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BETTER POLICIES FOR BETTER LIVES

Nuclear Energy Agency

NEA
NUCLEAR ENERGY AGENCY

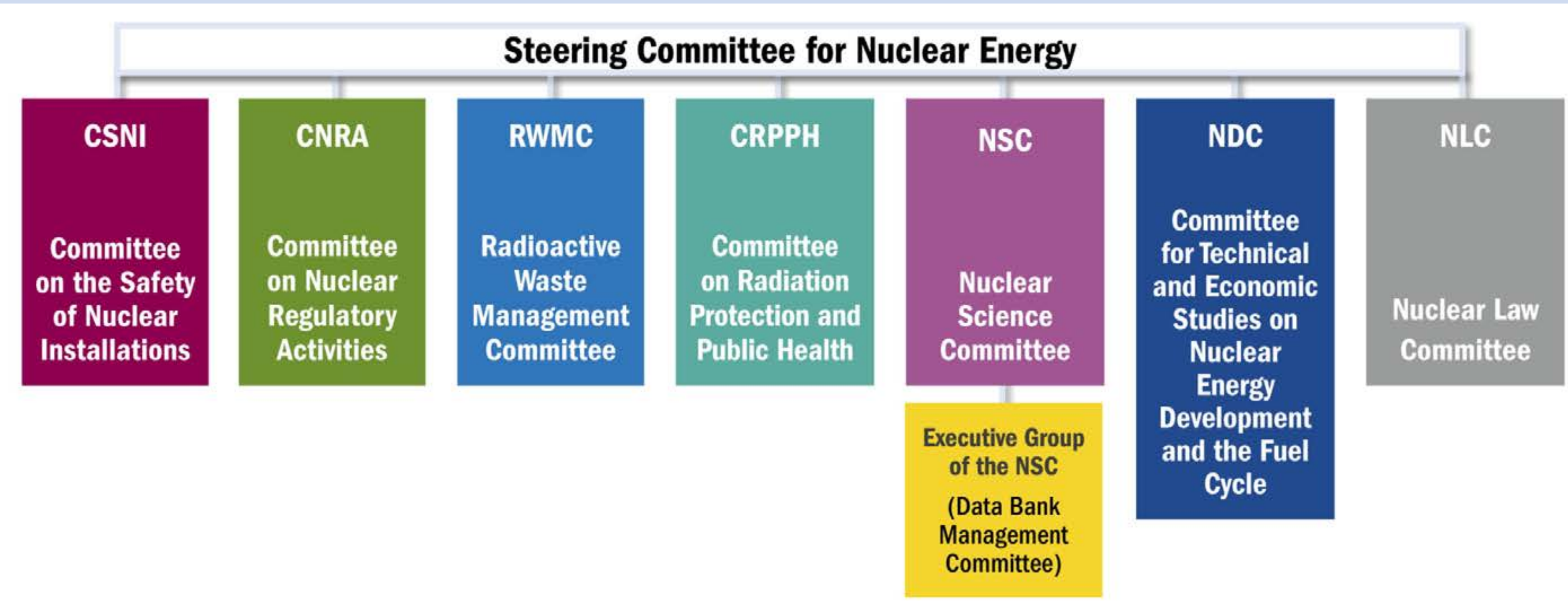
Nuclear Energy: *Analyses of Today, Next Steps for Tomorrow*

William D. Magwood, IV
Director-General
Nuclear Energy Agency
Nuclear Energy Assembly
Washington, DC, 14 May 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

NEA Committee Structure



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

U.S. Delegates to NEA Committees and Secretariat-Serviced Organizations

Steering Committee for Nuclear Energy

Peter Lyons, DOE
Richard Stratford, State
David Skeen, NRC

CSNI – Committee on the Safety of Nuclear Installations

Brian Sheron, NRC
Richard Reister, DOE
D. Sangimino, NRC
Steven West, NRC

CNRA – Committee on Nuclear Regulatory Activities

William Dean, NRC
Glenn Tracy, NRC
Lauren Quinones, NRC
Gene Carpenter, NRC

RWMC – Radioactive Waste Management Committee

William Boyle, NRC
Cathy Haney, NRC
Shawn Smith, NRC

CRPPH – Committee on Radiation Protection and Public Health

Michael Boyd, EPA
Rebecca Tadesse, NRC
Andy Wallo, DOE
P. Worthington, DOE

NSC – Nuclear Science Committee

John Herczeg, DOE
M. Brady-Rapp, PNNL
Marius Stan, ANL

NDC – Committee for Technical and Economic Studies on Nuclear Energy Development and the Fuel Cycle

Matthew Crozat, DOE
Tom Miller, DOE

NLC – Nuclear Law Committee

Margie Doane, NRC
Ben McRae, DOE
Deborah Pulley, NRC

GIF – Generation IV International Forum

John Kelley, DOE
Thomas O'Connor, DOE
Alice Caponiti, DOE
Harold McFarland, INL
Hans Gougar, INL

MDEP – Multinational Design Evaluation Program

Steve Burns, NRC
Gary Holahan, NRC

IFNEC – International Framework for Nuclear Energy Cooperation

Ed McGinnis, DOE

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).

