US Electric Utilities & IPPs

The Coming Carbon Bomb (Extending the Nuclear Life Limit)

Equities

Americas
Electric Utilities

Julien Dumoulin-Smith
Analyst
julien.dumoulin-smith@ubs.com
+1-212-713 9848

Michael Weinstein
Associate Analyst
michael.weinstein@ubs.com
+1-212-713 3182

Paul Zimbardo
Associate Analyst
paul.zimbardo@ubs.com
+1-212-713 1033

EPA's proposed carbon rules could founder without nuclear license extension

On our latest conf call, we discussed the prospects for 'Subsequent' license renewals for the existing nuclear industry from 60 to 80-years, as the fleet is poised to begin hitting this threshold question in the late 2020's, precisely when EPA's proposed carbon targets are meant to take effect. While this renewal process is only expected to kick-off in 2016, we suspect the NRC's decisions (still unclear) on allowing for further extensions could trigger substantial challenges in achieving the slated -30% reduction off 2005 levels targeted. We estimate a net +5% increase in US carbon emissions should all units (through 2040, or ~60GW) be replaced with gas rather than renewed.

Nuclear replacement could drive next major utility capex cycle in 2020's

We see the NRC's decision on whether to allow for a further 20-year license extension as the threshold question around an uptick in utility capex spending, beginning late this decade. We suspect efforts to replace potentially retiring units could drive spending easily in excess of $100 Bn+ to replace nuclear capacity retiring through 2040 with low or no emission assets. Coupled with natural attrition of the coal portfolio – and continued investment in renewables to achieve carbon targets – we suspect utility sector capex cycle is likely to accelerate once-more. This would follow a projected lull in the back half of the current decade (2016-2020) as demand growth has slowed, amidst meaningful efficiency and distributed resource policies.

What's the timeline? Expect initial indications in 2015, with approvals in 2020's

In August the NRC ruled that license renewal beyond 60 years was already covered by current regulations, which does not specify the number of years for which a plant can run, but states that a review must take place every 20 years. Thus no new regulation is needed for this process. Scientific and technical review has also shown that there aren't any specific technical reasons why a further 20 year extension may not be possible. As such, NEI expects utilities to start announcing their plans for subsequent license extensions by mid-2015, followed by the NRC issuing a guidance document by late 2016. NEI suspects initial decisions on subsequent license renewals could be announced by 2020/21. On the procedural level, NEI estimates up to $25 Mn in costs/fees to pursue Subsequent license renewal. However, success at the end of the NRC review remains unclear at this time.

But upgrades to plants to maintain safety could prove quite costly

Ultimately, it may very well be the economics of retrofits to make them compliant with future standards that drives plants not to move further with Subsequent license renewals to 80-years. Despite a paucity of data points on the subject, NEI's two case studies for similar upgrades were $750Mn and $1Bn, driving up the all-in cost of dispatch to a range of $53-60/MWh. The renewal process primarily examines stationary elements of the plant including large steel/concrete structures, as well as the containment vessels and buildings, alongside the plant's physical wiring. While much of the plant's operational parts are replaced throughout its life already, extensions could drive additional spend even prior to the license life as parts are replaced to maintain the plant beyond its current license period. We continue to see inflationary trends in the nuclear industry as problematic, particularly in merchant markets, unable to absorb the meaningful capital investments required.

So who's looking to build new now? Details from SO, NEE forthcoming

While the bulk of capacity replacing any retiring nuclear capacity would likely be a mix of gas-fired and renewable (wind) generation, many large regulated companies could yet seek to establish new nuclear programs. SO stands out as management has already taken first steps to add yet further new nuclear units (beyond Vogtle3/4), with licensing work likely to begin in 2015 for a mid-2020's in-service target. We also flag NEE's regulated FPL unit continues to actively evaluate further units at Turkey Point to offsets the states' growing dependence on gas. We think other utilities are likely to disclose initial processes on new units as part of their carbon compliance plans, with interest predicated in part on the success of SO and SCG in developing their ongoing new nuclear construction sites at a reasonable cost and timeline.

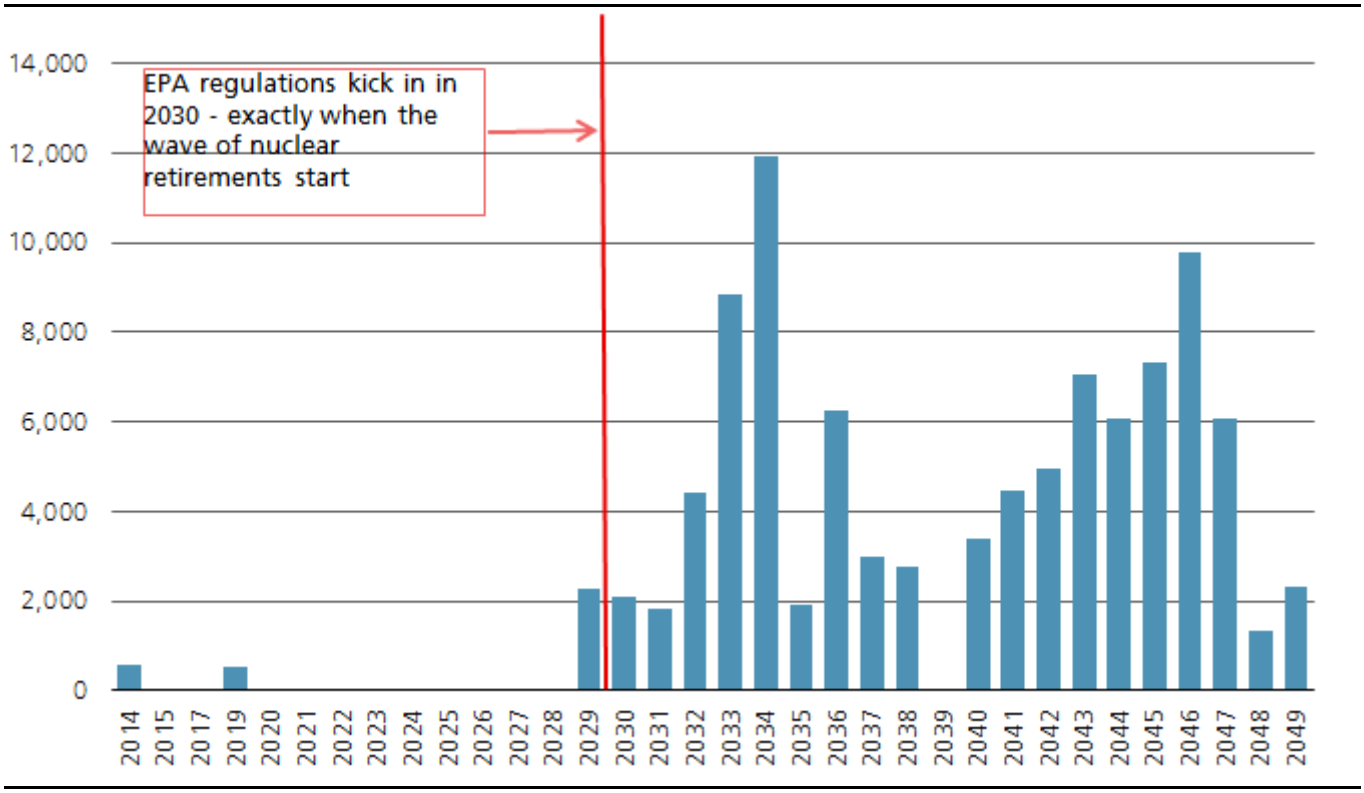
What about the merchant nukes? More capex and big swing to DCF

