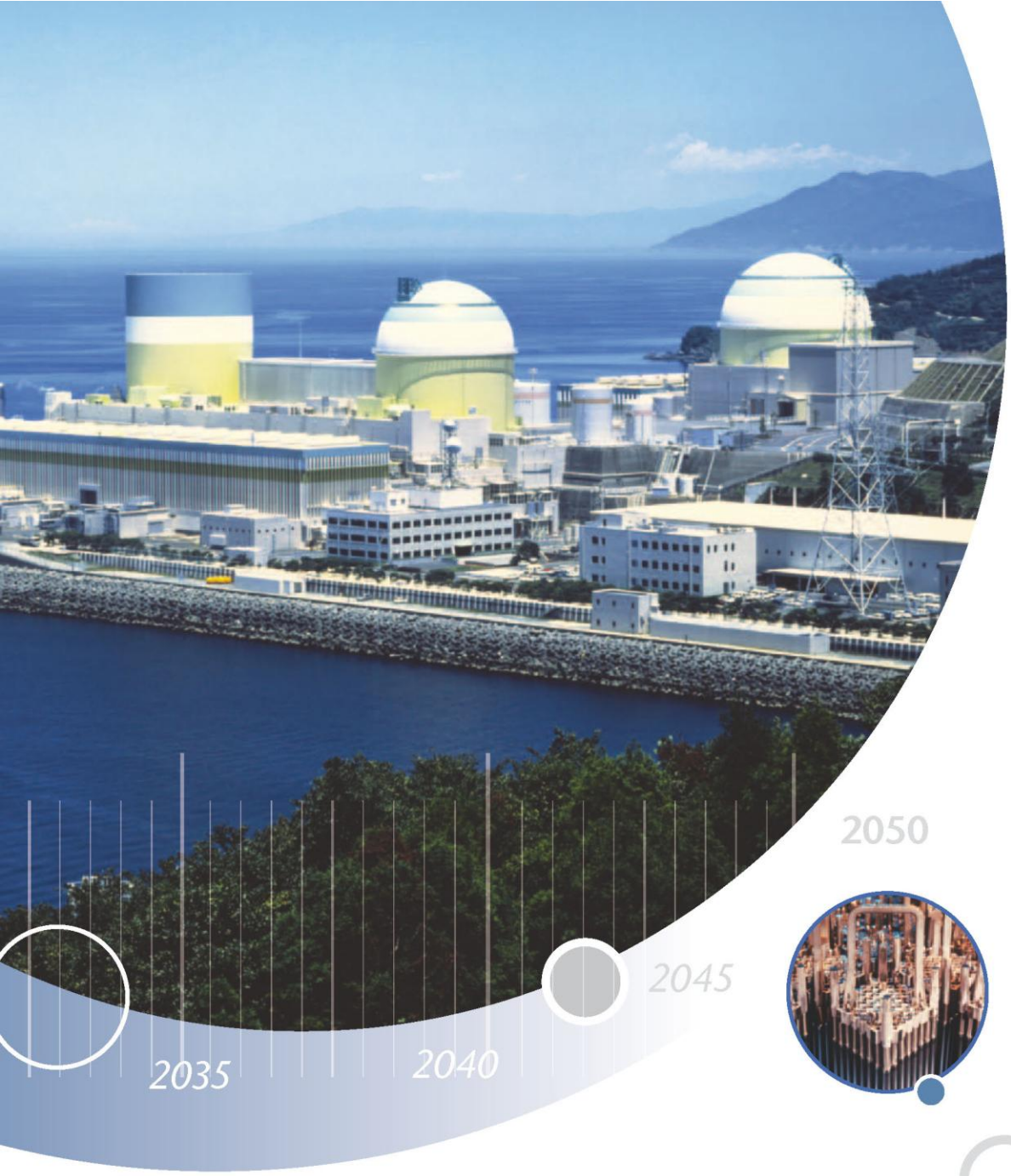

THE DIRECTION OF THE 2014 NUCLEAR ROADMAP

Technology Roadmap

Nuclear Energy

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2010 Nuclear Roadmap

The major topics covered were:

- Status and near–term deployment of current designs
- Required growth to fulfil the Blue Map requirements
- Technology developments to 2050
- Policy, financial and social aspects
- Action Plan

- Technology development included:
  - Near-term evolutions, waste, Gen IV, SMRs and co-generation
- Policy, financial and social covered:
  - Legal and regulatory
  - Financing
  - Civil society
  - Capacity building
  - Safeguards and security

Key findings 2010 roadmap

- Nuclear is a proven technology and can play an important role in a low-carbon strategy
- Installed capacity could reach 1 200 GW and supply 24% of the world's electricity in 2050 (ETP 2010)
- Political support and public acceptance are key for implementation of a nuclear programme
- Financing nuclear is another key challenge
- Expansion of nuclear industry capacities and skilled workforce
- In the longer term, GEN IV technologies could reduce costs and improve performance and security

