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Nuclear Energy Agency

NEA
NUCLEAR ENERGY AGENCY

Looking Forward: *Nuclear Energy Challenges and Opportunities*

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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

Key Activities of the NEA Committee on Radiation Protection and Public Health

- Expert Group on Radiological Protection Aspects of the Fukushima Accident (EGRPF)
- Expert Group on Radiological Protection Science (EGRPS)
- Working Party on Nuclear Emergency Matters (WPNEM)
- Expert Group on Lessons Learnt from Non-nuclear Events (EGNE)
- Fukushima Dialogues (an ICRP initiative cosponsored by NEA)

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

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21 Major Joint Projects

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A Current Joint Project

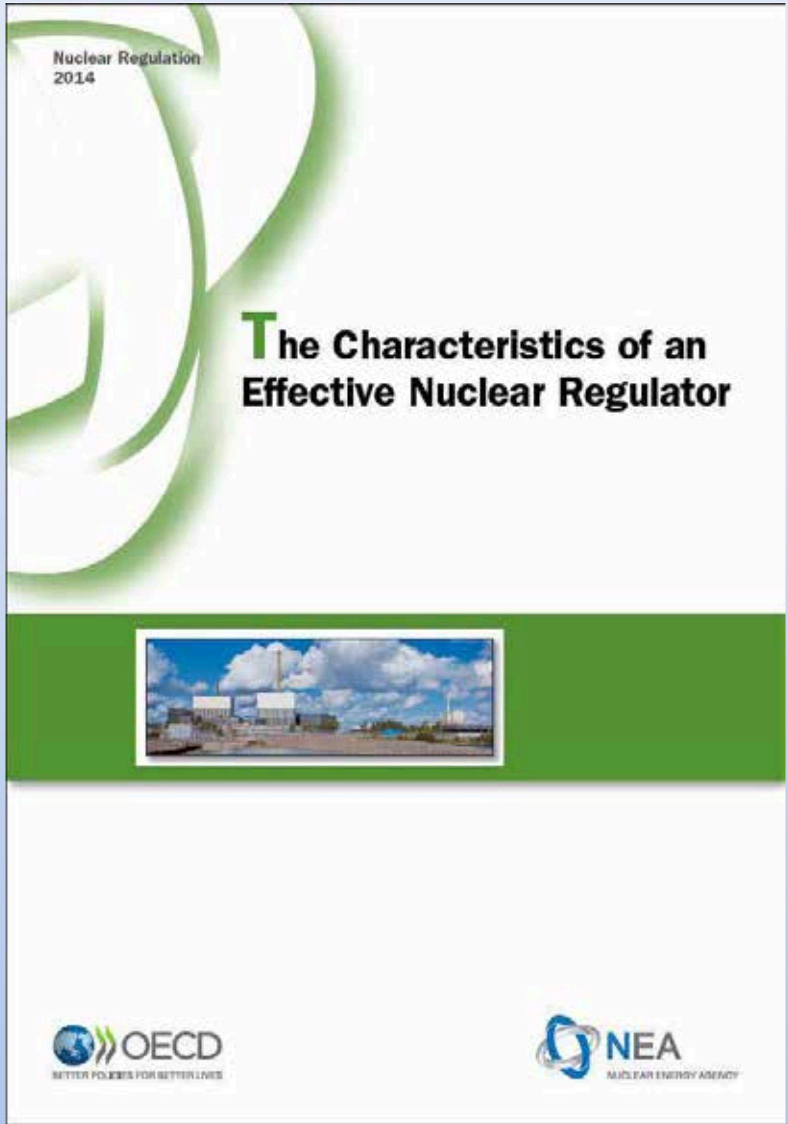
BSAF: *The Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Plant* – applying the scientific information gained from the Fukushima Daiichi accident to test and improve analysis tools used to ensure nuclear plant safety.

Fukushima Daiichi:
Learning the Lessons and Moving Forward

Fukushima Daiichi:
Key NEA Conclusions After the Accident

- NEA member countries determined that their reactors were **safe to continue operation**.
- New safety enhancements related to **extreme events** and severe accidents have been identified and are being implemented.
- A **questioning and learning attitude** is essential to continue improving the high level of safety standards and their effective implementation.
- Nuclear safety professionals have **a responsibility to hold each other accountable** to effectively implement nuclear safety practices.
- The Fukushima Daiichi NPP accident revealed **significant human, organisational and cultural challenges** — especially the need to ensure the independence, technical capability and transparency of the regulatory authority.

