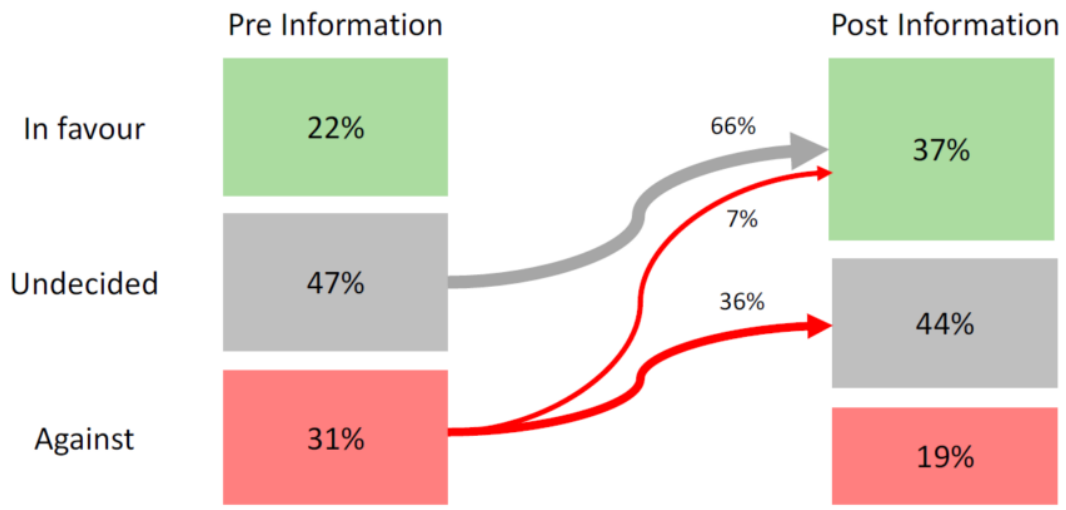
This fear translates into fears about nuclear power plants. It is a common belief that we are safely operating doomsday machines. i.e. that a nuclear accident can have such far reaching consequences that it can literally destroy the

world. If that is one's belief how can you convince him or her to support this technology? Talking about low probabilities is of little interest when the perceived consequence is so dire.

Yet, there is hope. There is generational change coming and this new generation is not afraid of technology, but rather sees it as the solution to everything. They have other issues on their minds such as climate change – they likely don't think much about nuclear power at all.

In our home country of Canada, a recent small study shows very interesting results. Without any scene setting, a simple question on whether the public is in favour of nuclear power shows about a fifth in favour, a third against and the most, about half in the undecided column. This probably demonstrates that nuclear power is not a top of mind issue for many Canadians. However, what is important about this study is that once the question is asked again, if prefaced by some scenarios providing information – such as today nuclear provides 17% of electricity in Canada but less than 1% of carbon emissions; or that Canada has more than 50 years of operating nuclear plants safely; or that small reactors may provide much needed energy to help in Canada's remote communities; then the result is quite different. The chart below suggests that given a positive reason to think about nuclear power, people are likely to change their view with support growing and opposition declining. The lesson here is that people can be open to a new discussion about nuclear power BUT this must be on the basis of them considering that it is a possible solution to an issue of relative importance to them.

CAN IDEAS SHIFT OPINION?



Or to be more clear, the first step is not trying to reduce the fear of nuclear. Without giving people a reason to listen you may as well be talking to yourself. What is needed is to LISTEN, understand what issues are important to the public and demonstrate that nuclear power is a possible solution. Whether their issue is climate change, energy poverty in the far north, energy innovation, high quality job creation, or just electricity reliability; it is only by addressing these issues that there will be an appetite for listening to us to find out more.

A great example is the group Environmental Progress in the USA. Here is a world renown life long environmentalist, Michael Shellenberger, taking up the fight to support nuclear power as a tool to meet environmental goals. I don't know Michael personally but I would guess that he didn't just wake up one day with a huge aha moment and decide nuclear power is a fantastic technology that he wanted to support; but rather he looked for solutions to what is important to him, the environment. This is clearly set out in the EP mission – *"Nature and Prosperity for All – Environmental Progress (EP) was founded to achieve two big goals: lift all humans out of poverty, and save the natural environment. These goals can be*

achieved by mid-century – but only if we remove the obstacles to cheap, reliable and clean energy." I expect that over time, in his quest to improve the environment, he came to consider nuclear as an option and became open to listening and learning more about whether this option would help to achieve these goals.

