Nuclear Power and Climate Change

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International Atomic Energy Agency

Overview

1. The energy-climate challenge
2. Need for NP
3. Supplying NP
4. Concerns about NP
5. Main messages

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Motto

"*… when nature goes bankrupt,*
there won't be a bailout".

WWF: Cracking the Climate Nut at COP 14,
Global Climate Policy Position Paper, December 2008.

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1. Challenge: Energy

Energy: All projections: fast increase in global energy demand over the next few decades

IEA: WEO (2007) and ETP (2008) Reference Scen

Declining *population* growth rate:

8.25 Bn (2030), 9.19 Bn (2050)

Slowing *economic* growth rate – world:

4.2% (2015), 3.3% (2030), 2.6% (2050)

Yet: Total *primary energy* demand (TPED):

17.7 Btoe (2030), 23 Btoe (2050)

2005 ➔ **EneCO2**: +55% (2030) +130% (2050)

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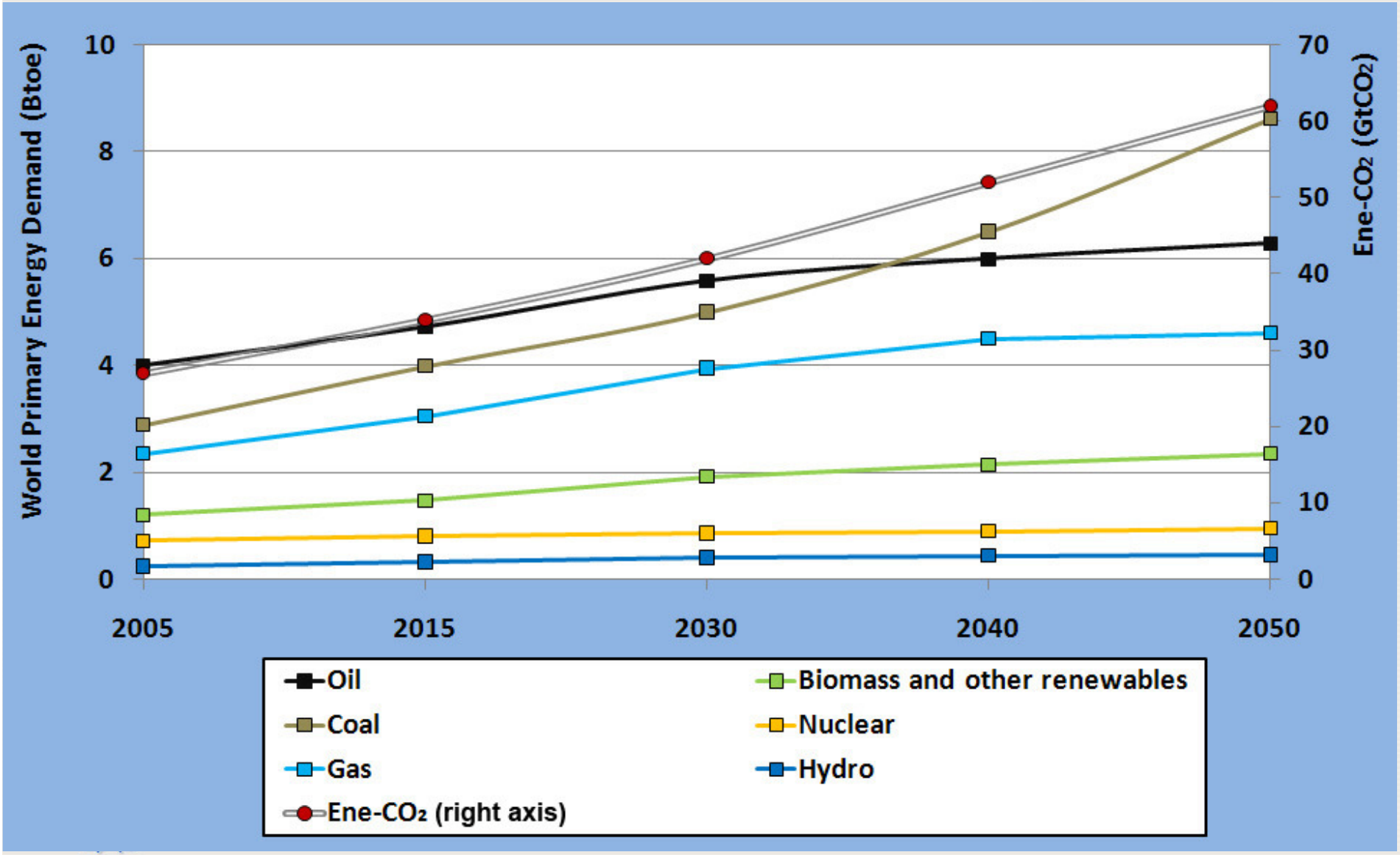
1. Challenge: IEA Reference scenario



1. Challenge: Climate

Climate:

UNFCCC Article 2: stabilize atmospheric GHG concentrations to avoid dangerous CC

IPCC AR4 (2007) confirmed:

Dangerous anthropogenic interference (DAI)

not a scientific question; science informs;

a *social and political* decision

EU target: 2°C GMT above pre-industrial

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1. Challenge: Stabilization levels

Stabilization level (ppm CO_2-eq)	Global mean temp. increase at equilibrium (°C)	Year CO_2 needs to peak	Year CO_2 emissions back at 2000 level	Reduction in 2050 CO_2 emissions compared to 2000
445 – 490	2.0 – 2.4	2000 - 2015	2000- 2030	-85 to -50
490 – 535	2.4 – 2.8	2000 - 2020	2000- 2040	-60 to -30
535 – 590	2.8 – 3.2	2010 - 2030	2020- 2060	-30 to +5
590 – 710	3.2 – 4.0	2020 - 2060	2050- 2100	+10 to +60
710 – 855	4.0 – 4.9	2050 - 2080		+25 to +85
855 – 1130	4.9 – 6.1	2060 - 2090		+90 to +140

Stabilization scenarios:
Mitigation efforts over the next 2-3 decades determine long-term stabilization levels

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Source: IPCC AR4

1. Challenge: To close the GHG gap

Contrast:

IEA scenarios: EneCO2 +*130%* by 2050

IPCC <2.4°C GMT: GHG -*50 to -80%* by 2050

Feasible?

IPCC AR4 (2007): technologies are available

IEA Energy Technology Perspectives (ETP 2008): energy revolution needed

Next: how to do it – mitigation potential

role for nuclear energy?

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2. Need: CO2 mitigation potential

IPCC WGIII Chapter 4 Focus: *Costs and potentials* for low-carbon *electricity* supply technologies

- Baseline: IEA WEO 2004 Reference

Mitigation components:

- *Fossil* sources: technology change (conversion efficiency); fuel switch (coal-to-gas: emission intensity) + decarbonisation (CCS)
- *Nuclear*
- *Renewables*: Hydro, wind, bioenergy (incl. biofuels for transport), geothermal, solar

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2. Need: CO2 mitigation potential

IPCC methodology:

Potential GHG emission reduction by 2030: low-carbon technologies displacing fossil-fuel power plants (in excess to shares in baseline scenario)

Each technology: as much as economically and technically possible; + practical constraints (stock turnover, manufacturing capacity, human resources, public acceptance)

Deployment costs: difference between low-C and replaced, including external costs (air pollution)