For merchant companies with upcoming nuclear expirations, we see a clear potential need for further capital investment, coupled with a meaningful swing in perceived DCF should investor expectations move away from assuming a terminal value on assets. While most notable in ETR's valuation over Indian Point (which has yet to receive its license extension to 40-years), we see this as a key strategic issue for Exelon later this decade. We believe should initial indications from NRC suggest Subsequent license extensions to be too costly, this could cause Exelon to dilute its exposure to merchant nuclear through additional transformative transactions.

The carbon bomb timeline:

We show below the forecast years for nuclear capacity closures based on current existing, and under review license status. The full reactor level data set on which the chart is based is reproduced at the end of this note in the Appendix section.

Figure 1: Nuclear capacity closures based on existing and currently under review licenses (MWs)



Source: NEI, SNL

Conference Call Transcript

*The following are highlights from our call with **Jason Remer from the Nuclear Energy Institute (NEI)** to discuss subsequent 20-year license extensions for the US nuclear portfolio, for up to 80-year lives. The comments below have been edited to improve grammatical clarity and provide enhanced context.*

Replay Information (available until 10/1):

Toll Free: 800 633 8284

Toll: +1 402 977 9140

Passcode: 21734350

Julien Dumoulin Smith: Good afternoon everyone. Thank you for joining us. We'll be discussing subsequent license renewals (SLR) for nuclear power plants with Jason Remer from the Nuclear Energy Institute today - basically what it means, how it can get done, and the process to see these nuclear license extensions accomplished. I'll turn it over now to Jason to provide context to this issue.

Jason Remer: Okay thank you Julien. I appreciate being with you this afternoon, and like Julien mentioned, we're going to be talking about a very important topic -Subsequent License Renewal (SLR), or nuclear plant license renewal beyond the current term of 60 years.

Just to introduce myself - Jason Remer, I'm Senior Project Manager for Engineering and licensing at the Nuclear Energy Institute in Washington D.C. I've got over 30 years' experience in energy and nuclear issues on utility staff, a government employee and as a consultant in energy issues.

NEI is the policy communication and lobbying arm of the US nuclear industry. Every US utility is a member, in addition to the enrichment and use of isotopes companies.

I want to start off with a little background on the current status of

nuclear license renewal. About 15 years ago we undertook the process to evaluate relicensing nuclear reactors for an additional 20 years. Currently we have 100 operating reactors across the country and 62 sites in 31 states. Five new nuclear units are under construction.

The fleet is well run at a 91% average capacity factor which compares well with coal at 59%, gas 50%, wind 32%, and solar 24%. The capacity factor makes a lot of difference, of course, to the actual energy you can dispatch to the grid independent of the capacity of the unit.

Nuclear currently represents 63% of the emission-free generation electricity providers in the United States. The original license created 40 years was not due to the equipment limitations but was due to economic and financial considerations basically a life in terms of the loan in the amortization of the equipment.

Currently the license renewal process works quite well, 73 plants have currently obtained renewed licenses from the NRC to operate 60 years. The process is governed by the license renewal rule 10 CFR 54 and 10 CFR 51 for the environmental side.

Let's talk a minute about license renewal beyond 60 years. Current regulations presently allow license renewals in 20 year increments. It does not specify for 60 year operation or 80 year operation or whatever it just says you should do it in 20 year increments. So currently the regulation allows subsequent license renewal.

In August of this year the NRC Commission confirmed that license renewal beyond 60 years was adequately regulated by the current regulations. In other words we don't need new regulations to continue on and renew the licenses for another 20 years.

They did however instruct the staff to update their guidelines for application, application preparation, and content. The industry overseen by any eyes working with the NRC to provide stakeholder

input to the process to ensure effectiveness and efficiency.

So basically how will this process work? Our license renewal process has worked well. It is fairly lengthy and complex but it actually has performed quite well and it is stable. So we hope the new process will work the same way. It's the same regulations, same process, and with some updates from lessons learned from the first run.

At the heart of license renewal is to ensure the safety of long-lived passive equipment through the application of what we call AG Management Programs or AMPS.

These AMPS provide guidance on inspections, tests, analysis and replacements for passive long-lived equipment - basically equipment that doesn't move or turn and basically which isn't replaced on a frequent basis. We have a strong connection with research and development being done by the Electric Power Research Institute (EPRI) and the Department of Energy. We actually have a joint R&D plan in this area and have very aggressively been pursuing R&D activity for the last few years.

However, I want to just make a point that R&D has always been ongoing in the nuclear area, and it will continue to guard all the safe operations that we perform. The scientists have told us that there aren't any generic technical issues that would prevent plants from submitting a SLR application for an additional 20 years of operation.

So what will change in the process? Currently U.S. nuclear plants are maintained and are up-to-date safe status at all times. If they are not safe they are not allowed to run. Two or more NRC inspectors are stationed at each nuclear plant at the United States. If it's a multi-unit site you can have more regulators stationed. They actually live in the communities and are part of the plant's staff in regards to coming in to work and where they are located.

This compares to a lot of the European processes, which are in essence periodic safety review process - where the regulator and the utilities sit

down together every 10 years and look at what it would take to run an additional 10 years based on whatever term they've established in the country.

In the U.S. process, on the other hand, the regulators are always watching the plants at all times and modifications are performed on a regular basis to address any issues that come up. Components are replaced as they wear out or reach near to end of their life to maintain the plant in a safe and ready process or position. Nonetheless, the increased operational horizon because of the 20 more years **will allow investment in more and efficient plant equipment and systems.**

In other words if you got another 20 years of operation, you might consider replacing the main turbine which is not only bringing it up to date to the most recent technology but also would give you additional output more than likely, increased safety, and reduce maintenance. You might also replace an analog control system with a digital control system.

