The World Nuclear Industry Status Report 2014
See www.WorldNuclearReport.org

From Fukushima to Hinkley:
Dismantling the Nuclear Argument for a Sustainable Energy Future

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Outline

• Global status of nuclear power
• Importance of UK to global sector
• Nuclear vs renewable energy
Reactor Startups and Shutdowns in the World
in Units, from 1954 to 1 January 2015

Source: IAEA-PRIS, MSC, 2015
Nuclear Reactors & Net Operating Capacity in the World
in GWe, from 1954 to 1 January 2015

Source: IAEA-PRIS, MSC, 2015
Nuclear Electricity Production by Country in 2013
(in TWh)

Source: IAEA-PRIS, MSC, 2013

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Nuclear Electricity Production in the World 1990-2013
in TWh (net) and share of electricity production (gross)

- 1990: 2,359 TWh
- 1995: max 2,660 TWh
- 2000: max 17.6%
- 2005: max 17.5%
- 2010: 10.8%
- 2013: 10.8%
## Reactors « Under Construction » in the World (1 January 2015)

<table>
<thead>
<tr>
<th>Country</th>
<th>Units</th>
<th>MWe (net)</th>
<th>Construction Start</th>
<th>Grid Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>25</td>
<td>24,756</td>
<td>2008-2013</td>
<td>2014-2018</td>
</tr>
<tr>
<td>India</td>
<td>6</td>
<td>3,907</td>
<td>2002-2011</td>
<td>2014-2016</td>
</tr>
<tr>
<td>South Korea</td>
<td>5</td>
<td>6,320</td>
<td>2008-2013</td>
<td>2014-2018</td>
</tr>
<tr>
<td>USA</td>
<td>5</td>
<td>5,633</td>
<td>1972-2013</td>
<td>2015-2019</td>
</tr>
<tr>
<td>UAE</td>
<td>3</td>
<td>4,035</td>
<td>2012-2014</td>
<td>2017-2018</td>
</tr>
<tr>
<td>Belarus</td>
<td>2</td>
<td>2,218</td>
<td>2013-2014</td>
<td>2019-2020</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2</td>
<td>630</td>
<td>2011</td>
<td>2016-2017</td>
</tr>
<tr>
<td>Ukraine</td>
<td>2</td>
<td>1,900</td>
<td>1986-1987</td>
<td>2015-2016</td>
</tr>
<tr>
<td>Argentina</td>
<td>1</td>
<td>25</td>
<td>2014</td>
<td>2018</td>
</tr>
<tr>
<td>Brazil</td>
<td>1</td>
<td>1,245</td>
<td>2010</td>
<td>2016</td>
</tr>
<tr>
<td>Finland</td>
<td>1</td>
<td>1,600</td>
<td>2005</td>
<td>2018</td>
</tr>
<tr>
<td>France</td>
<td>1</td>
<td>1,600</td>
<td>2007</td>
<td>2017</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>65</strong></td>
<td><strong>63,022</strong></td>
<td><strong>1972-2014</strong></td>
<td><strong>2015-2020</strong></td>
</tr>
</tbody>
</table>

Source: IAEA-PRIS, MSC, 2015
Age of World Nuclear Fleet
as of 1 July 2014

- 21-30 years: 146
- 31-40 years: 133
- 11-20 years: 37
- 0-10 years: 33
- >40 years: 39

388 Reactors
Mean Age: 28.5 Years
Operating Costs and Markets

• **Market Prices Barely Cover Costs**

  • **Belgium**: GDF-Suez lost court case against fuel tax
    --> Now “considers all options” for its 7 reactors

  • **France**: 4.5%/a operating cost increase 2007-2012
    --> Loss of €1.5 billion in 2012

  • **Sweden**: at least 3 reactors operated at loss in 2 of 4 past years
    --> New 17% tax increase might lead to earlier shutdowns

• **Forcing Shutdowns**

  • **Germany**: E.ON decides to shut down Grafenrheinfeld in May 2015,
    --> seven months earlier than required by law

  • **USA**: Five shutdown decisions, incl. 2 reactors licensed to operate beyond 2030
Importance of UK to international industry

• EDF Energy (4 reactors at Hinkley and Sizewell)
  – EDF Group: 45-50%
  – AREVA: 10%
  – China General Nuclear Corporation (CGN), China National Nuclear Corporation (CNCC): 30-40%
  – Discussions are also taking place with a shortlist of other interested parties who could take up to 15% - Saudi Arabia?