Nuclear Energy Agency



The Characteristics of an Effective Nuclear Regulator

NEA Regulatory Guidance Booklets
Volume 16, 2014, NEA/CNRA/R(2014)3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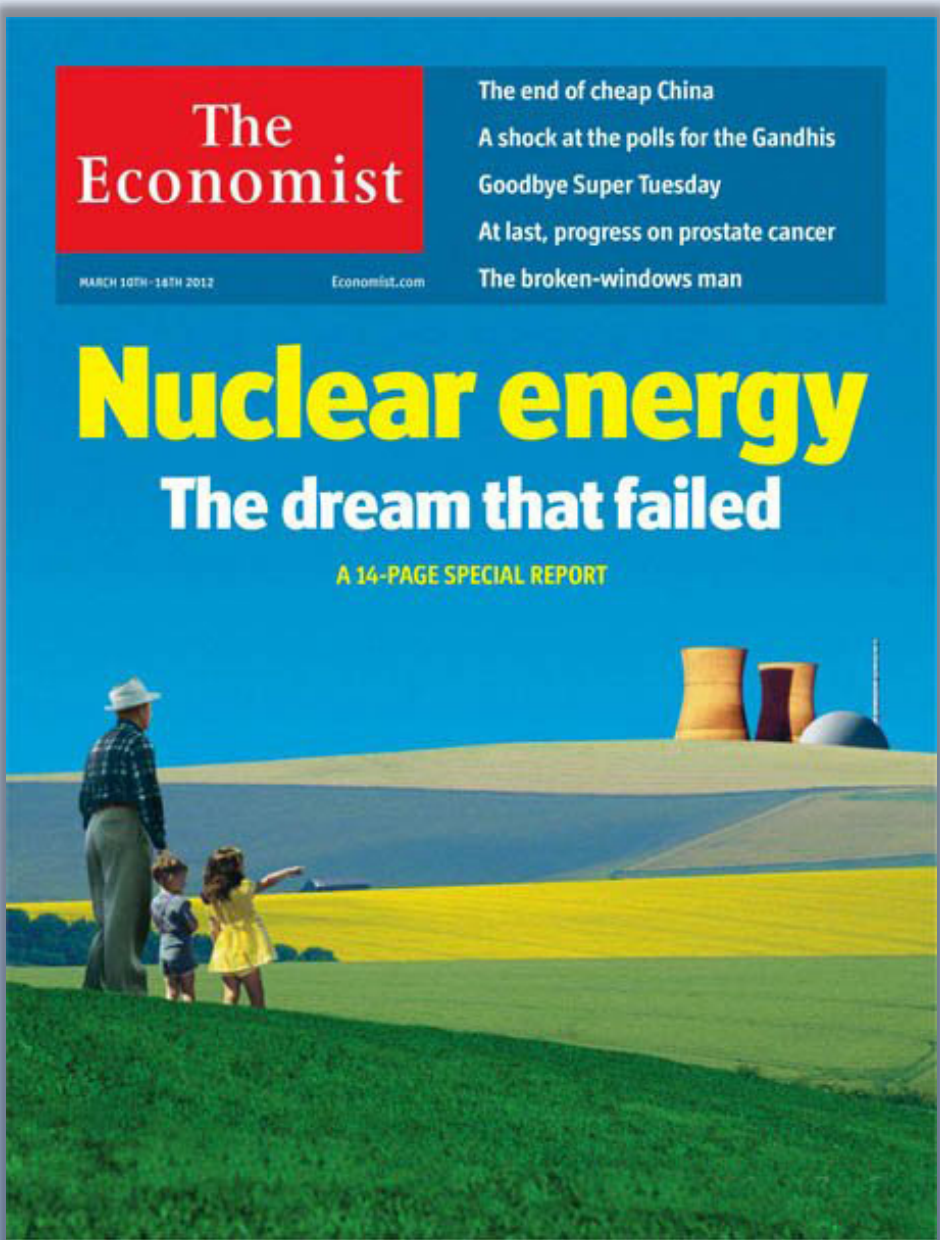
HAVE MADE IT CLEAR
PUT A FULL STOP
TO NUCLEAR
GREENPEACE
NO TO
NUCLEAR..
RETIRE
VERMONT
YANKEE
NO NUKES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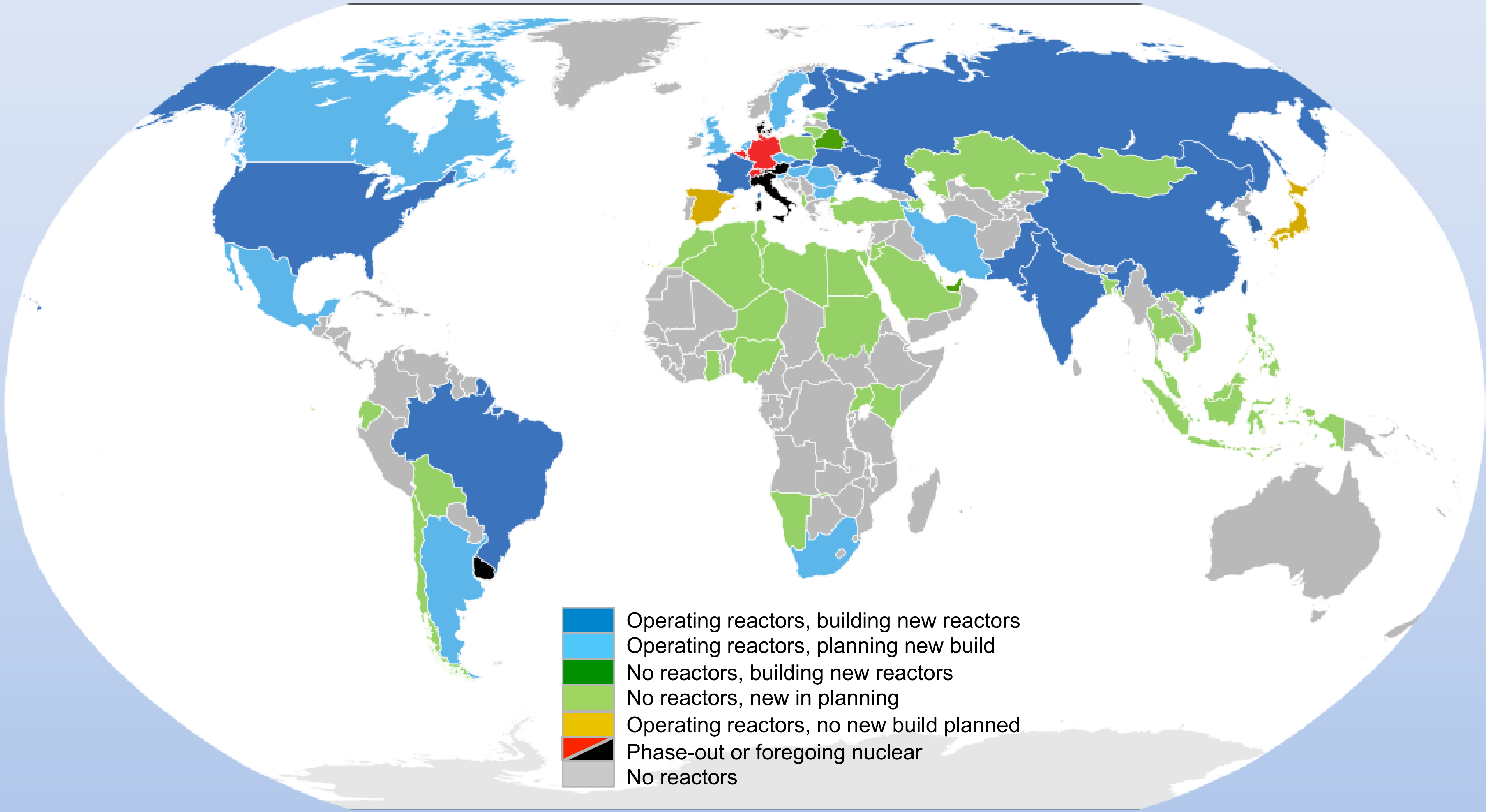
A 14-PAGE SPECIAL REPORT

Global View of Nuclear Power Today



Source data: World Nuclear Association
Update 2015

Nuclear Power Plants under Construction

(June 2015)