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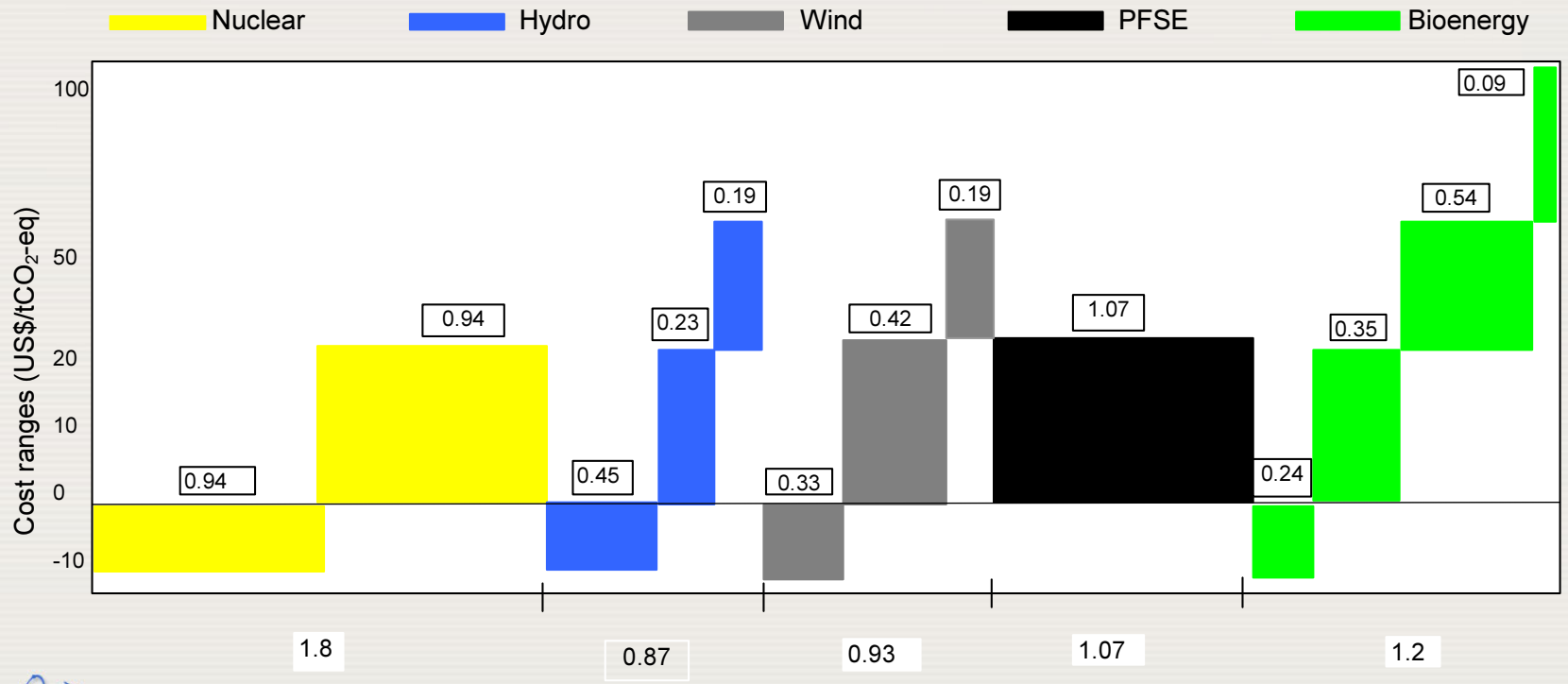
2. Need: CO2 mitigation potential

Summary: Potential GHG emissions avoided by 2030 in power generation: potential and cost ranges (potential > 0.5 GtCO2-eq) (Based on IPCC AR4)



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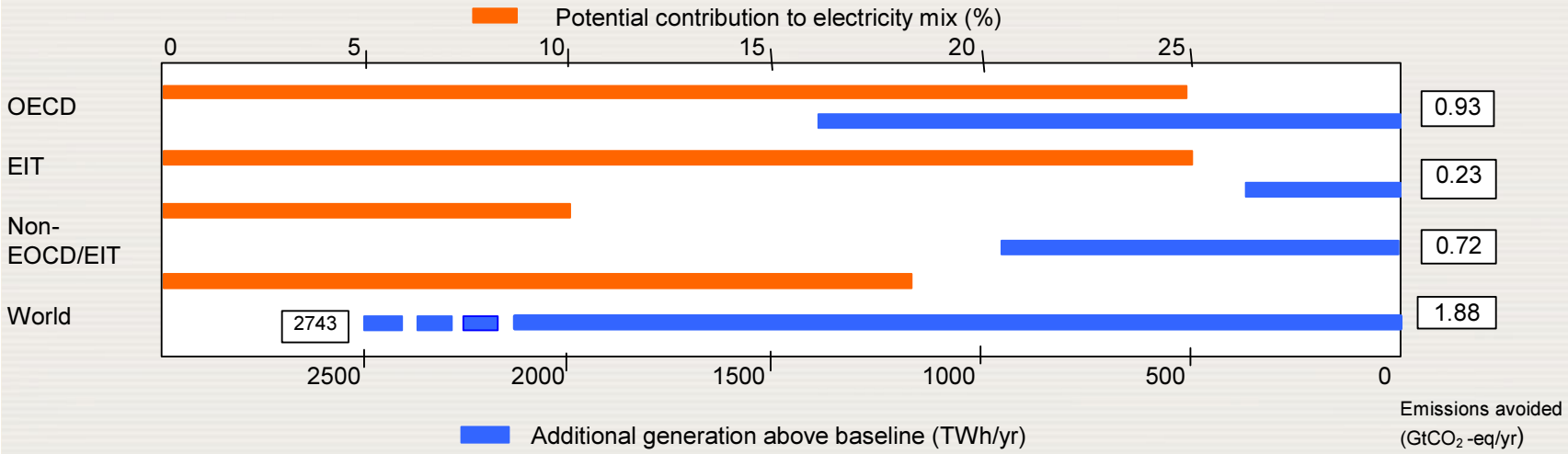
2. Need: CO2 mitigation potential

IPCC AR4:

Nuclear contribution and emissions avoided by 2030



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2. Need: Nuclear provides low CO2 energy

- Almost no GHG emissions during operation
- Some emissions in construction, fuel cycle, decommissioning

➔ *Very low* emissions on *life-cycle* basis:

15 studies; range: 2.8-24 gCO2-eq/kWh

Mean: below 10 gCO2-eq/kWh

Contributions: GHG emissions avoided in past

Low-carbon electricity sectors: countries with large shares of renewables and nuclear

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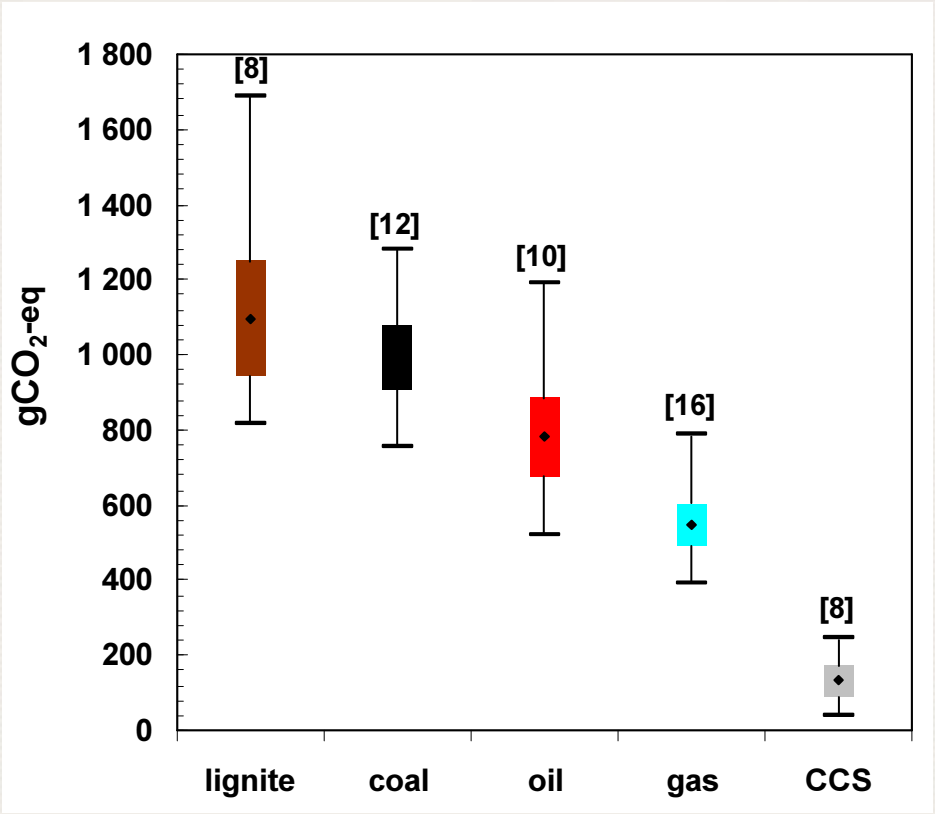
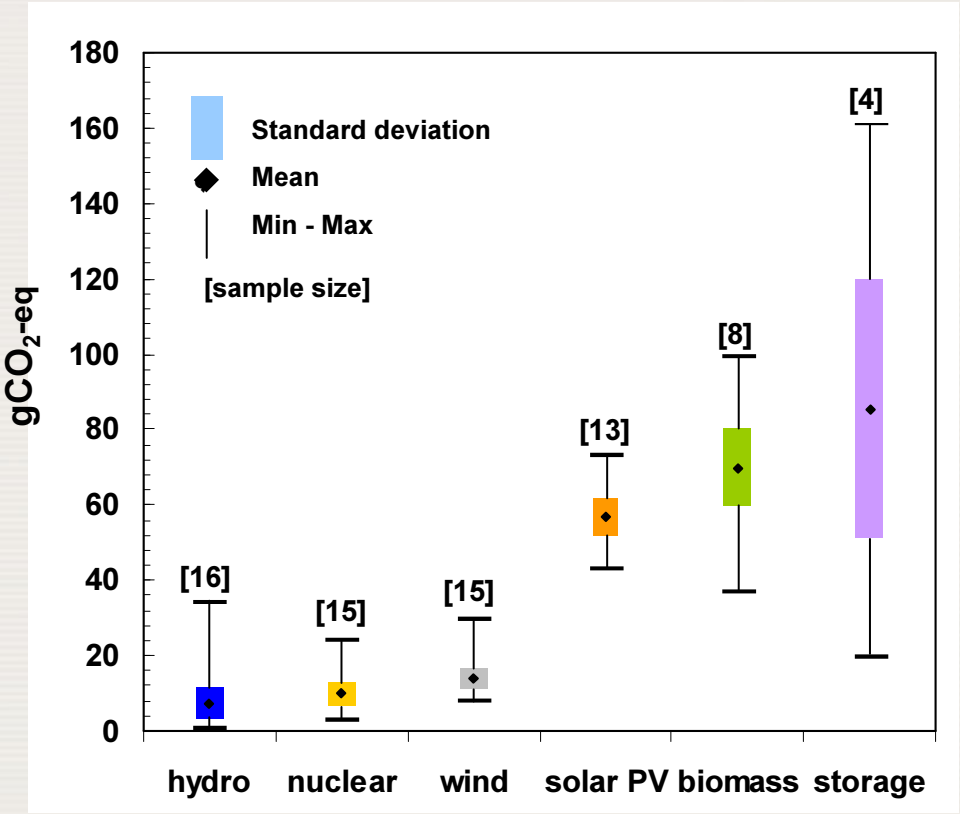
2. Need: Nuclear provides low CO2 energy