• Horizon (4 reactors at Wylfa and Oldbury)
  – Hitachi takes over E.on and RWE shares

• NuGen (3 reactors at Moorside – Cumbria)
  – January 2014, new ownership structure with Toshiba-Westinghouse (60%) and GDF Suez (40%); Iberdrola sold their shares

• Test case for EU State Aid
Nuclear Vs Renewables
Global Investment Decisions in New Renewables and Nuclear Power 2004-2013 (in $ billion)
Global Investment Decisions in New Renewables and Nuclear Energy 2004-2013 (in $ billion)

Sources: UNEP 2014 and WNISR original research
Wind, Solar and Nuclear Grid Connections in the World 2000–2013
(cumulated, in GWe)

Source: IAEA-PRIS, EPIA, GWEC 2014
Variations in Global Electricity Production Compared to Reference-Year 1997 from Nuclear, Wind and Solar Photovoltaics (in TWh/y)

Sources: BP, IAEA-PRIS, MSC, 2014
Traditional Utilities Under Pressure

The 20 largest European energy utilities lost over half of the €1 trillion stock market value since 2008, some a lot more.

*Europe’s electricity providers face an existential threat.*

The Economist, London, October 2013

*Utility business models are threatened by the dramatic growth in the deployment of technologies that generate electricity onsite or at the distribution grid level.*

Navigant Research, Boulder, USA, August 2014

*A new technological paradigm in electricity and the end of the reign of the large-scale utilities.*

Institute for Public Policy Research, London, September 2014
The Energy Revolution is Underway… And it is Fast

New Players
- Households (>2 million RE in Australia, 1.4 million in Germany)
- Farmers
- Municipalities
- Energy Coops (invested €1.4 billion in 5 years in Germany)
- Military (big player in micro-grid development in U.S.)

New Business/Financing Models
- Leasing (dominant PV investment scheme in U.S., soon China?)
- YieldCos (bring RE investments to stock market, pay dividends)
- Green Bonds (GDF raised €2.5 billion, EDF €1.4 billion)

New Competitive Concepts
- Decentralized storage (“fastest path to implement RE”, DNV)
- Electric vehicles + PV: Gas savings pay back for PV in 6-8 years (UBS)
- Smart communication concepts
Summary

• Global industry remain moribund and is losing share of electricity market
• 2 countries produce half the world’s nuclear electricity, in the EU France produces half the total
• Nuclear construction dominated by China, three quarters of projects are delayed
• Aging reactors become more expensive to operate, just as market price of electricity is falling
• UK is important for international nuclear new build with Chinese, French and Japanese companies interested in engaging/building
• Investment in renewable energy far exceeds that of nuclear leading to significantly higher installed capacity
• Since signing of Kyoto increased power production form solar and nuclear is similar while wind is 4 times greater
• Traditional, utilities are facing; losing their market share, shrinking revenues and poor economic performance, particularly as a result of great deployment of renewables, a trend set to continue

London, 5 March 2015
Thank You!

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Annexes
Number of Nuclear Reactors Listed as "Under Construction" by year, 1954 - 1 January 2015

- Cancelled or Suspended Projects
- Completed and Ongoing Projects

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Nuclear Reactors & Net Operating Capacity in the EU28
in GWe, from 1956 to 1 January 2015

123 GWe
177 reactors

121.7 GW
131 reactors

Source: IAEA-PRIS, MSC, 2014
Average Annual Construction Times in the World 1954-2014
(by grid connection date)

Source: IAEA-PRIS, MSC, 2014
Annual Electricity Production by Nuclear, Wind and Solar PV in China 2000-2013 (in TWh/y)

Source: BP 2014
Installed Nuclear, Wind and Solar Capacity in China 2000-2013
(in GWe)

- **Wind**
- **Solar**
- **Nuclear**

- 2000: Wind 2, Solar 0, Nuclear 1
- 2002: Wind 5, Solar 1, Nuclear 1
- 2004: Wind 6, Solar 1, Nuclear 2
- 2006: Wind 7, Solar 1, Nuclear 3
- 2008: Wind 8, Solar 3, Nuclear 0.1
- 2010: Wind 10, Solar 0.8, Nuclear 0.3
- 2012: Wind 12, Solar 3.3, Nuclear 6.8
- 2013: Wind 13, Solar 6.8, Nuclear 16
- 2014: Wind 18, Solar 16, Nuclear 91

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