I have read many of the posts by EP and they are excellent. But what is of interest to me as an industry person is that the arguments being made in support of nuclear power are not new. In fact, they are mostly the same arguments we have been making for the more than the 35 years we have been in this industry. So, what has changed? The dialogue. Once there was a clear goal that is not directly about nuclear power, there became an openness to learn more about those options that can help meet that goal. And then the facts can be discussed and as we know, the facts tell a good story.

What do we learn here? We have a huge opportunity today to change the discussion about nuclear power, but the first step is to stop and listen. It's not about talking about safety and the LNT model for radiation protection; it's about understanding the issues of importance to a new generation and then having a conversation to show that nuclear can be part of the solution. Just trying to educate has taken us nowhere. But once we listen, then we can expect others to open their minds and listen too. Only then can we say that nuclear power is not a 20th – century dinosaur; but rather is a technological wonder able to produce the huge amounts of clean reliable energy required for the 21st century and beyond.

Note: This is one of a series of posts to engage in a healthy discussion on public acceptance and nuclear advocacy. As we think about these issues we would like to point out an excellent book by Meredith Angwin, "*Campaigning for Clean Air: Strategies for Pro-Nuclear Advocacy*". If you are at all interested in nuclear advocacy, this is a must read.

In an era where facts no longer matter, consequences still do

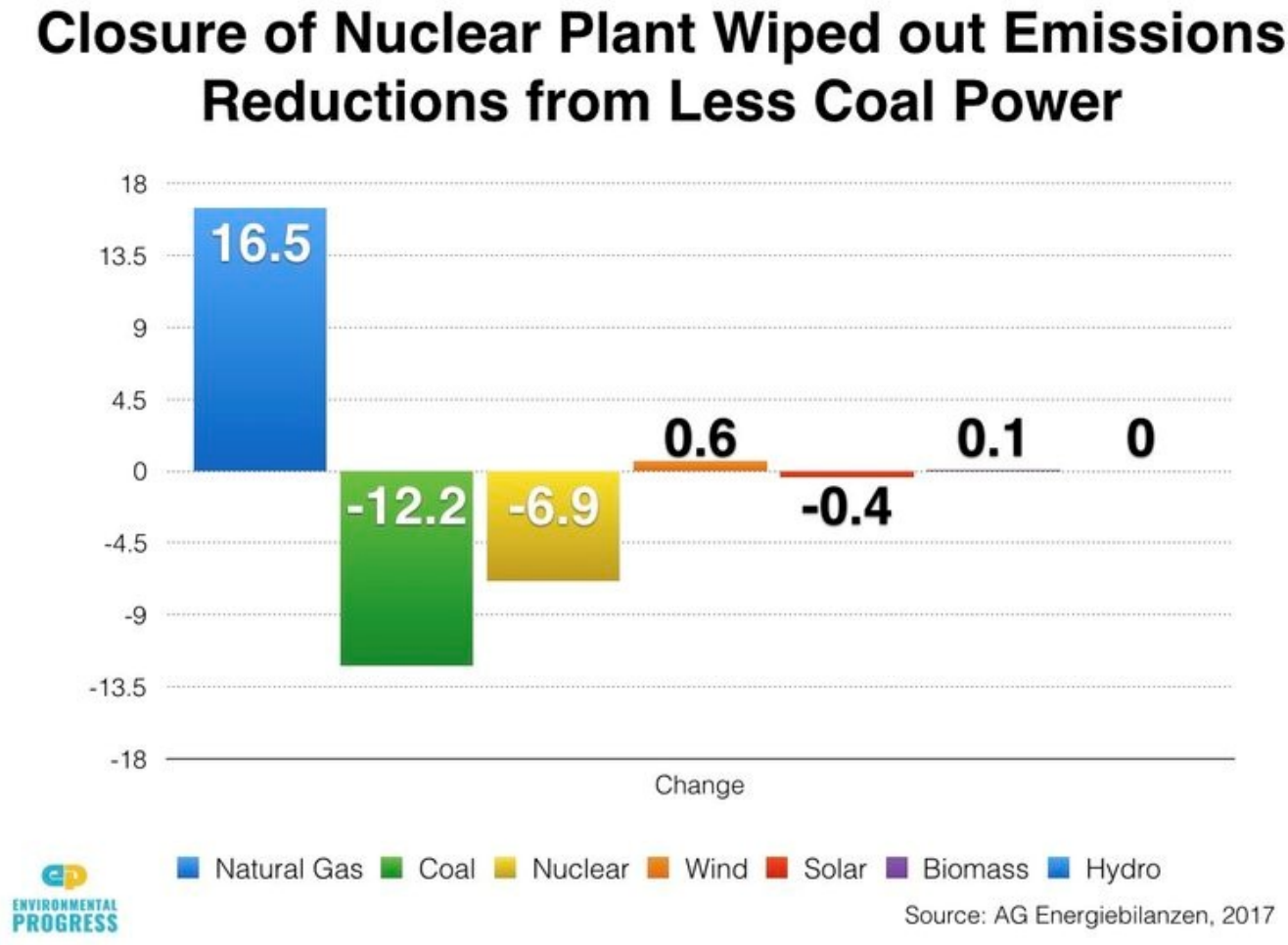
Over the last few years, we have written extensively about the strength of peoples' beliefs and how difficult it is to change them. In spite of this, I thought we were making progress with a push to more evidence-based decision making. For something as polarizing as nuclear power, facts-based decision making is critical to increasing support. (I understand the paradigm of fear of radiation is more emotional than fact based and I agree that we need to appeal to emotions to create the change we need – but let's leave that to a future discussion. In any case it certainly doesn't hurt to have the facts on your side.)