Major NEA Separately Funded Activities

Secretariat-Serviced Organisations

- **Generation IV In**
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- **International Fr**
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21 Major Joint Projects

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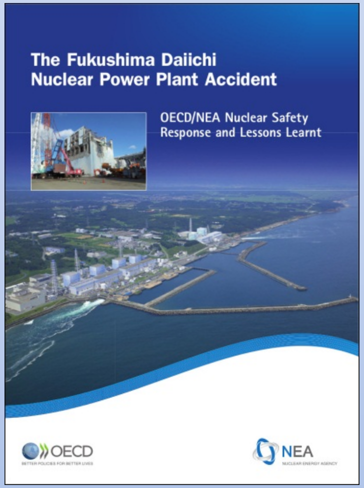
A Current Joint Project

BSAF: *The Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Plant* – applying the scientific information gained from the Fukushima Daiichi accident to test and improve analysis tools used to ensure nuclear plant safety.

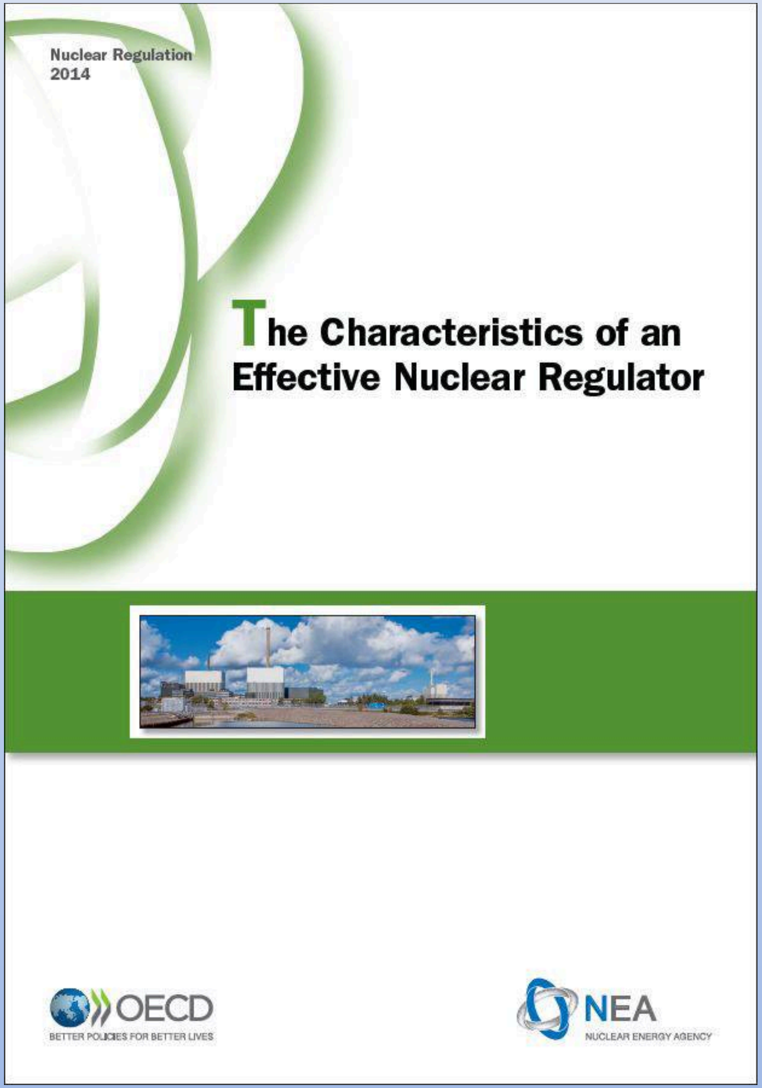
The Fukushima Daiichi Nuclear Power Plant Accident: OECD/NEA Nuclear Safety Response and Lessons Learnt

- **Involved 3 standing technical committees:**
  - Committee on Nuclear Regulatory Activities (CNRA)
  - Committee on the Safety of Nuclear Installations (CSNI)
  - Committee on Radiation Protection and Public Health (CRPPH).
- **Areas covered:**
  - Immediate response by NEA member countries, key messages and conclusions;
  - NEA actions in follow-up to the Fukushima Daiichi accident;
  - Direct support provided to Japan by the NEA.



Report Conclusions and Key Messages

- 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.