So that plan gives you a lot more ability to consider component replacements which while not necessary or vital (because the plant is technically safe already if it is operational) it will improve the performance of your plant. Currently, **the U.S. nuclear plants are spending on the average from $50 to $10 million per year per plant for capital plant improvements and regulatory required changes.**

Okay this is probably what you're most interested in because I understand you are a financial community. What will it cost? Assuming it is not very different from the standard license renewal application process, the actual SLR application process – i.e., the preparation on the application which takes a couple of years, the cost that NRC charges the utilities, and the process of resolving questions that come up - cost around 15 to 25 million. That's just the paperwork process and the regulatory approval process. Time wise, **it takes anywhere from 4 to 6 years front to back to perform and maybe longer depending on other factors.**

Capital investments will vary greatly depending on the plant condition or previous upgrades. There aren't any required plant investments to make to go to 80 years. Your condition of your equipment is evaluated on a case by case basis. Like I said, if you look at the horizon you have a much longer horizon to do investments that you may not be able to afford.

You say you only had 5 or 10 years left. NEI did do an economic analysis and we looked at two cases that people may want to make capital improvements - they probably will. **One case was investing $750 million and the other $1 billion, and the cost of electricity came out to be $53/MWh for the first and $/60MWh for the second.** And so it's well within the capability of the clients of electricity.

However, I just want to re-emphasize that's no generic number. Again it's different than a European process where they sit down and they make upgrades on an every 10-year basis or previously determined by the country, and they are required to make those upgrades.

We make safety upgrades as they become necessary. For a plant operating 60 years – there is no difference in capability the day before it turn 60 and the day after 60 - in other words a plant will be operated safely to the very date it shuts down.

Let's look at schedules. I did a little look at some of the plants that will be coming up for their end of their license period and what I found was without subsequent license renewal, **beginning in 2029, and over the next 5 years after that, 37 plants or over 1/3rd of the US fleet will retire - representing 30 gigawatts of lost emissions free generation**. So in other words, the first plant that has a renewed license will have that license expire in 2029, and so there will be a wave that will evolve 1/3 of the existing operating plants.

We do have interested plants, **interested utilities and pursuing subsequent renewal those will be announced in mid-2015. The**

NRC guidance to perform this subsequent renewal will issued we hope in 2016 so that we can begin application preparation. Generally like I mentioned before, license application takes about two years to put together and another two years to have the NRC review it.

So with their goal of 22 months it'll probably be more like a little bit more than that. So we hope to get the **first approved license for an additional 20 years approved in 2020.** With that I covered a lot of ground here I'd like to just if we have some questions or Julien if you have some questions that you'd like to ask I'll be open to consider that.

Julien Dumoulin Smith: Great, thank you very much Jason. My first question is around the 750 million and the 1 billion retrofit cost that you mentioned. How did you come up with that? Also, what did those costs comprise in terms of making those units compliant from a safety perspective, so as to get the threshold SLR for another 20 years in the first place?

Jason Remer: Now that's an important question Julien – the point is we the investment wasn't done to make them compliant – since they have been operating, they are already compliant. The cost estimate is simply a number that a company may wish to spend on upgrading equipment. **There are no equipment upgrades *required* so as to be able to move into the next 20 years.**

Let me give you an example. Say you were in year 50 and you replaced your main turbine with a new turbine. Now, you could operate 20 years at least with that same turbine. So it doesn't need to be replaced for the sake of the SLR.

So the main thing is not how much do we need to invest to get to that next level, or the capital expense as we go forward. And every plant will look at it differently. Some may choose early in the cycle and an additional 20 years to make some major capital improvements.

Others may say the cost of maintenance for this particular component

is too great, therefore I'm going to replace it in year say 58 rather than waiting until they get into the second operational phase. So I just want to make a distinction the numbers that NEI chose - I don't know how they came up with them. I think they just selected something that seemed fairly reasonable and tried to roll it up and say okay here's a couple of numbers we could use.

Julien Dumoulin Smith: Right can you just give me a little bit more background on where those numbers came from just specific sites or what those were.

Jason Remer: No. I wasn't involved in that study so I didn't really do that, but I have seen economic analysis by several companies and they all use a varying level of capital investment. I just want to reemphasize **it's not a number that you have to spend to get to the next 20 years.** They will spend it and it will be a greatly varying amounts.

Julien Dumoulin Smith: Great. And then perhaps this may or may not be an intuitive question but why 20 years further - I mean is there ever the potential for less than a 20 year extension and ultimately what would dictate that? How do you think about the 20 year increments from 60 to 80?

Jason Remer: Okay good question. Number 1: it's in the regulation that allows 20 year increments, and I guess it's somewhat arbitrary of sorts, it could have been 15 or it could have been 25. And so the regulation allows 20 year increments and the thing that would say we're done is if you came upon a component or an item that was not replaceable and when the economic to replace it was prohibitive - then you could say the end of the life of this unit is here.

Those items might include the containment or your reactor building that might be an item that would be not really replaceable that easily - I guess you could, but it would probably not be an economic consideration. Another might be the reactor itself possibly.

So once you've hit upon those non-replaceable items or those items that would require more capital investment than you had to make it economic, I think that's when you say okay we can get 15 more years

out of this or 10 more years. So it can be a varying length. And let me just reemphasize when the plant becomes unsafe because of any condition any equipment that can't be repaired then it's shut down immediately.

Julien Dumoulin Smith: Right. Where do other countries stand on this? I mean obviously we're not the only country in the world with nuclear unit licenses maturing? Could you provide a little bit of context.

Jason Remer: Sure. Well there's a lot of varying approaches to licensing across the world. Like I mentioned the Europeans use the periodic safety review and other countries use that as well, where every 5 or 10 years they sit down with the regulator. They then decide what needs to be done for upgrades and those upgrades then would be evaluated from a cost benefit standpoint and if it was cost beneficial to continue operation of plant then they would continue their operation for some number of years – this could be ten years, five years, whatever.

The rest of the world is looking at license renewal and subsequent renewal. The U.S. has definitely led in that area but the IAEA has recently issued International Generic Ageing Lessons Learned for Nuclear Power Plants (IGALL) which is a model program that would be applied to all plants in the world. And so the process is no way worked in the United States but it's being applied all over the world.

Julien Dumoulin Smith: Excellent. And so I suppose from your perspective what are your expectations around subsequent license renewal. Is your belief that for the bulk of the preexisting portfolio we would indeed receive this or what are your expectations? Or frankly the extent to which they receive it and decide to pursue it as well.

Jason Remer: Yes that's a good question. Number 1 most if not all plants will take advantage of the first rounds of license renewal if they're able to operate economically. We've had a few plants shut down for economic reasons and there will be a few more shut down before we're done. So we got to have a climate that allows economic operation of the plants. They got to be safe but they've also got to make money. If they don't make money then it's not a business.