With the populist surge in 2016 we have seen an accompanying rise in complete disregard for facts; all the way to the propagation of absolute lies (or "alternative facts") to support peoples' beliefs. I don't want to get into a political discussion nor take sides on right versus left. What I do want to do in today's post is to discuss something more fundamental – i.e. that although we are free to believe what we want – that beliefs have consequences – and that consequences matter.

So, let's look at what happens when countries believe they can eliminate nuclear power from the mix and replace it with more wind and solar power. Of course, I am talking about Germany. Reducing carbon emissions is a reasonable goal as evidence (alternative facts notwithstanding) shows that climate change is impacting our environment and has long-term implications

for our entire society. On the other hand, removing a low-cost low-carbon source of energy like nuclear power because of safety concerns is based on a strong element of fear rather than evidence. In fact, Germany's nuclear plants are likely some of the safest in the world and there is no reason to suspect they will result in a catastrophic accident that means the end of Germany as we know it – yet that is what people fear.

So, what happens in a case like this? The results are in. Fossil fuel use is increasing in Germany, carbon emissions are going up and so is the cost of energy. The German people are paying more money for an outcome that does more damage to the environment and hence, their health. Frankly, it's a high price to pay for the piece of mind that comes from eliminating the perceived risk of nuclear. Or in other words, the extreme fear of nuclear is driving policy more than concern for either energy cost or the environment.



