# GLOBAL PROSPECTS FOR NUCLEAR POWER

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*Tokyo, Japan*
*December 8, 2005*

As a great American philosopher once said:


*"It is hard to make predictions, especially about the future"*

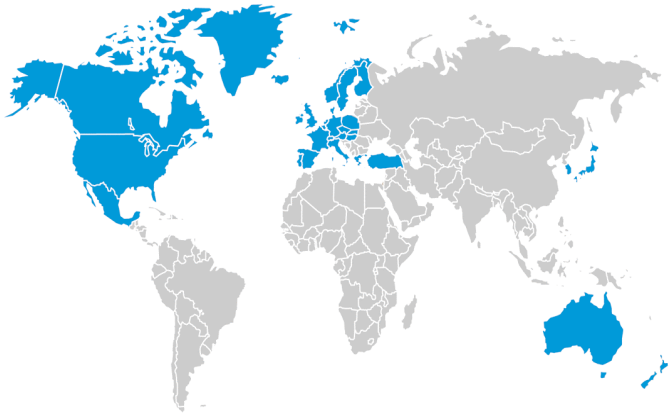
Yogi Berra

# WHAT IS NEA?

- Founded in 1958 as ENEA (European).
- Became NEA in the 1970s when Japan, Australia, the U.S. and Canada joined.
- A semi-autonomous agency of the OECD.
- Present membership: 28 OECD member countries.
- Size:
  - ~ 80 staff members;
  - Budget of 12 million euros;
  - Secretariat for projects totalling about 20 million euros/year.

# The NEA Mission

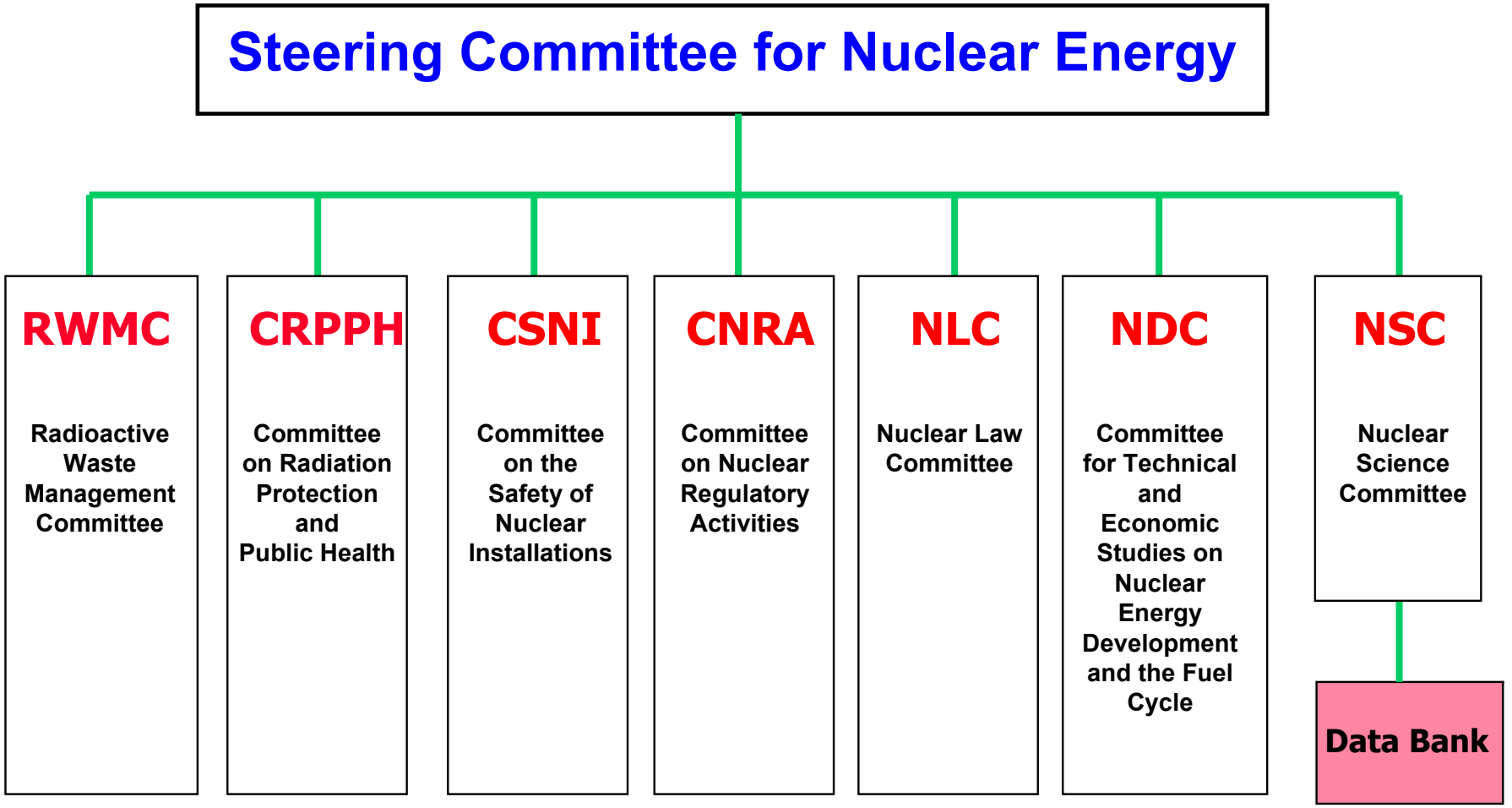
- To assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes.
- To provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy, and to broader OECD policy analyses in areas such as energy and sustainable development.