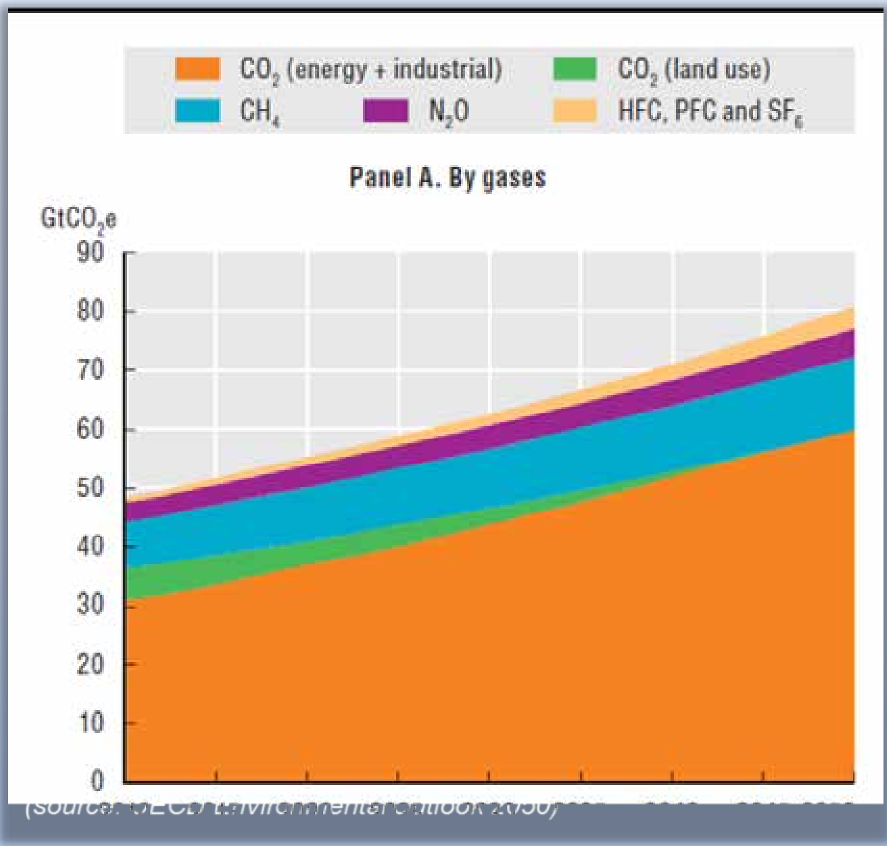
Location	No. of units	Net capacity (MW)
Argentina	1	25
Belarus	2	2 218
Brazil	1	1 245
China	24	23 738
Finland	1	1 600
France	1	1 630
India	6	3 907
Japan	2	1 325
Korea	4	5 360
Pakistan	2	630
Russia	9	7 371
Slovak Republic	2	880
Ukraine	2	1 900
United Arab Emirates	3	4 035
United States	5	5 633
***Other:* Chinese Taipei**	2	2 600
TOTAL:	**67**	**64 097**

Source: IAEA PRIS

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 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.

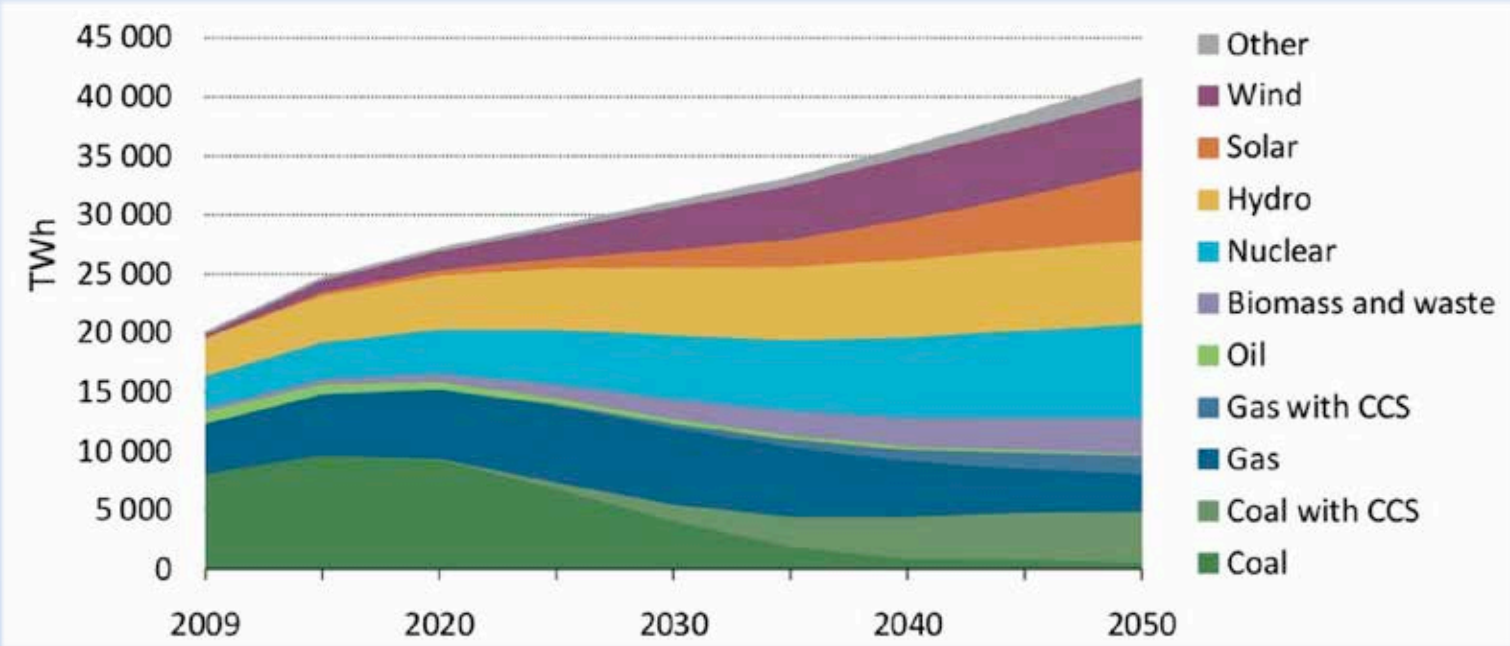
GHG emissions – baseline scenario:



Source: OECD Environmental Outlook 2050

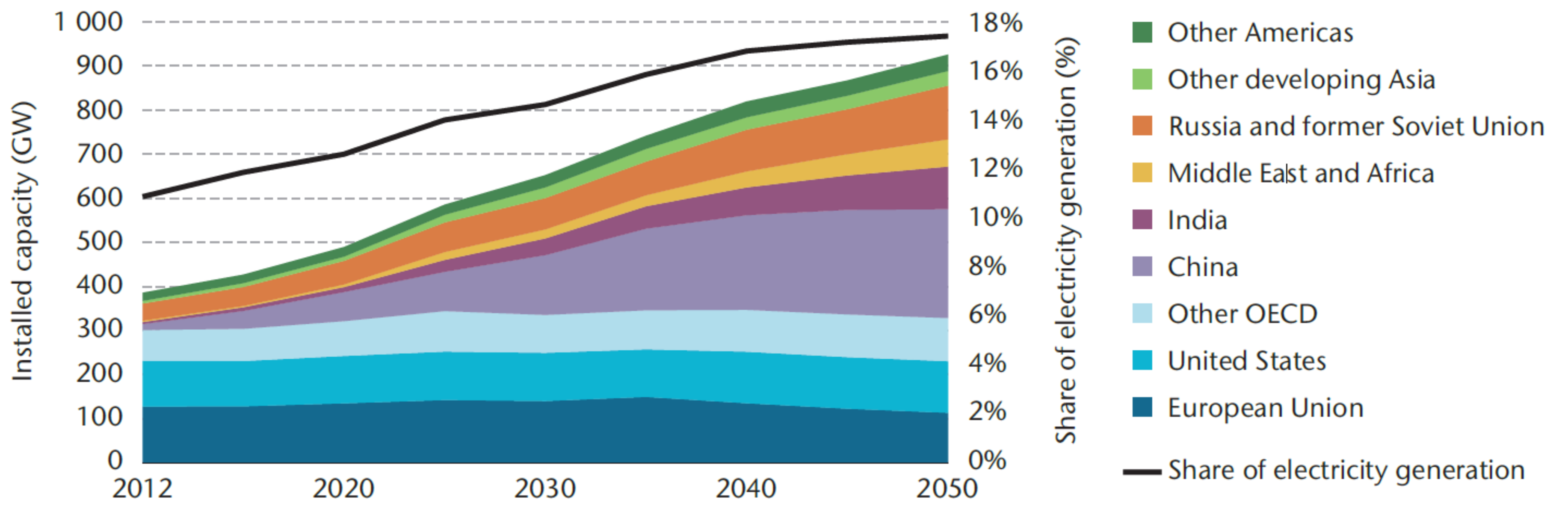
International Energy Agency 2°C Scenario:

Nuclear is Required to Provide the Largest Contribution to Global Electricity in 2050



- **Scenario assumes aggressive energy efficiency measures – 25% of all CO_2 emissions savings would be from efficiency gains**
- **Still, global electricity demand is expected to triple by 2050.**

Global Nuclear Capacity in the 2°C Scenario

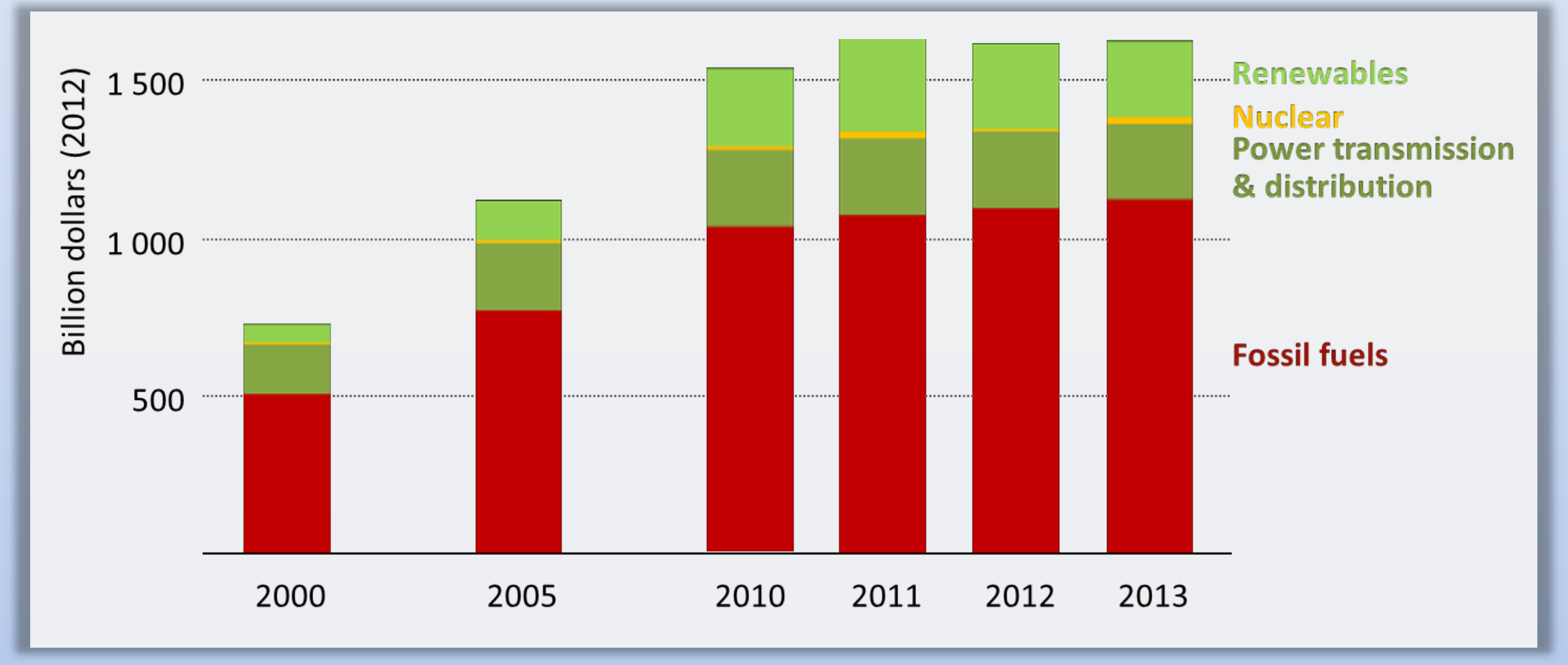


(All capacities are gross capacities)

- **930 GW by 2050 (up from 390 GW today) – an additional 500 reactors**
- **Nuclear's share of global electricity rises to 17% (up from 11% today)**
- **A formidable challenge – increase current capacity by 2.3X in 35 years**
- **Meanwhile, many current reactors will retire**

