Looking Forward: 
Nuclear Energy 
Issues and 
Opportunities

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European Nuclear Young Generation Forum
Paris, 24 June 2015
The NEA: A Forum for Cooperation

- Founded in 1958
- 31 member countries
- 7 standing technical committees
- 75 working parties and expert groups
- 21 international joint projects
The NEA's committees bring together top governmental officials and technical specialists from NEA member countries and strategic partners to solve difficult problems, establish best practices and to promote international collaboration.
Major NEA Separately Funded Activities

Secretariat-Serviced Organisations

- **Generation IV International Forum (GIF)** with the goal to improve sustainability (including effective fuel utilisation and minimisation of waste), economics, safety and reliability, proliferation resistance and physical protection.

- **Multinational Design Evaluation Programme (MDEP)** initiative by national safety authorities to leverage their resources and knowledge for new reactor design reviews.

- **International Framework for Nuclear Energy Cooperation (IFNEC)** forum for international discussion on wide array of nuclear topics involving both developed and emerging economies.

21 Major Joint Projects
(Involving countries from within and beyond NEA membership)

- **Nuclear safety research** and experimental data (thermal-hydraulics, fuel behaviour, severe accidents).

- **Nuclear safety databases** (fire, common-cause failures).

- **Nuclear science** (thermodynamics of advanced fuels).

- **Radioactive waste management** ( thermochemical database).

- **Radiological protection** (occupational exposure).
Fukushima Daiichi: Learning the Lessons and Moving Forward
Fukushima Daiichi:

Key NEA Conclusions After the Accident

• NEA countries’ nuclear plants are safe to continue operation.

• Safety enhancements related to extreme events and severe accidents were identified and are being implemented.

• Provisions for dealing with and managing radiological emergencies, onsite and offsite, must be planned, tested and regularly reviewed.

• Nuclear safety professionals have a responsibility to hold each other accountable to effectively implement nuclear safety practices.

• The Fukushima accident revealed significant human, organisational and cultural challenges — especially ensuring the independence, technical capability and transparency of the regulatory authority.
The Characteristics of an Effective Nuclear Regulator

NEA Regulatory Guidance Booklets
Global View of Nuclear Power Today

Source data: World Nuclear Association
Update 2015
Global View of Nuclear Power Today

**NUCLEAR SHARE OF ELECTRICITY GENERATION**

- **Current Status:**
  - 438 Nuclear Power Reactors in Operation
  - 379,261 MWn Total Net Installed Capacity
  - 2 Nuclear Power Reactors in Long-Term Shutdown
  - 67 Nuclear Power Reactors Under Construction

**Regional Distribution of Nuclear Power Plants**

- Africa
- America - Latin
- America - Northern
- Asia - Far East
- Asia - Middle East and South
- Europe - Central and Eastern
- Europe - Western

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COP 21 is Around the Corner

- UN-sponsored meeting begins November 2015 in Paris. 40,000 attendees are expected.
- Countries plan to negotiate an agreement intended to limit global warming to below 2°C by reducing global CO₂ emissions by 50% from 1990 levels.
- Energy represents 60% of global CO₂ emissions and the power sector produces the largest share of energy-related CO₂.

Source: OECD Environmental Outlook 2050
IEA 2°C Scenario:
Nuclear is Required to Provide the Largest Contribution to Global Electricity in 2050

Source: Energy Technology Perspectives 2014
Investment in Energy Supply: *Dominated by Fossil Fuels*

12 GWe/Year of New Nuclear Capacity Would Be Needed to Meet 2°C Scenario

2014: 3 construction starts, 5 GW connected
2015 NEA/IEA Technology Roadmap

Contents and Approaches

• Provides an overview of global nuclear energy today.
• Identifies key technological milestones and innovations that can support significant growth in nuclear energy.
• Identifies potential barriers to expanded nuclear development.
• Provides recommendations to policy-makers on how to reach milestones & address barriers.
• Case studies developed with experts to support recommendations.
2015 NEA/IEA Technology Roadmap

**Key Roadmap Recommendations**

- Governments should recognize the value of low-carbon capacity.
- R&D is needed to support long-term operation.
- Industry needs to optimise constructability of Gen III designs.
- Accelerate development of SMRs.
- Support development of one or two Gen IV reactors.
- Demonstrate nuclear desalination or hydrogen production.
- Invest in environmentally sustainable uranium mining.
- Continue cooperation and discussions on international fuel services.
- Establish policies and sites for long-term storage and disposal.
Review of project costs for new plants highlight concerns over FOAK project cost overruns.

Assessment of the impact of carbon pricing on nuclear power economics verifies advantages of nuclear power under carbon pricing schemes.

High penetration of renewables impact baseload power plants and overall system reliability; system costs should be accounted and allocated.

Capital investments to support long-term operations are expected to reach 500-1100 USD/kWe, including about 100-200 USD/kWe for post-Fukushima safety enhancements.
Primary Conclusions – *Financing*:
- Electricity price risk introduces bias against high-capital-cost, low-carbon technologies such as nuclear.
- In new build, shareholders not bondholders are most exposed to project risks.

Primary Conclusions – *Project Management*:
- Nuclear industry should advance convergence and standardisation of engineering codes and quality standards.
- Explicit change management regimes are essential.
- “Soft issues” such as project leadership, team building, experience, incentives and trust are very important to large projects and require investment.
NPV and Price Risk with Low Fixed Costs: Gas-Fired Power Plant

The NPV of a Gas-Fired Power Plant in Function of a Fall in Electricity Prices and the Onset of the Price Fall Years after Commissioning (EUR at r = 5%)
NPV and Price Risk with High Fixed Costs:
A New Nuclear Plant

The NPV of a Nuclear Power Plant in Function of a Fall in Electricity Prices and
the Onset of the Price Fall Years after Commissioning (EUR at r = 5%)
Levelling the Field for Low-Carbon Technologies

• **Low-carbon technologies:**
  – high ratios of fixed-to-variable costs
  – high certainty of prices and revenues over their lifetime
    • Nuclear investors spend 70% of *total lifetime costs* before operation
    • Wind and solar investors spend 90%

• **Deregulated electricity markets intrinsically favour fossil fuels**

• **Levelling the field for low-carbon technologies requires alternative market approaches such as:**
  – long-term power purchasing agreements (PPA)
  – Contracts for difference (CfD)
  – Regulated or guaranteed electricity tariffs covering average costs
Public Views of Nuclear Waste
Nuclear Waste: An Area of Continuing Study
Key Actions for the Next 10 Years

• **Ensure global nuclear safety.** Enhance peer oversight and cooperation of both regulators and operators.

• Establish a **level playing field for all low-carbon technologies** — favouring one technology over another distorts the market and impacts overall grid reliability.

• **New plant projects** in OECD countries must show success in completing projects on time and to budget.

• Enhance **standardisation**, harmonise and update codes and standards.

• Gain **political and public consensus** for long-term radioactive waste management strategies.
For the Longer Term Future: Nuclear Innovation 2050

• What technologies will be needed in 10 years? 30 years? 50 years?
• What research and development is needed to make these technologies available?
• Is the global community doing the R&D needed to prepare for the future?
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