

IFRI Seminar

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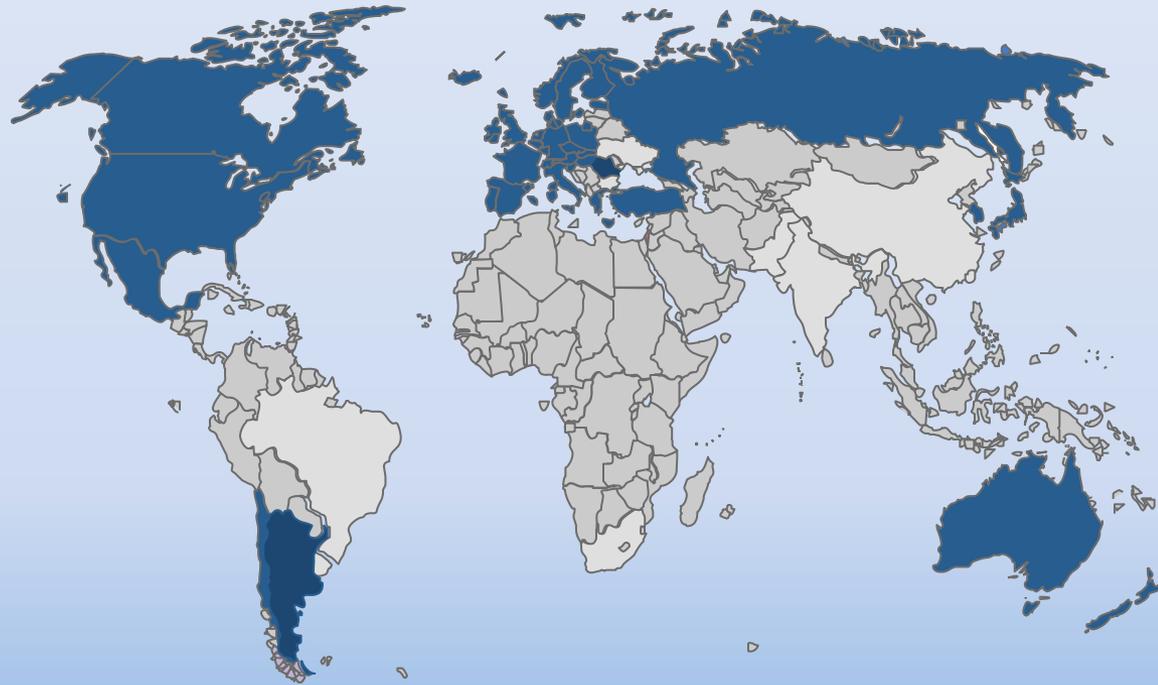
**Institut Français des
Relations Internationales**

11 July 2017

The NEA Serves as a Framework to Address Global Challenges

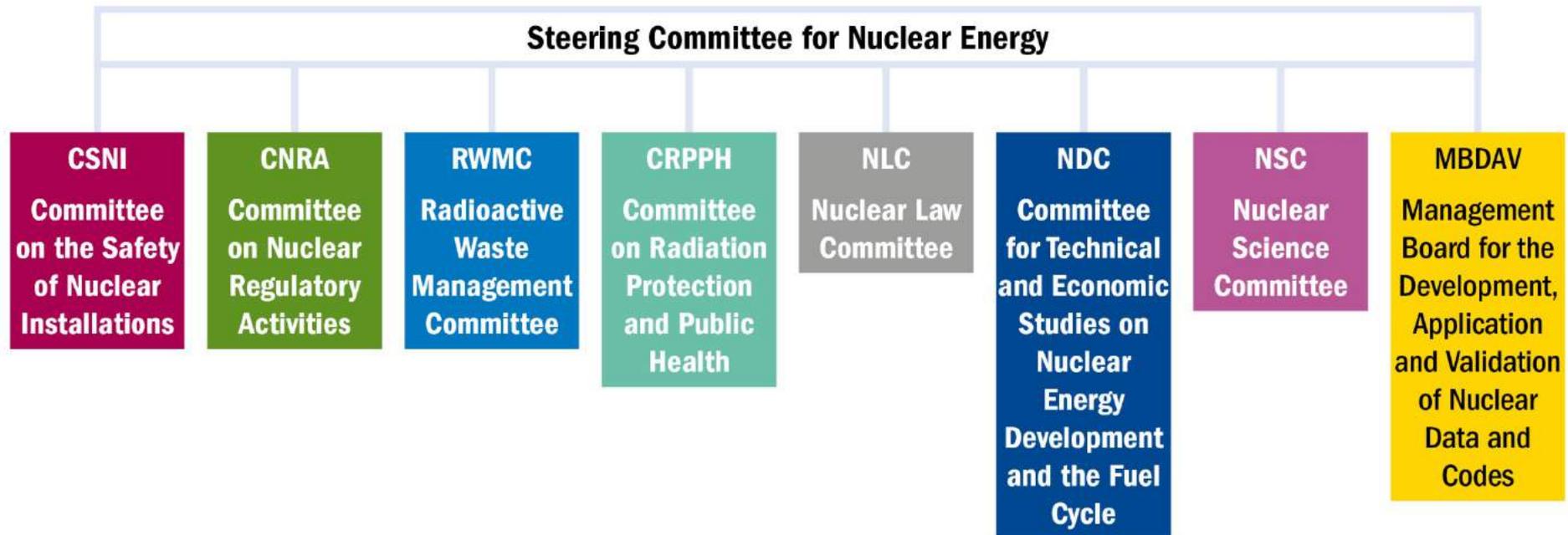
The Role of the NEA is to:

- Foster international co-operation to develop the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes.
- Develop authoritative assessments and forging common understandings on key issues as input to government decisions on nuclear technology policy
- Conduct multinational research into challenging scientific and technological issues.