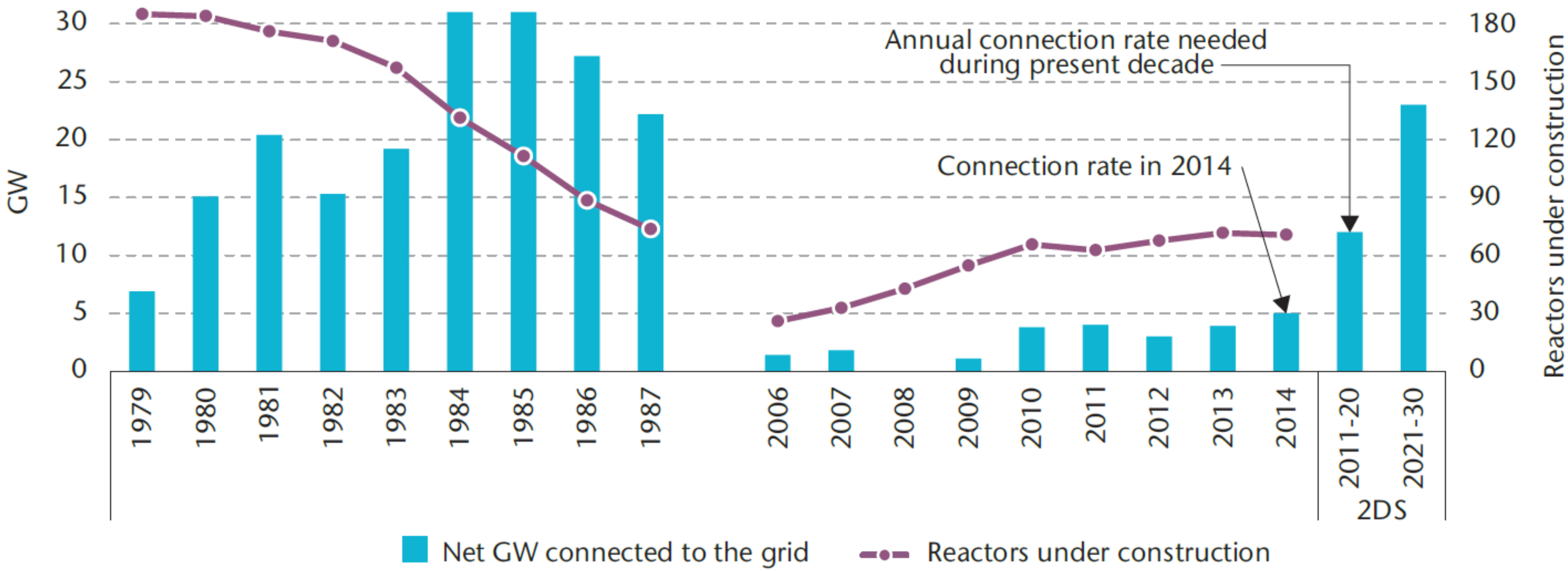
Actual Investment in Energy Supply:

Dominated by Fossil Fuels



Source: IEA (2014), *World Energy Investment Outlook*, International Energy Agency, OECD/IEA, Paris.

Nuclear Capacity Additions



- **In 2014, 3 construction starts, 5 GW connected**
- **Need more than 12 GW/year to meet target**
- **Nuclear is <u>not on track</u> to fulfil its role in the 2°C Scenario**

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.**

Public Views of Nuclear Waste

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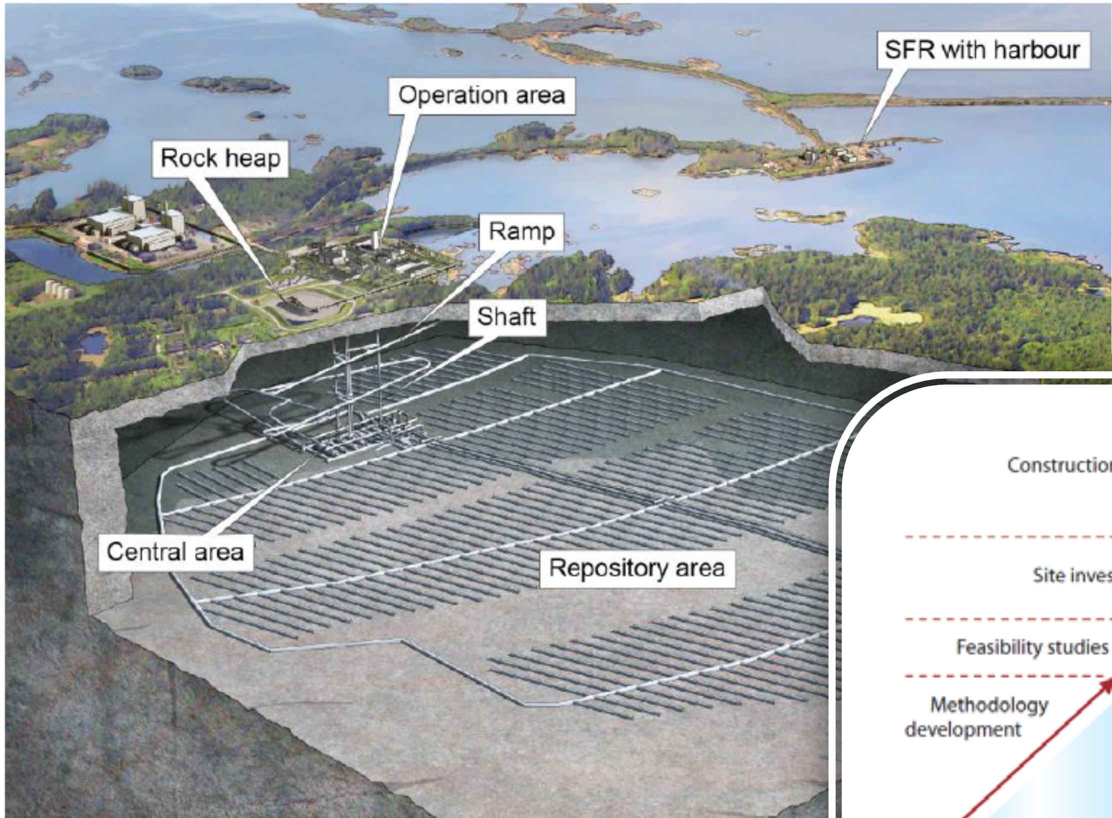
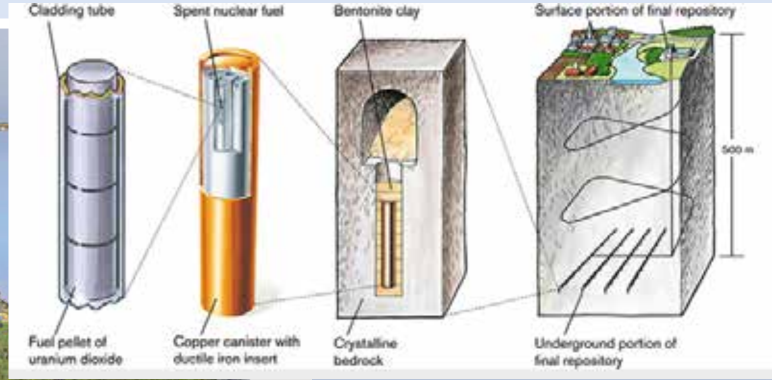
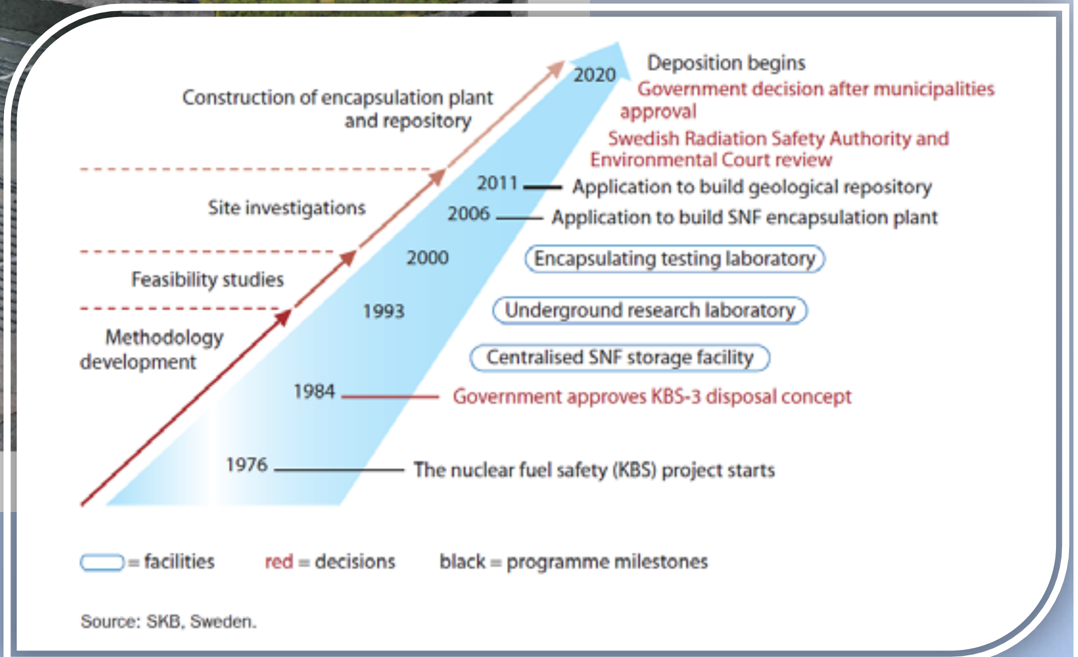
Nuclear Waste:
An Area of Continuing Study