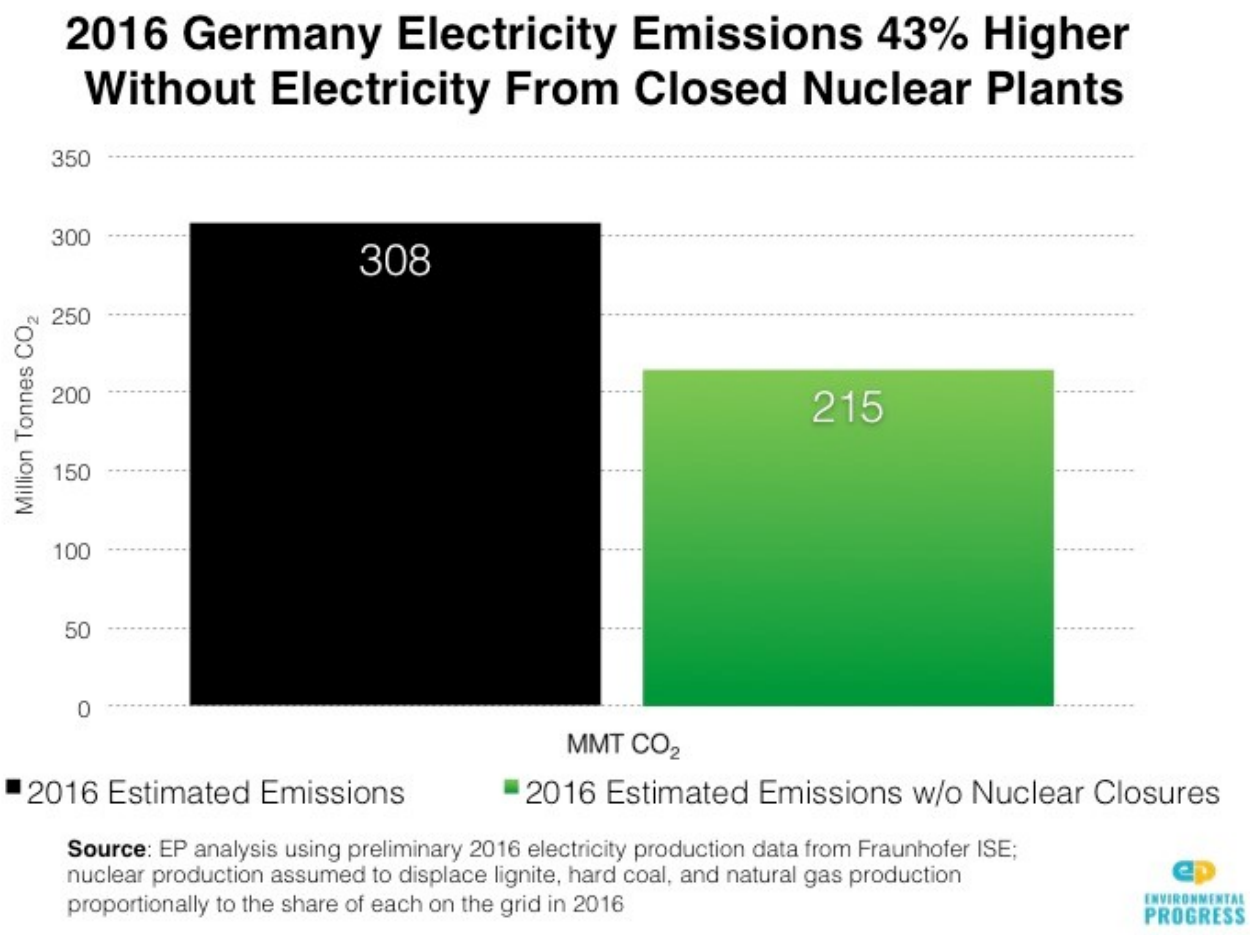
As shown above, closure of another nuclear plant in 2015 resulted in increased emissions in 2016 (the first full year it was out of service) even though there was a substantial substitution of gas to replace coal.

And after adding 10 percent more wind turbine capacity and 2.5 percent more solar panel capacity between 2015 and 2016, less than one percent more electricity from wind and one percent less electricity from solar was generated in 2016. So, not only did new solar and wind not make up for the lost nuclear, the percentage of time during 2016 that solar and wind produced electricity declined dramatically. And why was this the case? Very simply because Germany had significantly less sunshine and wind in 2016 than 2015.

This analysis was done by Environmental Progress and shows that the intermittency of these renewable sources of electricity both throughout the day and from year to year mean that even huge increases in capacity of these forms of generation will continue to require fossil backup in the absence of nuclear power making 100% renewables an unachievable goal. Another study shows that to achieve a 100% renewable system in Germany would require a back-up system capable of providing power at a level of 89% of peak load to address the intermittency.

Comparing Germany to France, France has more than double the share of low carbon energy sources and Germany has more than twice the cost of energy as France.

So, trying to decarbonize by also removing nuclear from the mix at the same time is simply too high a mountain to climb. The following shows that German emissions were 43% higher in 2016 without the nuclear plants that have been already shut down. Keep in mind that they still do have operating nuclear and with more plants to shut down, the future trend is not likely to change.



It's not just about Germany. As Japan struggles to get its nuclear plants back on line after the 2011 Fukushima accident, its use of coal has skyrocketed. In 2015 its use of fossil fuels for electricity generation was 82% compared to 62% in 2010 when the nuclear plants were in operation. And now Japan plans to build 45 new coal plants (20 GW) over the next decade to meet its energy needs.

Finally, we can also look at South Australia, a nuclear free zone. Recent blackouts due in part to lower wind availability and the inability of thermal plants to make up the shortfall are also leading to questions on 'how much renewables is too much'.

So, we can all continue to hold our beliefs very dearly and only listen to those that support them, while vilifying those that do not. However, please keep in mind that in a world where the farcical becomes reality, results still matter. And

for now, the results are clear, taking nuclear power out of the mix in Germany is not achieving its political-planners' goals. Yet these results are also not likely to change any German minds when it comes to nuclear power. But hey, why worry about the outcome when you know you are right or as said by comedian Chico Marx in the famous Marx brothers movie Duck Soup "Who you gonna believe – me or your own eyes?"?