Life cycle GHG emissions of different electricity generating options





Nuclear power: Very low lifetime GHG emissions make the technology a potent climate change mitigation option

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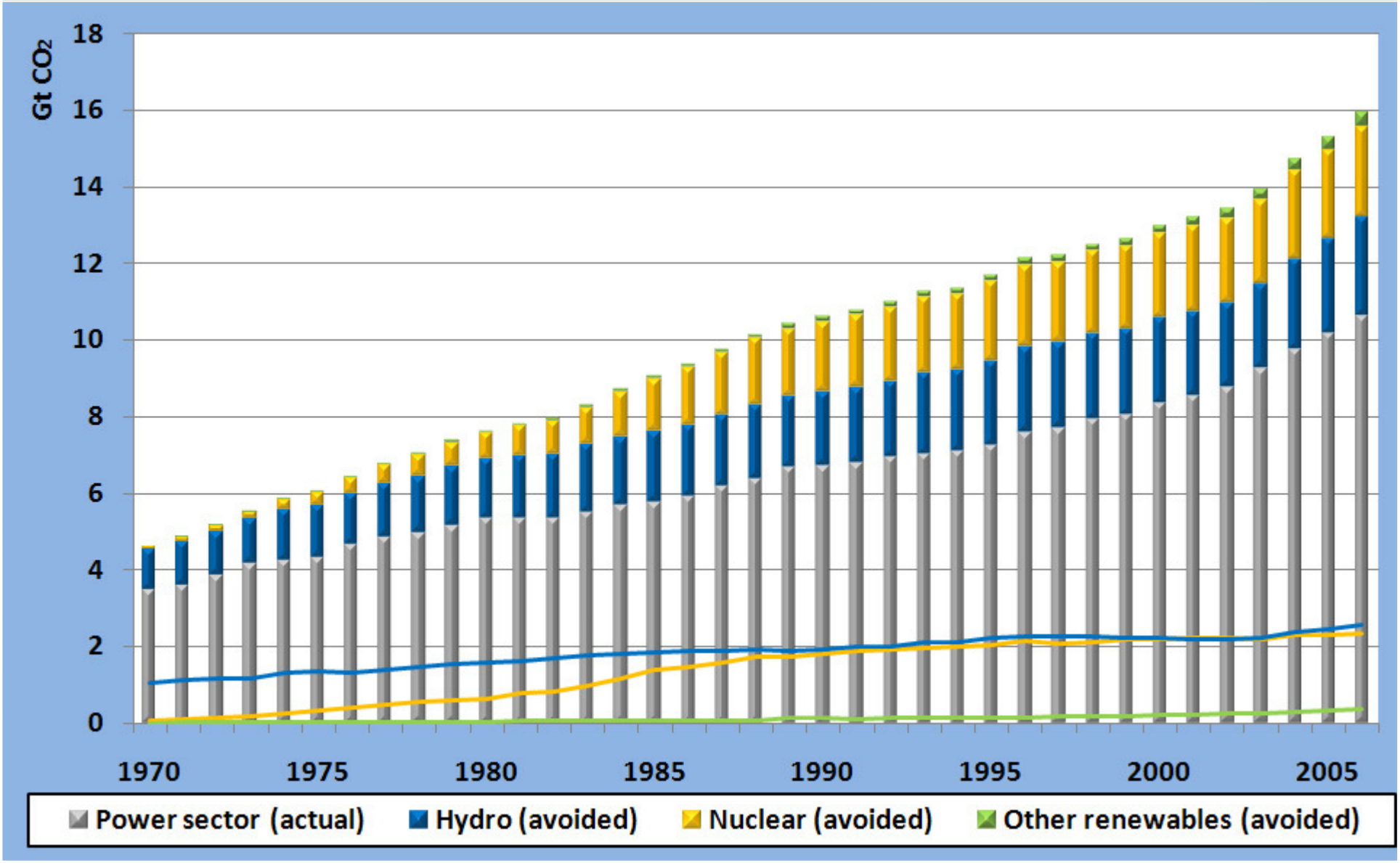
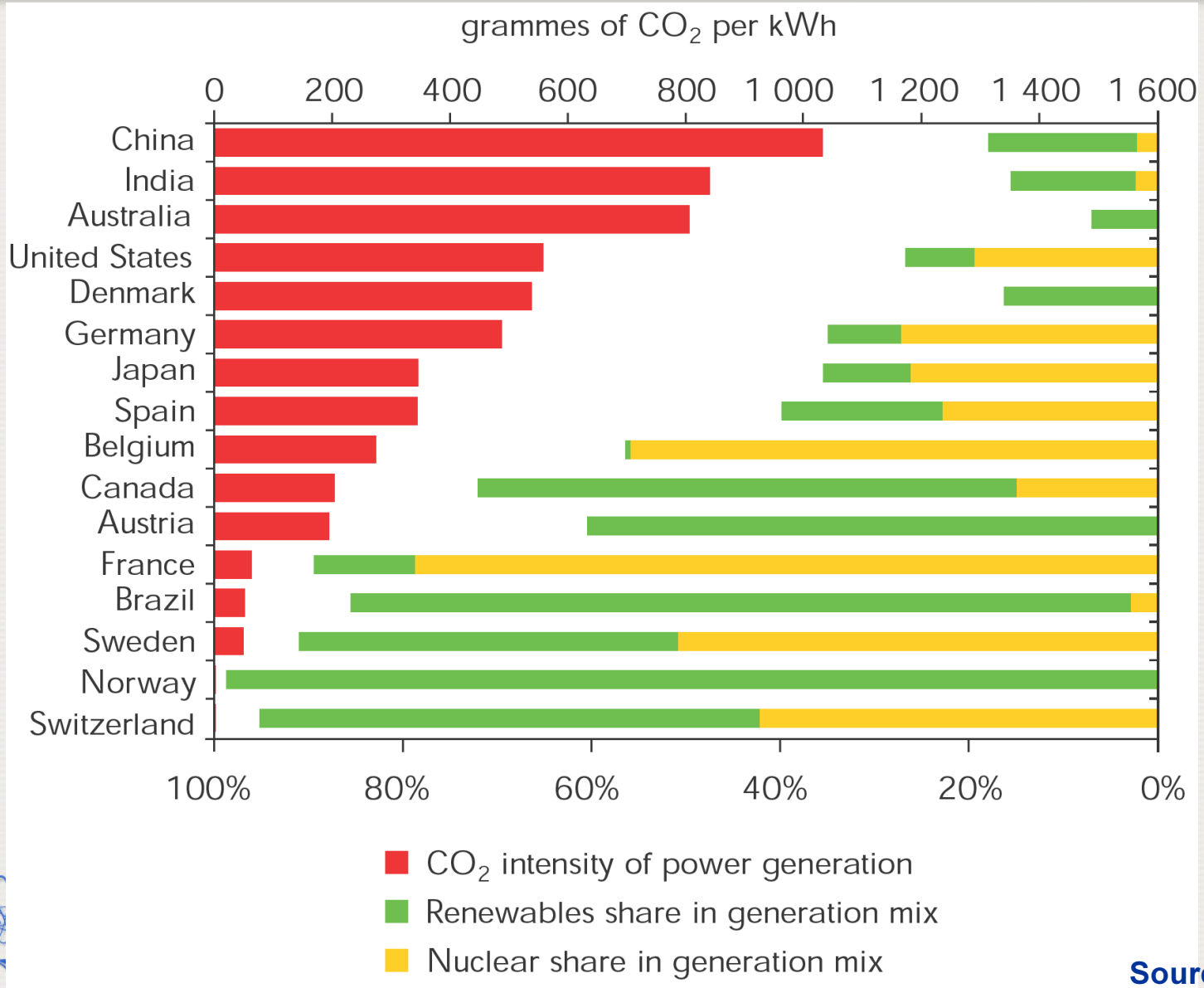
Source: Weisser, 2007