Developments since 2010 and consideration for 2014 update

- The Fukushima Daiichi accident :
  - Affects on development rates
  - Decisions on accelerating phasing out nuclear capacity
  - Stress tests and associated safety upgrades
  - Impact on costs of upgrading, new build and LTO
- Status of the existing fleet:
  - Capacity affected by phase-outs and premature shutdowns
  - Life extension decisions
  - Accelerated move to Generation III reactors
  - Slow progress of Generation IV
  - Revitalised interest in SMRs, especially in the US
- Fuel cycle:
  - Fuel developments
  - Waste repository progress and EU directive

Developments since 2010 and consideration for 2014 update

- The increased attention to decommissioning :
  - From shutdown reactors
  - Progress with technologies
  - Funding
  - Waste management
- Financing and markets:
  - Impact of liberalised markets and utility capitalisation
  - Assuring price stability - UK 'strike price' approach
  - BOO financing and increased equity deals
- Fuel cycle – uranium supply:
  - End of Russian-US agreement
  - Large increase in reserves
  - Increased attention to tailings
  - Slow progress on new mines

Developments since 2010 and consideration for 2014 update

- The trends in public acceptability:
  - From steep decline to slow return to support in many countries
  - Waste management
- Climate Change:
  - At political level, lower levels of commitment to reducing GHG emissions – hence potentially less importance to role of nuclear
  - At the same time, growing awareness of extreme weather events, pollution (China) → need for clean, low C technologies will grow
- Vendors:
  - New vendors emerging: ROSATOM foreign sales, China's ambitions
- Financial crisis:
  - Low demand, over capacity (generation), reduced investment capabilities

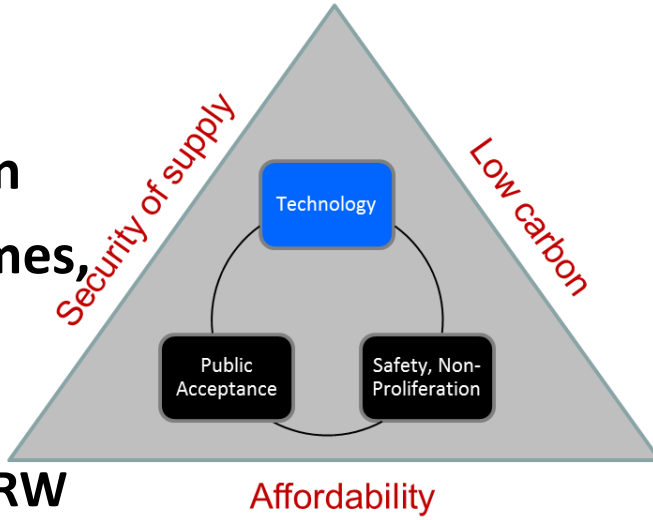
Nuclear can contribute to 2DS, but the following will need be addressed:

- Safe operation of nuclear power plants
- Competitiveness of nuclear electricity generation
- Lower investment costs, shorter construction times, simplification of design, standardisation…
- But also:
  - Safe, responsible, cost-effective management of RW
  - Safe and cost-effective management of decommissioning of existing fleet (greenfield)

→ Public acceptance

→ Increasing role of nuclear in energy policies.

- Technology plays an essential role (but not sufficient)



Robustness of Roadmap

- **Identification of threats & opportunities to 2050**
  - **Must think beyond the current role of nuclear energy in our energy systems**
- **Technologies ready to address:**

<u>New Opportunities:</u>

- **New markets for nuclear? (process) heat, hydrogen, water… other?**

<u>Mitigation of potential threats:</u>

- **Operation of NPPs in new types of electricity systems**
- **Effect of climate change (Extreme Weather Events)**
- **Uranium supply (geopolitical issues)**
- **More competitive technologies (alternative to nuclear energy)**
- ***Another nuclear accident?***
- ***Other threats?***

Input to the Roadmap, examples

And others…

Input welcome!

Objectives of this workshop

- Discuss the latest developments and how they are influencing the nuclear energy sector
- Identify issues that we have not mentioned
- Identify game changers, technological improvements, R&D that can lead to:
  - Faster deployment rate of new build
  - Wider implementation of geological disposal solutions for HLW
  - Safe and cost-efficient decommissioning of shut down facilities
  - Improved economics and competitiveness while maintaining highest levels of safety
- Views of industry, utilities on future prospects, technology evolutions
- Recommendations to policy makers

Discussion – <u>your</u> input

- **Your views on the future of nuclear in a low carbon energy system:**
  - technologies, their potential, their deployment "target"
  - Barriers, technological or not
  - R&D challenges
  - Best practices, lessons learnt
  - Policy recommendations

Let the discussion begin…