If the process – from a regulatory perspective - stays very similar to what it is for license renewal - which we believe it will, then **the barriers to applying for subsequent license renewal up to 80 years are fairly low, and I believe any plant that is making money and is operating safely and has applied the license renewal philosophy will apply for subsequent renewal.**

I think it's going to be a decision based on what is their long-term economic outlook for that particular plant and a particular region, which makes a huge difference in the profitability of these units. So if I had to give you a number about who would apply for it I think who would apply would be all that can see a profitable endeavor in going 20 more years.

Julien Dumoulin Smith: Got you. But you don't necessarily have an expectation for how much actually have done or approved?

Jason Remer: If I give you a number it would just be a guess. I can say 100% but that wouldn't be right, I don't think that'll happen. I could say 80% - I mean I think it's going to be a lot because I think our plants are generally in good shape and the scientist are saying there's really **no big reasons that we would technically and scientifically need to shut these units down.**

Julien Dumoulin Smith: And so could you elaborate just a little bit what are the issues - the technical aspects to pay attention to when it comes to running a nuclear plant for a long period of time. What are the technical limitations that one might have to address from a safety perspective?

Jason Remer: Sure. Good question Julien. A nuclear plant runs like any other major industry facility; a lot of equipment on pumps, valves, motors, components instruments etc. Most components that run - that move and change state to operate - like a pump or a valve or motor – these are the components that have been changed at least once with newer equipment or rebuilt equipment by the time the plants get into 60-year of operation. So these components are likely to be relatively new

anyway.

So if you went up to a plant today that was operating say in its 45th year you wouldn't see an antique. You would see modern equipment; you would see the latest technology at the control systems. You would see very advanced equipment applied at the plant. **Now the stuff that you can't replace like the reactor building, reactor vessel, large concrete structures, large steel structures, electrical cables, that's the equipment that we have to watch out for in license renewal.**

So the AG management programs like I mentioned allow you and provide to you rigorous procedures for evaluating and inspecting those equipments. You look at the concrete walls and evaluate is this wall cracking or is it in good shape. You might do inspections on your reactor vessel using various advanced techniques to determine that the metal was still in really good condition. You would use advanced technologies to evaluate your electrical cables.

Electrical cables actually can be replaced, but I think if you had to replace all of them it might be not economically feasible. So you'd be watching out for the big categories, concrete structures, large steel, metal, specially eradiate metals, and electrical cables those are the big three categories.

Julien Dumoulin Smith: Can you elaborate a little bit on the August decision you talked about earlier with NRC. What was potentially going to be evaluated here and could you give us a little bit of sense of what the test is into the current regulations.

Jason Remer: Sure. Basically what happened is as we begin to work with the NRC staff, the industry began to consider what are we going to do - are we going to look at extending the license for these units further out or are we just going to let them retire at 60?

And so as we began to evaluate that and the NRC staff basically wrote

a list of questions to the NRC commissioners asking them what do we need to do about this? Do we need to look at redoing the regulation [for relicensing] to add more requirements to it or are the requirements that are currently involved, are they sufficient?

And so this brought up a major debate on the scientific and technical merits of these different approaches. **And at the end of the day, they agree with us that the current regulations which is a broad framework is sufficient to allow us into this next period of operation.**

So they basically agreed with our current process. It is a living process it's not something that you do once and you're over with. It involves AG management programs that monitor and maintain the health of your plant equipment.

Julien Dumoulin Smith: Got you. Would you mind going over the timeline again?

Jason Remer: **In the middle of next year you should start hearing utilities announcing that they want to pursue subsequent renewal.** Initially, it could be three or four plants that we call lead plants. After that, the NRC will publish the final guidance document - not a regulation - probably in late 2016; and then the utilities will be able to start their application preparation process which takes a couple of years. So we would hope that at the end of '18 or maybe '19 that we would get an application into NRC and then they would take a couple of years to review and approve it and so 2020/2021 we would see the first applications actually approved for extended operation.

Julien Dumoulin Smith: I'm curious so that's an interesting timeline also in the context of making alternate decisions should there be a rejection or decision not to pursue these subsequent license renewals.

What are you seeing on new nuclear activities and how does that jive with the timeline to make sure that the aggregate size of the portfolio doesn't necessarily decline too substantially should some of these not

be renewed.

Jason Remer: Yes well on the first point, once a company turns in the application and gets accepted for review by the NRC, then the company can continue to operate under existing plans and modes. In fact Indian Point is in that situation right now. They're operating but they don't have the renewed license fully approved yet. Their hearings are ongoing so the regulations allow continued operations

So I tell you what would be in the best interest of companies to put the license application in even if they thought maybe they will not continue operations – because it gives them a chance to save their place in line for continued operation if that's what they choose to do.

If you don't turn your subsequent renewal application in, you're running the clock out and as we've seen at a couple of sites, economic benefits from the nuclear plant goes away - and that really puts a wall up for communities in a fairly rough situation because you have to determine where's the power going to come from.

Julien Dumoulin Smith: Excellent. Well operator why don't we see if there's any questions on the line.

Question: You mentioned carbon free emissions a number of times - I was just wondering if any of the EPA rules or any of the concerns about carbon and all the other stuff is a consideration as you go through your reviews of these license renewals?

Jason Remer: Well if somebody pays for it, I think it would be, but as it stands right now -nobody is monetizing the carbon emissions at this point. I know the regulations are out there and they're going to force some things to happen. Given that nuclear plants are zero emission, I think it would figure in to the economic calculus once there's some forcing function on carbon which the new EPA rule may provide.

Question: Right. That would be from the plant owner's perspective but from the NRC's license renewal perspective, has there been an added consideration for that or not?

Jason Remer: Yes. During the environmental review they have to consider all forms of energy generation and what will have the least impact on the environment so that evaluation has to be done and the NRC does consider carbon impacts at this point.

Question: Okay. And then lastly, with regard to nuclear waste, is there any action on that front that you see?

Jason Remer: That's not exactly my area, but I do know that they just published the nuclear waste confidence rule - the safe storage rule - that will allow on site storage of used fuel for an indefinite period of time or for a determined period of time until the government figures out what they're going to do with the stored fuel. So it doesn't really limit you at this point, and the quantity of fuel even after a long term is really, really small compared to any other power source.

Question: So how does the NRC look at the cost of continuing to store the spent fuel on its decision? I think you partially answered that question but there's a significant amount of accumulated spent fuel and other spent radioactive material being stored on site at these plants. So what consideration is given and if these plants do start to close what's going to happen to that fuel? The US Government hasn't decided for decades now what it's going to do with their **spent fuel.**

Jason Remer: Again that's not really my area, but what I can say is **that it doesn't really impact at this point license renewal or subsequent renewal.** The licensing for the storage containers for used fuel is actually another process that NRC goes through. NRC really doesn't care about economics in that regard I mean - I hate to say it this way but they don't care if you run the plant or not.