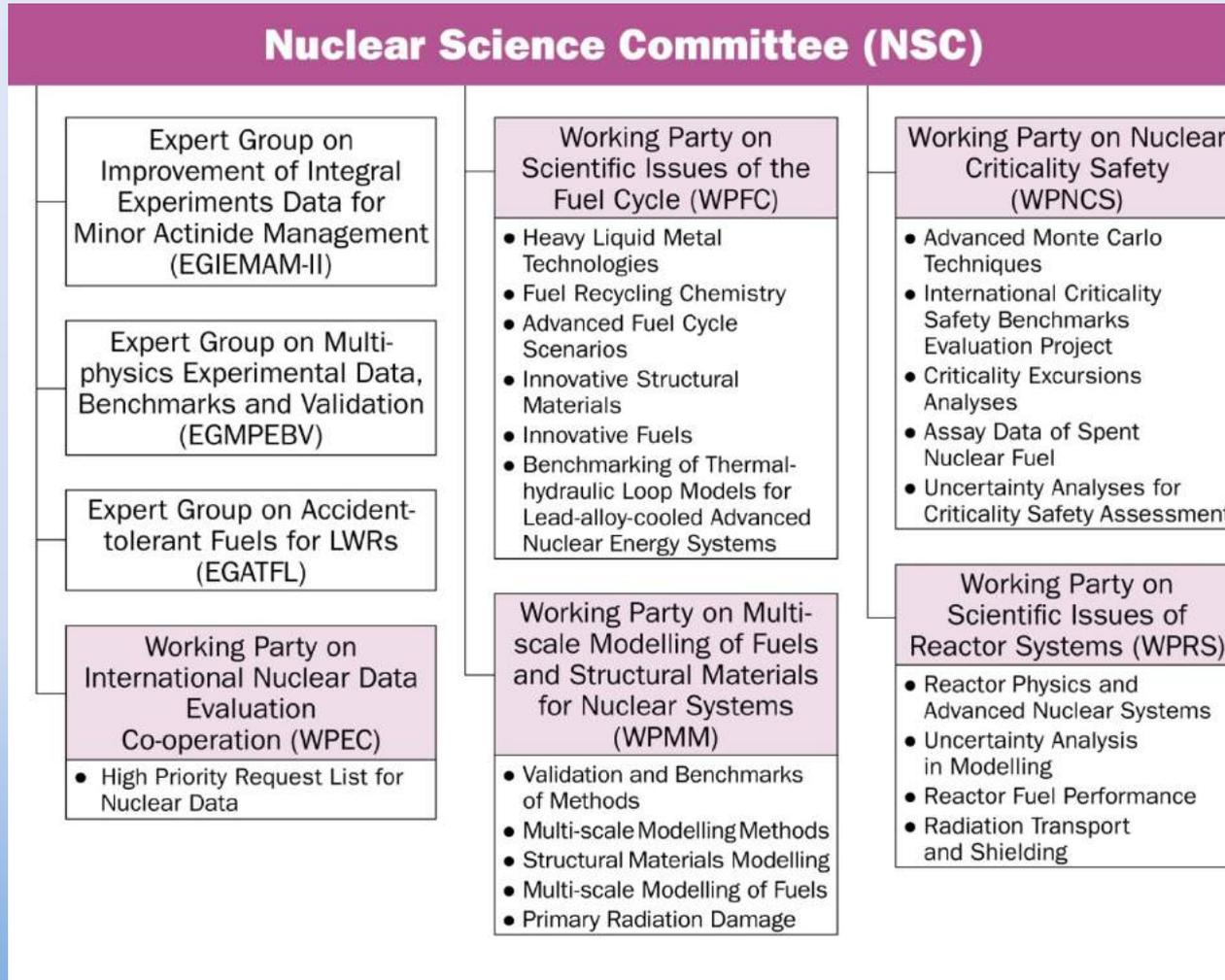
33 NEA Countries Operate about 90% of the World's Installed Nuclear Capacity

NEA Standing Committees



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.

NEA Nuclear Science Activities



NEA joint project in the nuclear science area:

Thermodynamics of Advanced Fuels – International Database (TAF-ID) Project

NEA joint projects in the nuclear science area beginning soon:

Thermodynamic Characterization Of Fuel debris and Fission products based on scenario analysis of severe accident progression at Fukushima Daiichi NPP (TCOFF)

NEA Education and Skills & Technology (NEST) Framework

Major NEA Separately Funded Activities

NEA 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.