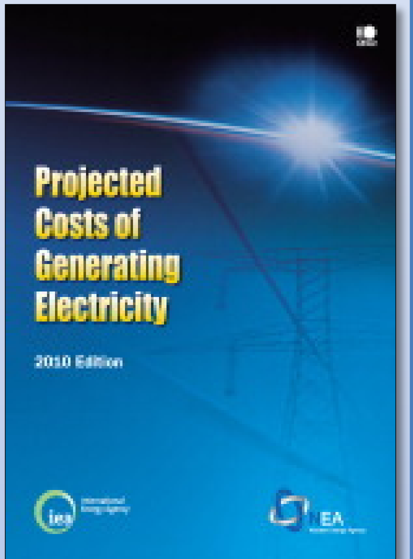


The Characteristics of an Effective Nuclear Regulator

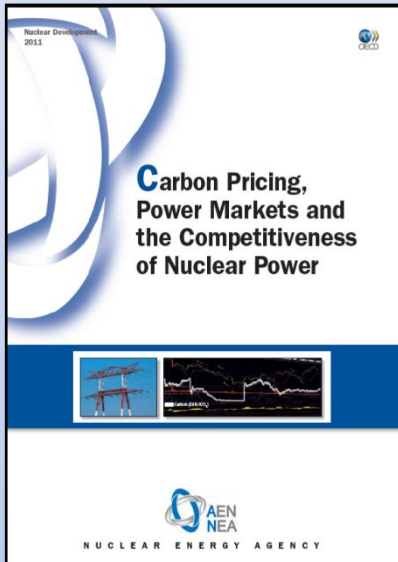
NEA Regulatory Guidance Booklets
Volume 16, 2014, NEA/CNRA/R(2014)3

New Build

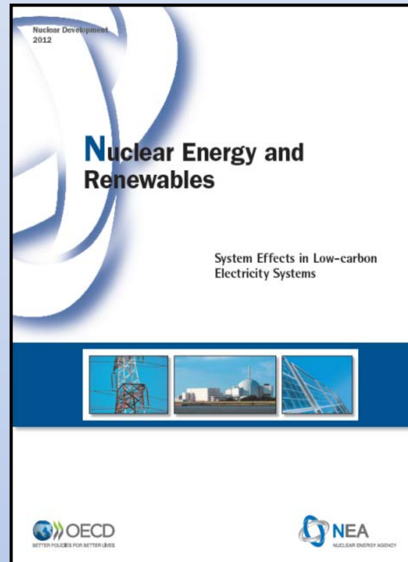
Existing Reactors



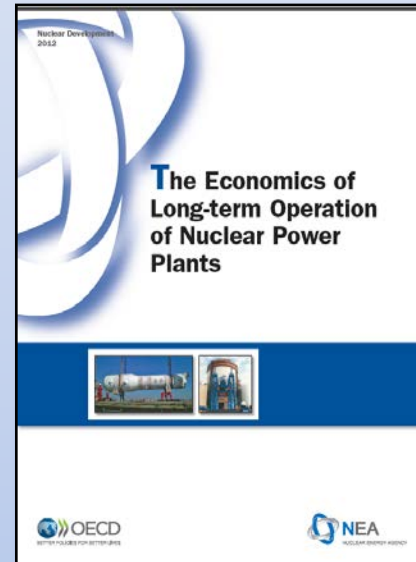
Review of project costs for new plants highlight concerns over FOAK project cost overruns



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.