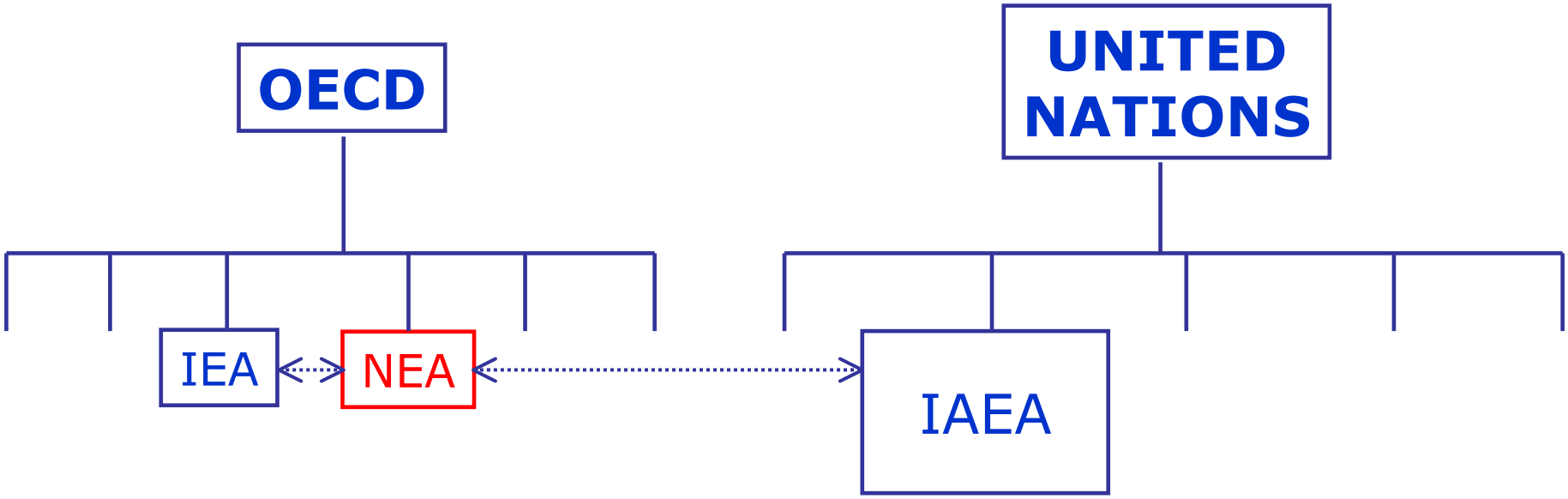
# The NEA Membership

- Australia
- Austria
- Belgium
- Canada
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Italy
- Japan
- Korea
- Luxembourg
- Mexico
- Netherlands
- Norway
- Portugal
- Slovak Republic
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom
- United States

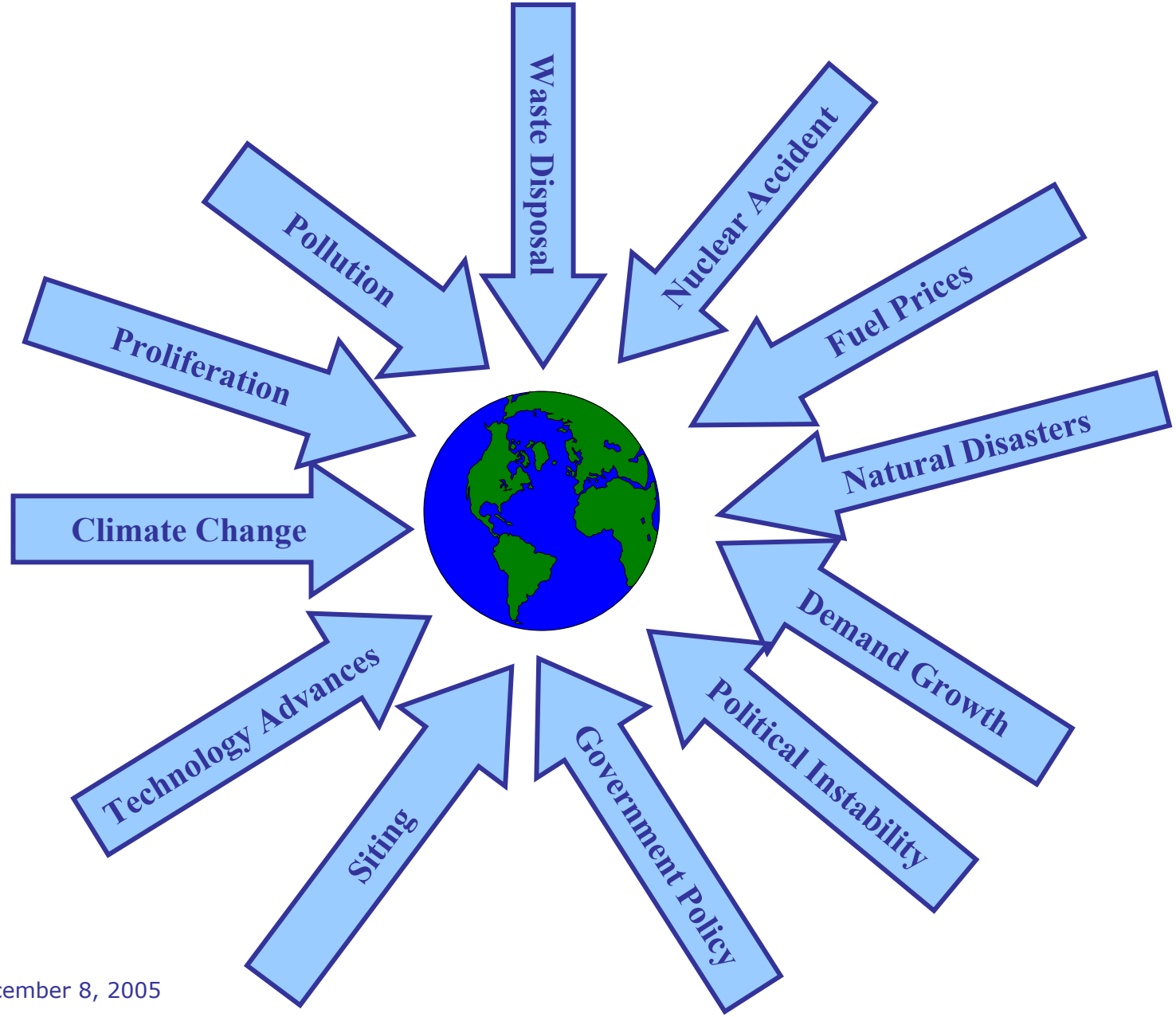
# NEA Committees



# NEA & RELATED INTERNATIONAL ORGANIZATIONS

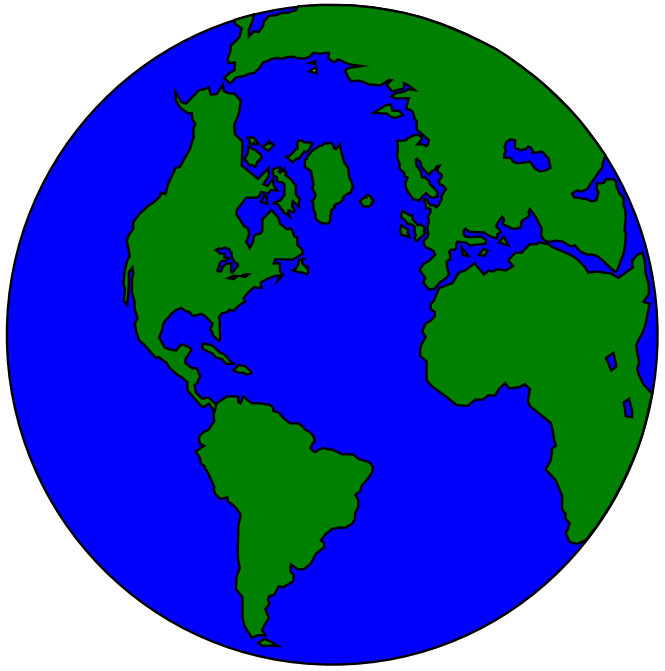



***OECD:*** *Organization for Economic Co-operation and Development*
***IEA:*** *International Energy Agency*
***NEA:*** *Nuclear Energy Agency*
***IAEA:*** *International Atomic Energy Agency*