2. Need: avoided CO_2 emissions by hydro, nuclear, renewables

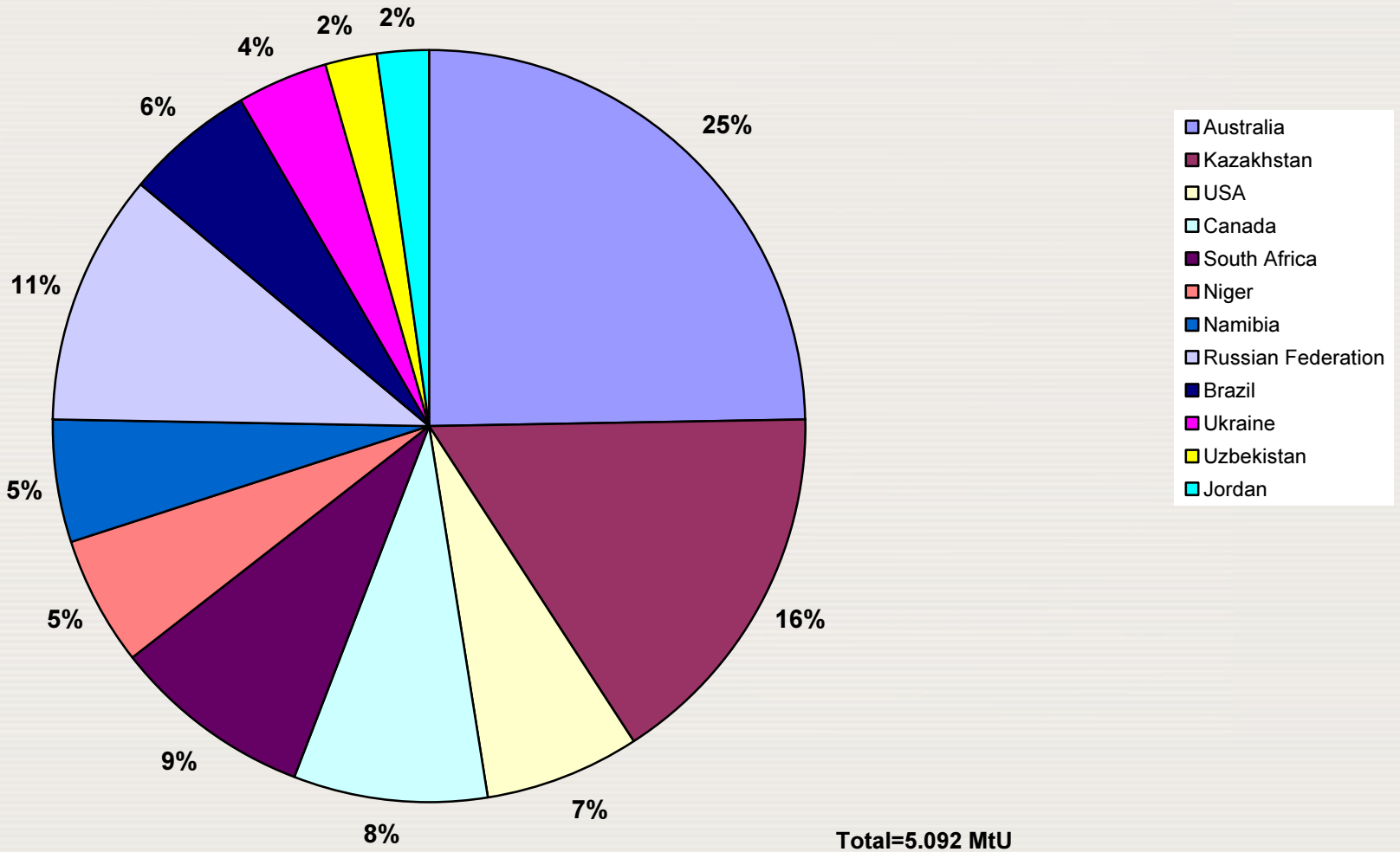


2. Need: Power Sector CO_2 Emissions vs Shares of Renewables & Nuclear Power



Source: IEA WEO2006

2. Need: Supply security concerns Resources spread, fuel market competitive



Total=5.092 MtU

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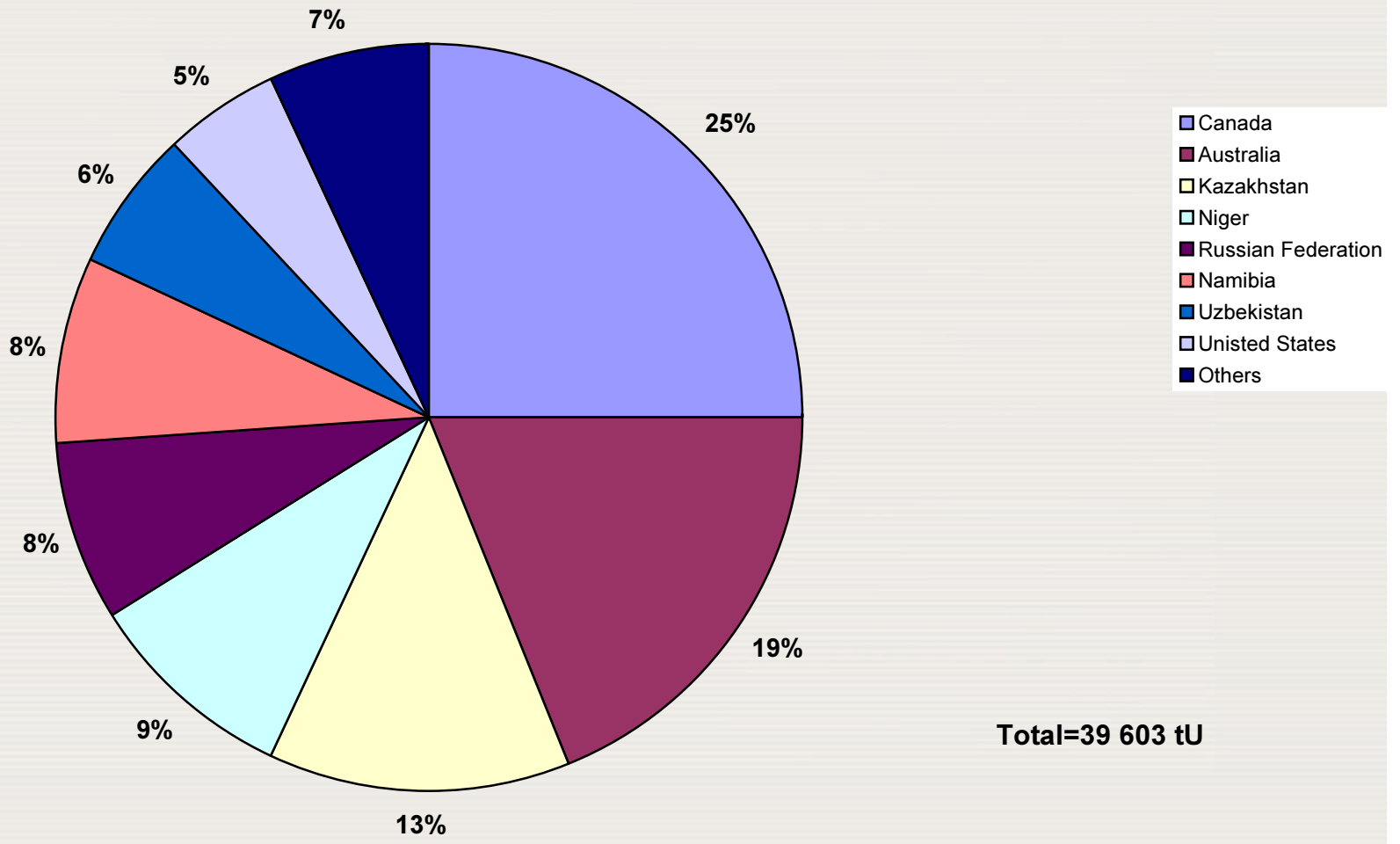
2. Need: Supply security concerns Resources spread, fuel market competitive



