

# Public Acceptance of Geological Disposal of Carbon Dioxide and Radioactive Waste: Similarities and Differences

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# Differences and Similarities

- Geological disposal of carbon dioxide (CO<sub>2</sub>) and radioactive waste (RW) are fundamentally different problems
- Unlike CO<sub>2</sub>, Radioactive Waste is not a single well-characterized entity
- But there are points of similarity:
  - difficulty of extricating not-in-my-backyard (NIMBY) considerations from other concerns
  - inability to divorce the politics of waste streams from the underlying electricity generating technologies
  - challenge of communicating highly technical nature of both issues
  - both CO<sub>2</sub> storage and RW play key roles in the larger debate over energy policy, particularly as a proxy issue for non-governmental organizations (NGOs)

# Comparative Assessment

<b>Subject</b>	<b>Radioactive Waste Disposal</b>	<b>CO<sub>2</sub> Storage</b>
<b>Public awareness</b>	Broad public awareness	Minimal public awareness of any aspect of CCS
<b>Public understanding</b>	Generally weak in spite of high awareness	Basic understanding of carbon cycle but minimal to none on CO <sub>2</sub> storage itself
<b>Public acceptability of solution</b>	Acceptability poor and greater acceptance not necessarily linked to greater understanding	Linked to climate change and perceived adequacy of other solutions , but still too early to determine
<b>Demographics</b>	Strong female opposition across time and region	Little evidence of major differences visible at this stage
<b>Timing</b>	Not necessary to address immediately. In most cases deferred for decades.	Essential to resolve storage before operation begins because of volume of waste stream

# Comparative Assessment II

<b>Subject</b>	<b>Radioactive Waste Disposal</b>	<b>CO<sub>2</sub> Storage</b>
<b>Risk communications</b>	Extensively studied but practice remains weak	Few examples of good practice, poorly studied
<b>Trust in actors</b>	Involves energy industry and government, some of least trusted actors in society. Exacerbated by image of 'nuclear priesthood'.	Involves energy industry and government, some of least trusted actors in society
<b>Views of grassroots and environmental NGOs</b>	Generally hostile although there has been successful engagement on narrow question of repository siting	Main environmental groups are neutral to moderately positive. Some resistance from grassroots groups less concerned with climate change alone.
<b>Support for associated energy technology</b>	Support for nuclear power remains divided and this division has continued for decades	Unabated coal is becoming increasingly unpopular, although there remains support for coal miners in many countries

# Terminology: 'storage' and 'disposal'

	Proponents' principal recommendation	Opponents' principal recommendation
<b>Radioactive Waste</b>	<b>'<u>Deep Geological Disposal</u>'</b>	<b>'<u>Indefinite Surface Storage</u>'</b>
<b>Carbon Dioxide</b>	<b>'<u>Carbon Capture and Storage</u>'</b>	

*Proponents of nuclear power avoid the word 'storage' to avoid any implication that temporary measures are a 'solution'.*

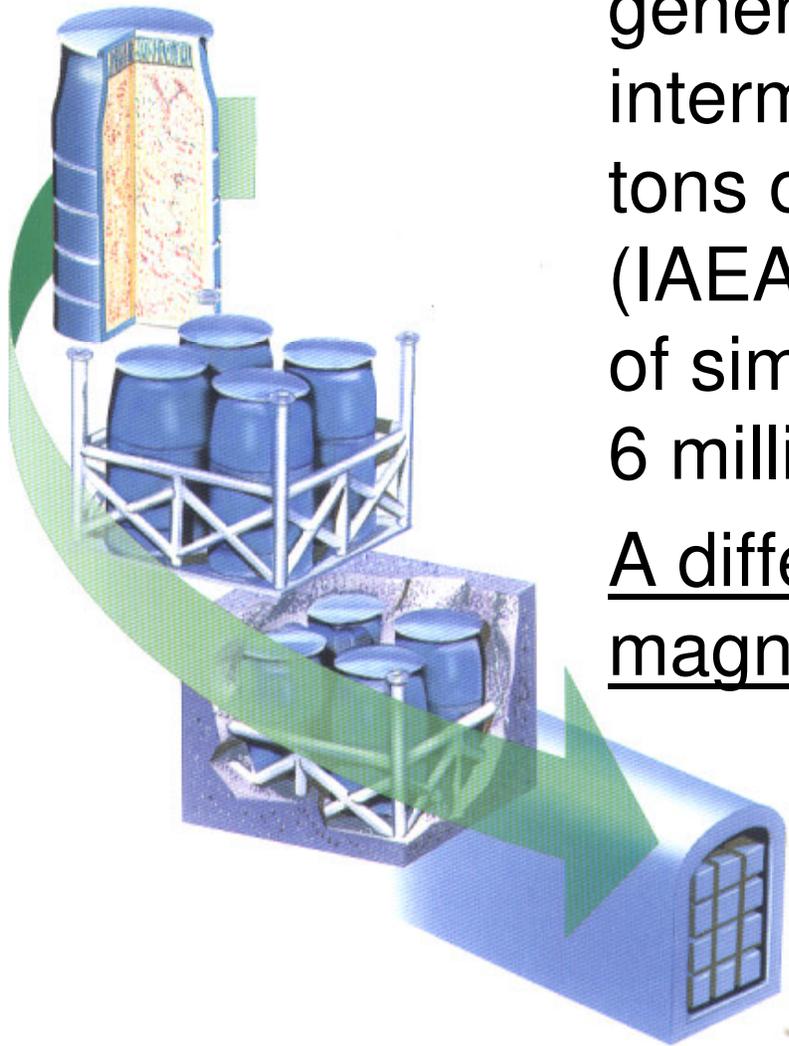
*Proponents of CCS avoid the word 'disposal', despite having no interest in CO2 retrieval, and in part to avoid any perceived similarity to nuclear*