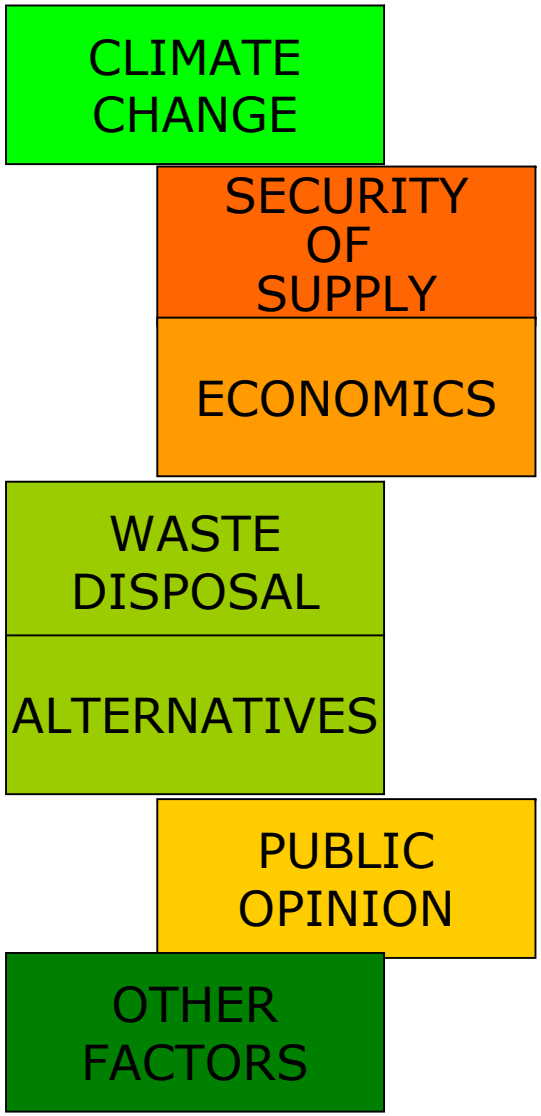

Waste Disposal
Nuclear Accident
Pollution
Fuel Prices
Proliferation
Natural Disasters
Climate Change
Demand Growth
Technology Advances
Political Instability
Siting
Government Policy

# Three Mega-factors

- ***Global Warming***
- ***Reliability of Supply***
- ***Growing Demand in Developing Countries***



# HOW DOES NUCLEAR STACK UP?



# Nuclear Power Use Today

| | OECD Countries | World | Japan |
|---|---|---|---|
| # of Plants | 359 | 440 | 53 |
| # GWe | 304 | 362 | 48 |
| % of Electricity Supply | ~23% | ~16% | ~35 |
| # of Countries | 17 | 30 | – |