Deep Geological Repositories



Source: SKB website, http://www.skb.se/



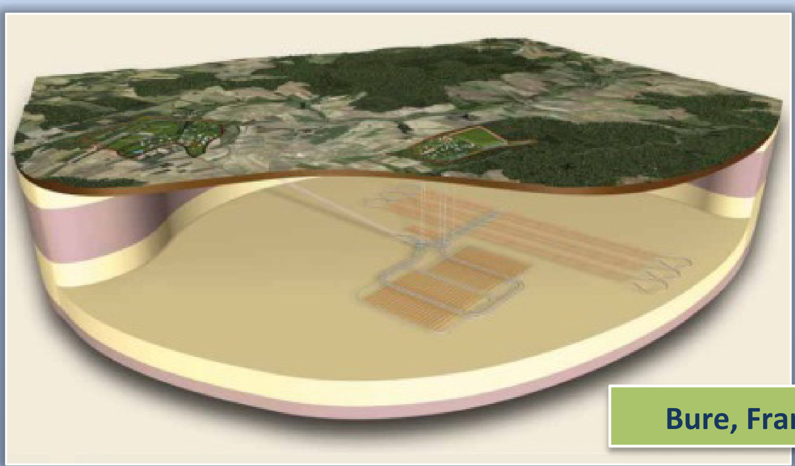


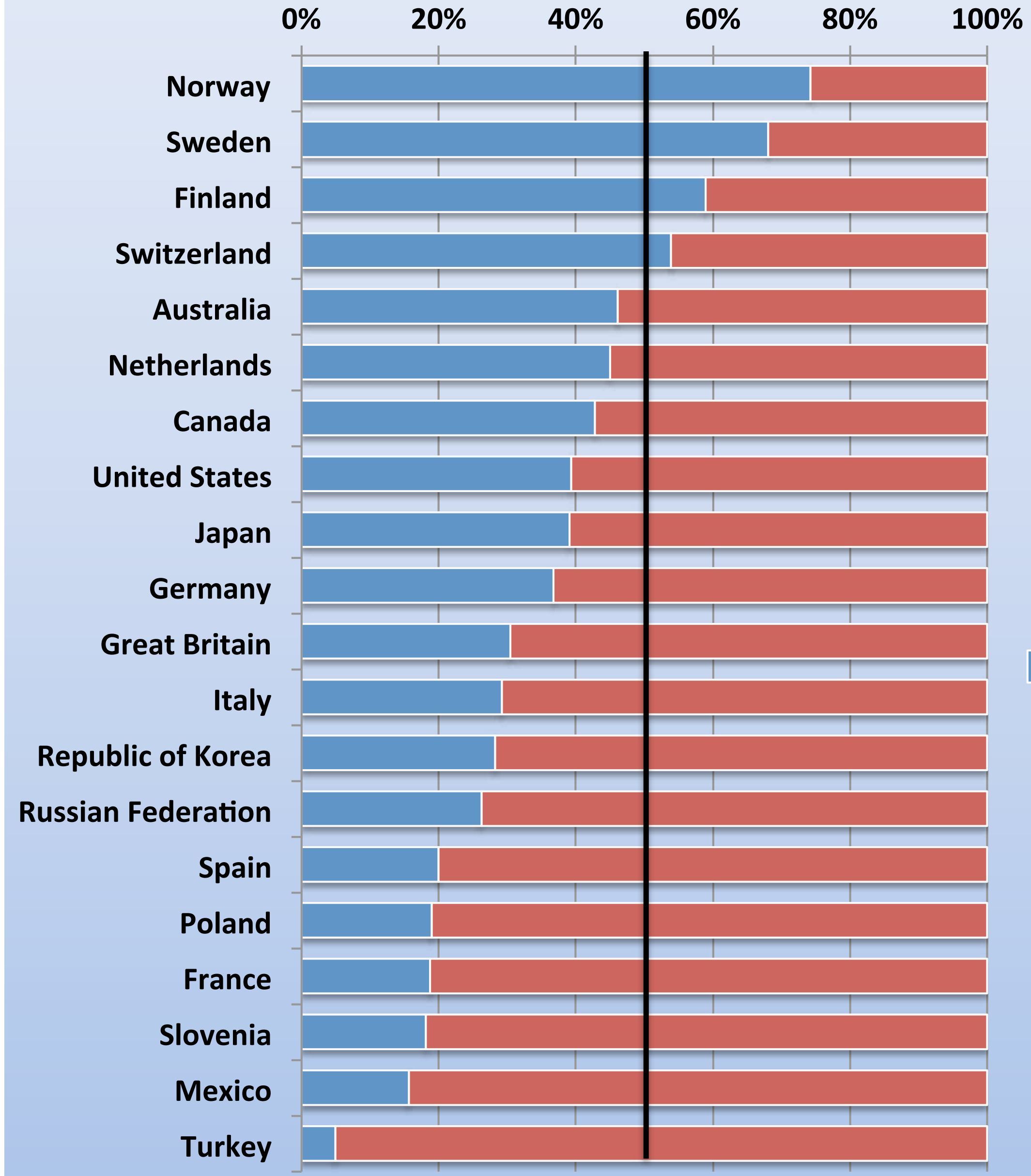
Source: SKB, Sweden.