A Review of Nuclear New Build: Project Structure, Supply Chain and Financing

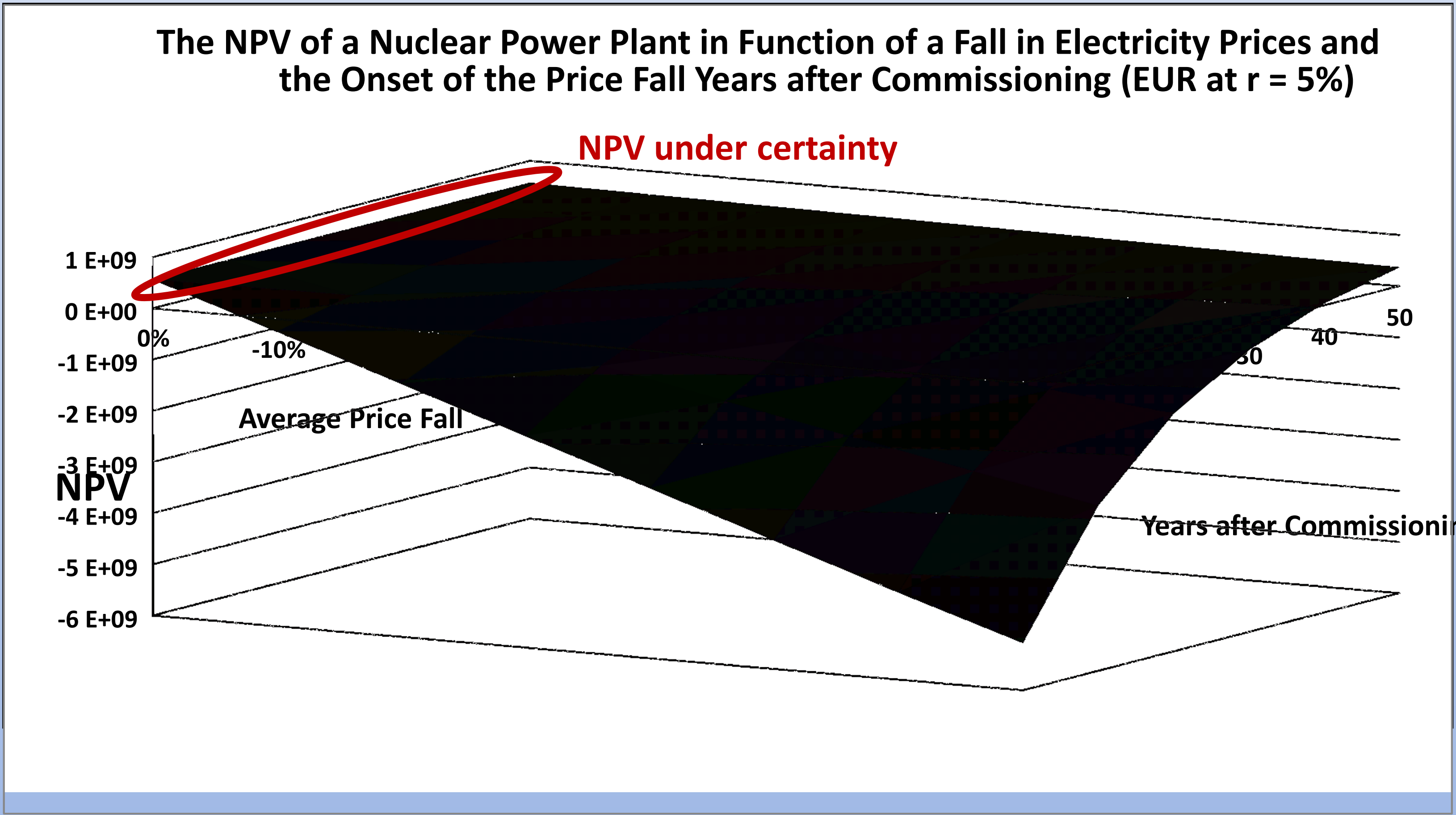
Primary Conclusions – *Financing:*

- 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.

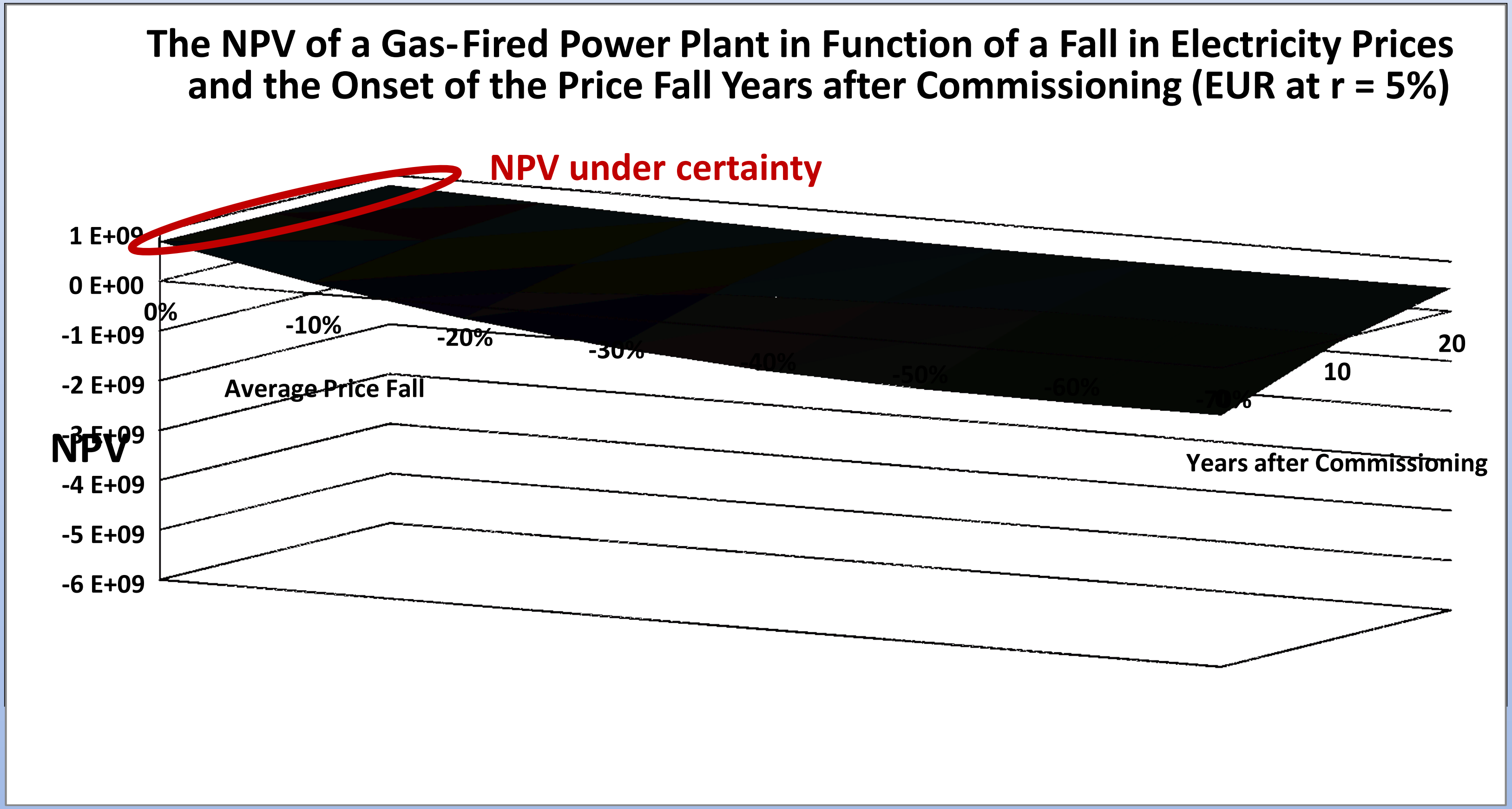
Primary Conclusions – *Project Management:*