# Nuclear Power Use Today

| | OECD Countries | World | Japan |
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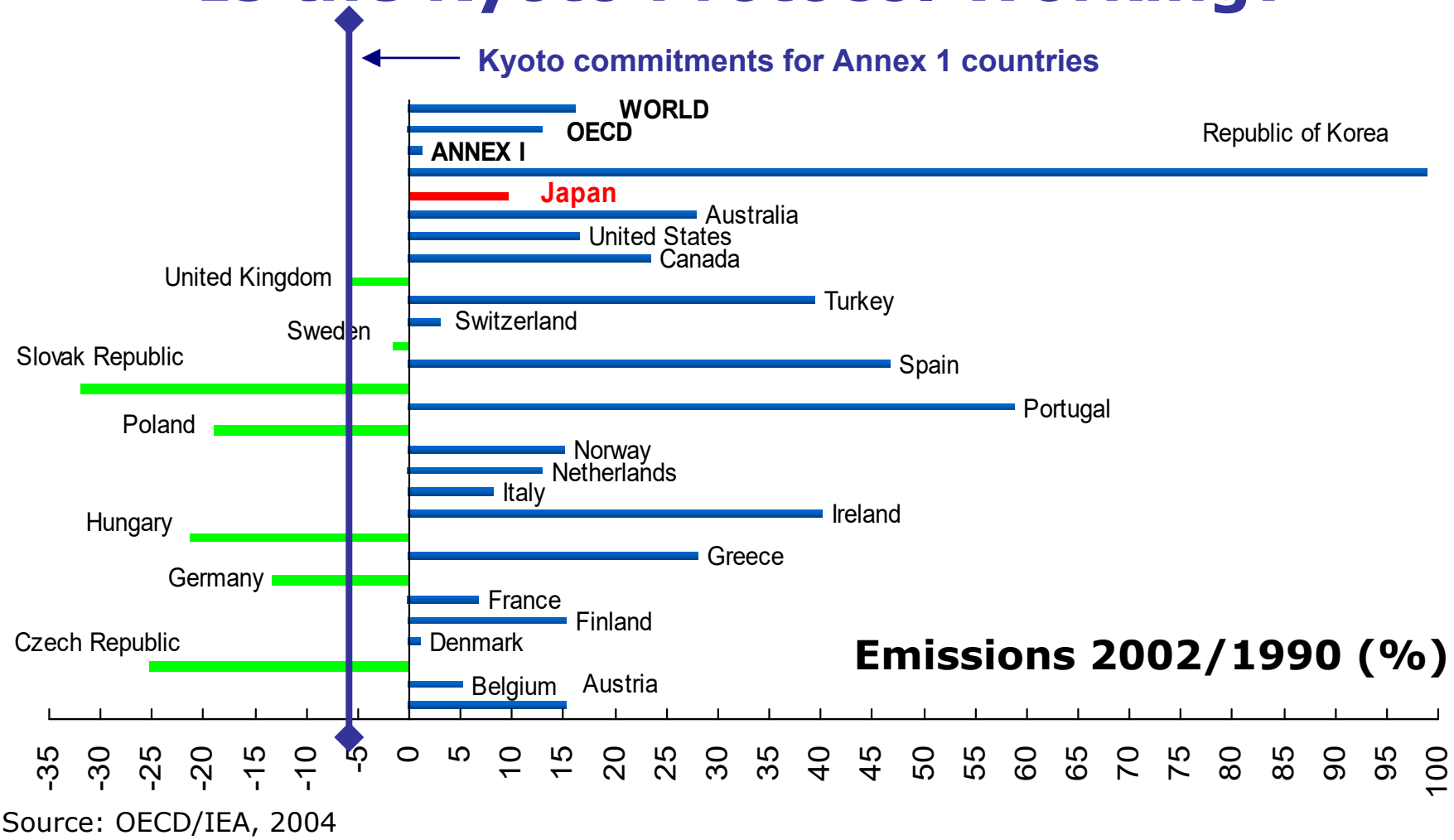
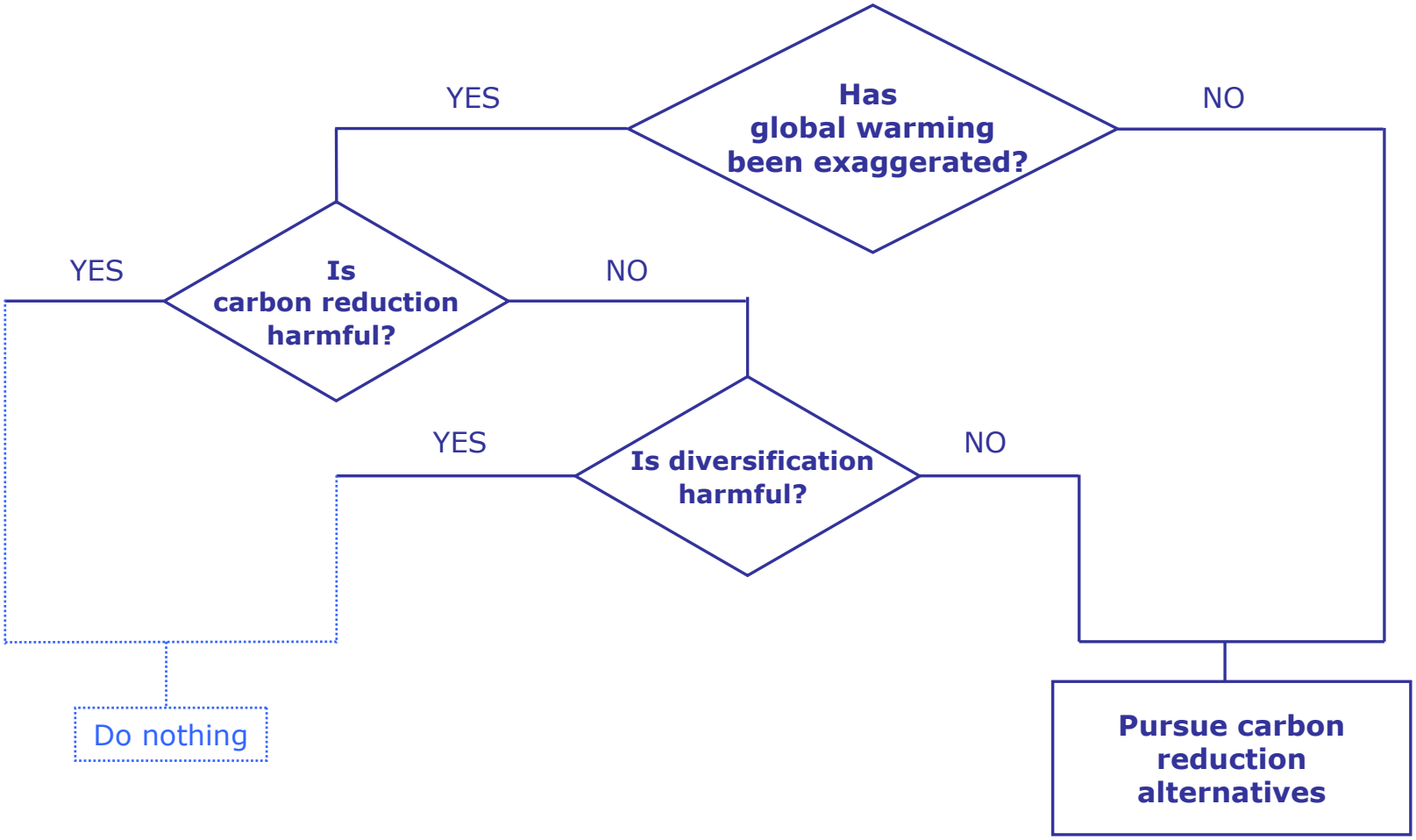
# Climate Change: Is the Kyoto Protocol Working?




Source: OECD/IEA, 2004

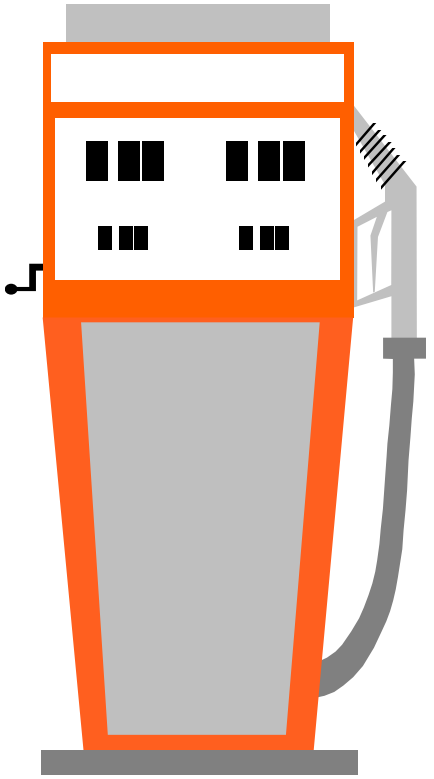
# DOES IT MATTER (FOR NUCLEAR DEVELOPMENT) IF GLOBAL WARMING IS REAL?




*NUCLEAR POWER EMITS MINIMAL GREENHOUSE GASES*

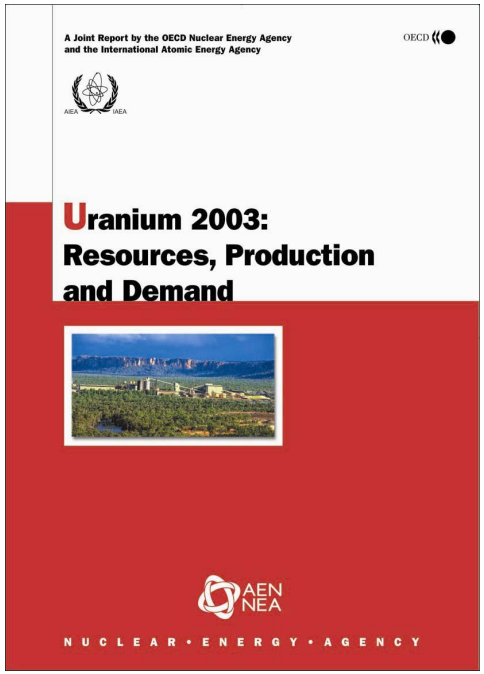
# Security of Supply:
## *Issues*

- **Potential short-term disruptions of fossil fuels:**
  - Political (disruption and/or cost increases)
  - Terrorism
  - Natural disasters
- **Potential mid- and long-term issues**
  - Growing competition
  - Diminishing resources/increasing cost of resources



