The Essential Role of Nuclear Power in Mitigating Climate Change: How can the nuclear community deliver

King Lee
Director Harmony Programme

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Many scenarios used to envisage the future. The IEA 2 Degree Scenario is a common benchmark.

**Electricity generation by technology**

- Other Distributed Gen
- Rooftop Solar PV

Source: DECC, December 2013 “EMR Delivery Plan”, 100g 2030 scenario with central fossil fuel price projections and demand.
Accelerating rise in world electricity consumption

Source: 1945-1979, International Energy Agency databases and analysis
1980-2012, Energy Information Administration
Accelerating rise in world electricity consumption

Source: 1945-1979, International Energy Agency databases and analysis
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IEA 2 degree scenario: electricity growth in low carbon scenario
IEA 2 degree scenario: generation mix

Source: 1945-1979, International Energy Agency databases and analysis
1980-2012, Energy Information Administration
Harmony goal: ready to deliver more nuclear to ensure 2 degree scenario

- Level playing field
- Harmonised regulatory processes
- Effective safety paradigm

1000 gigawatt new nuclear capacity by 2050

25% of electricity supply 2050

Nuclear energy to deliver reliable, affordable and clean electricity
IEA: nuclear clean energy new build target more achievable than previously thought

Global nuclear industry: Harmony targets require 10 GW per year new capacity between 2016-2020. In past twelve months 11.3 GW has been connected to the grid.

International Energy Agency: “Nuclear power plant grid connections doubled in 2015. Furthermore, progress and construction times in 2015 show the long-term 2DS targets to be more achievable than previously thought.”

“Tracking Clean Energy Progress 2016”

Energy Technology Perspectives 2016
Nuclear makes major contribution in IEA World Energy Outlook

Global nuclear generation output increasing by almost two and a half times by 2040

Nuclear generation is a cost-competitive low-carbon generation option. Cost for wind and solar is 22-40% higher

Low carbon energy sources dominate the generation mix in 2040: hydro 20%, nuclear 18%, wind 18% and solar PV 9%

IEA, World Energy Outlook, November 2016: the 450 ppm scenario
Nuclear makes quick, lasting decarbonisation possible

Decarbonising electricity generation – need for low life cycle emissions: Nuclear energy is among the best

Source: World Nuclear Association meta study, incl. IPCC 2014
Nuclear is an important part of the low carbon solution.
Global nuclear status

Operating reactors
- building new
- planning new
- no new planned
Newcomer
- building new
- planning new
Phasing out
Global nuclear electricity output: Five years of growth since 2011

Preview: WNPR 2017
Highest level of construction in twenty five years: 60 reactors worldwide

China
- 22 reactor starts
- 2 construction starts

China 2016:
- 5 reactor starts
- 2 construction starts

China 2015:
- 8 reactor starts
- 6 construction starts

Source World Nuclear Association
Levelised cost of electricity (LCOE)

Levelised costs of electricity ranges (at 7% discount rate)

Levelised cost of electricity

LCOE plus System Cost
Ranges for France, Korea, UK and US, $/MWh, 7% discount factor

- Nuclear
- Gas
- Onshore Wind
- Offshore Wind
- Solar PV
Effective safety paradigm
(Energy accident fatalities for non-OECD countries)

The alternatives to nuclear are far more dangerous – even including accidents

Source: Paul-Scherrer Institut. Data for nuclear accidents modified to reflect UNSCEAR findings/recommendations 2012 and NRC SOARCA study 2015
Effective safety paradigm
(Energy accident fatalities for OECD countries)

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* Gen II PWR, Swiss

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Effective safety paradigm (Energy accident fatalities for OECD countries)
The challenges

There are currently several barriers standing in the way of achieving the Harmony goal.

• Most electricity markets are distorted and do not recognize the full costs of different forms of electricity generation.

• Effective nuclear regulation is fundamental to safe operation. The development of nuclear safety regulations and standards not kept pace with the growth of recent internationalisation and globalisation of new build projects.

• The current nuclear debate tends to focus on nuclear safety issues alone, ignoring other factors such as economics, industrial, social, public health and environment. The current energy system fails to consider safety from a global society perspective. The health and environmental benefits of nuclear energy are not put in perspective with those of alternative energy sources which are more dangerous.
The global nuclear industry: tackling barriers, engage in dialog, develop key actions

**Level playing field:**
Establish a level playing field for all low-carbon energy technologies, valuing not only health and environmental qualities, but also reliability and grid system costs.

**Harmonised regulatory processes:**
Ensure harmonised regulatory processes to provide a more internationally consistent, efficient and predictable nuclear licensing regime, to facilitate significant growth of nuclear capacity, without compromising safety and security.

**Effective safety paradigm:**
Create an effective safety paradigm where the health, environmental and safety benefits of nuclear are valued when put in perspective with other energy sources, by focusing on increasing genuine public wellbeing whilst ensuring high safety standards are met.
Markets should be reformed to:

- support capital investments
- include grid system costs
- eliminate nuclear-only taxes
- reform subsidies
- give credit for low carbon emissions
- value 24/7 reliability
- support innovative finance solutions
Harmonised regulatory processes

- streamline licensing processes
- harmonisation of safety requirements
- harmonise and update global codes and standards
- enabling international trade
- enhance regulatory efficiency and effectiveness
- nuclear innovation: enable development and timely licensing of new technologies
Effective safety paradigm

• Strong political and industry leadership to communicate long term benefit versus risk
• Embrace a holistic approach to society risks from electricity generation so that health and environmental benefits of all sources are maximised
• Recognise the health impacts of the alternatives to nuclear energy
• Introduce policies and response measures that genuinely increase public wellbeing – to limit overall impact, not just radiation
• Stop leading with the nuclear safety first message
Harmony goal for new nuclear build is 1000 GW

Harmony programme 2016-2050
Deliver 1000 GW new nuclear capacity to 2050

<table>
<thead>
<tr>
<th>Period</th>
<th>Connection rate</th>
<th>Added capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-2020</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>2021-2025</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>2026-2050</td>
<td>33</td>
<td>825</td>
</tr>
<tr>
<td><strong>Total new nuclear capacity</strong></td>
<td></td>
<td><strong>1000 GW</strong></td>
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</tbody>
</table>
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Level playing field:
Establish a level playing field for all low-carbon technologies, valuing not only environmental qualities, but also reliability and grid system costs.

Harmonised regulatory processes:
Enhance standardisation, harmonise and update global codes and standards. Timely licensing of new technologies.

Effective safety paradigm:
Increase genuine public wellbeing from a society perspective. Ensure global nuclear safety. Confidence in management of nuclear technology and operations.
Harmony Goals for a Sustainable Energy Future

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