Total=39 603 tU

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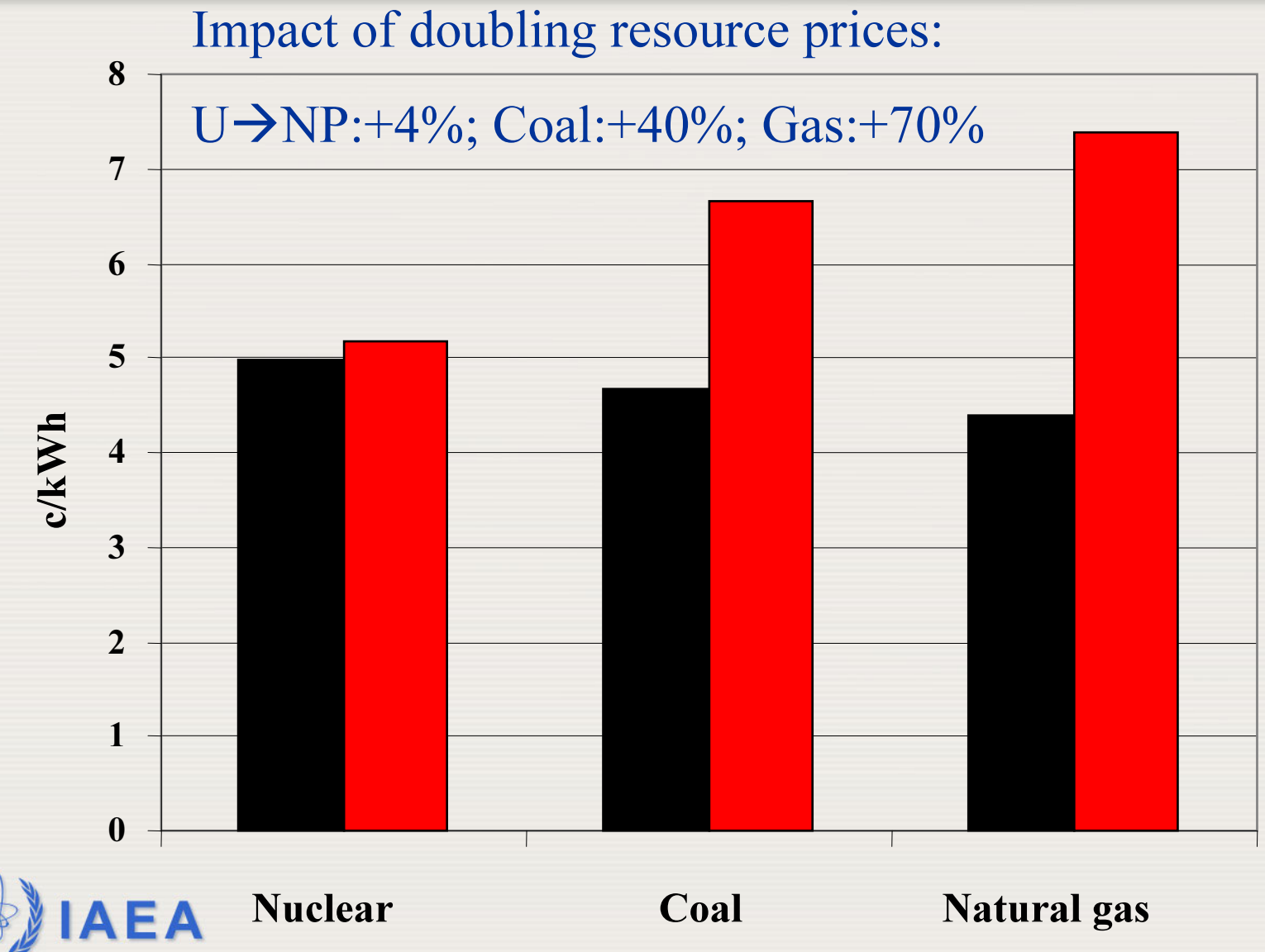
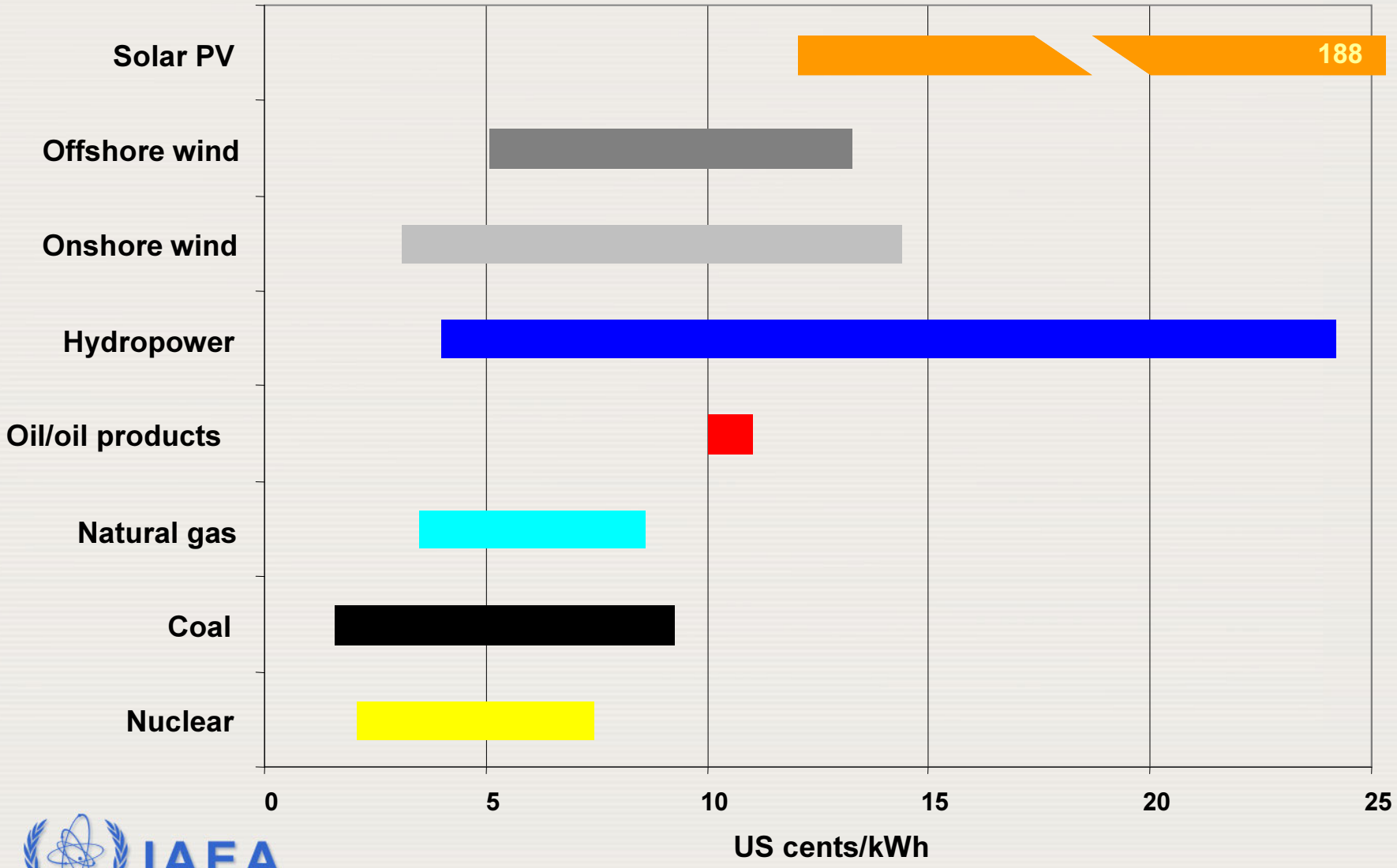
2. Need: Supply security concerns
Fuel cost a small fraction of electricity cost