Julien Dumoulin Smith: Well Jason let me just ask you another question here. Cutting back to that broader question about carbon, I think that's the big issue

here obviously. What is your perception of the administration's solution to potential uptake in carbon as a result of nuclear retirements?

Is there concern at the federal level as you perceive it to retirements, or at the state level as well? I ask because if you juxtaposed the issue of newly imposed carbon regulations emits that seems to be fit fairly neatly into the concentrated timeline for nuclear retirement.

Jason Remer: Yes I'd love to answer that Julien, but that's not really the area I work in and so I would just be conjecturing if I did answer it. However let me just say a lot of **their nuclear plants that are struggling financially are merchant plants and until we figure out how to weigh their value all that they provide to the grid both the stability, environmental benefits, and basically availability we're going to see some more trouble in that area.**

So we have to do something that makes good sense across the board and not put all our eggs in one basket. I think the rush to gas to do everything is going to be a bad choice ultimately.

Julien Dumoulin Smith: Well Jason I think we'll leave it there. Thank you.

END of Transcript. Appendix with forecast nuclear reactor closure data in Appendix below.

Appendix

Expected 60 year license expiration for US nuclear reactor fleet

Reactor name	State	License renewed	60 year expiration	MW
Browns Ferry 1	Alabama	Yes	2033	1,152.0
Browns Ferry 2	Alabama	Yes	2034	1,152.0
Browns Ferry 3	Alabama	Yes	2036	1,190.0
Joseph M. Farley 1	Alabama	Yes	2037	888.2
Joseph M. Farley 2	Alabama	Yes	2041	888.2
Palo Verde 1	Arizona	Yes	2045	1,403.1
Palo Verde 2	Arizona	Yes	2046	1,403.1
Palo Verde 3	Arizona	Yes	2047	1,403.1
Arkansas Nuclear One 1	Arkansas	Yes	2034	902.5
Arkansas Nuclear One 2	Arkansas	Yes	2038	942.5
Diablo Canyon 1	California	Under review	2041	1,159.0
Diablo Canyon 2	California	Under review	2045	1,164.0
Millstone 2	Connecticut	Yes	2035	909.9
Millstone 3	Connecticut	Yes	2045	1,253.0
Turkey Point 3	Florida	Yes	2032	877.2
Turkey Point 4	Florida	Yes	2033	877.2
St. Lucie 1	Florida	Yes	2036	1,080.0
St. Lucie 2	Florida	Yes	2043	1,080.0
Edwin I. Hatch 1	Georgia	Yes	2034	857.1
Edwin I. Hatch 2	Georgia	Yes	2038	857.1
Vogtle 1	Georgia	Yes	2047	1,160.0
Vogtle 2	Georgia	Yes	2049	1,160.0
Dresden 2	Illinois	Yes	2029	1,009.3
Dresden 3	Illinois	Yes	2031	1,009.3
Quad Cities 1	Illinois	Yes	2032	1,009.3
Quad Cities 2	Illinois	Yes	2032	1,009.3
La Salle 1	Illinois	File 1Q 2015	2042	1,170.0
La Salle 2	Illinois	File 1Q 2015	2043	1,170.0
Byron 1	Illinois	Under review	2044	1,224.9
Braidwood 1	Illinois	Under review	2046	1,224.9
Byron 2	Illinois	Under review	2046	1,224.9
Clinton	Illinois	File 1Q 2017	2046	1,138.3
Braidwood 2	Illinois	Under review	2047	1,224.9

Source: NEI, SNL

Expected 60 year license expiration for US nuclear reactor fleet (cont'd)

Reactor name	State	License renewed	60 year expiration	MW
Duane Arnold	Iowa	Yes	2034	679.5
Wolf Creek 1	Kansas	Yes	2045	1,267.7
Waterford 3	Louisiana	File 1Q 2015	2044	1,199.8
River Bend 1	Louisiana	File 1Q 2016	2045	1,035.9
Calvert Cliffs 1	Maryland	Yes	2034	918.0
Calvert Cliffs 2	Maryland	Yes	2036	910.7
Pilgrim 1	Massachusetts	Yes	2032	670.0
Palisades	Michigan	Yes	2031	811.8
Donald C. Cook 1	Michigan	Yes	2034	1,152.0
Donald C. Cook 2	Michigan	Yes	2037	1,133.3
Fermi 2	Michigan	Under review	2045	1,217.0
Monticello	Minnesota	Yes	2030	685.0
Prairie Island 1	Minnesota	Yes	2033	593.1
Prairie Island 2	Minnesota	Yes	2034	593.1
Grand Gulf 1	Mississippi	Under review	2042	1,440.0
Callaway	Missouri	Under review	2044	1,235.8
Fort Calhoun	Nebraska	Yes	2033	502.0
Cooper	Nebraska	Yes	2034	801.0
Seabrook 1	New Hampshire	Under review	2050	1,242.0
Oyster Creek 1	New Jersey	Yes	2019	550.0
Salem 1	New Jersey	Yes	2036	1,170.0
Salem 2	New Jersey	Yes	2040	1,170.0
Hope Creek 1	New Jersey	Yes	2046	1,290.7
Ginna	New York	Yes	2029	614.0
Nine Mile Point 1	New York	Yes	2029	641.8
Indian Point 2	New York	Under review	2033	1,299.0
James A. Fitzpatrick	New York	Yes	2034	882.0
Indian Point 3	New York	Under review	2035	1,012.0
Nine Mile Point 2	New York	Yes	2046	1,259.3
Brunswick 2	North Carolina	Yes	2034	1,001.6
Brunswick 1	North Carolina	Yes	2036	1,001.6
McGuire 1	North Carolina	Yes	2041	1,220.3
McGuire 2	North Carolina	Yes	2043	1,220.3
Shearon Harris 1	North Carolina	Yes	2046	950.9

Source: NEI, SNL

Expected 60 year license expiration for US nuclear reactor fleet (cont'd)