- 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 High Fixed Costs: A New Nuclear Plant



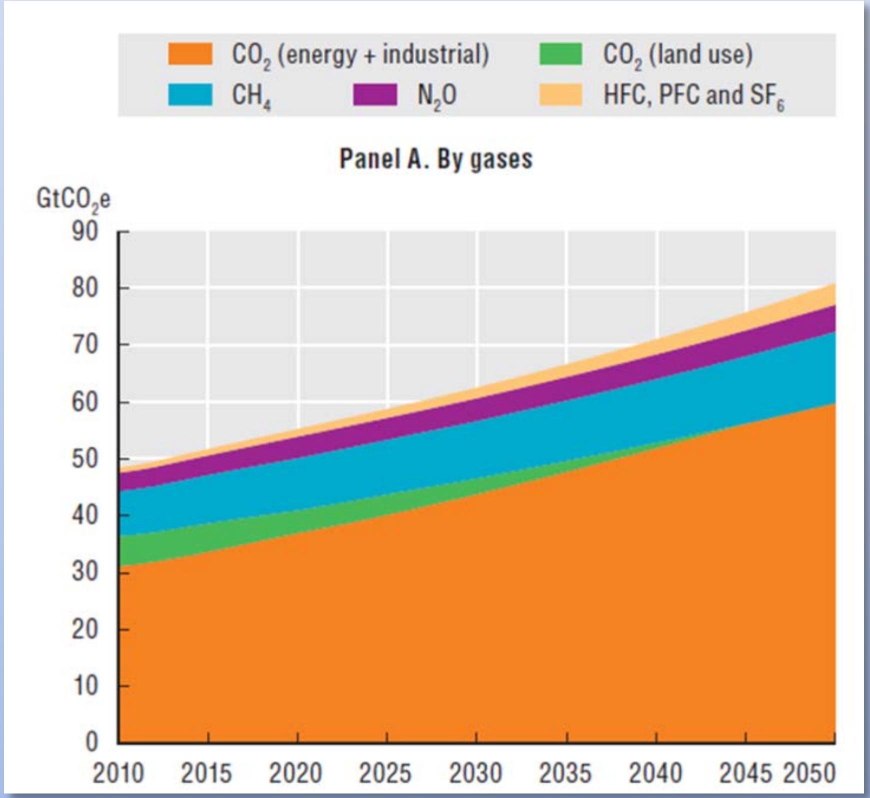
NPV and Price Risk with Low Fixed Costs: Gas



COP 21 is Coming Soon

- 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 CO_2 emissions by 50% from 1990 levels.
- Energy represents 60% of global CO_2 emissions and the power sector produces the largest share of energy-related CO_2.

GHG emissions – baseline scenario:



Source: OECD Environmental Outlook 2050

2015 NEA/IEA Technology Roadmap

Contents and Approaches

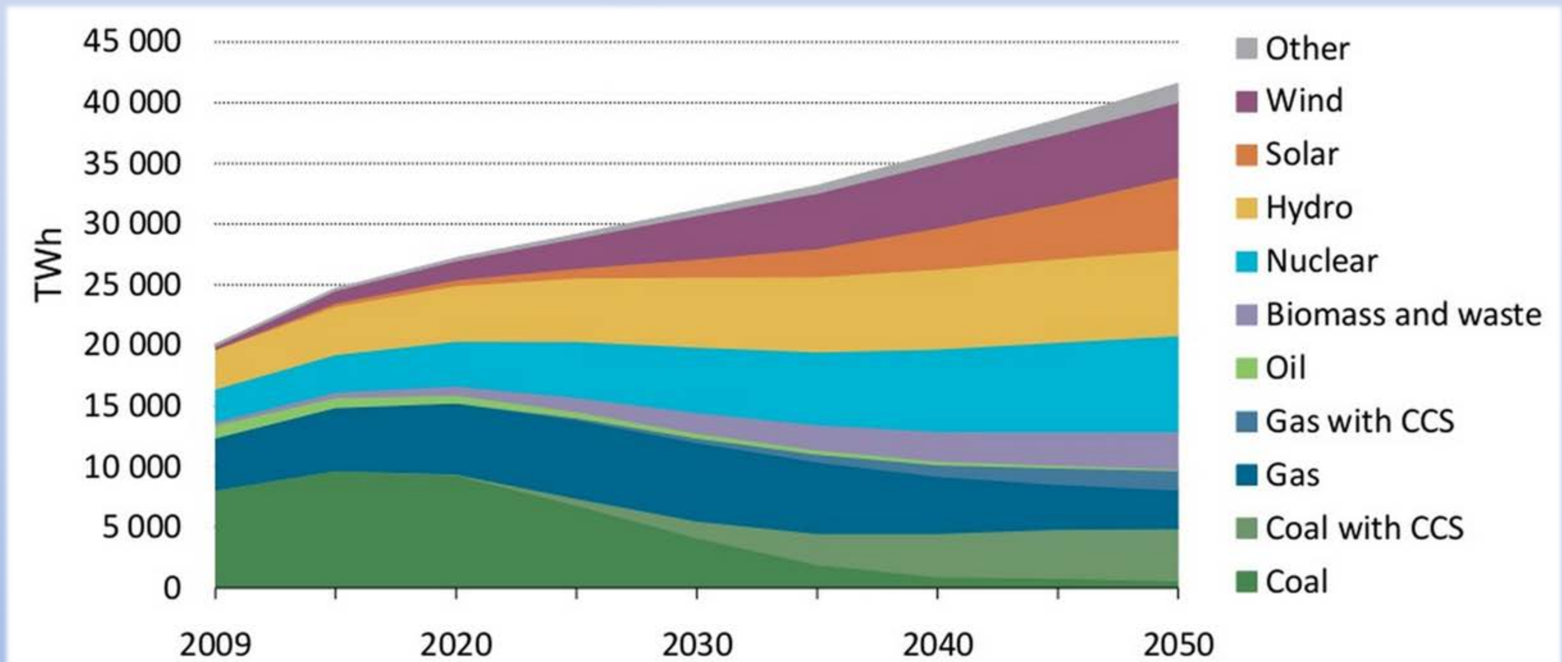
- **Provides an overview of global nuclear energy today.**
- **Identifies key technological milestones and innovations that can support significant growth in nuclear energy.**
- **Identifies potential barriers to expanded nuclear development.**
- **Provides recommendations to policy-makers on how to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