# Security of Supply:
## *The Role of Nuclear Power*

- Nuclear energy is a domestic source which alleviates dependence on imported fossil fuels
- Uranium resources are large
- Uranium producers are widely distributed
- Substantial amounts of uranium are in stable countries
- Technology can increase the lifetime of uranium resources




***Nuclear Power Can Improve Security of Supply***

# Effect of technology on U resource longevity

*[Only conventional resources are taken into account]*

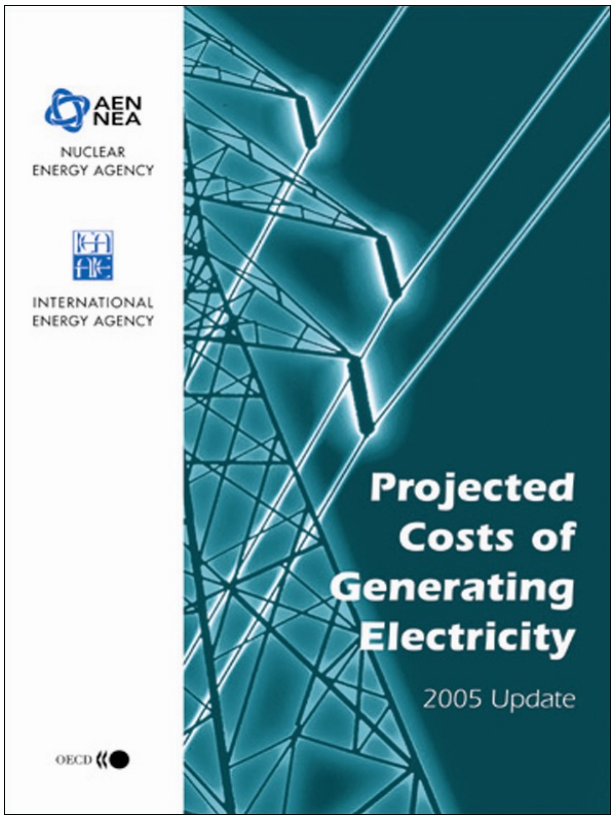
| Reactor/Fuel cycle | Years of electricity generation at 2003 level (~2 600 TWh/year) | |
|---|---|---|
| | Known U resources 4 589 000 t | Conv. U resources 14 383 000 t |
| LWR once through | 65 | 210 |
| LWR with recycling | 76 | 250 |
| LWR & Fast Reactors with recycling | 98 | 315 |
| Pure Fast Reactors with recycling | 1 950 | 6 300 |



Source: IAEA/NEA, 2004

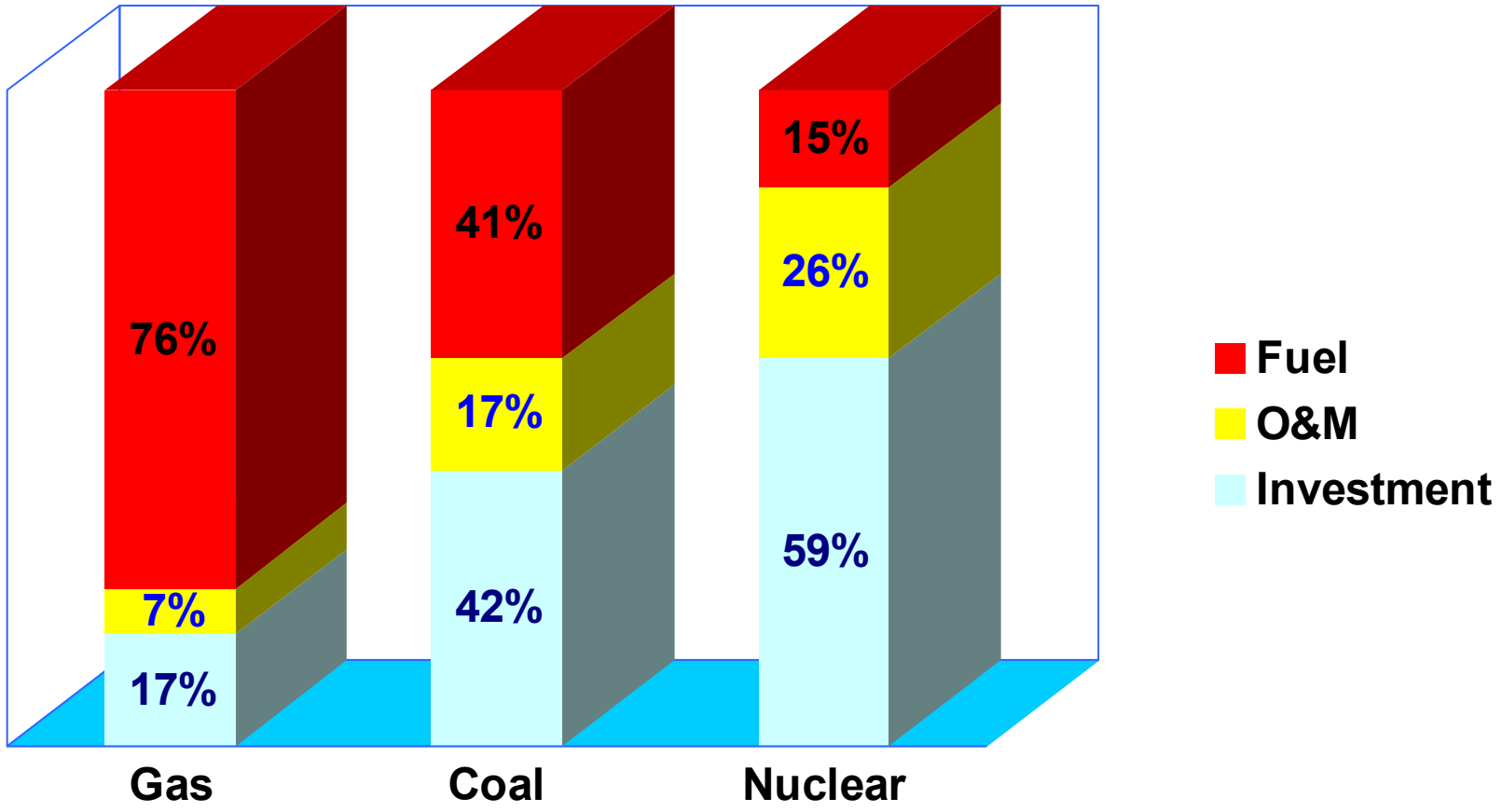
# ECONOMICS OF NUCLEAR POWER:
## *Framework of the 2005 OECD study*

- 130 power plants considered
  - 13 NPPs, 27 Coal Plants, 23 Gas Plants
- Commissioning by 2010-2015
- Data from 21 countries
- Levelized generation costs at 5 & 10% discount rate