*No proponents use the word 'dumping', but it is much used by opponents*

# Scale

A 1,000 MWe light water reactor will generate some 800 tons of low- and intermediate-level waste and 30 tons of spent nuclear fuel per year (IAEA 1997). A new coal-fired plant of similar size will produce perhaps 6 million tons of CO<sub>2</sub> per year.

A difference of four orders of magnitude.



# What About The Waste?

Royal Commission for Environmental pollution recommended in 1976 that no commitment should be made to a 'large programme' of nuclear power until a 'method exists to ensure the safe containment' of RWs 'for the indefinite future'. Arguably radioactive waste then became a proxy battle for much wider questions about nuclear energy.

# What About The CO<sub>2</sub>?

- Might CCS take on the status of Achilles' heel for the fossil fuel industry?
- An insistence that no new coal plants be built without CCS is reminiscent of RW debate.
- CCS has the potential to become a proxy battle for wider questions about fossil fuel usage.

# Issue-Attention Cycle

- Pre-Problem Stage - expert/IG attention
- Alarmed discovery & euphoric enthusiasm
- Realization of costs of significant progress
- Gradual decline in intense public interest
- Post-Problem Stage - “twilight realm of lesser attention or spasmodic recurrences”

A. Downs, *Public Interest* 28 (1972): 38-50

# CO2 Leakage?

Storage of CO2 underground is nominally a matter involving lifetimes of thousands of years, but is primarily a question of the next century, during which the adequacy of the global response to climate change will be revealed.

The British Geological Survey, for example, has argued that currently 'leakage' from fossil generation is effectively 100%

# Threats

Threats to an RW repository fall into two classes. The first class relates to natural geological and hydrological processes, together with the materials science of immediate waste encapsulation. Timescales of such risks are typically measured in tens or hundreds of thousands of years or more.

The second class of threat is more difficult to analyse and involves human intrusion into a geological repository either accidentally or deliberately.

# Bulletin of the Atomic Scientists

## Plutonium Store Competition



Note: The artist imagines a central Washington DC location for a plutonium store just under the Ellipse, a field 1 km in circumference, near the White House, which takes to an extreme the notion that plutonium storage should not be *out of sight and out of mind*.

Images copyright Michael Simonian see: <http://www.designboom.com/eng/cool/simonian.html> - used with permission]

# The power of imagery

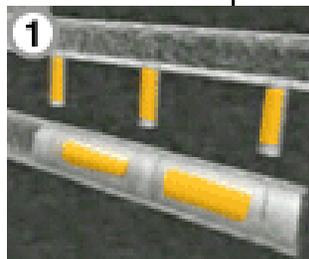
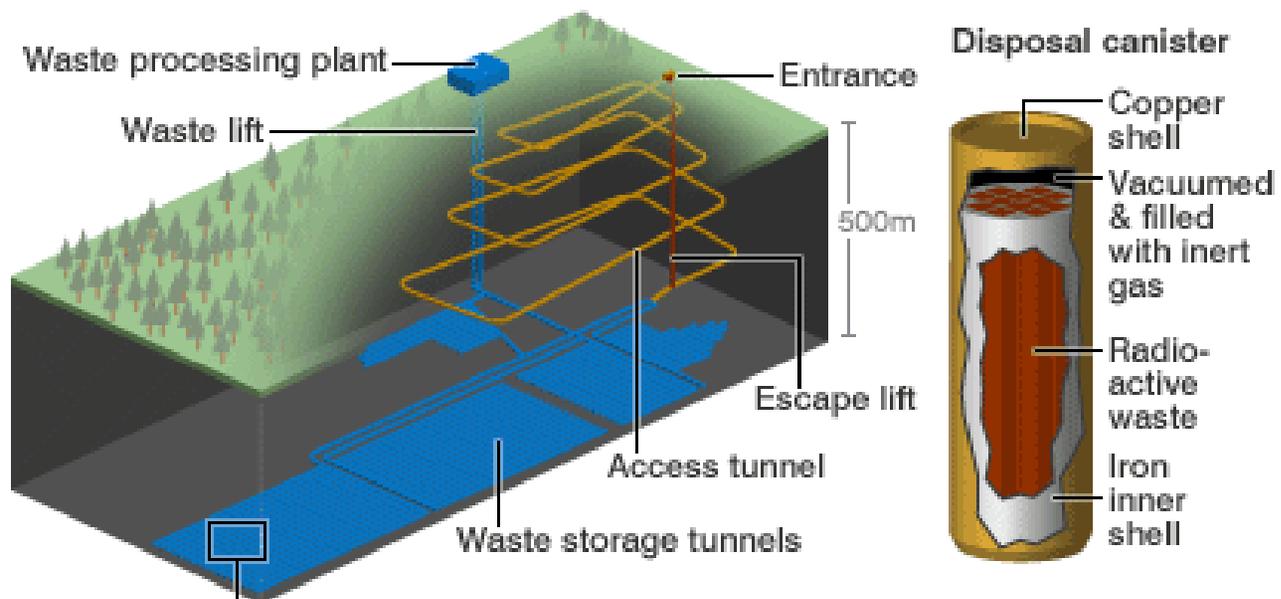
Is it dishonest to design  
nuclear waste labs to  
look like this?