Reactor name	State	License renewed	60 year expiration	MW
Davis Besse	Ohio	Under review	2037	952.2
Perry 1	Ohio	File 9/2015	2046	1,311.6
Peach Bottom 2	Pennsylvania	Yes	2033	1,159.7
Peach Bottom 3	Pennsylvania	Yes	2034	1,159.7
Three Mile Island 1	Pennsylvania	Yes	2034	975.6
Beaver Valley 1	Pennsylvania	Yes	2036	923.4
Susquehanna 1	Pennsylvania	Yes	2042	1,298.0
Limerick 1	Pennsylvania	Under review	2044	1,138.5
Susquehanna 2	Pennsylvania	Yes	2044	1,298.0
Beaver Valley 2	Pennsylvania	Yes	2047	923.4
Limerick 2	Pennsylvania	Under review	2049	1,138.5
H.B. Robinson 2	South Carolina	Yes	2030	768.6
Oconee 1	South Carolina	Yes	2033	886.7
Oconee 2	South Carolina	Yes	2033	886.7
Oconee 3	South Carolina	Yes	2034	846.0
V.C. Summer	South Carolina	Yes	2042	1,029.6
Catawba 1	South Carolina	Yes	2043	1,205.1
Catawba 2	South Carolina	Yes	2043	1,205.1
Sequoyah 1	Tennessee	Under review	2040	1,220.5
Sequoyah 2	Tennessee	Under review	2041	1,220.5
Watts Bar 1	Tennessee	File 4Q 2018	2055	12,698.9
South Texas Project 1	Texas	Under review	2047	1,354.3
South Texas Project 2	Texas	Under review	2048	1,354.3
Comanche Peak 1	Texas	File 3Q 2016	2050	1,215.0
Comanche Peak 2	Texas	File 3Q 2016	2053	1,215.0
Vermont Yankee 1	Vermont	Yes	2032	563.4
Surry 1	Virginia	Yes	2032	847.5
Surry 2	Virginia	Yes	2033	847.5
North Anna 1	Virginia	Yes	2038	979.7
North Anna 2	Virginia	Yes	2040	979.7
Columbia Generating Station 2	Washington	Yes	2043	1,200.0
Point Beach 1	Wisconsin	Yes	2030	643.0
Point Beach 2	Wisconsin	Yes	2033	643.0

Source: NEI, SNL

Statement of Risk

Risks for Utilities and Independent Power Producers (IPPs) primarily relate to volatile commodity prices for power, natural gas, and coal. Risks to IPPs also stem from load variability, and operational risk in running these facilities. Rising coal and, to a certain extent, uranium prices could pressure margins as the fuel hedges roll off Competitive Integrateds. Further, IPPs face declining revenues as in the money power and gas hedges roll off. Other non-regulated risks include weather and for some, foreign currency risk, which again must be diligently accounted in the company's risk management operations. Major external factors, which affect our valuation, are environmental risks. Environmental capex could escalate if stricter emission standards are implemented. We believe a nuclear accident or a change in the Nuclear Regulatory Commission/Environment Protection Agency regulations could have a negative impact on our estimates.

Risks for regulated utilities include the uncertainty around the composition of state regulatory Commissions, adverse regulatory changes, unfavorable weather conditions, variance from normal population growth, and changes in customer mix. Changes in macroeconomic factors will affect customer additions/subtractions and usage patterns.

Required Disclosures

This report has been prepared by UBS Securities LLC, an affiliate of UBS AG. UBS AG, its subsidiaries, branches and affiliates are referred to herein as UBS.

For information on the ways in which UBS manages conflicts and maintains independence of its research product; historical performance information; and certain additional disclosures concerning UBS research recommendations, please visit www.ubs.com/disclosures. The figures contained in performance charts refer to the past; past performance is not a reliable indicator of future results. Additional information will be made available upon request. UBS Securities Co. Limited is licensed to conduct securities investment consultancy businesses by the China Securities Regulatory Commission.

Analyst Certification: Each research analyst primarily responsible for the content of this research report, in whole or in part, certifies that with respect to each security or issuer that the analyst covered in this report: (1) all of the views expressed accurately reflect his or her personal views about those securities or issuers and were prepared in an independent manner, including with respect to UBS, and (2) no part of his or her compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed by that research analyst in the research report.

UBS Investment Research: Global Equity Rating Definitions

12-Month Rating	Definition	Coverage[1]	IB Services[2]
Buy	FSR is > 6% above the MRA.	48%	33%
Neutral	FSR is between -6% and 6% of the MRA.	41%	30%
Sell	FSR is > 6% below the MRA.	11%	23%
Short-Term Rating	**Definition**	**Coverage[3]**	**IB Services[4]**
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	less than 1%	less than 1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	less than 1%	less than 1%

Source: UBS. Rating allocations are as of 30 June 2014.
1:Percentage of companies under coverage globally within the 12-month rating category. 2:Percentage of companies within the 12-month rating category for which investment banking (IB) services were provided within the past 12 months.
3:Percentage of companies under coverage globally within the Short-Term rating category. 4:Percentage of companies within the Short-Term rating category for which investment banking (IB) services were provided within the past 12 months.

KEY DEFINITIONS: Forecast Stock Return (FSR) is defined as expected percentage price appreciation plus gross dividend yield over the next 12 months. **Market Return Assumption (MRA)** is defined as the one-year local market interest rate plus 5% (a proxy for, and not a forecast of, the equity risk premium). **Under Review (UR)** Stocks may be flagged as UR by the analyst, indicating that the stock's price target and/or rating are subject to possible change in the near term, usually in response to an event that may affect the investment case or valuation. **Short-Term Ratings** reflect the expected near-term (up to three months) performance of the stock and do not reflect any change in the fundamental view or investment case. **Equity Price Targets** have an investment horizon of 12 months.

EXCEPTIONS AND SPECIAL CASES: UK and European Investment Fund ratings and definitions are: Buy: Positive on factors such as structure, management, performance record, discount; **Neutral:** Neutral on factors such as structure, management, performance record, discount; **Sell:** Negative on factors such as structure, management, performance record, discount. **Core Banding Exceptions (CBE):** Exceptions to the standard +/-6% bands may be granted by the Investment Review Committee (IRC). Factors considered by the IRC include the stock's volatility and the credit spread of the respective company's debt. As a result, stocks deemed to be very high or low risk may be subject to higher or lower bands as they relate to the rating. When such exceptions apply, they will be identified in the Company Disclosures table in the relevant research piece.

Research analysts contributing to this report who are employed by any non-US affiliate of UBS Securities LLC are not registered/qualified as research analysts with the NASD and NYSE and therefore are not subject to the restrictions contained in the NASD and NYSE rules on communications with a subject company, public appearances, and trading securities held by a research analyst account. The name of each affiliate and analyst employed by that affiliate contributing to this report, if any, follows.

UBS Securities LLC: Julien Dumoulin-Smith; Michael Weinstein; Paul Zimbardo.

Unless otherwise indicated, please refer to the Valuation and Risk sections within the body of this report.

Global Disclaimer

This document has been prepared by UBS Securities LLC, an affiliate of UBS AG. UBS AG, its subsidiaries, branches and affiliates are referred to herein as UBS.