Global Leaders in HLW Disposition

Waste type	Country	Location	Formation	Status	Projected Start of Operations
HLW/SF	Finland	Eurajoki	Crystalline rock	Licence pending	2020
HLW/SF	Sweden	Forsmark	Crystalline rock	Licence pending	2025
HLW/SF	Switzerland	3 potential sites	Opalinus clay	Siting regions identified	~2040
LILW-LL & HLW/SF	France	Region of Bure (URL)	Callovo-Oxfordian Clay	Siting region identified	2025


Forsmark, Sweden


Bure, France



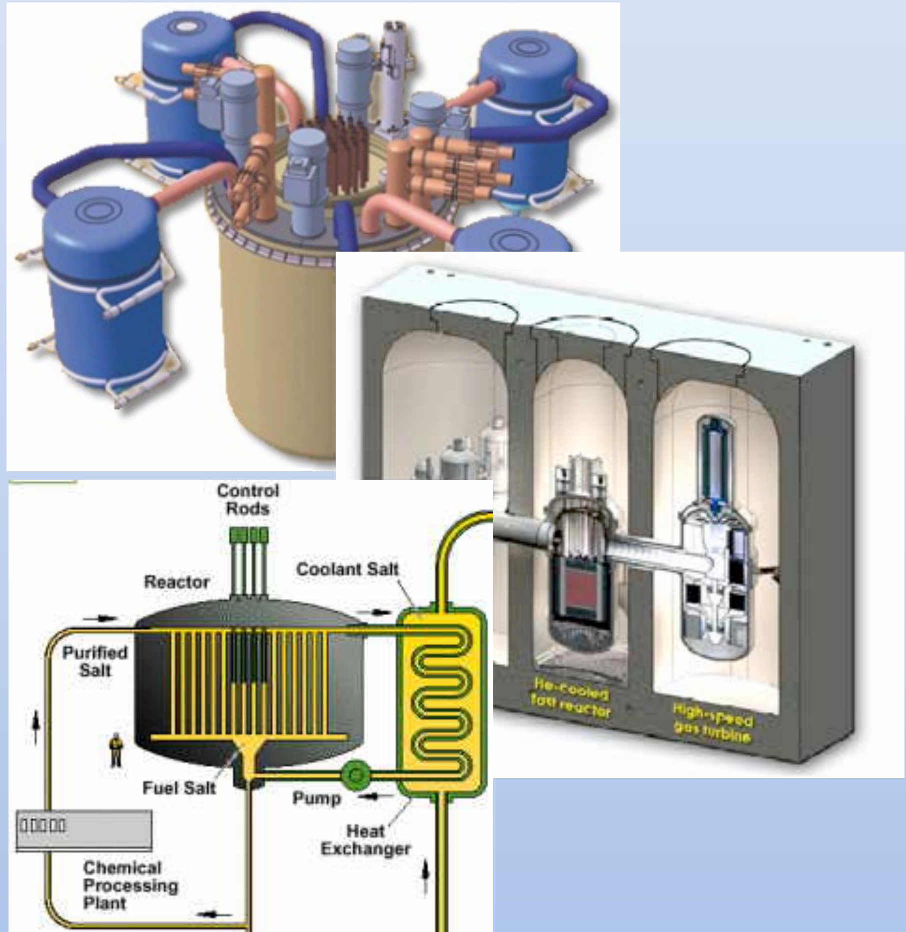
The Trust Factor: *An Element of National Policy in NEA Member Countries*

Respondents agreeing that "most people can be trusted"

Source: Data from the fifth World Values Survey (2005 – 2008)
www.worldvaluessurvey.org

For the Longer Term Future:

Nuclear Innovation 2050



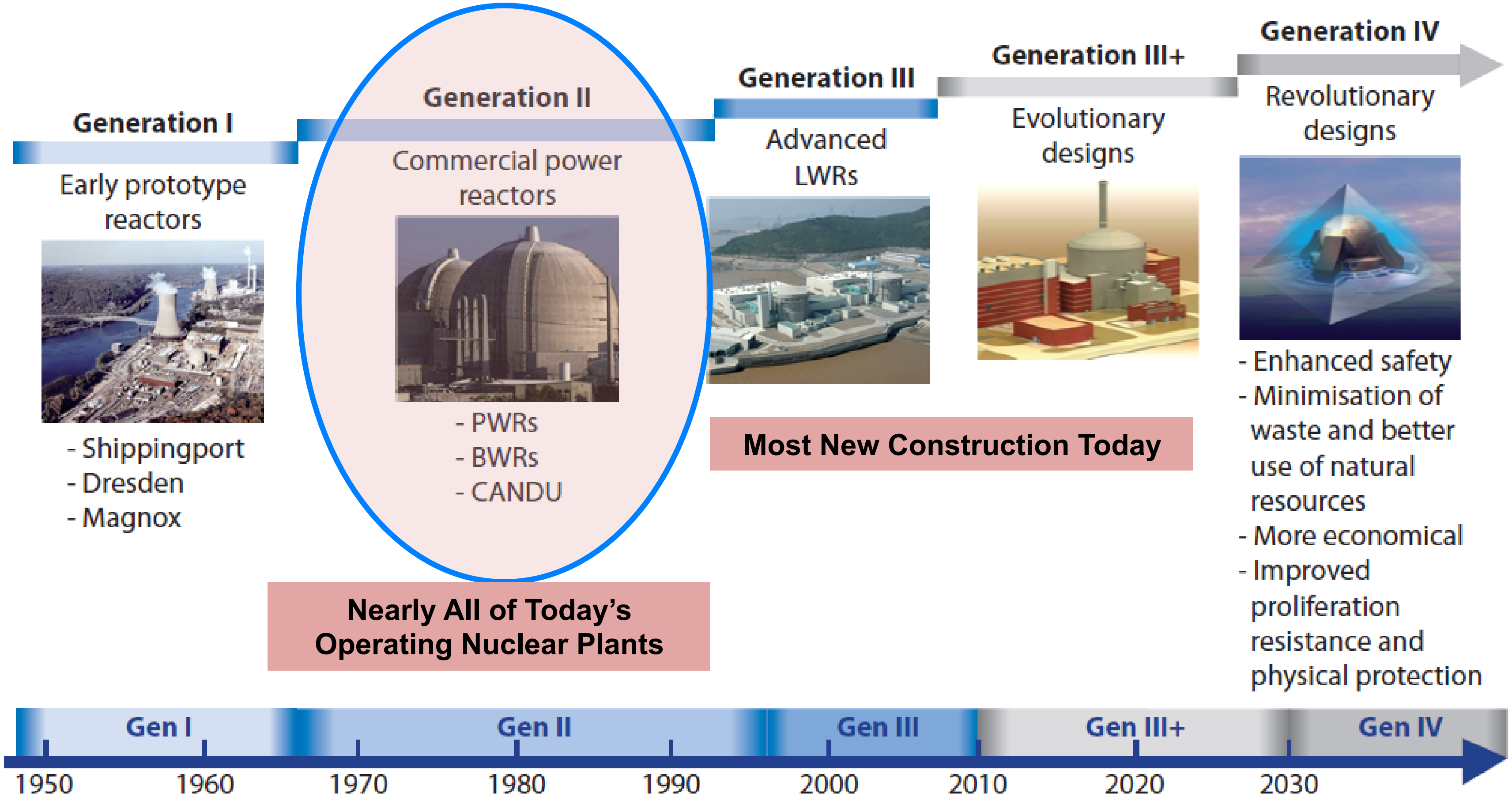
- What technologies will be needed in 10 years? 30 years? 50 years?
- What research and development is needed to make these technologies available?
- Is the global community doing the R&D needed to prepare for the future?