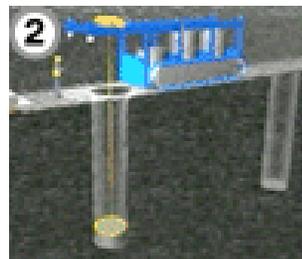
Source and  
permission: SKB

# Illustration of RW Storage: Finland

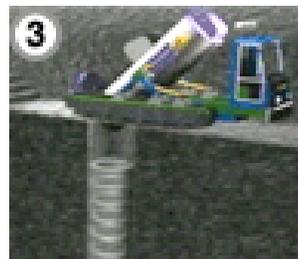
## DEEP DISPOSAL OF RADIOACTIVE WASTE - THE FINNISH MODEL



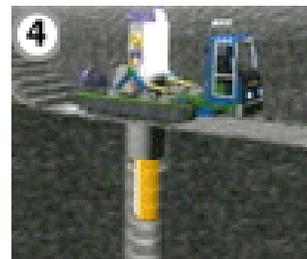
1  
Canisters stored vertically/horizontally



2  
Hole drilled in tunnel and lined with clay

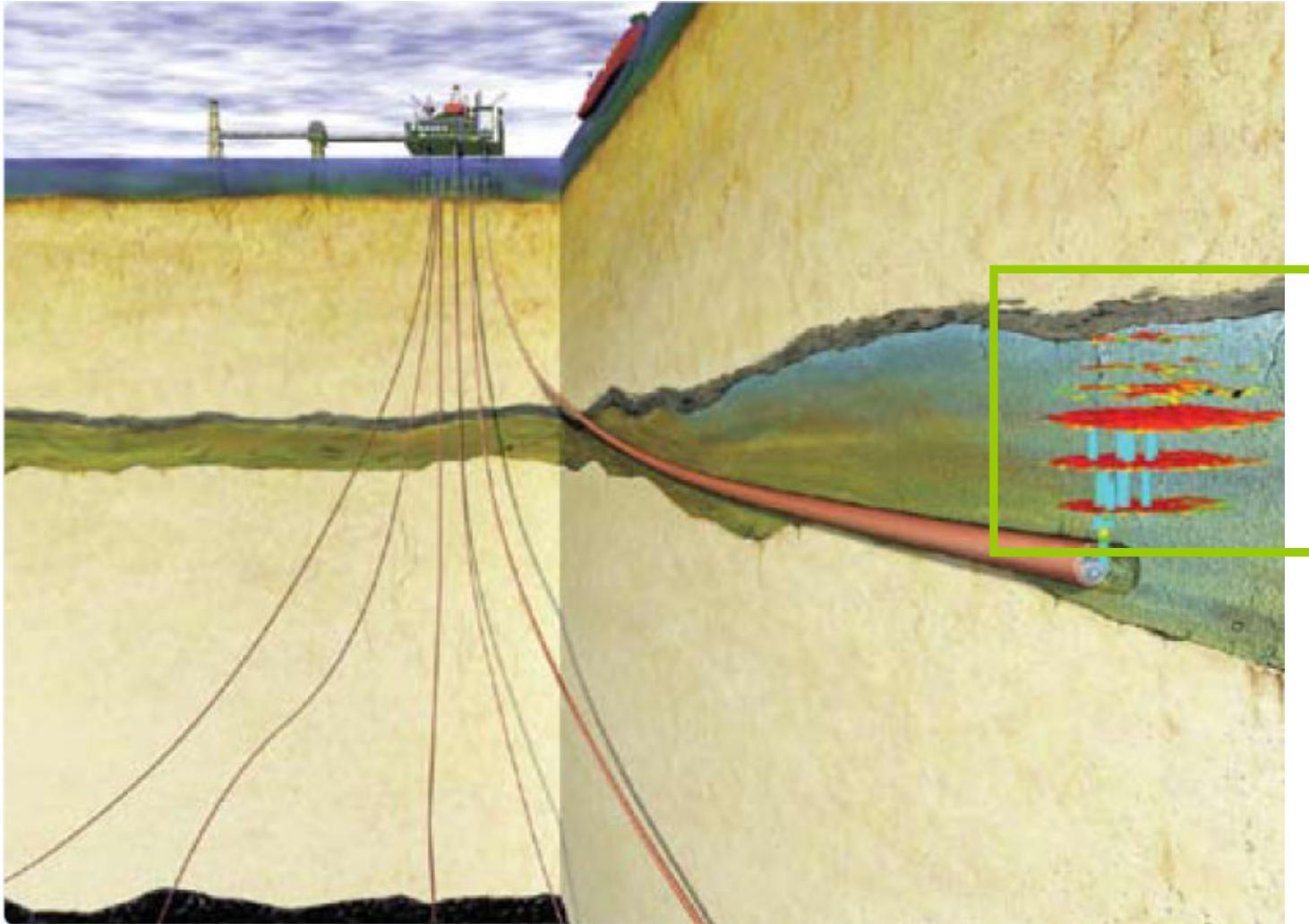


3  
Canister transferred from transporter



4  
Canister sunk and hole sealed with clay

# Illustration of CO2 Storage: Sleipner Field



Source: StatoilHydro

# Media Coverage

Lake Nyos, Cameroon 1986

“We are not guinea pigs!”



# Public Attitudes

- Eurobarometer surveys reveal stable patterns in public attitudes to RW. The dominant opinion is that roughly 3/4 consider themselves 'not well informed'
- Almost all Europeans believe there is an urgent need to find a solution to RW now, but over 70% do not believe there is any safe way of getting rid of HLW
