From: Jim Green (FoE).
Sent: Thursday, 8 October 2015 11:16 PM
To: NFCRC:ECO Analyses
Subject: Fwd: Nuclear Fuel Cycle Royal Commission

Hello, I'm told by the NFCRC that you are accepting comments on the assumptions and methodology used in the economic analyses.

I have questions and comments regarding just one assumption, namely:
"The first is that the international energy agency products [predicts] that global nuclear power generation capacity will grow by 37% from 2014 to 2030. Today's generating capacity is 376 gigawatt and in 2030 international energy agencies expecting the generating capacity to be 518.6 gigawatt."
http://nuclearrc.sa.gov.au/app/uploads/2015/10/151006-Topic-5-Day-1-Transcript-full.pdf

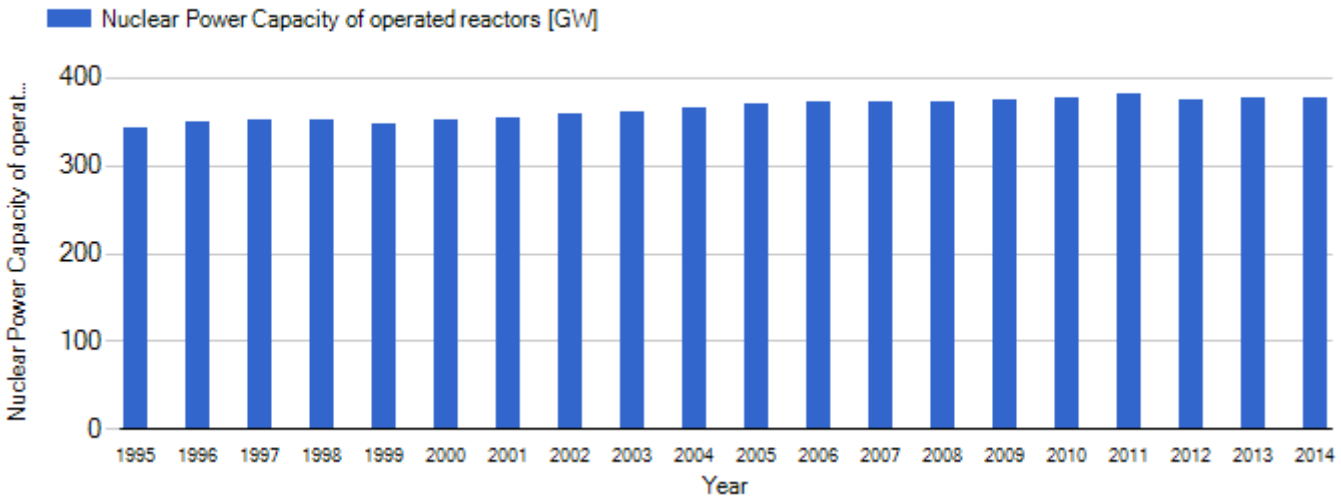
My questions are:
1. What is the justification for using that assumption regarding nuclear growth?
2. What other predictions (if any) have been considered?
3. Have you looked at the International Energy Agency's past predictions for nuclear growth and assessed their accuracy / inaccuracy?

My comments are as follows:

1. Almost certainly, the IEA has a tracked record of overestimating nuclear growth. The IAEA certainly does (see below) and of course industry bodies such as the WNA routinely provide inflated projections.

2. To its credit, the IAEA has published information assessing the 'accuracy' of its past predictions of nuclear growth (more information and reference in the article below).
Unsurprisingly, the IAEA's 'high' projections are always too high and often absurd.
The IAEA's middle/reference projections are also too high, sometimes by a wide margin.
EVEN THE IAEA'S LOW PROJECTIONS ARE ALMOST ALWAYS TOO HIGH! By 13% on average, using the figures provided by the IAEA.