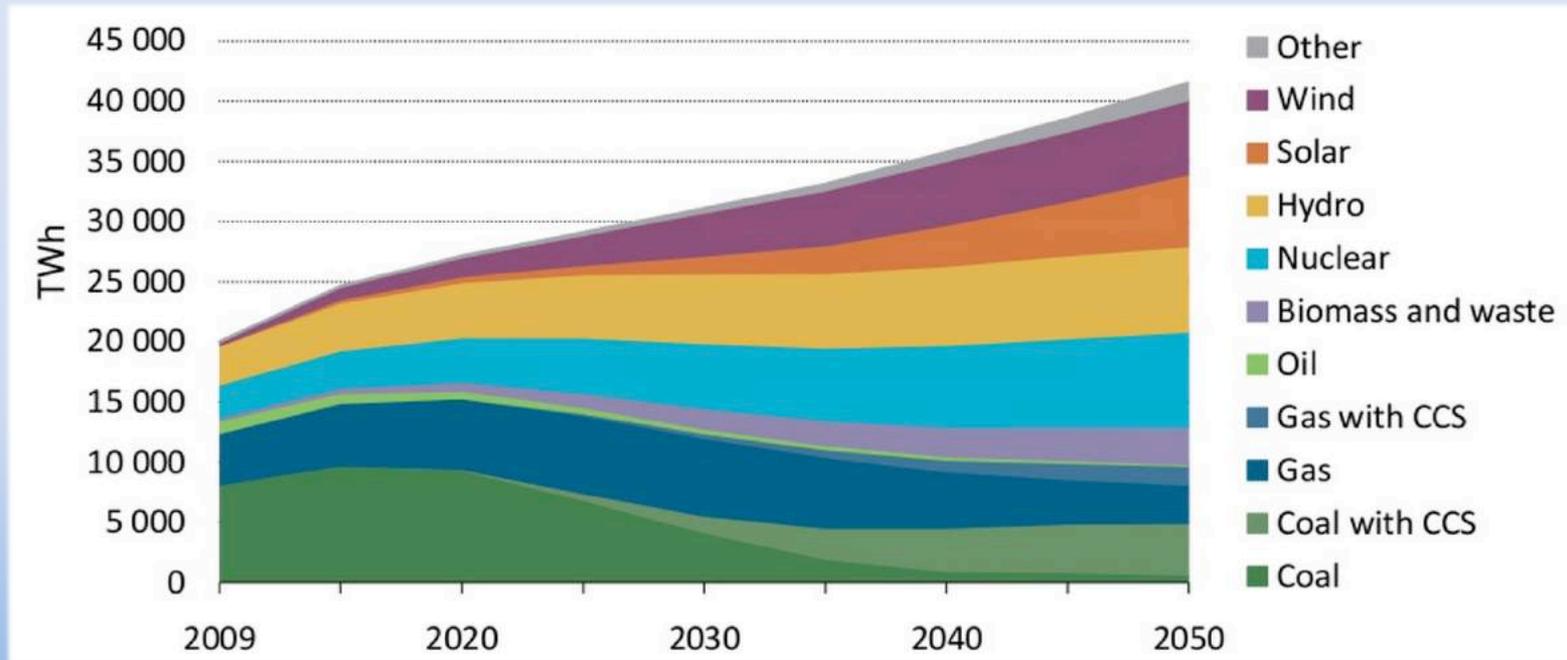
22 Major Joint Projects

(Involving countries from within and beyond NEA membership)

- **Nuclear safety research** and experimental data (e.g., thermal-hydraulics, fuel behaviour, severe accidents).
- **Nuclear safety databases** (e.g., fire, common-cause failures).
- **Nuclear science** (e.g., thermodynamics of advanced fuels).
- **Radioactive waste management** (e.g., thermochemical database).
- **Radiological protection** (e.g., occupational exposure).
- **Halden Reactor Project** (fuels and materials, human factors research, etc.)

IEA 2°C Scenario:

In the most economic scenario, nuclear provides largest contribution to global electricity in 2050