- Women are less likely to favour deep underground storage and less likely to believe that nuclear power allows for diversification of the energy supply
- By contrast, the lay public has good familiarity with CO<sub>2</sub>
- CO<sub>2</sub> storage is less familiar than RW storage and studies find little awareness of CCS or even recognition that CCS addresses climate change (vs other environmental issues)
- Respondents often provide 'pseudo-opinions', which are found to be unstable and easily changed according to the information provided

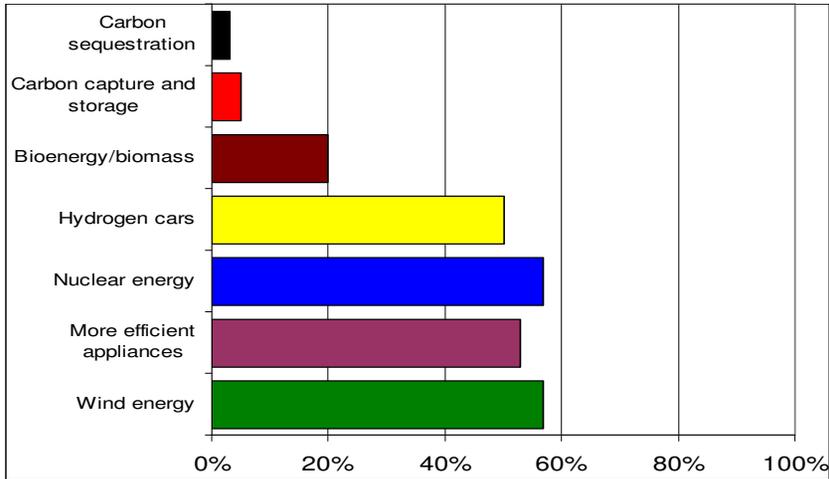
# Four Degrees of Opinion

- Direction of Opinion: Pro/Con
  - Favor environmental protection
- Degree/extremity of opinion: Strong/mild
  - Assessment of severity of problem
- Salience: degree of personal interest
  - Environment rates as an important issue
- Intensity: degree of personal commitment
  - Active in environmental movement

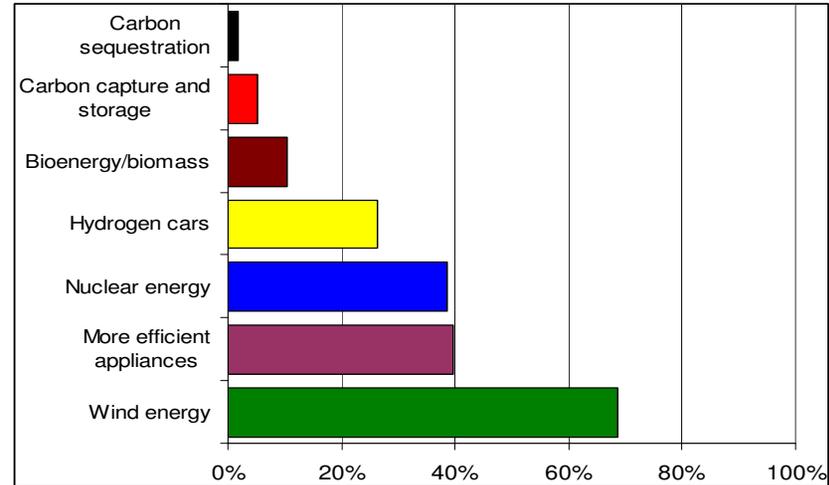
# Public Awareness

(heard/read of the following in the past year)