Remembering the Future

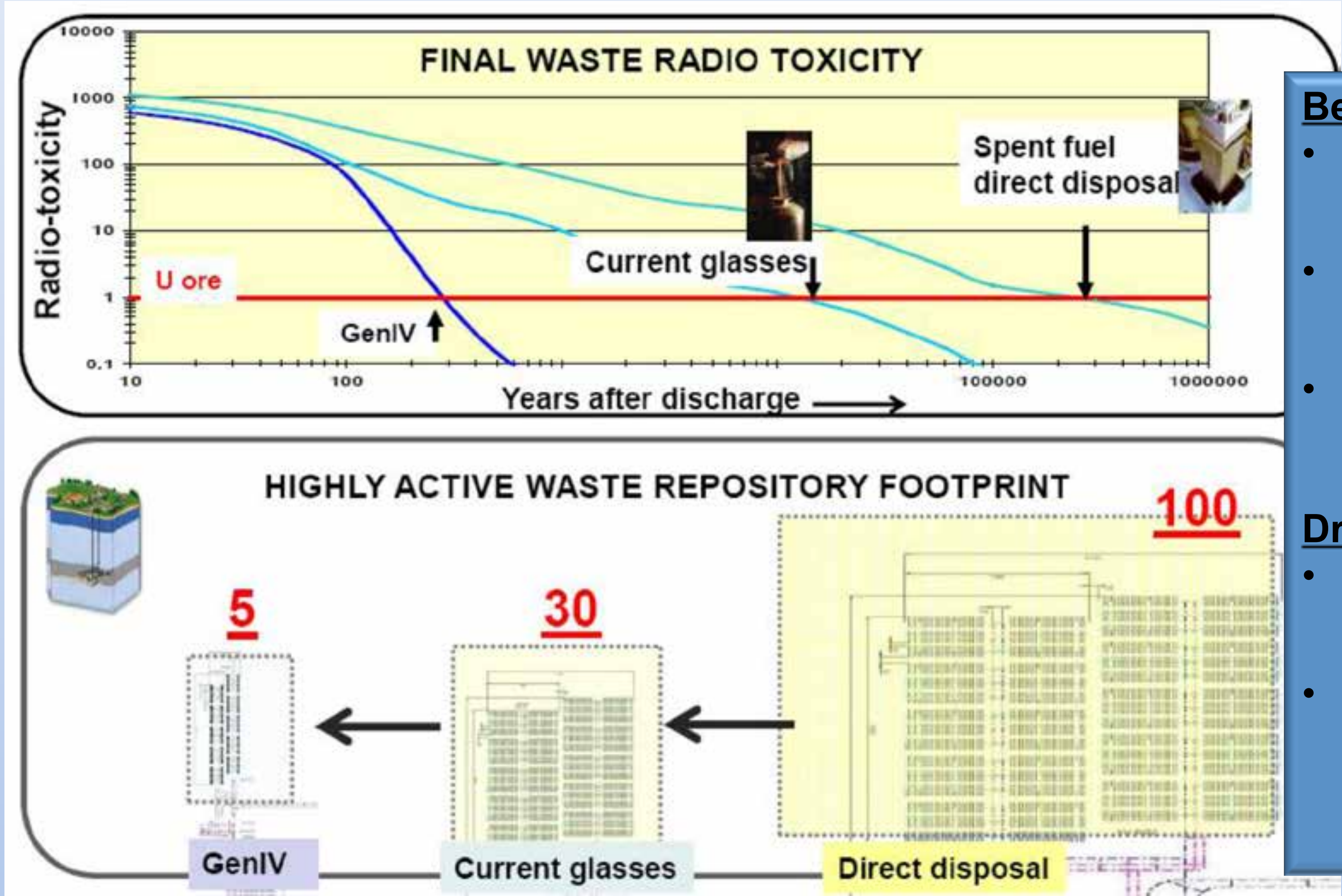
They Way We Were

Atomic Energy Commission Chairman Glenn Seaborg and NASA Administrator James Webb July 1961

Nuclear Reactors: Generations I to IV



A Better Way?



Benefits

- Reduced use of natural resources)
- Reduced volume waste
- Reduced toxicity (lifetime waste)

Drivers

- Better management of nuclear waste
- Avoid burdening future generations with toxic materials

Graph from C. Behar, "French R&D program on SFR and the ASTRID prototype", Fast Reactors 2013 conference, see http://www.iaea.org/NuclearPower/Downloadable/Meetings/2013/2013-03-04-03-07-CF-NPTD/6.behar.pdf

Continuing the Scientific Enterprise

Key Areas of NEA Exploration

- Development of advanced materials
- Multiscale/Multiphysics modelling, verification and validation.
- Accident tolerant fuels.
- Developing databases of experimental results—such as those examining the behaviour of materials in geologic repositories.

A New Brand of Joint Project

- Advanced, multinational research that includes universities as well as research labs
- Strong role for students and professors in addressing important science and technology issues

Thank you for your attention

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