International Perspectives on the Future of Nuclear Power in the Post-Fukushima Era

August 2012
Dr Jonathan Cobb
The end of cheap China
A shock at the polls for the Gandhis
Goodbye Super Tuesday
At last, progress on prostate cancer
The broken-windows man

Nuclear energy
The dream that failed

A 14-PAGE SPECIAL REPORT
Negative news

- Potential reduction of the French fleet
- Germany reverts to 2022 phase-out policy
- Two out of a fleet of 50 reactors online in Japan with reduction in nuclear contribution predicted
- Delays in commissioning Kudankulam reactors in India due to violent public protests
- According to IAEA, only 10 new countries expressing interest in nuclear (30 in 2010)
  - Italy, Kuwait, Venezuela and Senegal have cancelled plans
Drivers for nuclear

• Economics
  – Quarter of world’s reactors with load factors above 90%
  – Two thirds over 75% (compared with around 25% in 1990)
  – Carbon taxes and other climate change policies

• Security of supply
  – Several years’ supply of fuel can be easily and inexpensively stored
  – Uranium available in broad range of countries
  – Round the clock energy production

• Climate change
  – Nuclear gives rise to no more than 2% of coal-fired carbon dioxide emissions and no more than 5% of gas
WNA Projections (2011 Fuel Market Report)
Reference Case Capacity

Net GWe (2011 to 2030)

Today 2030

Canada

USA

Latin America

E Europe

Russia

China

Asia

Other

India

Europe

Other

Emerging

Operating

Serious
Projections for key nuclear countries

Reference case - 2030

GWe

China
India
Japan
Russia
USA

2009
2011
Projections for key nuclear countries

Reference case - 2030

GWe

China
India
Japan
Russia
USA

Revision in 2013

2009
2011
NP projections 2011 – low

2030: Nuclear share in global electricity generation: 11.8%
NP projections 2011 – high

2030: Nuclear share in global electricity generation: 14.0%
IAEA, WNA and WEO Projections
Japan

- All 50 units in Japan were off line in May 2012
- Ohi 3 & 4 (Kansai) restarted
  - "Japanese society cannot survive if we stop all nuclear reactors or keep them halted." PM Noda, June 2012
- Overall, 35 units likely to restart; fate of others in doubt
- *Potential* 12% shortage of electricity supply anticipated this summer
- Carbon emissions have risen to 1.21 GT / yr – 14.1% above 1990 level
- $40 billion / year additional imports of fossil fuel
- Debate over nuclear power’s share of electricity generation, will be between zero and 25% by 2030, lower than previously projected.
China

- Since March 2011, approvals for new NPPs suspended until safety plan in place
- Existing 13 units allowed to continue operating, also construction of 25 units (two of these now operating)
- Following a 14-month safety assessment, State Council (equivalent to Cabinet) has given preliminary approval to a safety plan (31 May)
- However, some NPPs still need to develop severe accident prevention and mitigation guidelines, and are relatively weak in tsunami assessment and response.
- Relevant agencies and companies have organized “correction and reform” and have achieved initial results
China

- A period of public consultation on the safety assessment
- No timetable for restart of approvals for new reactors
- Three “Gen 3” domestic designs under development:
  - CAP1400 - SNTPC (based on AP1000)
  - ACPR1000 – CGNPC (based on Framatome technology)
  - ACP1000 - CNNC
- Many commentators believe AP1000 to be the main force of new reactors to be built before 2020
- Delay in new build has given “pause for breath” to fast-expanding programme.
India

• 4.8 GW of nuclear capacity – current
• 5.3 GW under construction
• 63 GW of nuclear envisaged by 2032 under India’s integrated energy policy (9% of electricity share)
  – Up to 40 GW of this could be imported LWR

• Violent public opposition, notably around Kudankulam
• India’s liability Act still a deterrent to many Western companies

Operator recourse against suppliers: s.17
• The Operator has legal recourse to a supplier where:
  
(b) the "nuclear incident has resulted as a consequence of an act of supplier or his employee, which includes supply of equipment or material with patent or latent defects or sub-standard services"
France

- Francois Hollande recently elected on a ticket of reducing the country’s dependency on nuclear:
  - Close 2 units at Fessenheim within current term
  - Reduce nuclear’s share in mix from current 75% to about 50% by 2030 (through shutting 26 of the country’s oldest units)
  - Supports completion of Flamanville 3
  - Does not oppose construction of a further EPR at Penly

- Due to current economic crisis, and poor showing of Greens at recent presidential and parliamentary elections, doubts over whether Hollande will deliver on promises.
• Government remain committed to new nuclear build in the UK without public subsidies.
• Public support has returned to pre-Fukushima accident levels.
• Mechanisms in place to establish floor price for carbon to support all low carbon generation
• Need for new owners of Horizon project following withdrawal of original players.
• New build prospects at tipping point, awaiting commitment by industry to begin new build in response to government policy changes. Government has indicated wish for there to be a growing nuclear component in the electricity generation mix, but will not introduce prescriptive policies to mandate it.
Other new build

- **Brazil**
  - Two nuclear reactors generating 3% of its electricity
  - 1400 MW unit under construction
  - Proposal for four units to come on line in the 2020s, but weaker commitment than previously
- **South Africa**
  - 2 x 900 MW units existing
  - Plans to have 9.6 GW of new nuclear by 2030 under its Integrated Resource Plan
  - First unit expected to be commissioned by 2023
New nuclear countries

- UAE and Turkey have ordered first NPPs from Korea and Russia respectively
- Belarus and Bangladesh signed intergovernmental agreements in 2011 for first NPP
- Vietnam signed loan agreement in 2011 (2 GW coming into operation by 2020).
  - 8 GW nuclear planned for 2025
- Poland to invite bids for new reactors later this year
- Iran commissioned its first NPP in Sept 2011
- Jordan in discussion with Areva / MHI and Rosatom to construct first 1.1 MW reactor
  - Suspended pending economic evaluation
Factors to watch

-Availability and price of natural gas (US example)
-Nuclear construction costs (can we reach $2,000 / kw installed outside East Asia?)
-Public perception / Radiation phobia
-Germany’s experiment with renewables
-Re-start of fleet in Japan
-Impact of stress tests (ASN example)
Trends

- Coal is increasingly confined to making electricity
- Oil is increasingly just for mobile transport
- Gas has largely taken over from oil for heat, and is important for electricity
- Electricity use is increasing rapidly for many applications – very versatile
- Uranium is a minor part of energy supply
- Wind and solar are popular but raise questions on any large scale. Biomass oversold
- Hydrogen a long way in future
- Drivers: always cost, increasingly security, maybe CO2 emissions
Coal (thermal coal)

- Remains the main source of electricity (40%)
- Will be important into future
- Carbon capture & storage will enhance its role
- Enormous resources
Natural gas

- Plentiful, especially with advent of shale gas in recent years
- Versatile – not just heat source, also chemical feedstock
- Global warming implications
- Political implications in Europe – dependence on Russia
- Current suppressed prices in some regions means gas is attractive option for new build, but generation economics are hostage to fuel costs.
Conclusions

• National policy changes to existing nuclear countries in response to Fukushima have been limited.
• Greater impact of Fukushima is more likely in potential new nuclear countries where there is no experience of the normally reliable operations of nuclear plants.
• The biggest influence on the future of nuclear energy in many regions remains economics, not a response to Fukushima. Where there are continuing low gas prices this will likely reduce investment in nuclear capacity.
• Expectation of nuclear having a major role in combatting climate change are reliant on a rational political response.