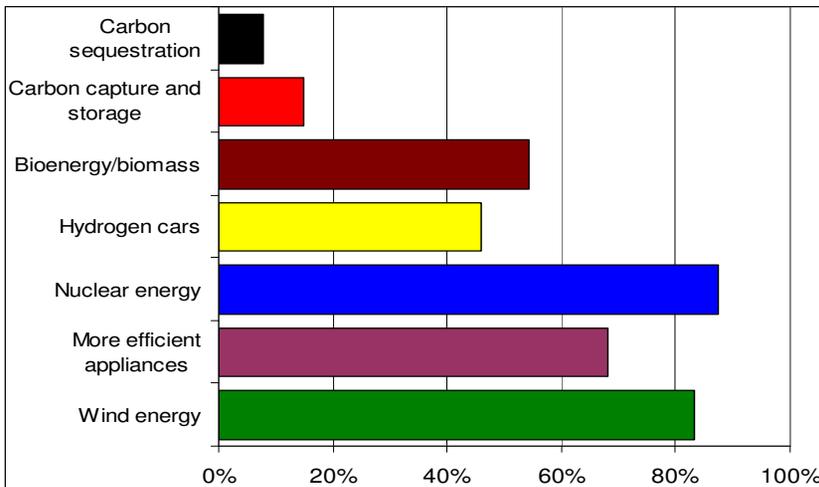
## US



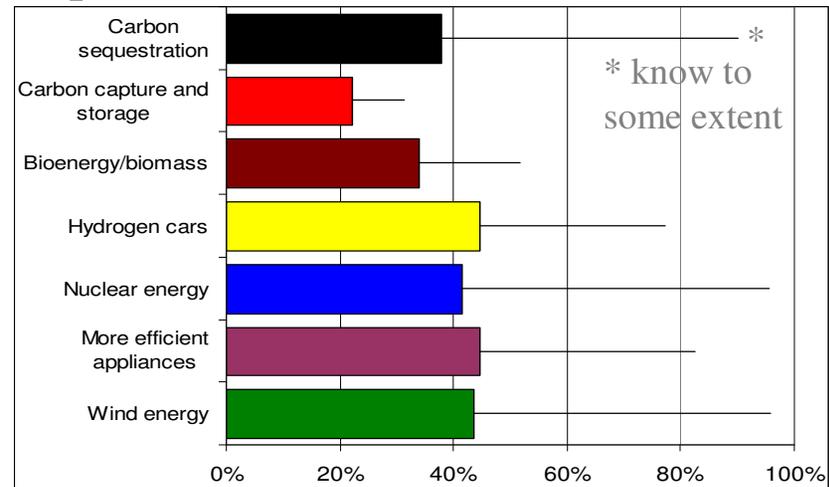
## UK



## Sweden



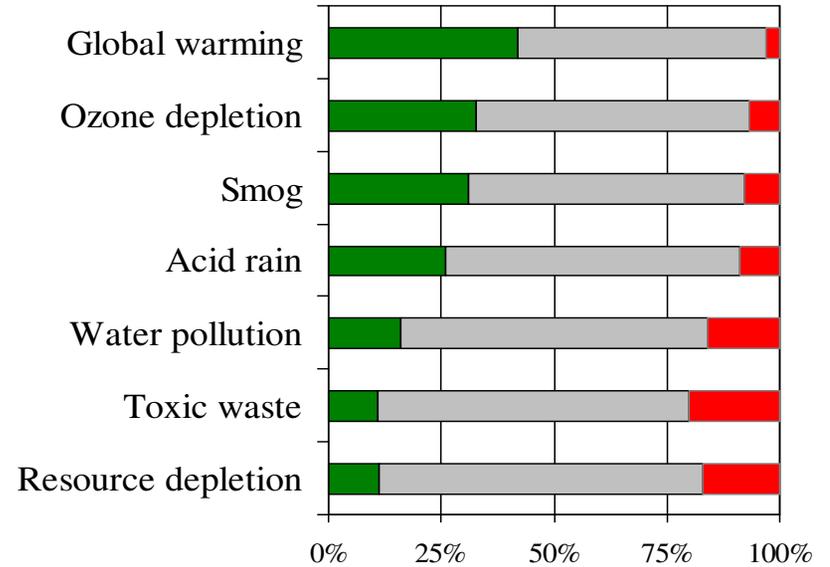
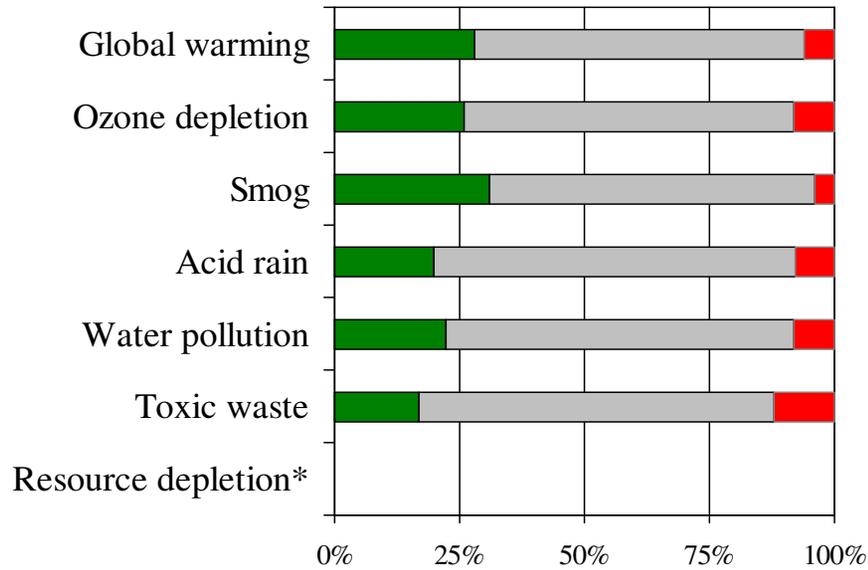
## Japan