2015 NEA/IEA Technology Roadmap

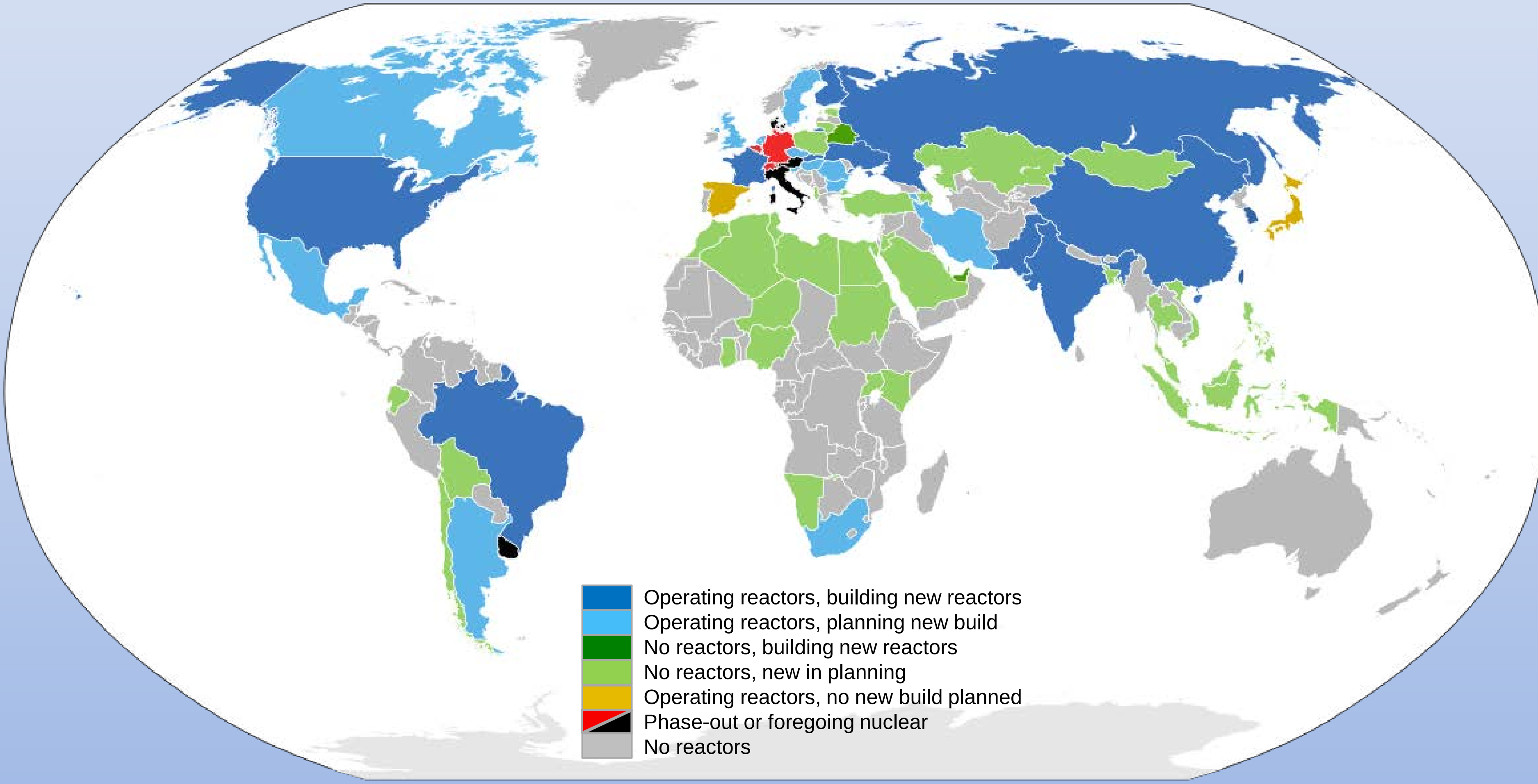
Key Roadmap Recommendations

- **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.**

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



Global View of Nuclear Power Today



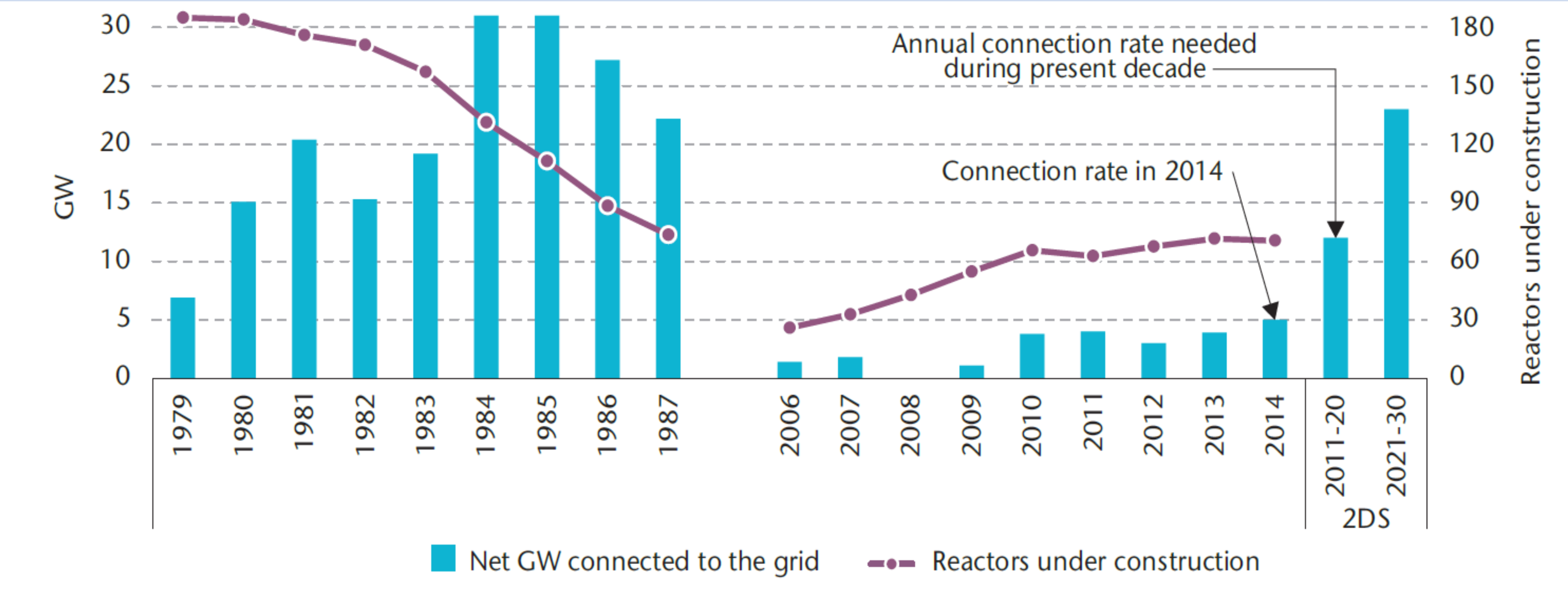
Source data: World Nuclear Association
Update 2015

Nuclear Power Plants under Construction
(May 2015)

Location	No. of units	Net capacity (MW)
Argentina	1	25
Belarus	2	2 218
Brazil	1	1 245
China	23	22 738
Finland	1	1 600
France	1	1 630
India	6	3 907
Japan	2	1 325
Korea	4	5 360
Pakistan	2	630
Russia	9	7 371
Slovak Republic	2	880
Ukraine	2	1 900
United Arab Emirates	3	4 035
United States	5	5 633
Other: Chinese Taipei	2	2 600
TOTAL:	**71**	**68 136**