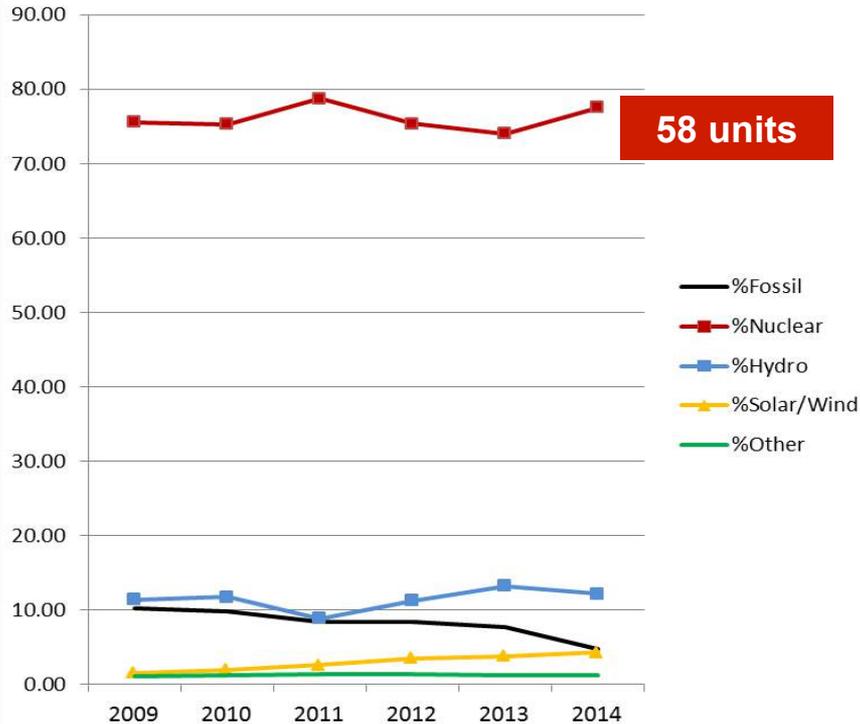


Source: IEA

Recent Evolutions of the Electricity Mix in France & Germany

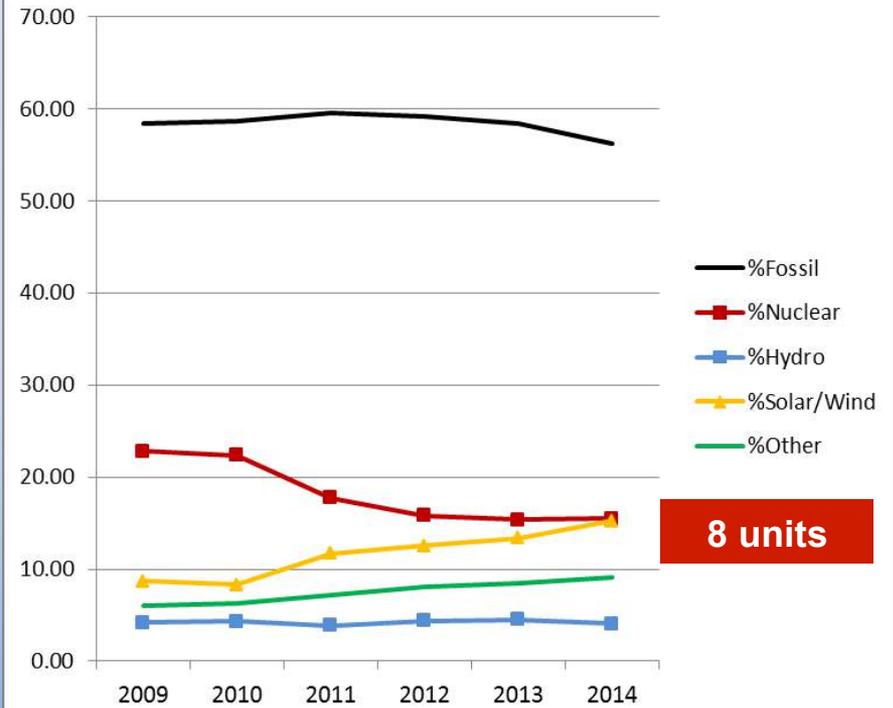
Electricity Mix France (2009-2014):

94% low C in 2014 vs. 89% in 2009



Electricity Mix Germany (2009-2014):