This document is for distribution only as may be permitted by law. It is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation or would subject UBS to any registration or licensing requirement within such jurisdiction. It is published solely for information purposes; it is not an advertisement nor is it a solicitation or an offer to buy or sell any financial instruments or to participate in any particular trading strategy. No representation or warranty, either express or implied, is provided in relation to the accuracy, completeness or reliability of the information contained in this document ('the Information'), except with respect to Information concerning UBS. The Information is not intended to be a complete statement or summary of the securities, markets or developments referred to in the document. UBS does not undertake to update or keep current the Information. Any opinions expressed in this document may change without notice and may differ or be contrary to opinions expressed by other business areas or groups of UBS. Any statements contained in this report attributed to a third party represent UBS's interpretation of the data, information and/or opinions provided by that third party either publicly or through a subscription service, and such use and interpretation have not been reviewed by the third party.

Nothing in this document constitutes a representation that any investment strategy or recommendation is suitable or appropriate to an investor's individual circumstances or otherwise constitutes a personal recommendation. Investments involve risks, and investors should exercise prudence and their own judgement in making their investment decisions. The financial instruments described in the document may not be eligible for sale in all jurisdictions or to certain categories of investors. Options, derivative products and futures are not suitable for all investors, and trading in these instruments is considered risky. Mortgage and asset-backed securities may involve a high degree of risk and may be highly volatile in response to fluctuations in interest rates or other market conditions. Foreign currency rates of exchange may adversely affect the value, price or income of any security or related instrument referred to in the document. For investment advice, trade execution or other enquiries, clients should contact their local sales representative.

The value of any investment or income may go down as well as up, and investors may not get back the full (or any) amount invested. Past performance is not necessarily a guide to future performance. Neither UBS nor any of its directors, employees or agents accepts any liability for any loss (including investment loss) or damage arising out of the use of all or any of the Information.

Any prices stated in this document are for information purposes only and do not represent valuations for individual securities or other financial instruments. There is no representation that any transaction can or could have been effected at those prices, and any prices do not necessarily reflect UBS's internal books and records or theoretical model-based valuations and may be based on certain assumptions. Different assumptions by UBS or any other source may yield substantially different results.

This document and the Information are produced by UBS as part of its research function and are provided to you solely for general background information. UBS has no regard to the specific investment objectives, financial situation or particular needs of any specific recipient. In no circumstances may this document or any of the Information be used for any of the following purposes:

(i) valuation or accounting purposes;

(ii) to determine the amounts due or payable, the price or the value of any financial instrument or financial contract; or

(iii) to measure the performance of any financial instrument.

By receiving this document and the Information you will be deemed to represent and warrant to UBS that you will not use this document or any of the Information for any of the above purposes or otherwise rely upon this document or any of the Information.

Research will initiate, update and cease coverage solely at the discretion of UBS Investment Bank Research Management. The analysis contained in this document is based on numerous assumptions. Different assumptions could result in materially different results. The analyst(s) responsible for the preparation of this document may interact with trading desk personnel, sales personnel and other parties for the purpose of gathering, applying and interpreting market information. UBS relies on information barriers to control the flow of information contained in one or more areas within UBS into other areas, units, groups or affiliates of UBS. The compensation of the analyst who prepared this document is determined exclusively by research management and senior management (not including investment banking). Analyst compensation is not based on investment banking revenues; however, compensation may relate to the revenues of UBS Investment Bank as a whole, of which investment banking, sales and trading are a part.

For financial instruments admitted to trading on an EU regulated market: UBS AG, its affiliates or subsidiaries (excluding UBS Securities LLC) acts as a market maker or liquidity provider (in accordance with the interpretation of these terms in the UK) in the financial instruments of the issuer save that where the activity of liquidity provider is carried out in accordance with the definition given to it by the laws and regulations of any other EU jurisdictions, such information is separately disclosed in this document. For financial instruments admitted to trading on a non-EU regulated market: UBS may act as a market maker save that where this activity is carried out in the US in accordance with the definition given to it by the relevant laws and regulations, such activity will be specifically disclosed in this document. UBS may have issued a warrant the value of which is based on one or more of the financial instruments referred to in the document. UBS and its affiliates and employees may have long or short positions, trade as principal and buy and sell in instruments or derivatives identified herein; such transactions or positions may be inconsistent with the opinions expressed in this document.