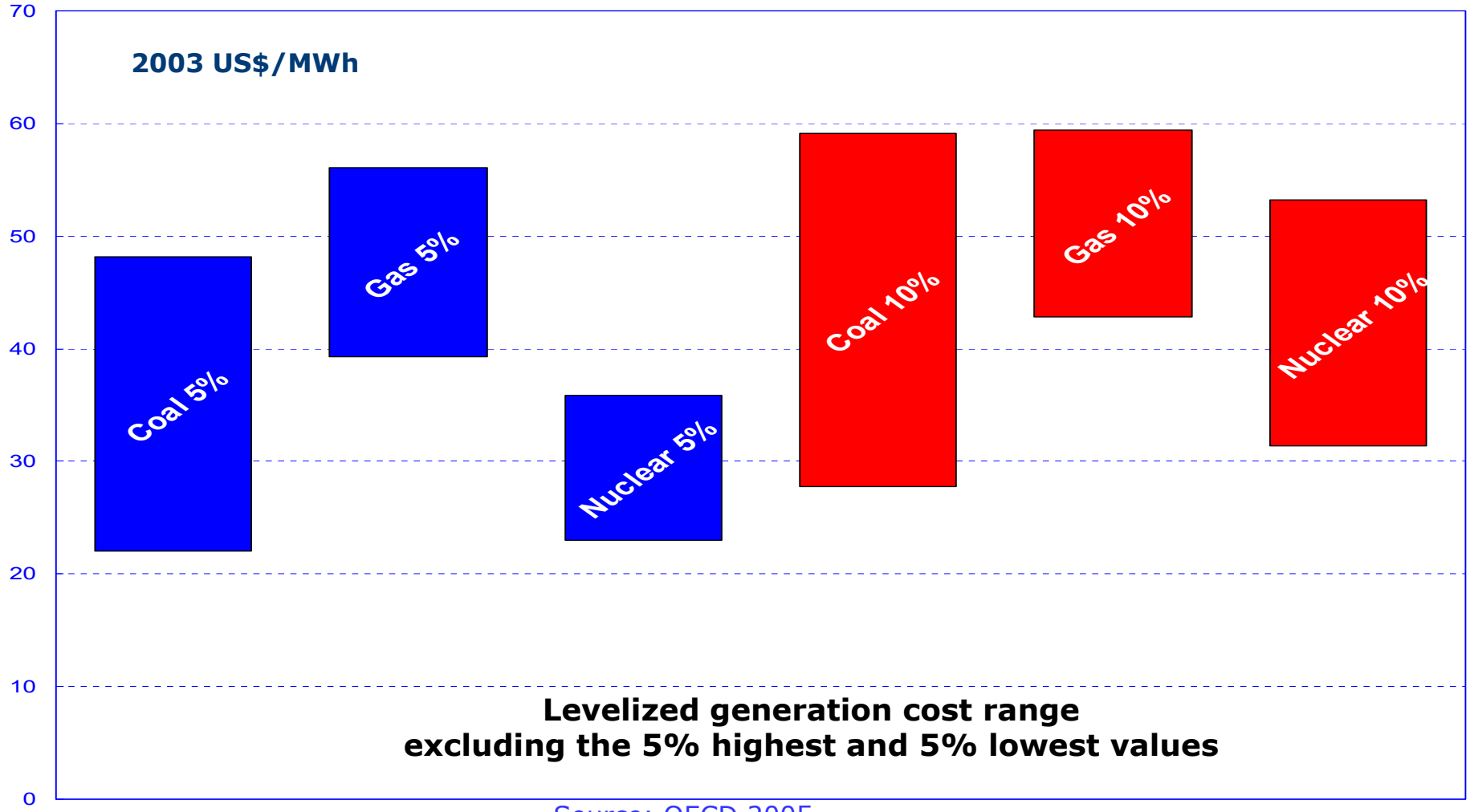
# Generation cost structure

## *2005 OECD study*




Source: OECD 2005

# Projected costs of generating electricity
## *2005 OECD study*




Source: OECD 2005

# Radioactive Waste Disposal:
## *What is the Issue?*

- Not a technical issue
  - Volumes are small, easy to manage and dispose of safely
  - Experts are confident that geological disposal is an appropriate safe solution
- Societal issue
  - Technical confidence alone is not enough
  - Acceptance by the broader public needs to be gained

# Radioactive Waste Disposal:
## *Actions and Options*

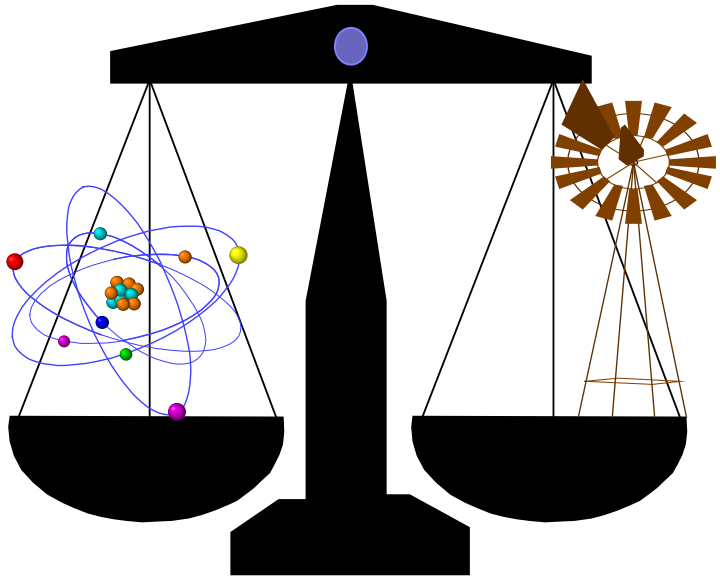
- Moving Forward:
  - Olkiluoto in Finland
  - US Government decision on Yucca Mountain
  - Others are following (Sweden, France, …)
- Other possibilities:
  - Reprocessing to reduce volume and halflife
  - Interim storage

# Public Opinion: Views of Leading Environmentalists Changing

- Announced Support for Nuclear Power
  - **James Lovelock** (Creater of Gaia Hypothesis)
  - **Patrick Moore** (Greenpeace co-founder)
  - **Stewart Brand** (Whole Earth Catalog founder)
  - **Rev. Hugh Montefiore** (former Board Member, Friends of the Earth)
  - **Jared Diamond** (Board Member, World Wildlife Federation)
- Maybe…
  - **Jonathan Lash** (President, World Resources Institute)
  - **Paul Gilding** (former Greenpeace Executive Director)
  - **Fred Krupp** (Executive Director Environmental Defense)
  - **James Speth** (Yale School of Forestry and Environmental Studies)

# Alternatives: Are there better options?

- ⇨ Oil + Gas
- ⇨ Coal
- ⇨ Hydroelectric
- ⇨ Renewables
- ⇨ Conservation
- ⇨ Fusion