You should revisit your assumptions. The likelihood of 37% nuclear capacity growth between 2014 and 2030 is near-zero. The current low estimates from both the IAEA and the WNA are for zero or marginally negative growth over the next 15-20 years (see below) so the most rational assumption would be a continuation of the pattern that has prevailed for the decade: stagnant nuclear capacity.



https://www.iaea.org/PRIS/WorldStatistics/WorldTrendNuclearPowerCapacity.aspx

The following article provides more detail.

Please provide answers to my questions above or at least have the courtesy to tell me if you do not intend to respond to those questions (explaining your reasons for refusing to answer my questions).

Yours sincerely, Jim Green

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Fanciful growth projections from the World Nuclear Association and the IAEA

Jim Green, Nuclear Monitor #811, 23 Sept 2015, http://www.wiseinternational.org/nuclear-monitor

The 17th edition of the World Nuclear Association's biennial 'Nuclear Fuel Report' has been released.[1] According to the WNA, the report is "definitive reference source of the world industry" and is available for £870 (US$1340, €1200). Some would say the annual World Nuclear Industry Status Report is the definitive source – and it's free![2]

"Nuclear electricity output is set to increase at a faster rate over the next five years than we have seen for more than two decades," said WNA director general Agneta Rising.[3] The claim is disingenuous given that growth over the past two decades has been negligible – there was 438 operational reactors at the end of 2014 compared to 434 in 1995.[4]

The WNA provides three scenarios for nuclear power from 2015 (379 gigawatts capacity) to 2035. In the 'reference' and 'upper' scenarios, nuclear reaches 552 GW and 720 GW respectively − growth of 46−90% over 20 years. In the 'lower' scenario, nuclear capacity stagnates until 2030 and then declines with "many" reactor closures in the period to 2035.

The middle 'reference' scenario in such reports is typically promoted as being the most credible − by industry bodies themselves and by the mainstream media. Thus Reuters reported: "The World Nuclear Association Nuclear Fuel report forecasts global nuclear capacity will grow to 552 gigawatts equivalent (GWe) by 2035 from 379 GWe currently, as many countries build new plants as a lower-carbon option and for energy security."[3]

However, based on long experience, a rule of thumb to apply to projections from nuclear promotional bodies is to ignore the upper and middle/reference scenarios but give some credence to the low scenario. Even the WNA's reference scenario of 46% nuclear capacity growth in 20 years − a compound annual growth rate of 1.9% − is modest and falls well short of matching industry rhetoric about a nuclear 'renaissance'.

The WNA states:

"In both established and potential markets, nuclear power faces an increased competitive challenge from other modes of generation especially in deregulated markets, while continuing to face regulatory and political hurdles. Electricity demand growth is low in most of the countries where nuclear power is well-established, but remains strong in many developing countries and it is in these countries that the great majority of nuclear capacity growth is to be expected."[1]

The WNA's wishful thinking is at odds with a recent assessment by Steve Kidd, an independent consultant and economist who worked for the WNA for 17 years. Kidd writes:

"Looking forward, despite the many forecasts that point to sustained growth of nuclear, there will be a substantial number of reactor closures. ... Closures for economic reasons are increasingly worrying. Electricity markets are changing rapidly and grids are getting integrated. The incursion of cheap shale gas and lots of renewable power is beginning to cause acute problems for today's operating nuclear units. Loadfollowing, which is economically sub-optimal, will become essential for some reactors to continue. Even where production costs are maintained at low levels, revenues become unstable and reactors can start losing money. Incentives for zero-carbon and reliable operation are found to be insufficient. It is almost certain that further units in the US will close for these reasons. In Europe, the same is likely to happen as the renewable power input surges upwards. ...