United Kingdom and the rest of Europe: Except as otherwise specified herein, this material is distributed by UBS Limited to persons who are eligible counterparties or professional clients. UBS Limited is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority. **France:** Prepared by UBS Limited and distributed by UBS Limited and UBS Securities France S.A. UBS Securities France S.A. is regulated by the ACP (Autorité de Contrôle Prudentiel) and the Autorité des Marchés Financiers (AMF). Where an analyst of UBS Securities France S.A. has contributed to this document, the document is also deemed to have been prepared by UBS Securities France S.A. **Germany:** Prepared by UBS Limited and distributed by UBS Limited and UBS Deutschland AG. UBS Deutschland AG is regulated by the Bundesanstalt fur Finanzdienstleistungsaufsicht (BaFin). **Spain:** Prepared by UBS Limited and distributed by UBS Limited and UBS Securities España SV, SA. UBS Securities España SV, SA is regulated by the Comisión Nacional del Mercado de Valores (CNMV). **Turkey:** Distributed by UBS Limited. No information in this document is provided for the purpose of offering, marketing and sale by any means of any capital market instruments and services in the Republic of Turkey. Therefore, this document may not be considered as an offer made or to be made to residents of the Republic of Turkey. UBS AG is not licensed by the Turkish Capital Market Board under the provisions of the Capital Market Law (Law No. 6362). Accordingly, neither this document nor any other offering material related to the instruments/services may be utilized in connection with providing any capital market services to persons within the Republic of Turkey without the prior approval of the Capital Market Board. However, according to article 15 (d) (ii) of the Decree No. 32, there is no restriction on the purchase or sale of the securities abroad by residents of the Republic of Turkey. **Poland:** Distributed by UBS Limited (spolka z ograniczona odpowiedzialnoscia) Oddzial w Polsce. **Russia:** Prepared and distributed by UBS Securities CJSC. **Switzerland:** Distributed by UBS AG to persons who are institutional investors only. UBS AG is regulated by the Swiss Financial Market Supervisory Authority (FINMA). **Italy:** Prepared by UBS Limited and distributed by UBS Limited and UBS Italia Sim S.p.A. UBS Italia Sim S.p.A. is regulated by the Bank of Italy and by the Commissione Nazionale per le Società e la Borsa (CONSOB). Where an analyst of UBS Italia Sim S.p.A. has contributed to this document, the document is also deemed to have been prepared by UBS Italia Sim S.p.A. **South Africa:** Distributed by UBS South Africa (Pty) Limited, an authorised user of the JSE and an authorised Financial Services Provider. **Israel:** This material is distributed by UBS Limited. UBS Limited is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority. UBS Securities Israel Ltd is a licensed Investment Marketer that is supervised by the Israel Securities Authority (ISA). UBS Limited and its affiliates incorporated outside Israel are not licensed under the Israeli Advisory Law. UBS Limited is not covered by insurance as required from a licensee under the Israeli Advisory Law. UBS may engage among others in issuance of Financial Assets or in distribution of Financial Assets of other issuers for fees or other benefits. UBS Limited and its affiliates may prefer various Financial Assets to which they have or may have Affiliation (as such term is defined under the Israeli Advisory Law). Nothing in this Material should be considered as investment advice under the Israeli Advisory Law. This Material is being issued only to and/or is directed only at persons who are Eligible Clients within the meaning of the Israeli Advisory Law, and this material must not be relied on or acted upon by any other persons. **Saudi Arabia:** This document has been issued by UBS AG (and/or any of its subsidiaries, branches or affiliates), a public company limited by shares, incorporated in Switzerland with its registered offices at Aeschenvorstadt 1, CH-4051 Basel and Bahnhofstrasse 45, CH-8001 Zurich. This publication has been approved by UBS Saudi Arabia (a subsidiary of UBS AG), a Saudi closed joint stock company incorporated in the Kingdom of Saudi Arabia under commercial register number 1010257812 having its registered office at Tatweer Towers, P.O. Box 75724, Riyadh 11588, Kingdom of Saudi Arabia. UBS Saudi Arabia is authorized and regulated by the Capital Market Authority to conduct securities business under license number 08113-37. **United States:** Distributed to US persons by either UBS Securities LLC or by UBS Financial Services Inc., subsidiaries of UBS AG; or by a group, subsidiary or affiliate of UBS AG that is not registered as a US broker-dealer (a **'non-US affiliate'**) to major US institutional investors only. UBS Securities LLC or UBS Financial Services Inc. accepts responsibility for the content of a document prepared by another non-US affiliate when distributed to US persons by UBS Securities LLC or UBS Financial Services Inc. All transactions by a US person in the securities mentioned in this document must be effected through UBS Securities LLC or UBS Financial Services Inc., and not through a non-US affiliate. **Canada:** Distributed by UBS Securities Canada Inc., a registered investment dealer in Canada and a Member-Canadian Investor Protection Fund, or by another affiliate of UBS AG that is registered to conduct business in Canada or is otherwise exempt from registration. **Brazil:** Except as otherwise specified herein, this material is prepared by UBS Brasil CCTVM S.A. to persons who are eligible investors residing in Brazil, which are considered to be: (i) financial institutions, (ii) insurance firms and investment capital companies, (iii) supplementary pension entities, (iv) entities that hold financial investments higher than R$300,000.00 and that confirm the status of qualified investors in written, (v) investment funds, (vi) securities portfolio managers and securities consultants duly authorized by Comissão de Valores Mobiliários (CVM), regarding their own investments, and (vii) social security systems created by the Federal Government, States, and Municipalities. **Hong Kong:** Distributed by UBS Securities Asia Limited and/or UBS AG, Hong Kong Branch. **Singapore:** Distributed by UBS Securities Pte. Ltd. [mica (p) 107/09/2013 and Co. Reg. No.: 198500648C] or UBS AG, Singapore Branch. Please contact UBS Securities Pte. Ltd., an exempt financial adviser under the Singapore Financial Advisers Act (Cap. 110); or UBS AG, Singapore Branch, an exempt financial adviser under the Singapore Financial Advisers Act (Cap. 110) and a wholesale bank licensed under the Singapore Banking Act (Cap. 19) regulated by the Monetary Authority of Singapore, in respect of any matters arising from, or in connection with, the analysis or document. The recipients of this document represent and warrant that they are accredited and institutional investors as defined in the Securities and Futures Act (Cap. 289). **Japan:** Distributed by UBS Securities Japan Co., Ltd. to professional investors (except as otherwise permitted). Where this document has been prepared by UBS Securities Japan Co., Ltd., UBS Securities Japan Co., Ltd. is the author, publisher and distributor of the document. Distributed by UBS AG, Tokyo Branch to Professional Investors (except as otherwise permitted) in relation to foreign exchange and other banking businesses when relevant. **Australia:** Clients of UBS AG: Distributed by UBS AG (Holder of Australian Financial Services License No. 231087). Clients of UBS Securities Australia Ltd: Distributed by UBS Securities Australia Ltd (Holder of Australian Financial Services License No. 231098). Clients of UBS Wealth Management Australia Ltd: Distributed by UBS Wealth Management Australia Ltd (Holder of Australian Financial Services Licence No. 231127). This Document contains general information and/or general advice only and does not constitute personal financial product advice. As such, the Information in this document has been prepared without taking into account any investor's objectives, financial situation or needs, and investors should, before acting on the Information, consider the appropriateness of the Information, having regard to their objectives, financial situation and needs. If the Information contained in this document relates to the acquisition, or potential acquisition of a particular financial product by a 'Retail' client as defined by section 761G of the Corporations Act 2001 where a Product Disclosure Statement would be required, the retail client should obtain and consider the Product Disclosure Statement relating to the product before making any decision about whether to acquire the product. The UBS Securities Australia Limited Financial Services Guide is available at: www.ubs.com/ecs-research-fsg. **New Zealand:** Distributed by UBS New Zealand Ltd. The information and recommendations in this publication are provided for general information purposes only. To the extent that any such information or recommendations constitute financial advice, they do not take into account any person's particular financial situation or goals. We recommend that recipients seek advice specific to their circumstances from their financial advisor. **Dubai:** The research distributed by UBS AG Dubai Branch is intended for Professional Clients only and is not for further distribution within the United Arab Emirates. **Korea:** Distributed in Korea by UBS Securities Pte. Ltd., Seoul Branch. This document may have been edited or contributed to from time to time by affiliates of UBS Securities Pte. Ltd., Seoul Branch. **Malaysia:** This material is authorized to be distributed in Malaysia by UBS Securities Malaysia Sdn. Bhd (253825-x). **India:** Prepared by UBS Securities India Private Ltd. (Corporate Identity Number U67120MH1996PTC097299) 2/F, 2 North Avenue, Maker Maxity, Bandra Kurla Complex, Bandra (East), Mumbai (India) 400051. Phone: +912261556000 SEBI Registration Numbers: NSE (Capital Market Segment): INB230951431, NSE (F&O Segment) INF230951431, BSE (Capital Market Segment) INB010951437.

The disclosures contained in research documents produced by UBS Limited shall be governed by and construed in accordance with English law.