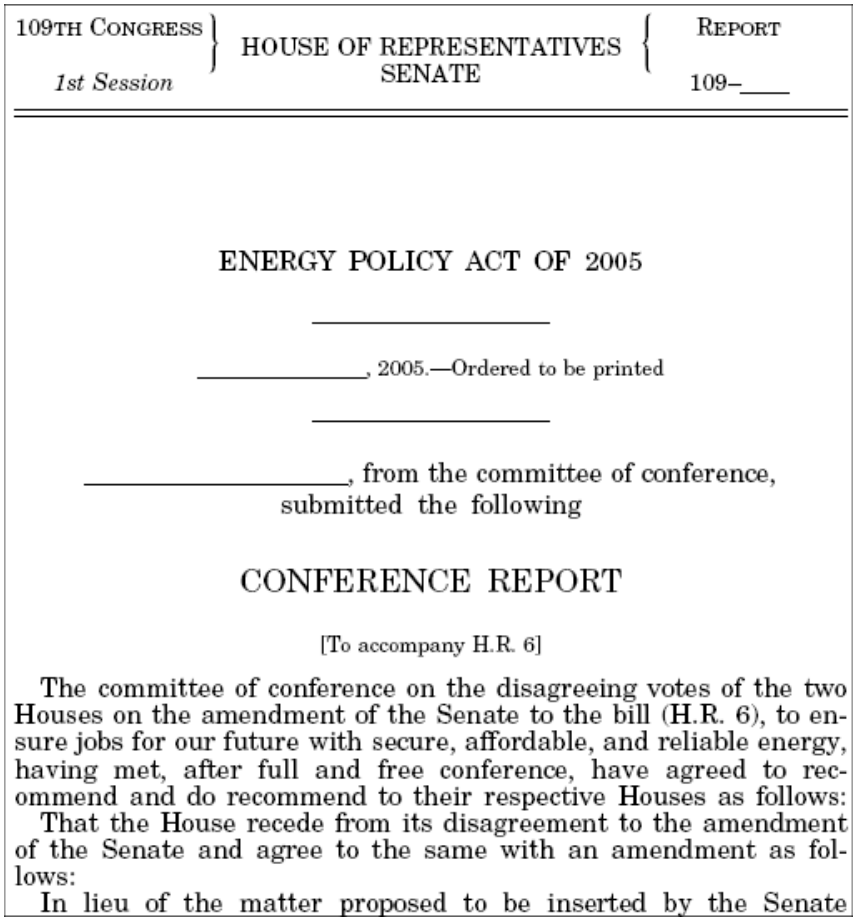


# Other Factors:
# Nuclear Power Development in 2005

- **In OECD**
  - **Canada:** Bruce 3 and Pickering 1, PHWRs, re-connected
  - **Finland:** Olkiluoto 3, PWR/EPR, under construction
  - **France:** Flamanville 3, PWR/EPR, decision to construct
  - **Japan:** Hamaoka 5 and Shika 2, ABWRs, connected; Tomari 3, PWR, initiation of construction
  - **Republic of Korea:** Ulchin 6, PWR, connected
  - **United States:** Energy Bill
- **Outside OECD**
  - **China:** Quinshan 2-2 under construction; ~ 30 units planned by the government
  - **India:** 8 units under construction; 8 more announced
  - **Russia:** 4 units under construction
  - **Chile, Indonesia, Vietnam…**

# Other Factors: US Energy Bill

- Covers all energy technologies
- Builds on momentum of last several years (in nuclear)
- Provides financial incentives for new construction
- Authorizes strong R&D program
- Appropriations are needed to implement most provisions



109TH CONGRESS, 1st Session | HOUSE OF REPRESENTATIVES, SENATE | REPORT 109–____

ENERGY POLICY ACT OF 2005

_____, 2005.—Ordered to be printed

_____, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany H.R. 6]

The committee of conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 6), to ensure jobs for our future with secure, affordable, and reliable energy, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the Senate

# Major Nuclear Provisions of U.S. Energy Bill

- Financial Incentives for New Construction
  - Production tax credit (first 6000 MW of new capacity)
  - Loan guarantees for innovative technologies
  - "Standby Support" for certain construction and startup delays (first 6 reactors)
- Research and Development
  - Generation IV designs
  - Next Generation Nuclear-Hydrogen Co-generation Plant
  - Advanced Fuel Cycle Initiative
- Other Provisions

# Recent Announcements in the U.S.

| UTILITY OR CONSORTIUM | TECHNOLOGY (NUMBER) | SITE | EXPECTED DATE OF LICENCE APPLICATION |
|---|---|---|---|
| **NUSTART** | AP-1000 (2)<br>ESBWR | BELLAFONTE<br>GRAND GULF | LATE 2007-EARLY 2008 |
| **DOMINION** | ESBWR | NORTH ANNA | 2007 |
| **DUKE** | AP-1000 (2) | TBD | LATE 2007-EARLY 2008 |
| **PROGRESS ENERGY** | TBD (4) | TB2 (2 sites) | LATE 2007 |
| **CONSTELLATION** | EPR | TBD | MID-2008 |
| **SOUTHERN NUCLEAR** | TBD | VOGTLE | MARCH 2008 |
| **ENTERGY** | ESBWR | RIVER BEND | "IN PARALLEL WITH NUSTART" |

# Other factors: Generation IV International Forum (GIF)

*To foster collaborative R&D aiming at developing future generation nuclear energy systems*


***Euratom joined (7/2003)***

8 common goals
- sustainability
- economics
- safety and reliability
- proliferation resistance and physical protection

6 systems selected for R&D

NEA is in charge of Technical Secretariat

# CONCLUSIONS

- Concerns about global warming and security of supply are creating renewed interest in nuclear power
- No other energy alternative has a clear advantage over nuclear power
- There have recently been a number of significant nuclear developments around the world
- There are many factors, both positive and negative, which can affect the future of nuclear power