# Can CCS Reduce These Environmental Concerns?

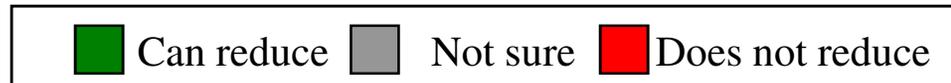
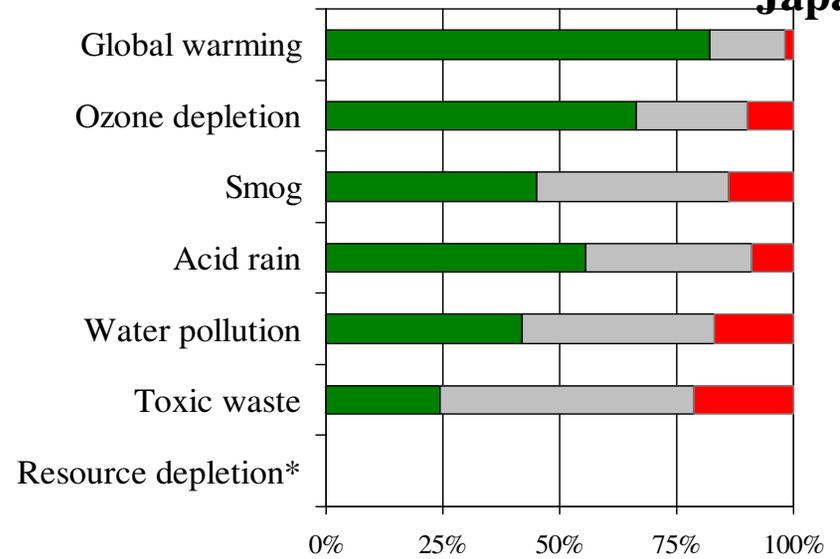
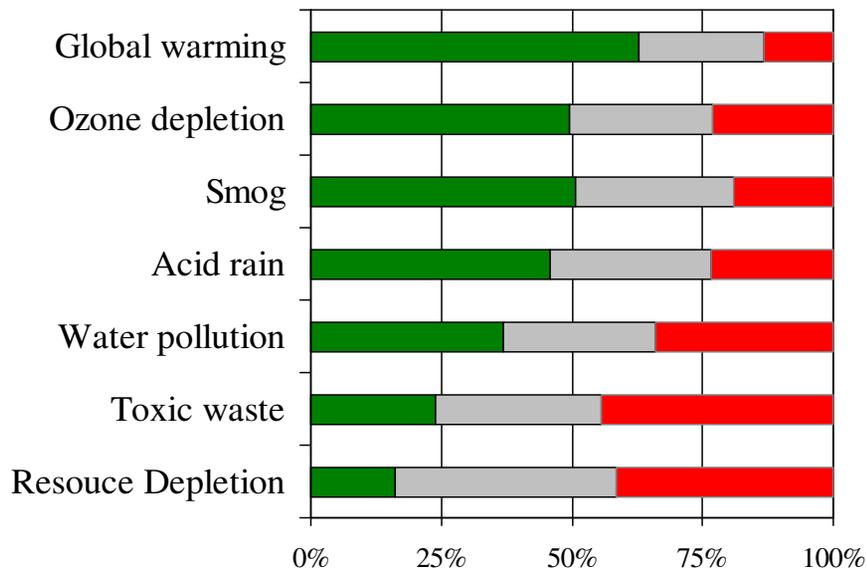
US 2006