35% low C in 2014 vs. 36% in 2009

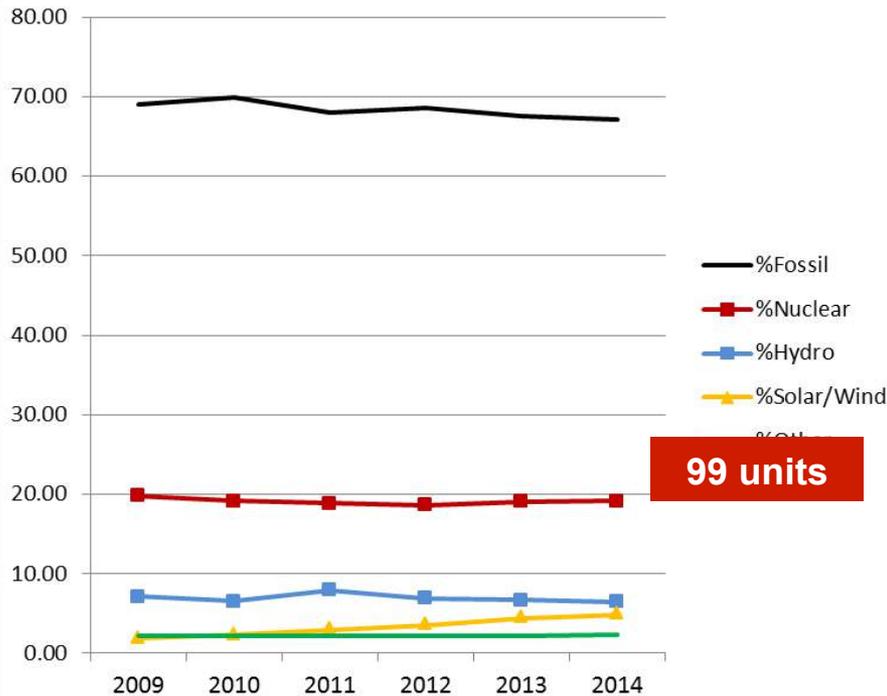


Source: IEA data

Recent Evolutions of the Electricity Mix in the US and Japan

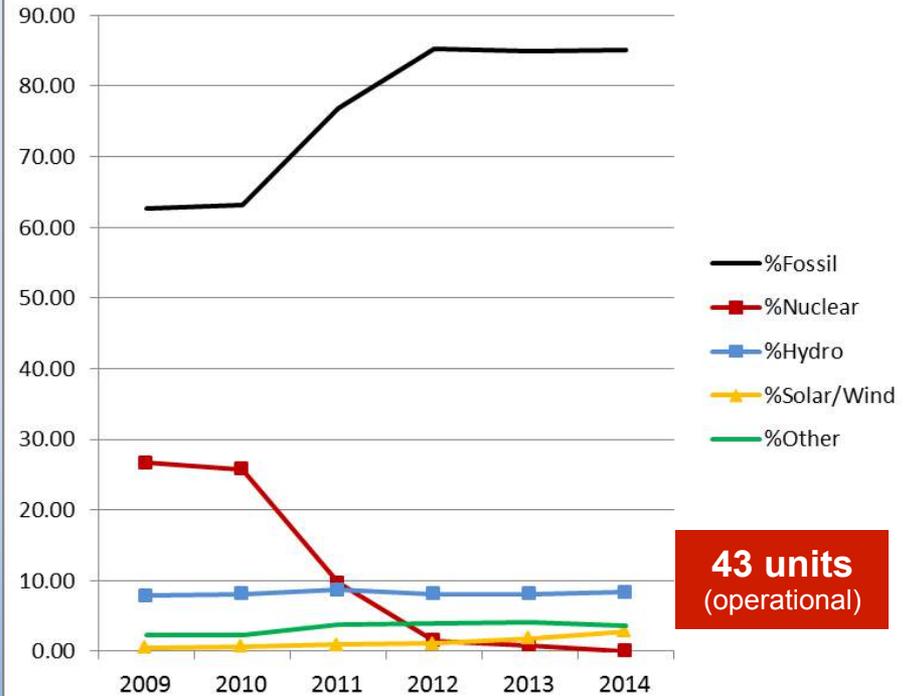
Electricity Mix US (2009-2014):

31% low C in 2014 vs. 29% in 2009



Electricity Mix Japan (2009-2014):

11% low C in 2014 vs. 35% in 2009

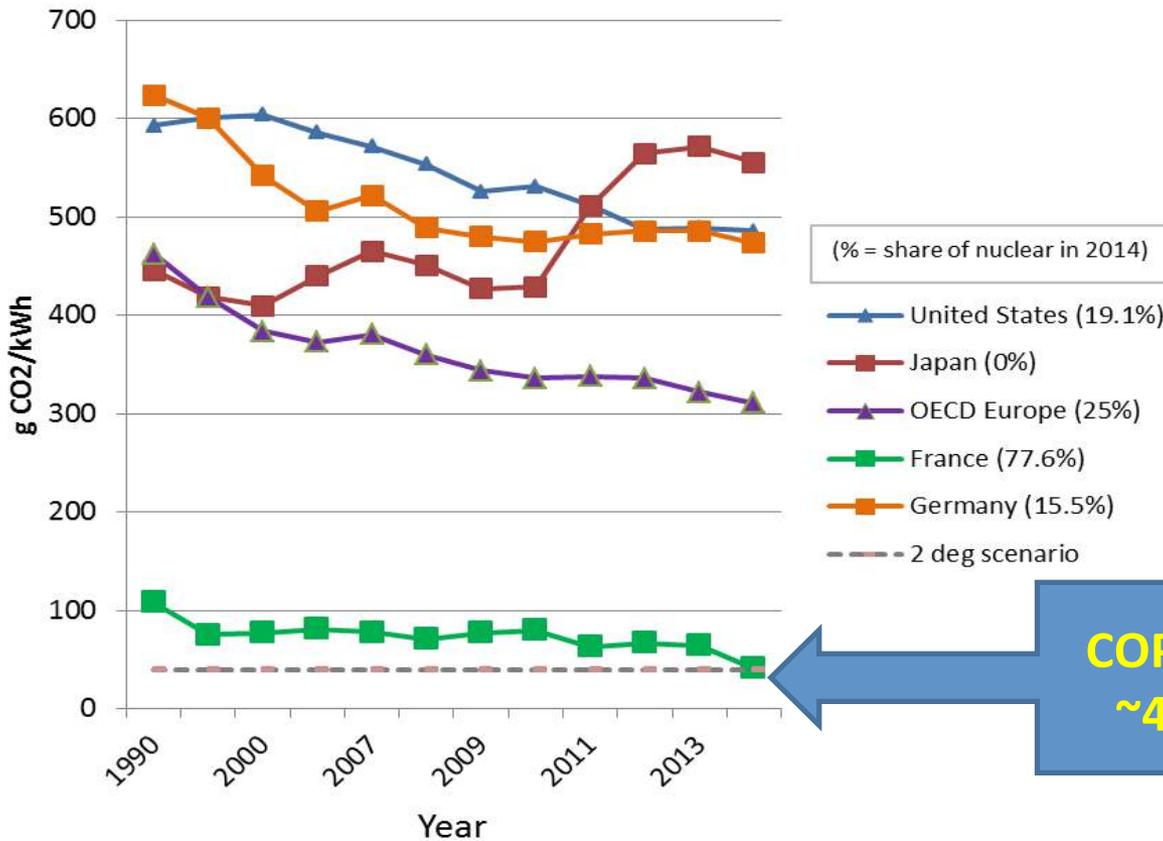


Source: IEA, data

Electricity Mix and Carbon Footprint (g CO₂ per kWh produced)

CO₂ emissions per kWh produced

(from IEA CO₂ Emissions from Fuel Combustion 2016)



Main trends:

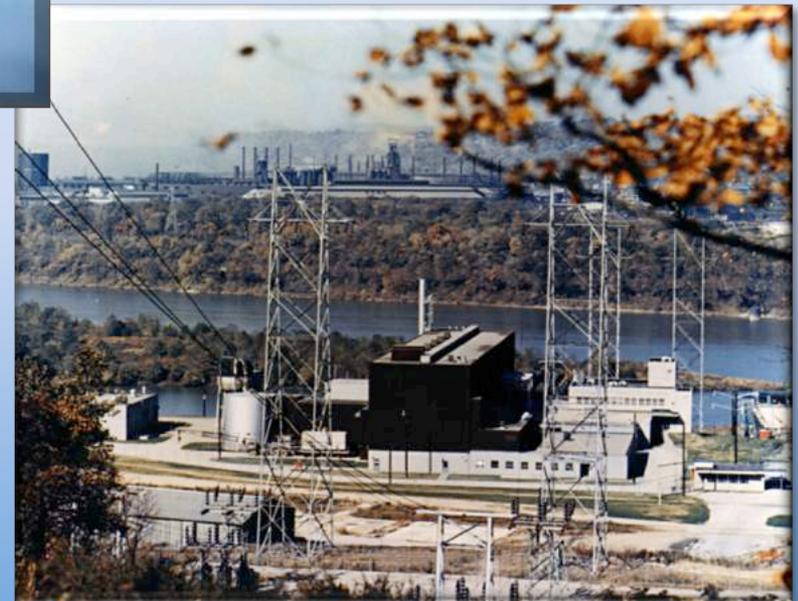
- US: coal to gas switch, ↗ RES
- Japan: nuclear ↘↘↘, fossil ↗↗↗
- France: fossil ↘, RES ↗
- Germany: nuclear ↘↘, RES ↗↗

**COP 21 Objective:
~40g CO₂ /kWh**

Source: IEA data



The US AEC: *A Remarkable Instrument*



Clockwise: December 1951 photo of EBR-1 team after the first production of electric power from atomic energy. Hanford PUREX Process "Canyon" Building, circa 1956. Shippingport Atomic Power Station outside Pittsburgh, PA, circa 1957. All photos courtesy the U.S. Department of Energy.

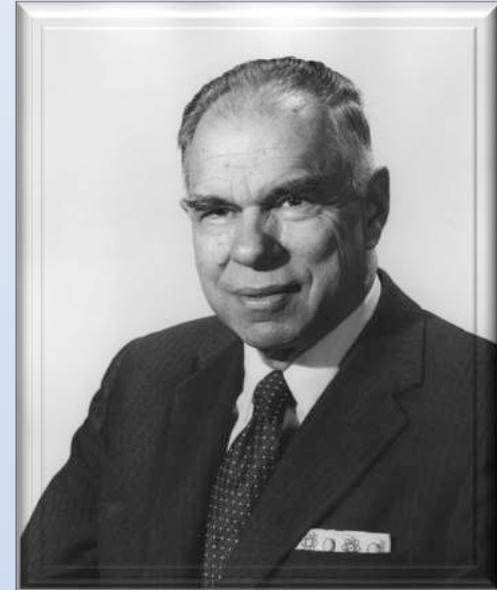
The 1960s: Agencies Set the Agenda



*AEC Chair Glenn Seaborg and NASA
Administrator James Webb – July 1961*

The AEC: “Atoms for Peace”

- The AEC was created in 1946 to take control of Manhattan Project assets, build the US nuclear deterrent, and develop civilian applications for nuclear technology.
- The AEC:
 - Sponsored or supported early commercial plants
 - Created and managed the US uranium market
 - Supplied essentially all uranium enrichment services to US plants and to allied countries
 - Conducted and supported most U.S. reactor R&D
 - Regulated nuclear power and nuclear safety
- **However, by the late 1960s, AEC’s power, scope, and potential conflicts of interest became a matter of public debate.**



*Glenn T. Seaborg Chaired
AEC from 1961 to 1971*

The 1970s: Changing Direction

- **18 May 1974 – “Smiling Buddha” - India's “peaceful nuclear explosion”**
- **October 1976 – President Ford’s Statement on Nuclear Policy**
- **April 1977 – President Carter’s Decision on Nuclear Policy**



“I have concluded that the reprocessing and recycling of plutonium should not proceed unless there is sound reason to conclude that the world community can effectively overcome the associated risks of proliferation.”

“[W]e will defer indefinitely the commercial reprocessing and recycling of the plutonium produced in the U.S. nuclear power programs. From our own experience, we have concluded that a viable and economic nuclear power program can be sustained without such reprocessing and recycling... [W]e will redirect funding of U.S. nuclear research and development programs to accelerate our research into alternative nuclear fuel cycles which do not involve direct access to materials usable in nuclear weapons.”