"We have learned one thing for certain: it's a lot easier to shut a reactor down than to build a new one. There are alternatives to nuclear for power generation and the competition is getting continuously stiffer. Hence well-researched and articulate critiques against the concept of any nuclear growth ... such as the annual World Nuclear Industry Status Report, are becoming increasingly difficult to ignore. The combination of aging operating reactors, delayed construction plans combined with escalating costs of new units and competition from renewable power technologies is becoming a compelling story to any lay reader. ...
"Whether the number of reactor start-ups exceeds the number of closures depends on China. Over the next few years, the number of start-ups (five to six per annum) combined with Japanese reactors returning to service should certainly outweigh the number of closures. But in the 2020s things get more unpredictable for both closures and start-ups. Most people's expectations of Chinese growth in nuclear have been cut back substantially. ... Russia's

domestic program has also slowed, while many of the claimed reactor export deals are little more than statements of intent. India remains something of an enigma, but it shows few signs of overcoming general problems in completing major infrastructure projects, including local land rights and volatile public opinion."

"The optimistic view that nuclear will eventually take up the substantial place allocated for it in energy scenarios that mitigate climate change (e.g. some of the scenarios in the International Energy Agency's World Energy Outlook or the main case in the IEA/OECD-NEA Technology Roadmap − Nuclear Energy) holds increasingly little water."

IAEA report

The International Atomic Energy Agency (IAEA) has produced the 35th edition of its publication, 'Energy, Electricity and Nuclear Power Estimates for the Period up to 2050'.[5] The report provides estimates of energy, electricity and nuclear power trends up to the years 2030 and 2050. The IAEA has yet again downwardly revised its projections of nuclear power growth, and now projects capacity growth by between 2.4% and 68% from 2014 to 2030 (average annual capacity growth of 0.1−3.3%). Uncertainty related to energy policy, license renewals, shutdowns and future constructions accounts for the wide range, the IAEA states.

The IAEA notes numerous "challenges":

"Over the short term, several factors are weighing on the growth prospects of nuclear power, leading to temporary delays in deployment of some plants, according to the report. These factors include low prices for natural gas, subsidized renewable energy sources, and the global financial crisis, which presents hurdles for capital-intensive projects. Heightened safety requirements as a result of stress tests introduced in the wake of the Fukushima accident and the deployment of advanced technologies have also contributed to delays."[6]

Effects of the Fukushima accident include "earlier than anticipated retirements, delayed or possibly cancelled new construction, and increased costs owing to changing regulatory requirements".[5]

For many years the IAEA has indulged in the subterfuge of talking about 'operable' reactors, including those that are not operating but might one day be restarted. In its latest report the IAEA is even more disingenuous − all 'operable' reactors are now described as being 'in operation' even though a good number are not (in particular, 42 reactors in Japan).

The IAEA notes that more than half of the world's 438 power reactors 'in operation' are over 30 years old. Despite the need to replace "scores" of retiring reactors, the IAEA claims that nuclear power is still set to maintain − and possibly increase − its role in electricity generation. "In order to maintain such a role, each retiring reactor would need to be replaced," said David Shropshire, the mathematically-challenged head of the IAEA's Planning and Economic Studies Section.[6]

In fact, nuclear power accounted for 17.6% of world electricity generation in 1996 but just 11.1% in 2014, and it will not maintain that share unless fanciful growth projections are realized and/or total electricity generation and

demand stagnate. According to the IAEA report, nuclear accounted for 11.1% of total world electricity generation in 2014 (in terrawatt-hours) and will account for 8.6−11.3% in 2030 and 4.2−10.8% in 2050.

The report provides regional projections:

- Middle East and South Asia: current capacity of 6.9 GW projected to reach 25.9−43.8 GW by 2030.
- Eastern Europe: current capacity of 49.7 GW projected to reach 64.1−93.5 GW by 2030.
- 'Far East' (including China and South Korea): current capacity of 87.1 GW projected to reach 131.8−219 GW by 2030.
- Western Europe: current capacity of 113.7 GW to fall to 62.7−112 GW by 2030.
- North America: current capacity of 112.1 GW, projected capacity in 2030 of 92−139.7 GW.