3. Supply: Competitive costs



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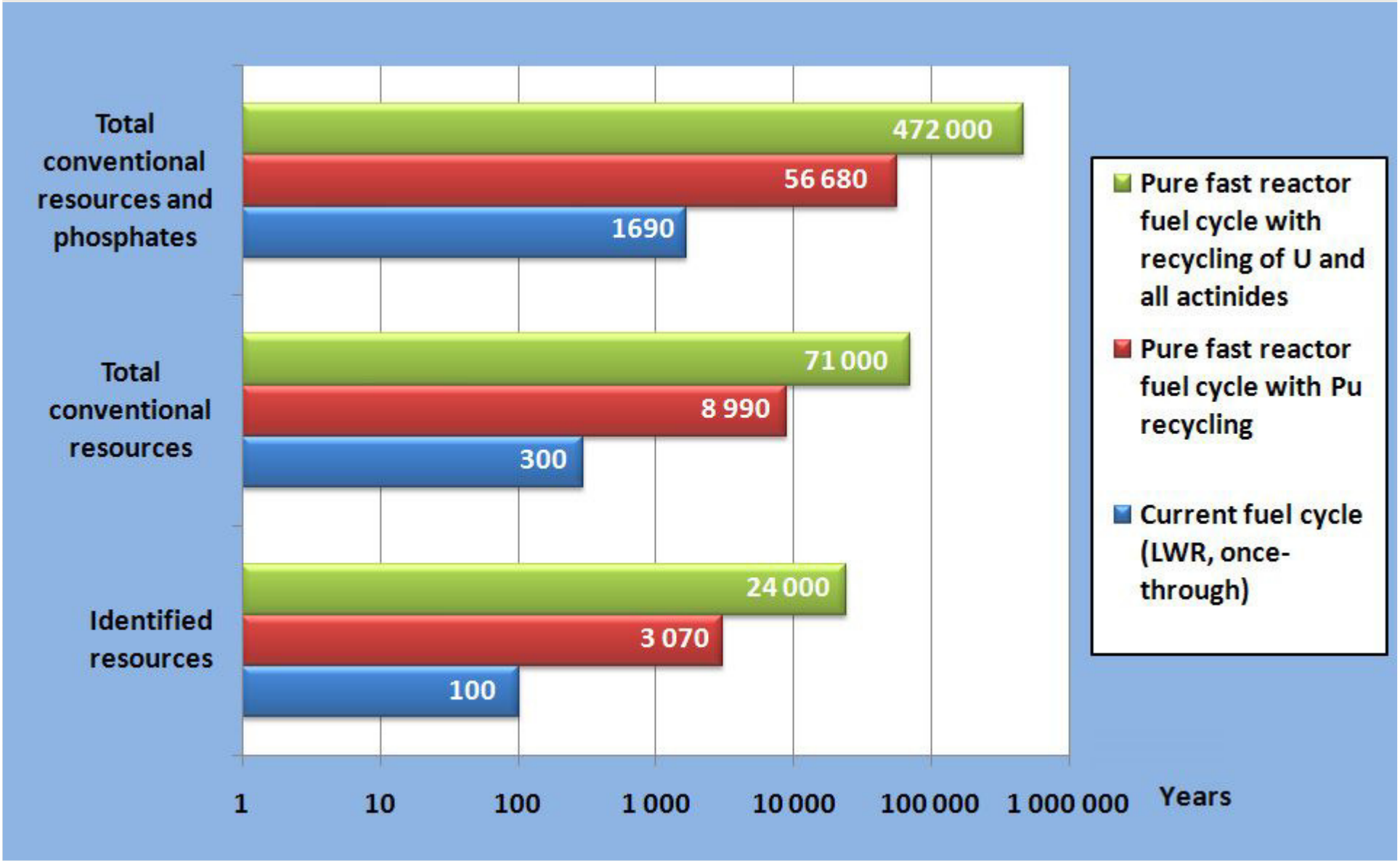
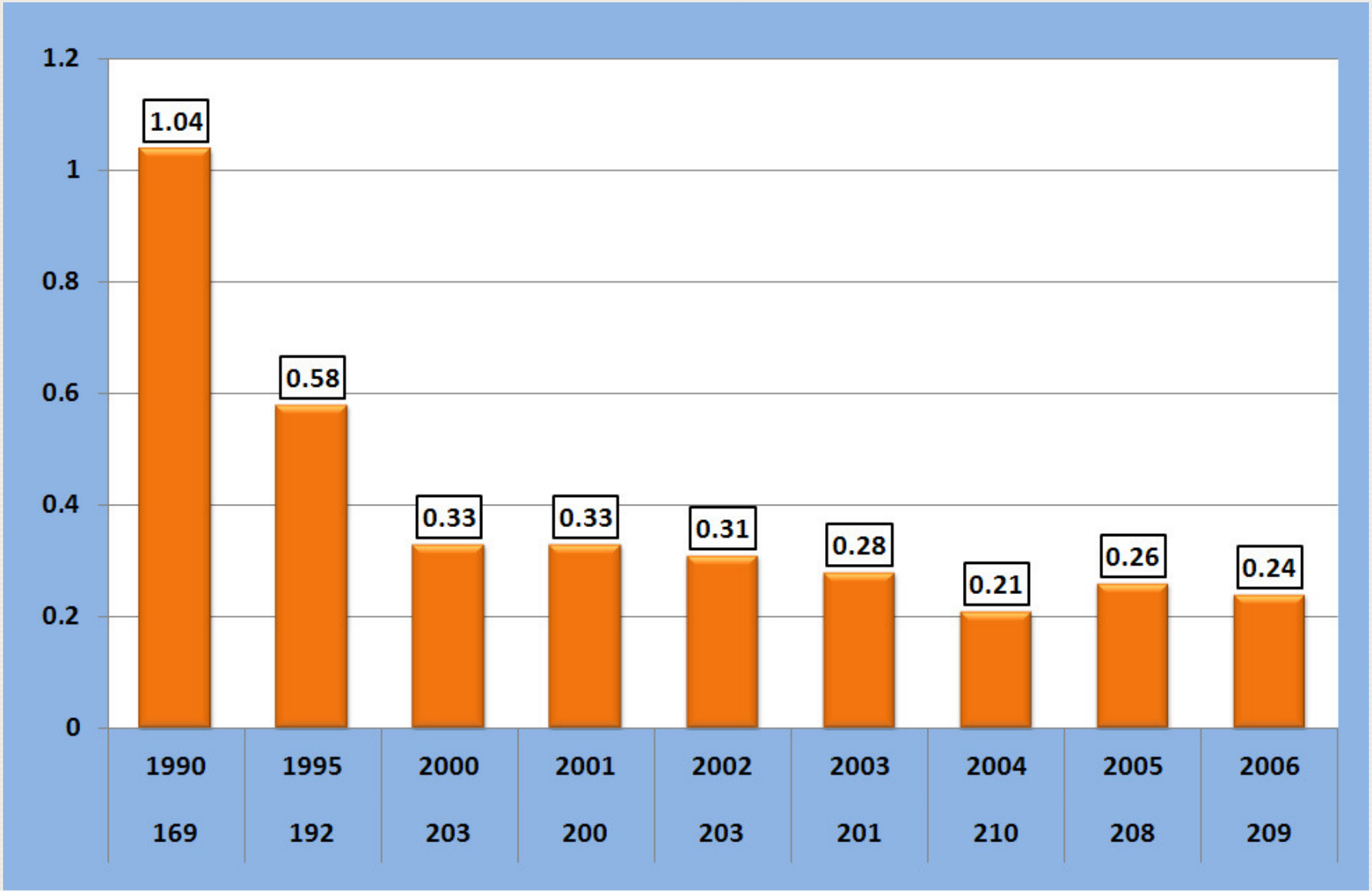
3. Supply: Sufficient uranium available