UK

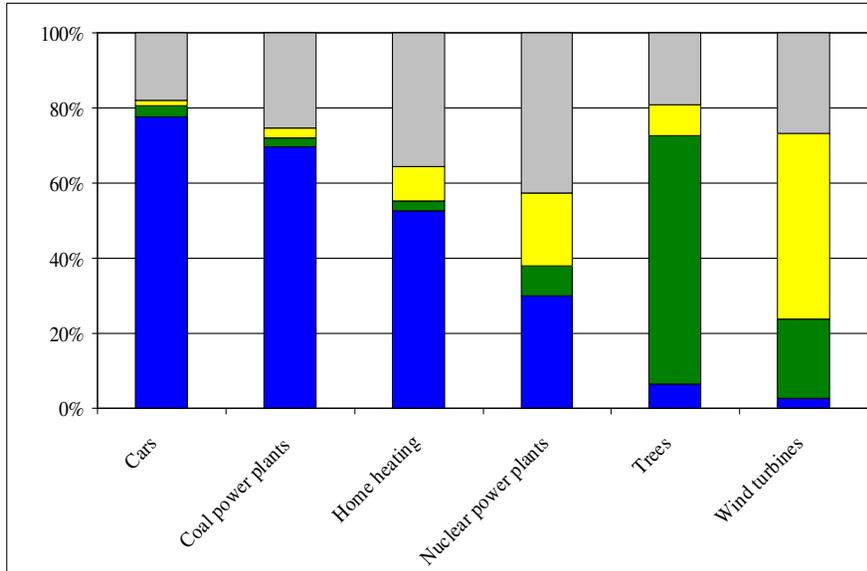


Sweden

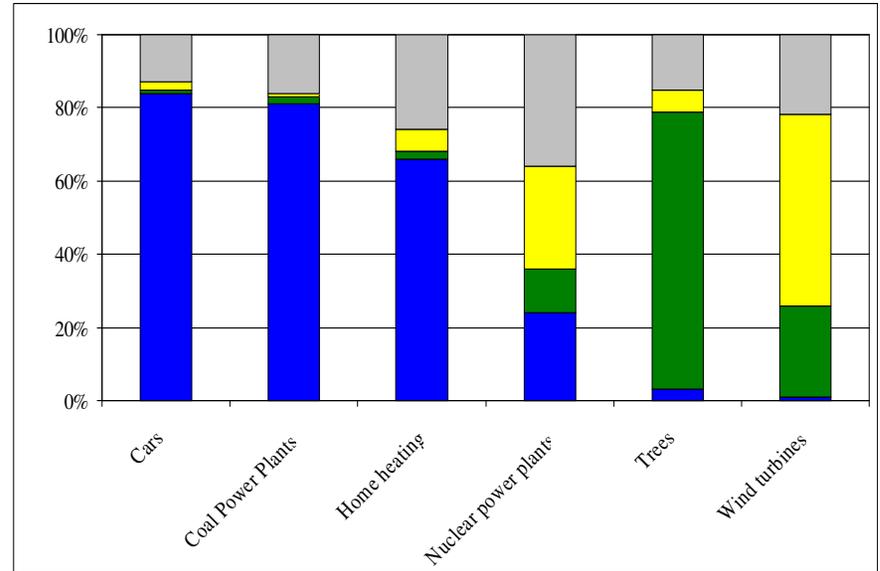
Japan



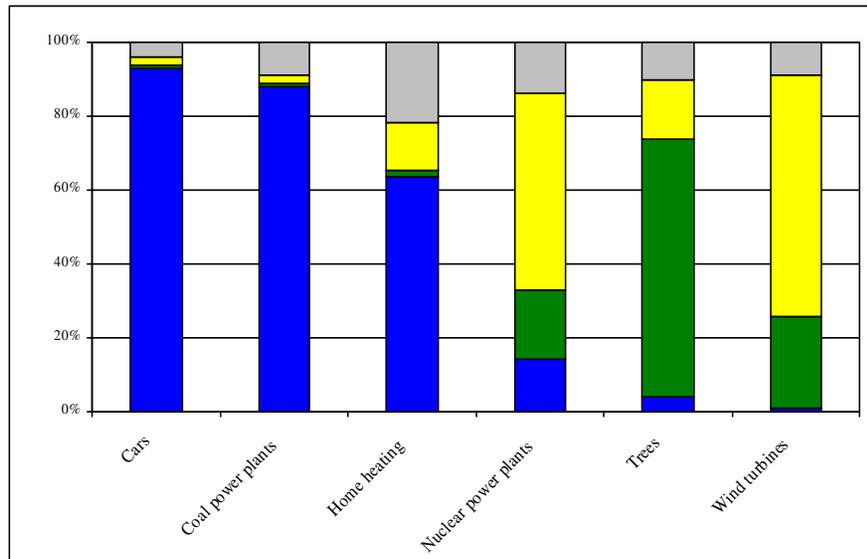
# US How do the Following Contribute to Carbon Dioxide Levels?