Fighting for the environment – keep nuclear in the mix

Earlier this month I enjoyed a week of vacation sitting on the beach in front of a beautiful camp (or cottage, cabin or country house, depending on where you are from) staring at a stunning view of the north shore of Lake Superior, the world's largest fresh water lake. This is pretty far north (at the 49^{th} parallel), and this year the summer has been very hot. Once again, July has been the hottest month ever recorded.

It’s times like this of quiet reflection that the issue of environment comes to the forefront. Contrast this idyllic view to that of some of the world’s cities where pollution is rampant and health is impacted every day. This is the short term need – make the air breathable for all those that are having their health impacted negatively by pollution primarily coming from burning coal to generate electricity and from burning fossil fuels in cars each and every day. And then there is the issue of climate change. Harder for many to understand as the consequences are not as easy to see in the short term; but clearly the environmental issue of our time.

Let me start by saying that I am not one of those people that believe we should directly tie the future of nuclear power to climate change but rather that the case for nuclear needs to be made on its merits – reliability, economics, sustainability and yes, its environmental attributes. In fact, today environmental attributes of any generation technology should be the price of entry – low carbon and low polluting technologies are the ones that should make the list to be considered for deployment. However once on the list it is the other attributes that need to be considered when planning

and implementing a robust electricity supply system.

Looking at this beautiful view, I find it hard to understand how so many are trying to disadvantage the environment by excluding nuclear power from the list of technologies that are environmentally friendly. And not just for new generation, but many are fighting to close existing plants that have been providing clean, economic and reliable electricity to the grid for decades. Examples abound.

In California, a decision was recently taken to shut down Diablo Canyon in 2025 rather than extend its life and replace it with renewables and demand management. This decision has recently been severely criticized by Dr. James Hansen, one of the world's most prominent climate scientists who has asked the Governor for a debate on the issue stating "*Retirement of the plant will make a mockery of California's decarbonization efforts. Diablo Canyon's yearly output of 17,600 gigawatt-hours supplies 9 percent of California's total in-state electricity generation and 21 percent of its low-carbon generation. If Diablo closes it will be replaced mainly by natural gas, and California's carbon dioxide emissions will rise…*" [Read the entire text of the letter here]

In New York state there has been an important victory as nuclear has been included in the clean energy standard as legislators have acknowledged the important role that nuclear plays in reducing carbon emissions; and in fact accepts that meeting carbon objectives is simply impossible without nuclear. However, this is just a first step. It protects existing nuclear but also maintains the future target of 50% renewables, making nuclear a bridge to the future. Well if existing nuclear is good, then so should new nuclear – but that fight is for another day.

Of course the battle to include nuclear as a low carbon energy option is not uniquely a US issue. A new study * by the University of Sussex and the Vienna School of International

Studies suggests that "*a strong national commitment to nuclear energy goes hand in hand with weak performance on climate change targets*". While the authors do note that "*it's difficult to show a causal link*", this does not stop them from suggesting it is likely there. It is easy to say that Germany has done a good job and reduced its carbon emissions by 14% since 2005. What is not said is that Germany's carbon reduction efforts have really struggled since it closed a number of nuclear plants in 2011 after the Fukushima accident and has yet to get back on track; which was likely a key factor in Sweden where the Greens have accepted the need for continued nuclear operation to meet its climate goal.

Here in my home jurisdiction of Ontario Canada, we had the largest carbon reduction in all of North America as coal was removed from the generation mix in 2014. This was not done by replacing coal with renewables although renewable generation has increased, but was made possible by refurbishing and returning nuclear units into service.

I have written extensively about peoples' belief systems over the years and this is what is standing between nuclear and success. Ask anyone in the street about clean electricity and you will hear that renewables, primarily wind and solar, are what is needed to transform our energy systems. Ask about nuclear and the response is much more likely to be mixed.

It is great news that many environmentalists are now seeing the necessity of nuclear in the mix. As concluded by James Hansen in his letter" It *would be a tragedy if we were to allow irrational fear to harm the climate and endanger the future of our children and grandchildren*." So if we are to avoid a tragedy, we in the nuclear industry have a lot of work to change the narrative and continue to increase public support. The agreement in New York is a good beginning but the hard work has only just begun.

*** The study referenced above was retracted by the authors on**

November 25, 2016 as they admitted mistakes in the analysis. The link to the retraction on Retraction Watch is here.