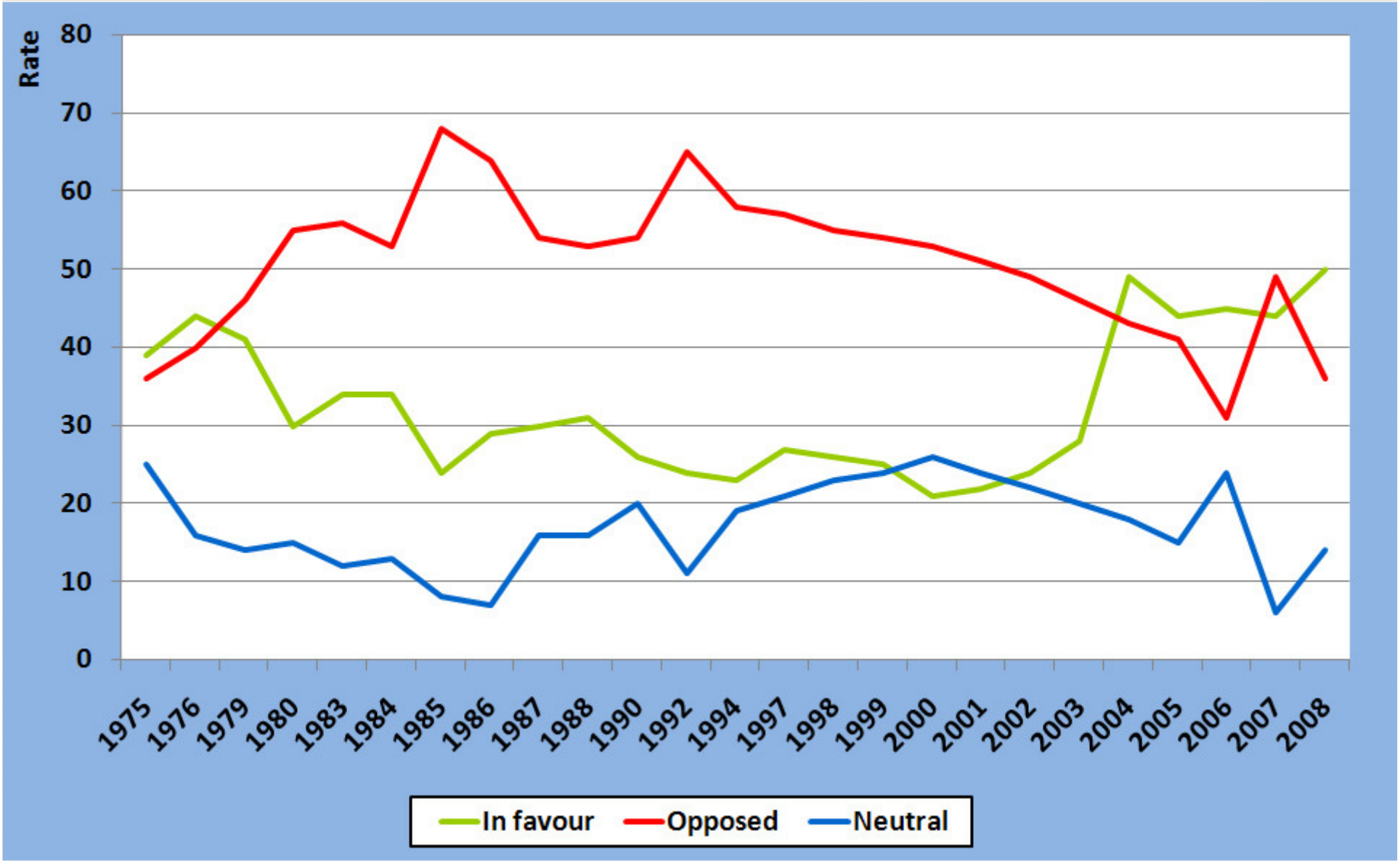


4. Concerns: Plant safety improving

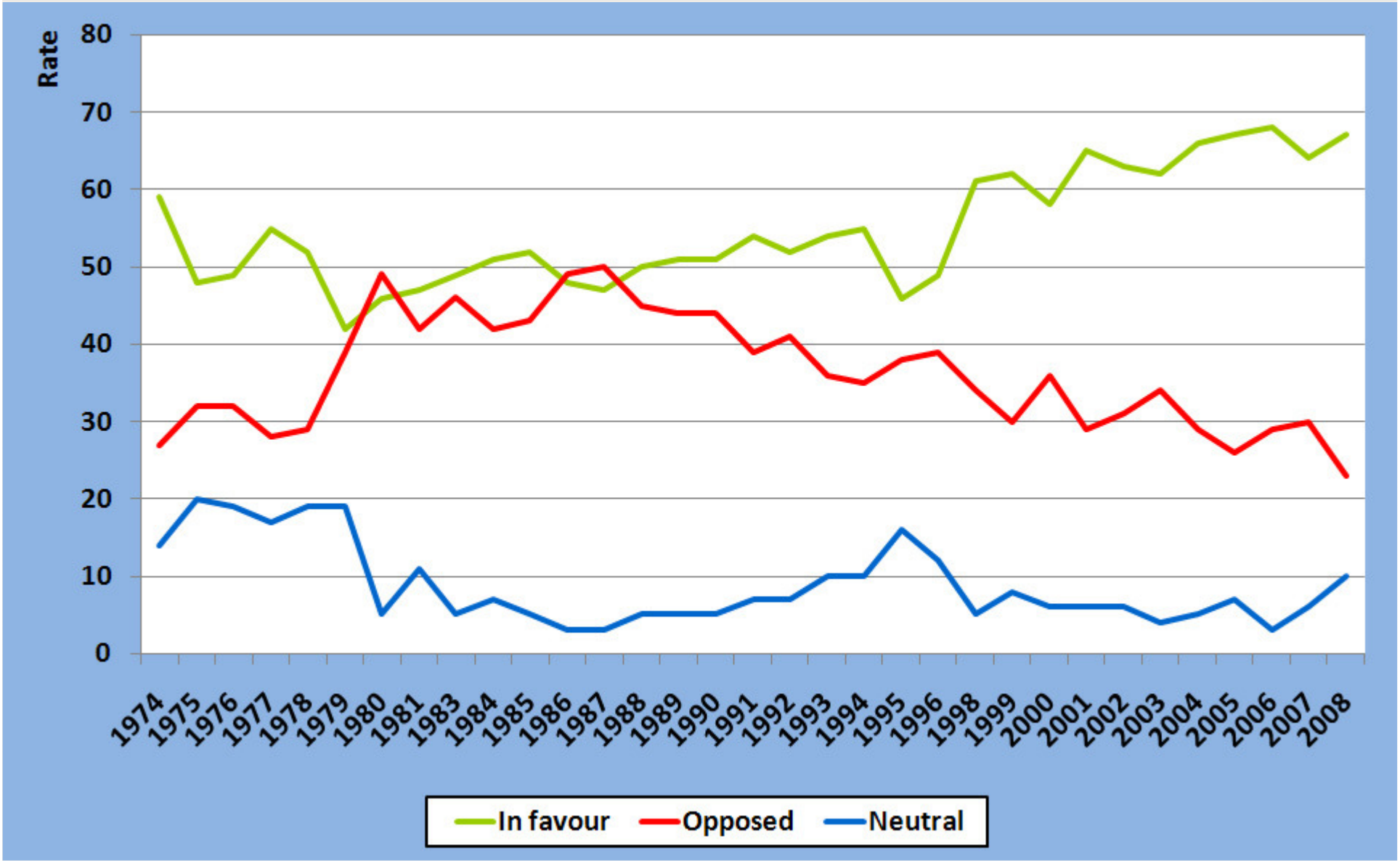
Ind. accidents at NPPs per 200K person-hours



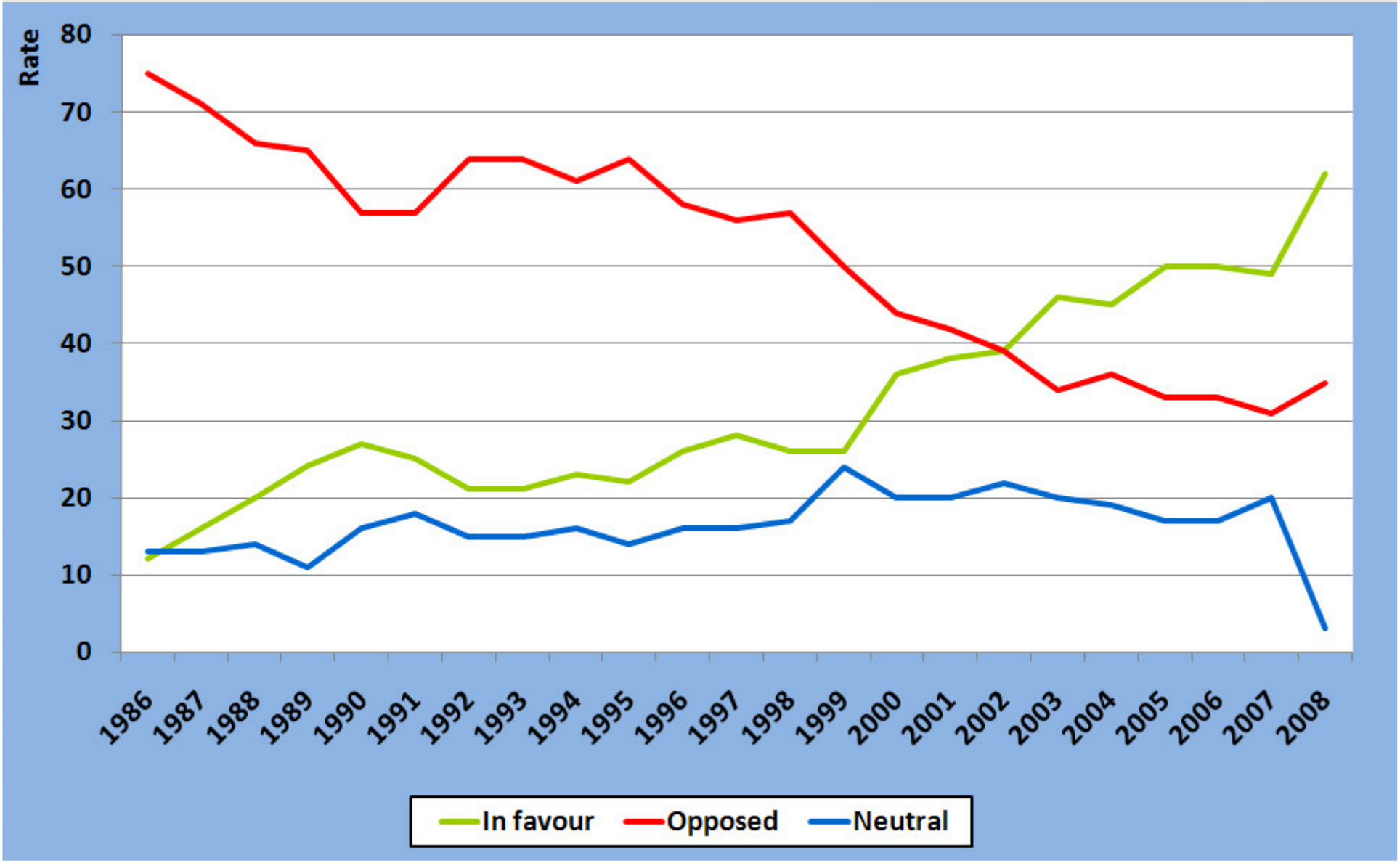
4. Concerns: Public acceptance improving UK