The 1980s: Searching for Stable Ground

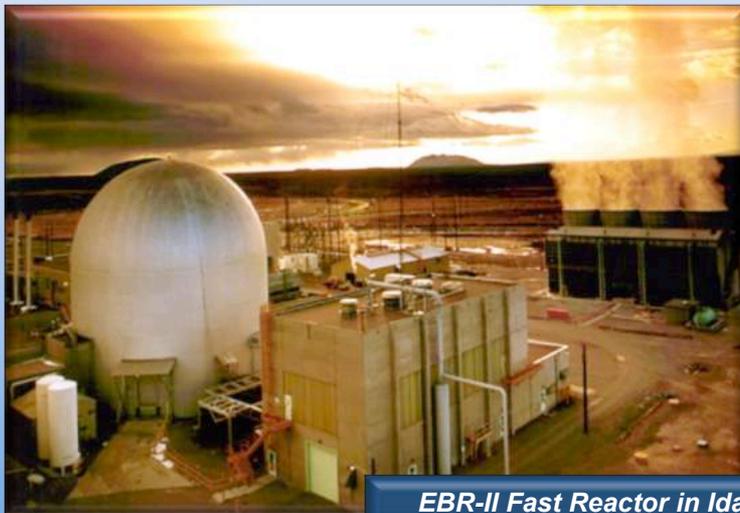


Three Mile Island Site

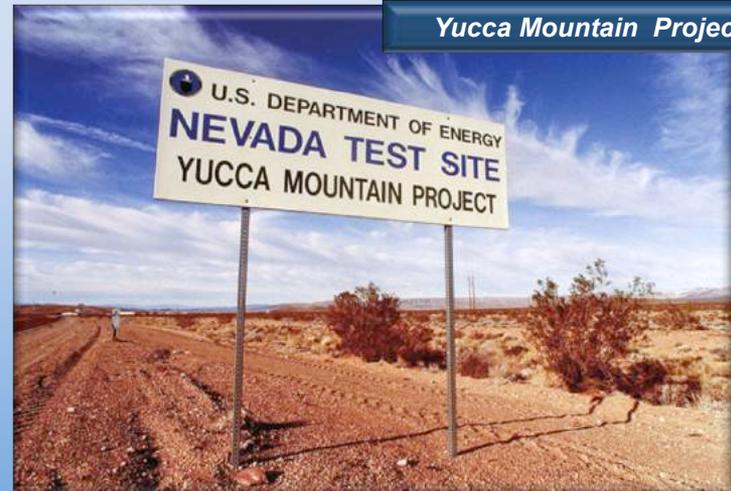
1979 – The TMI NPP Accident

1984 – The Integral Fast Reactor program begins

1986 – Yucca Mountain is designated by Congress as the site to explore a HLW repository



EBR-II Fast Reactor in Idaho



Yucca Mountain Project Site

The 1990s: Falling off the Cliff



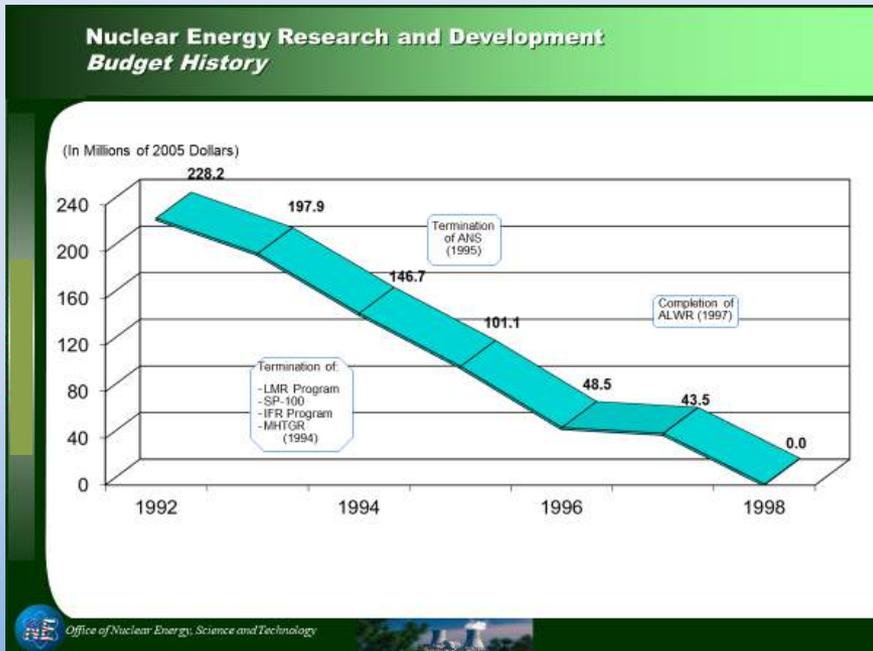
*President Clinton's First State of the
Union Address
February 17, 1993*

“ . . . my recommendation makes more than 150 difficult reductions to cut the Federal spending by a total of \$246 billion. We are eliminating programs that are no longer needed, such as **nuclear power research and development.**”

The 1990s: Falling off the Cliff

U.S. Department of Energy Nuclear Energy R&D Budgets (1992-1998)

U.S. Undergrad Nuclear Engineering Enrollment (1990-1999)



A Look Back *The Future Outlook 21 Years Ago*

“The AEO96 reference case forecast assumes that all nuclear units will operate to the end of their current license terms, with **49 units (37 gigawatts) retiring through 2015.**

Given these assumptions, **61 nuclear units are projected to provide 10 percent of total electricity generation in 2015...**”