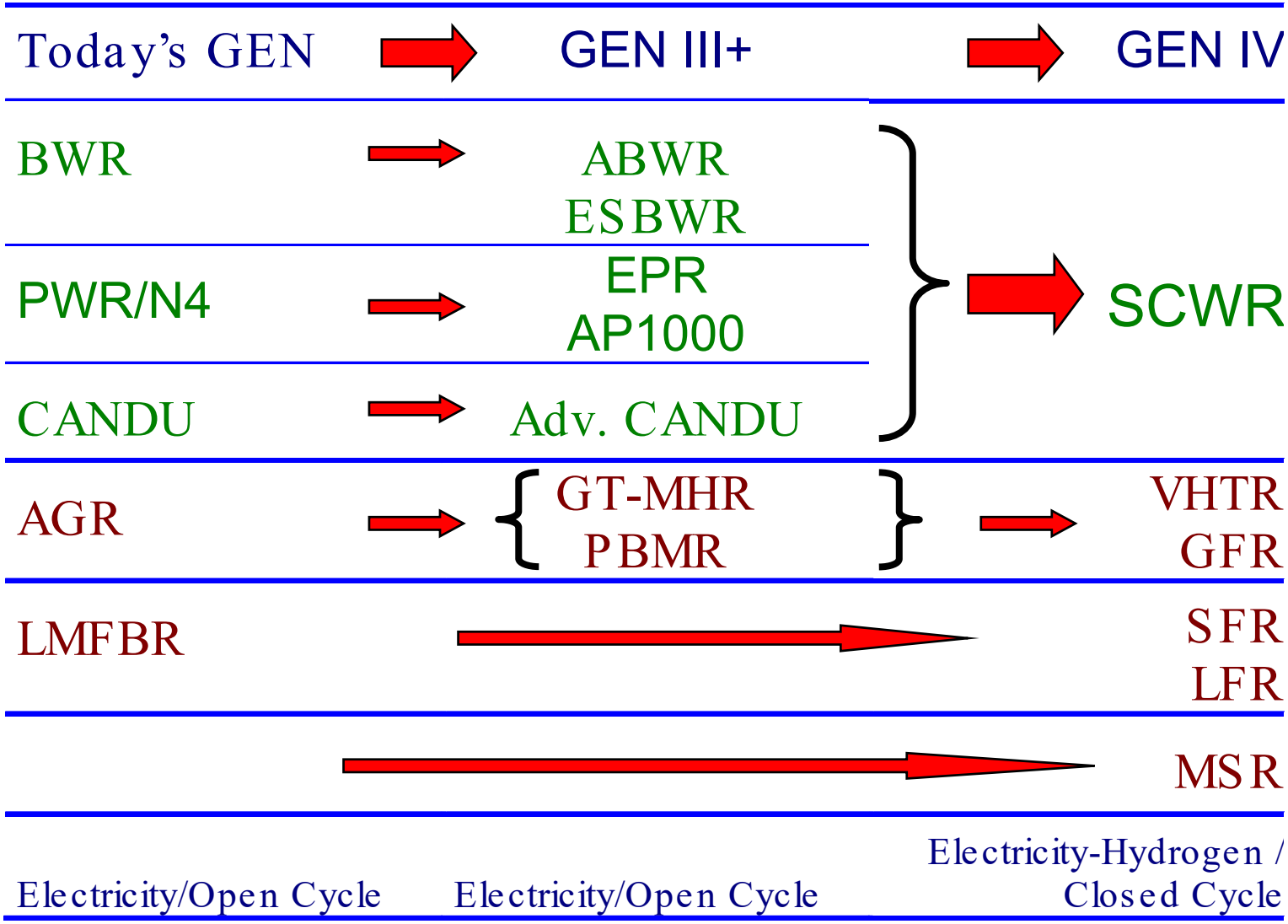
# IN CONCLUSION:


*"It ain't over till it's over"*

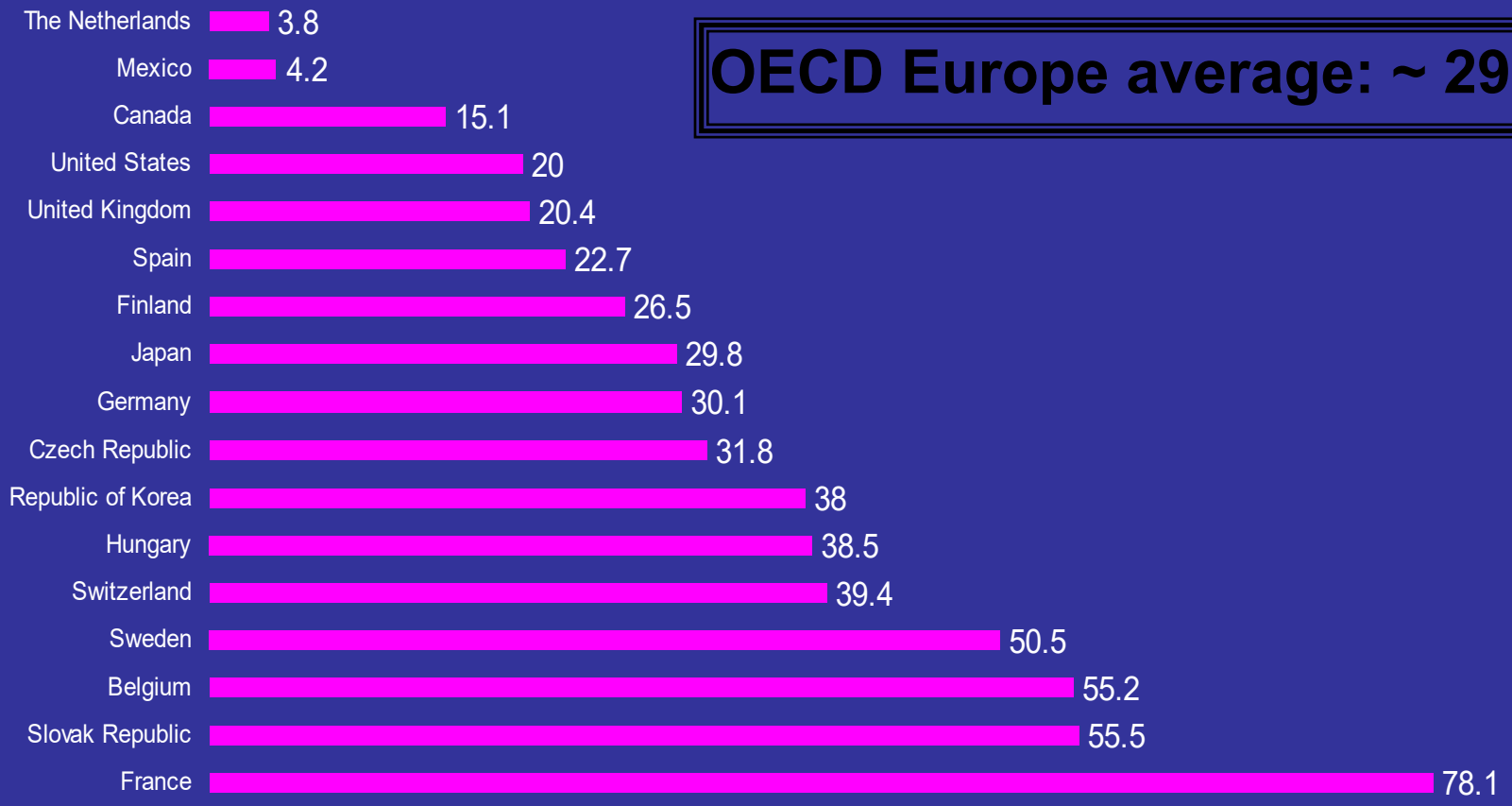
Yogi Berra

# BACKUP

# Evolution of nuclear energy systems



# Nuclear Share (%) in Electricity Generation - OECD Countries 2004




**OECD Europe average: ~ 29%**

Source: NEA 2005