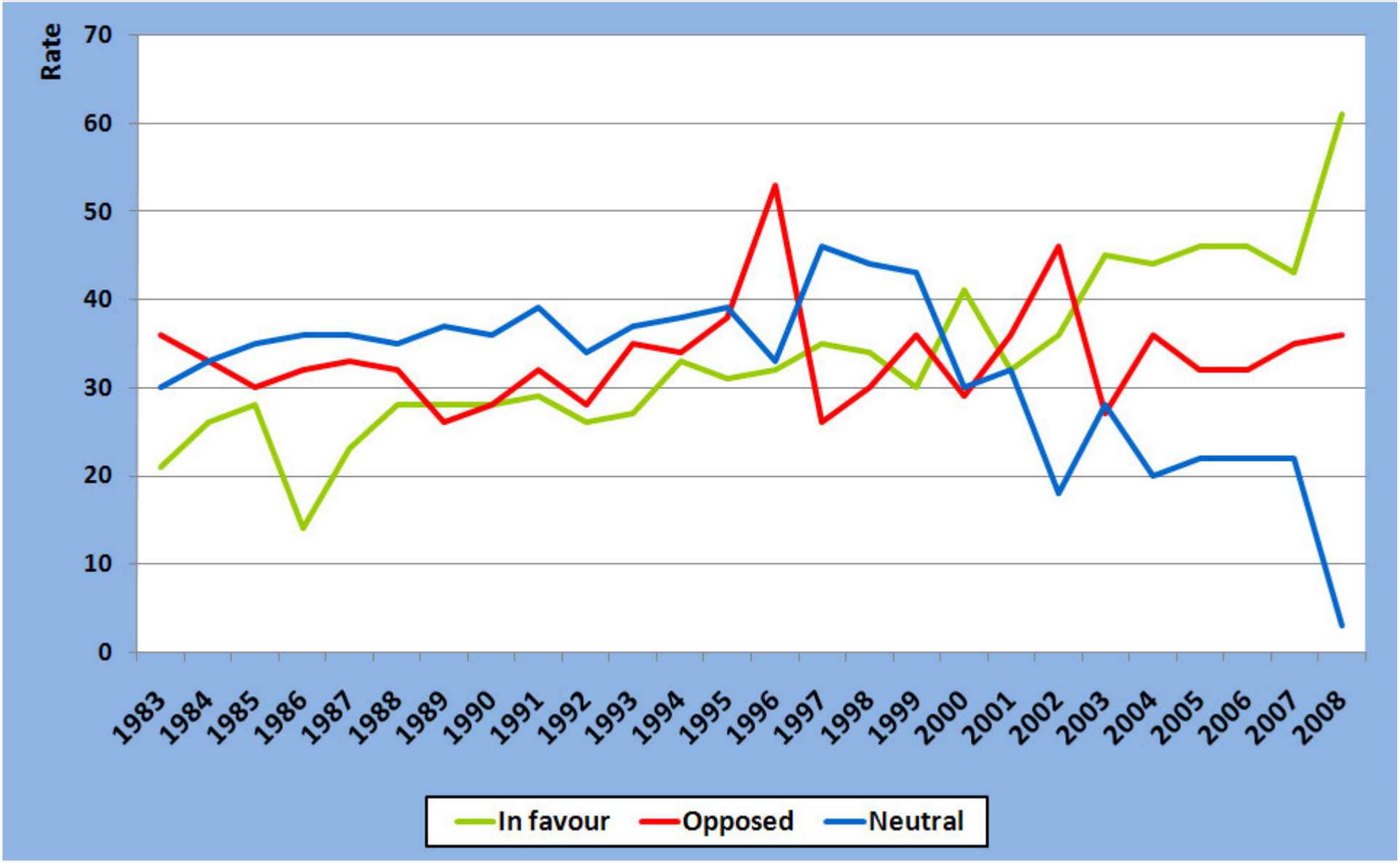
4. Concerns: Public acceptance improving USA



4. Concerns: Public acceptance improving Sweden



4. Concerns: Public acceptance improving Finland



5. Main messages

Nuclear power: *low-carbon* technology

life-cycle emissions: <10 gCO2-eq/kWh

Reduction potential if replacing fossil-based:

IPCC AR4: 1.88 GtCO2-eq by 2030

largest volume, lowest average cost

Other benefits: supply security, El. price stability

Supply: possible, but firm policies and stable regulation needed

Concerns (safety, proliferation, waste, public acceptance) remain but easing

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5. Main messages

3E problems: climate change, fast growing energy demand, domestic energy sources, supply security, import prices, current account balance, competitiveness, sustainability ...

Nuclear energy is *not a magic cure* but:

it could be *part of the remedy*

Where, when, how much, what arrangements:

depends on *national* circumstances and

priorities → *decision of sovereign states*

IAEA mandate: tools, capacity building, information, support, services to MSs

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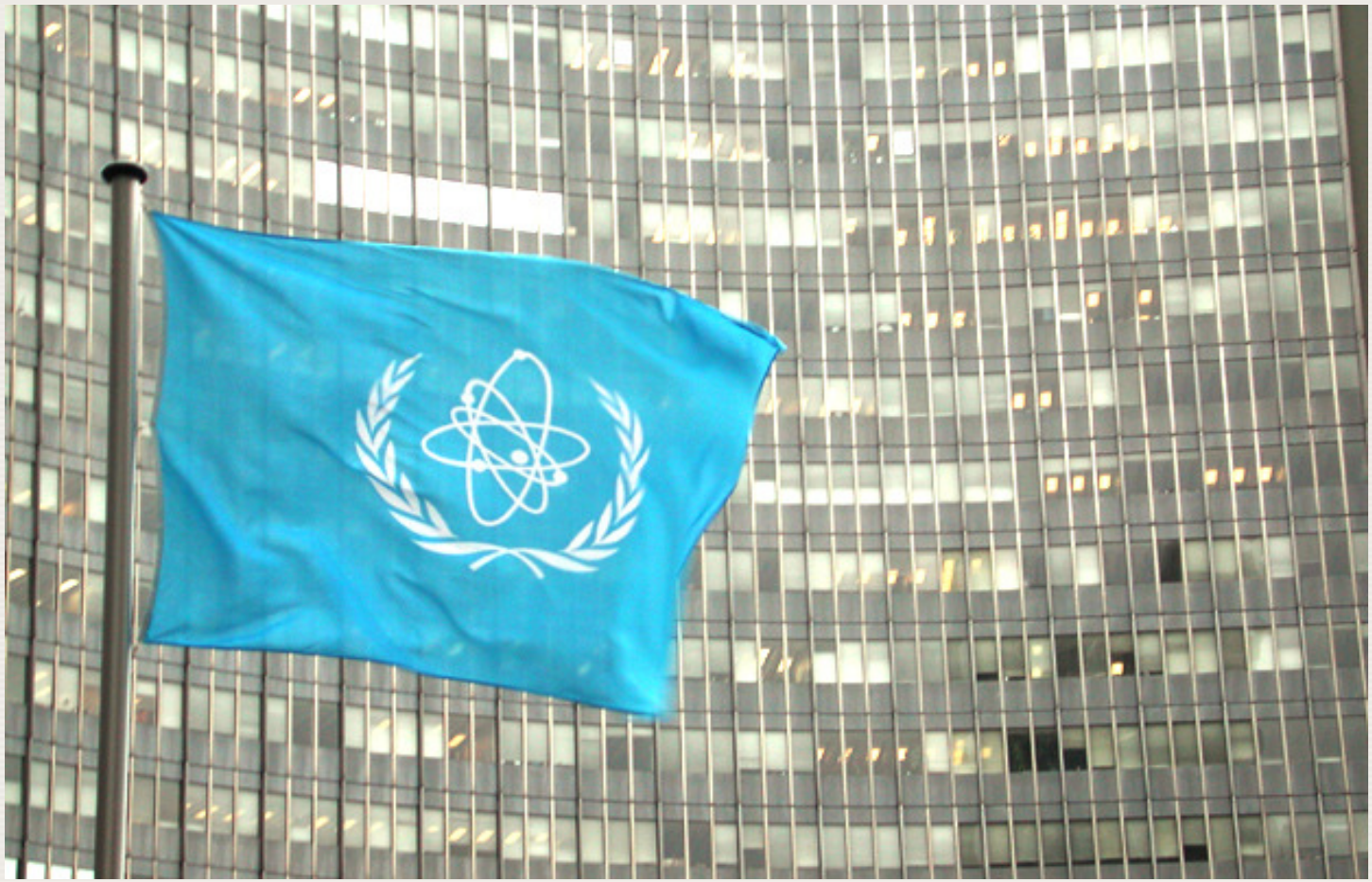
IAEA - http://www.iaea.org/OurWork/ST/NE/index.html



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…atoms for peace.