U.S. Energy Information Administration
Annual Energy Outlook 1996

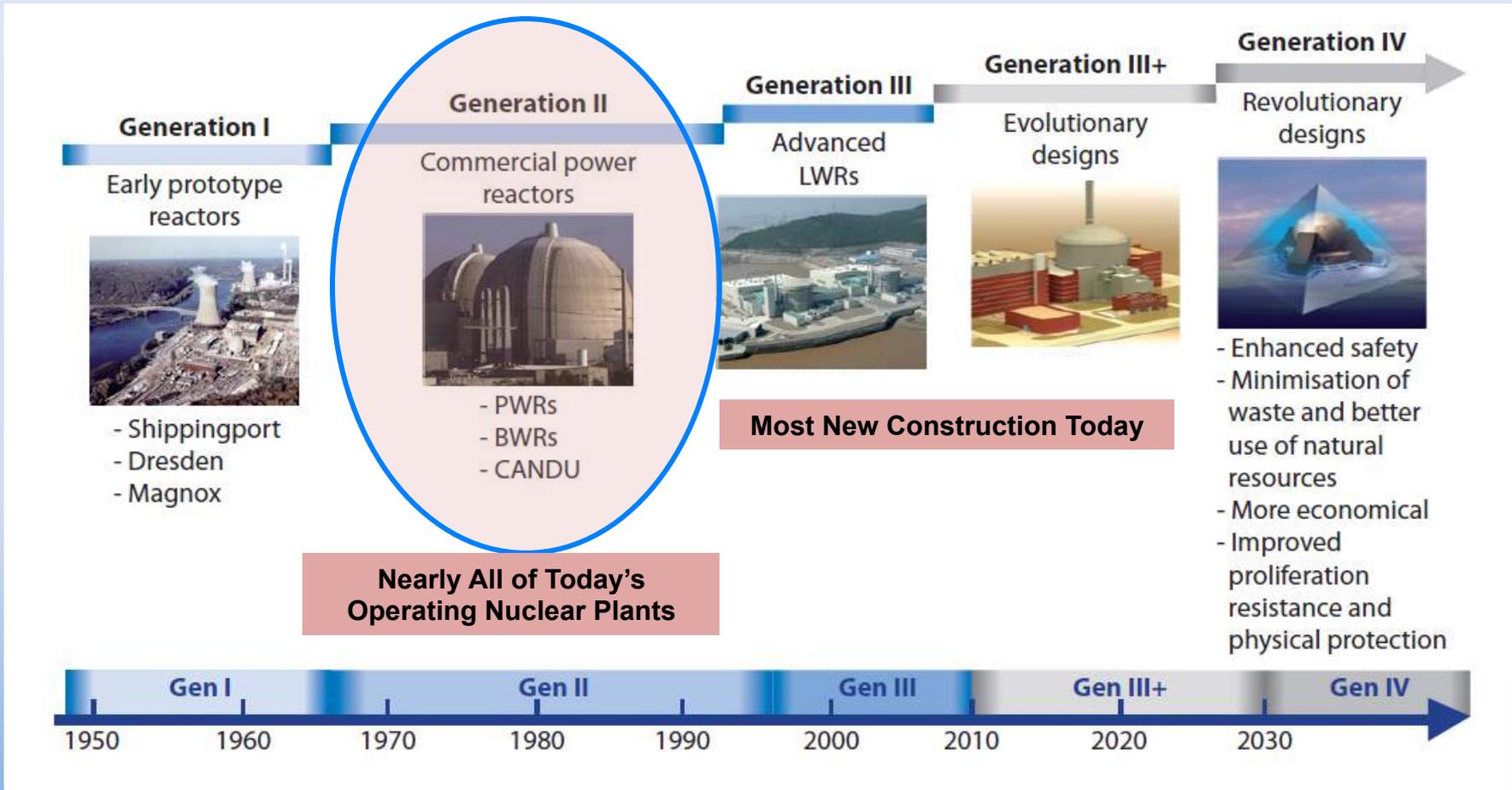
The 2000s – Starting a Renaissance

- **PCAST Report to the President on Federal Energy R&D for the Challenges of the 21st Century**
- **New program to revive nuclear education**
- **New technology programs**
- **Bilateral R&D agreements with France, Japan, and Korea**
- **Nuclear Energy Research Advisory Committee (NERAC)**
- **Generation IV International Forum**
- **Idaho National Laboratory**
- **Nuclear Power 2010 program**



*First International Meeting to form the
Generation IV International Forum
January 2000*

Reactor Technology: Generations I to IV



GIF Member Activities

(date indicates signature of GIF Charter) ●

	 Canada (2001) ●	 China (2006) ●	 France (2001) ●	 Japan (2001) ●	 Korea (2001) ●	 Russia (2006) ●	 RSA (2001) ●	 Swiss (2002) ●	 USA (2001) ●	 EU (2003) ●
SFR ●		● ●	● ●	● ●	● ●	● ●			● ●	● ●
VHTR ●		● ●	● ●	● ●	● ●			● ●	● ●	● ●
LFR* ●				● ●	● ●	● ●				● ●
SCWR ●	● ●	● ●		● ●		● ●				● ●
GFR ●			● ●	● ●						● ●
MSR* ●			● ●			● ●		● ●	● ●	● ●

* All activities, except LFR and MSR (under a MoU), are carried out under a system arrangement.


Australia
(2016) ●

Australia signed the Charter on 22 June 2016, and plans to sign the GIF Framework Agreement and become active in VHTR and MSR. ●


Argentina
(2001) ●


Brazil
(2001) ●


UK
(2001) ●

Currently inactive GIF members ●

NP2010: Paving the Way



Georgia Power's Vogtle Unit 4

Georgia Power and SCANA (South Carolina) are building a total of four Westinghouse AP1000 reactors (Generation III+). About half the cost of design, engineering, and licensing was paid for by the Nuclear Power 2010 program

The projects are each about 65% complete and scheduled for completion around 2020.



SCANA's VC Summer Unit 2

The Last 15 Years: *Fits and Starts*

- | | |
|------------------|--|
| 2004-2006 | DOE started and stopped the Next Generation Nuclear Plant (Generation IV VHTR) project |
| 2006-2008 | DOE started and stopped the Global Nuclear Energy Partnership |
| 2009-2016 | DOE terminated the Yucca Mountain repository and began developing a consent-based siting process |
| 2012 | NRC authorized construction of four Generation III+ reactors |
| 2013 | DOE launched SMR Licensing Technical Support program (modelled after NP2010) |
| 2017 | DOE ends consent-based siting efforts and prepares to restart Yucca Mountain project |

Next Steps?



Thank you for your attention



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