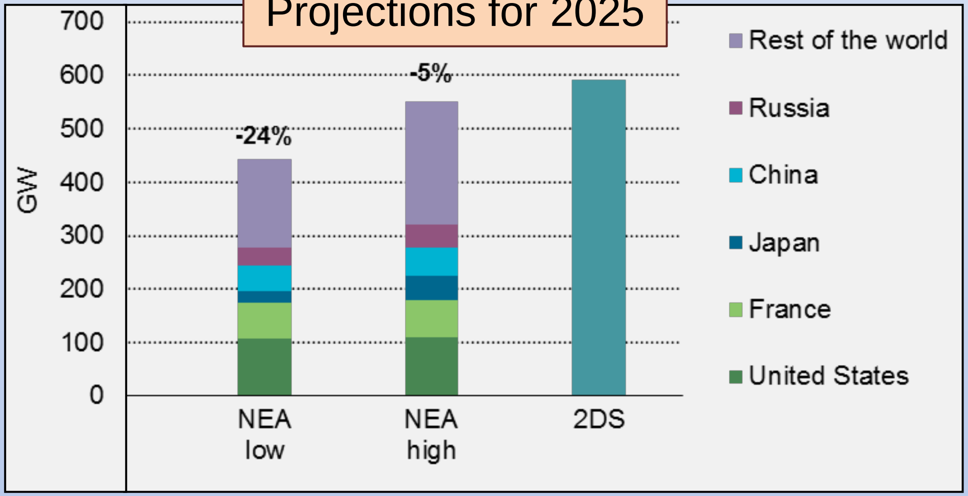
Source: IAEA PRIS

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



2014: 3 construction starts, 5 GW connected

Nuclear Capacity Projections for 2025



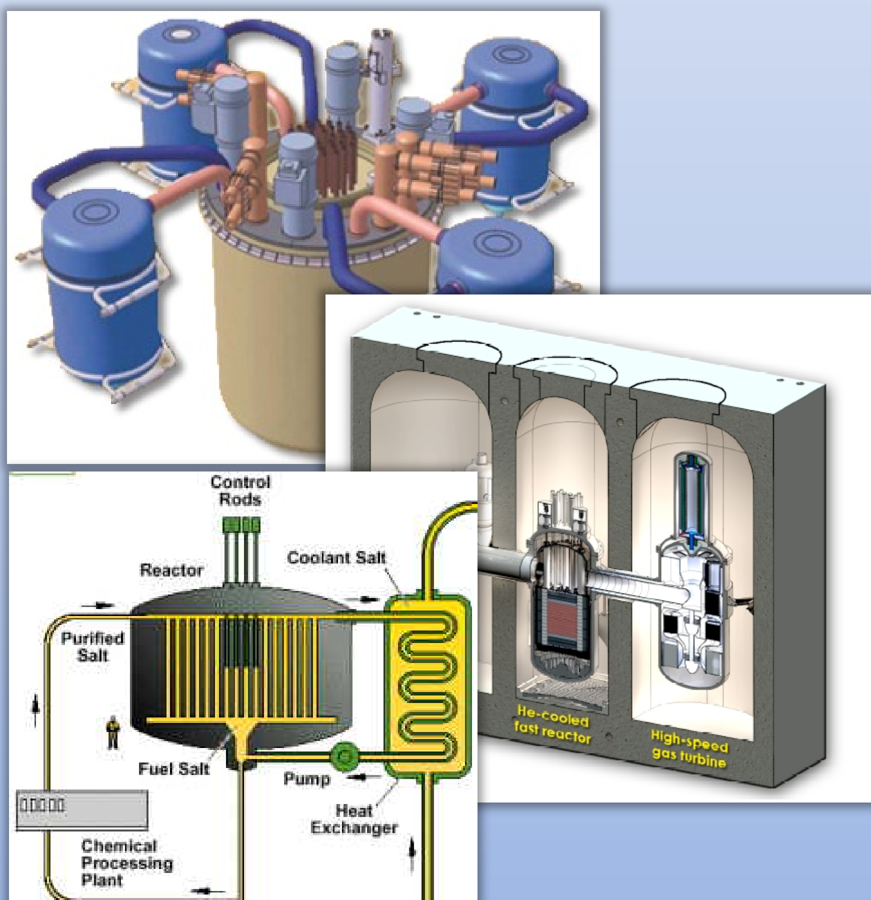
Installed capacity in 2025 is likely to be between 5% and 24% below projected requirements to meet IEA 2°C scenario

- Each country must determine the energy policy that best fits its needs and priorities
- To the degree those priorities include significant reductions in carbon emissions, it appears the world is not on pace to build enough nuclear plants to match the IEA 2°C scenario.

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.

Nuclear Innovation 2050 – A Roadmap for the Future of Nuclear Energy Technology



- 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?

Thank you for your attention

More information @ http://www.oecd-nea.org/

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