The IAEA notes that its projections out to 2050 are all but meaningless given the high degree of uncertainty: "Given all the uncertainties, these estimates should be considered as suggestive of the potential outcomes."[5]

The report states that that nuclear power accounted for 4.6% of the world's total energy requirement in 2014, and estimates that nuclear's contribution will be 4.1−5.3% in 2030 and 2.3−4.8% in 2050.

The IAEA's 'low' scenario − negligible 2.4% growth of global nuclear capacity from 2014−2030 (0.1% annual growth) − is designed to produce "conservative but plausible" estimates, the IAEA states, and assumes a continuation of current market, technology and resource trends with few changes to policies affecting nuclear power.

To its credit, the IAEA has published data demonstrating its habit of overestimating nuclear power growth.[7] The IAEA's 'high' forecasts have consistently proven to be ridiculous. For example:

- **In 1985, the IAEA's high estimate was 702 GW capacity in the year 2000, but actual capacity in 2000 was 350 GW (50% of the estimate).**
- **In 1990, the IAEA's high estimate was 528 GW capacity in the year 2005, but actual capacity in 2005 was 368 GW (70% of the estimate).**

Even the IAEA's 'low' forecasts are too high − by 13% on average. For example:

- **In 1985, the IAEA's 'low' estimate was 502 GW capacity in the year 2000, but actual capacity in 2000 was 350 GW (70% of the estimate).**
- **In 1990, the IAEA's 'low' estimate was 450 GW capacity in the year 2005, but actual capacity in 2005 was 368 GW (82% of the estimate).**

The data compiled by the IAEA shows that only one of the IAEA's forecasts has proven to be accurate – and that was just a five-year 'low' forecast of growth from 2000 to 2005.

The IAEA's forecasts have been sharply reduced since 2010 as the following table shows.

IAEA series: 'Energy, Electricity and Nuclear Power Estimates' (iaea.org)

	2010	**2011**	**2013**	**2015**
Low estimate 2030 nuclear capacity (GWe)	546	501	435	385
High estimate 2030 nuclear capacity (GWe)	803	746	722	632
Estimate 2030 nuclear share of elec. generation capacity (%)(6.2% in 2014)	8.5–10.4	5.2–6.2	4.5–6.2	3.8–5.1
Estimate 2050 nuclear share of elec. generation capacity (%)	5.0–11.9	2.7–6.0	2.2–5.6	1.8–4.8

The IAEA's current 'low' estimate for 2030 (385 GWe) is down 29.5% from the pre-Fukushima, 2010 'low' estimate of 546 GWe. The high estimate (632 GWe) is down 21% from the pre-Fukushima, 2010 high estimate of 803 GWe.

References:

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2. www.worldnuclearreport.org/

3. Nina Chestney, 10 Sept 2015, 'World nuclear capacity set to grow by 45 percent by 2035', www.reuters.com/article/2015/09/10/us-energy-nuclear-idUSKCN0RA14220150910

4. IAEA, 'Nuclear Power Capacity Trend', https://www.iaea.org/PRIS/WorldStatistics/WorldTrendNuclearPowerCapacity.aspx

5. IAEA, 2015, 'Energy, Electricity and Nuclear Power Estimates for the Period up to 2050', www-pub.iaea.org/books/IAEABooks/10939/Energy-Electricity-and-Nuclear-Power-Estimates-for-the-Period-up-to-2050-2015-Edition

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6. Jeffrey Donovan / IAEA, 8 Sept 2015, 'IAEA Sees Global Nuclear Power Capacity Expanding in Decades to Come', www.iaea.org/newscenter/news/iaea-sees-global-nuclear-power-capacity-expanding-decades-come

7. IAEA, 2007, Energy, Electricity and Nuclear Power: Developments and Projections – 25 Years Past and Future', tables 33 and 34, p.56, www-pub.iaea.org/mtcd/publications/pdf/pub1304_web.pdf

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