Let’s create awareness for all the benefits that nuclear technology brings to mankind

When a report on the benefits of nuclear technology starts with “*The public are often unaware of the extent to which aspects of their everyday life involve products and processes originated from the application of nuclear technology via the nuclear industry*”, it tells me that the time has come to tell this story and increase public awareness.

I had the opportunity to attend the Nuclear Industry Summit in Washington last month and was privileged to participate in Working Group 3 which had the mandate to summarize the role of the nuclear industry globally. The NIS was a very successful event. It was a companion event to the Nuclear Security Summit held by President Obama and provided an opportunity for the nuclear industry to interact and present its views to global leaders on the key issues of nuclear security and how the industry addresses it.

With the 5th anniversary of Fukushima having just passed last month and the 30th anniversary of Chernobyl this month, we have a steady reminder of the issues that never seem to go away for the nuclear industry. It is our nature. In his very enjoyable talk to the Canadian Nuclear Industry Conference in February, Malcolm Grimston asks the key question of why is it that the safest source of large scale electricity generation we have ever come up with is considered so dangerous by enough people that in a number of countries there is an effort to stop using nuclear energy? I have commented on Malcolm's presentations before and I really enjoy his perspective. We in the industry tend towards the problem being an irrational public – Malcolm insists the public are quite rational and that it is actually the industry that is providing much of the information that frames public views. An example is the constant talk by the industry about safety and how safety is the most important issue. While intended to provide comfort, it can achieve quite the opposite effect. If safety is even more important than generating electricity reliably and efficiently the answer is quite simple – shut down the plants and safety is assured. I won't go into more detail but I do recommend you watch Malcom's presentation when you have 25 minutes to spare.

Or as was so eloquently put by the CEO of Ontario Power Generation at the CNA conference when talking about the nuclear industry, "*we make sure to find the black cloud around*

every silver lining left to our own devices." Yes, we in the industry often succumb to the narrative and as Malcom suggests, probably even feed the beast. (Aside: I also urge you to watch Jeff Lyash's presentation when you have 20 minutes to spare. It is an excellent view of the industry going forward.)

So rather than talk about safety and nuclear waste as we tend to do over and over again; in this post I want to help increase awareness of the many benefits that nuclear technology brings to us all across a range of industries. The paper submitted by Working Group 3 led by Dr. John Barrett, President of the CNA is a must read. It is one of those papers that once read makes you wonder; why hasn't this paper been written this way before? So please read the paper – it is about 20 pages and well worth it.

But for those who may not get there quickly enough here is a summary of the benefits that nuclear technology brings to society each and every day. As stated in the paper, "*Nuclear technology is vital for more than just providing reliable, low-carbon energy. It also has life-saving medical application; improves manufacturing, mining, transport and agriculture; and help us discover more about the planet we live on and how we can sustainably live with it.*"

So for example, did you know that

- nuclear technology saves lives through use of radioisotopes for screening, diagnosis and therapy of various medical conditions? According to the WNA, over 10,000 hospitals worldwide use radioisotopes. Radioisotopes are used in therapy to control and damage cancerous growths. Iodine-131 is used to treat thyroid cancer; Phosophorus-32 to treat leukemia. Nuclear techniques are used for neonatal screening for sickle cell disease, hypothyroidism and cystic fibrosis, as well as childhood cancers.

- radiation is used to preserve seeds and food products and breed disease-resistant plants. In plant breeding, some 1800 new crop varieties have been developed through mutation induced by ionising radiation.
- irradiation technology is increasingly being used to preserve food – spices, grains, fruit, vegetables and meat. It avoids the use of potentially harmful chemical fumigants and insecticides
- use of the IAEA's Sterile Insect Technique irradiates the eggs of these insects to sterilise them before hatching. The IAEA estimates that, by suppressing insect pest populations with SIT, pesticide use worldwide has been reduced by 600,000 litres annually.
- in industrial radiography, nuclear substances are used for the non-destructive examination and testing of new materials. Radiation from the substances passes through the material and allows defects in welds or constituency to be recorded on film or a digital imager.

This list does not do justice to the report itself which I strongly suggest you read. It's time to stop being on the defensive and make sure that we no longer have to write reports that start with "*The public are often unaware of the extent to which aspects of their everyday life involve products and processes originated from the application of nuclear technology via the nuclear industry.*" It is time to celebrate our successes and not just talk about where we need to improve. We are proud to be part of the nuclear industry and we are confident that we are making a difference that helps to make the world a better place.