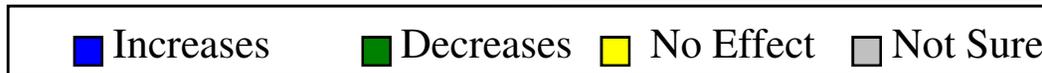
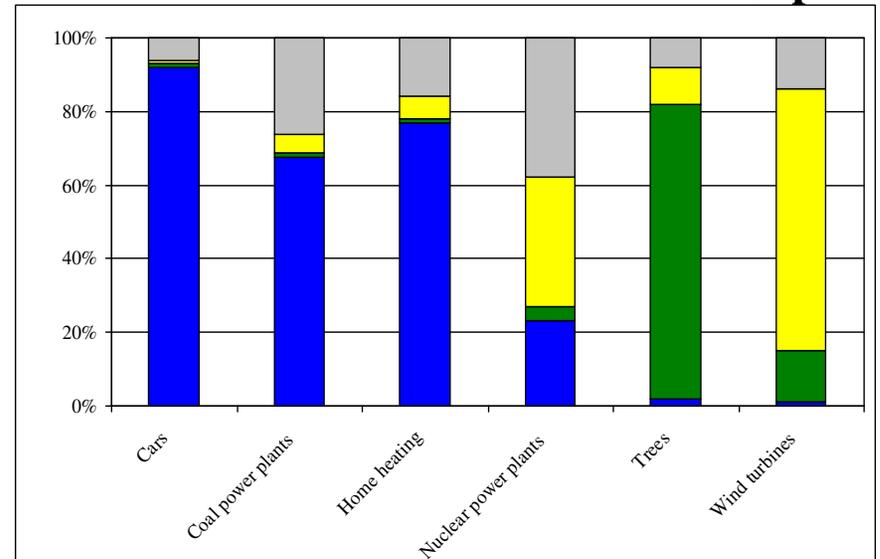
UK



Sweden



Japan



# Does Nuclear Power Contribute Significantly to Global Warming?

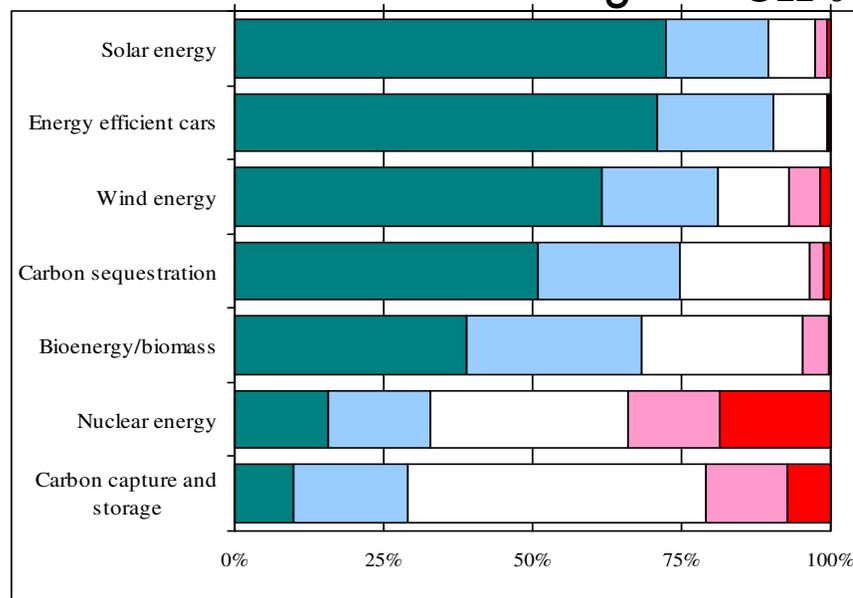
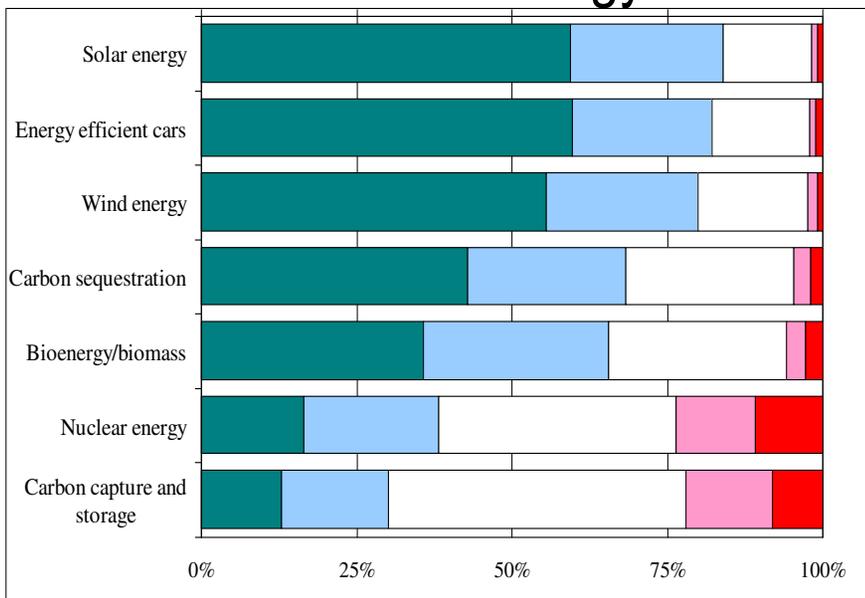
	Yes	No		Yes	No
Belgium	48	27	Italy	42	22
Denmark	24	58	Holland	35	46
Germany	39	35	Austria	41	32
Greece	79	6	Portugal	59	10
Spain	64	9	Finland	28	54
France	57	26	Sweden	20	67
Ireland	61	11	UK	45	27
			<b>EU15</b>	<b>47</b>	<b>27</b>

Source: DG-Research, Eurobarometer, Energy: Issues, Options and Technologies Science and Society, March 2003

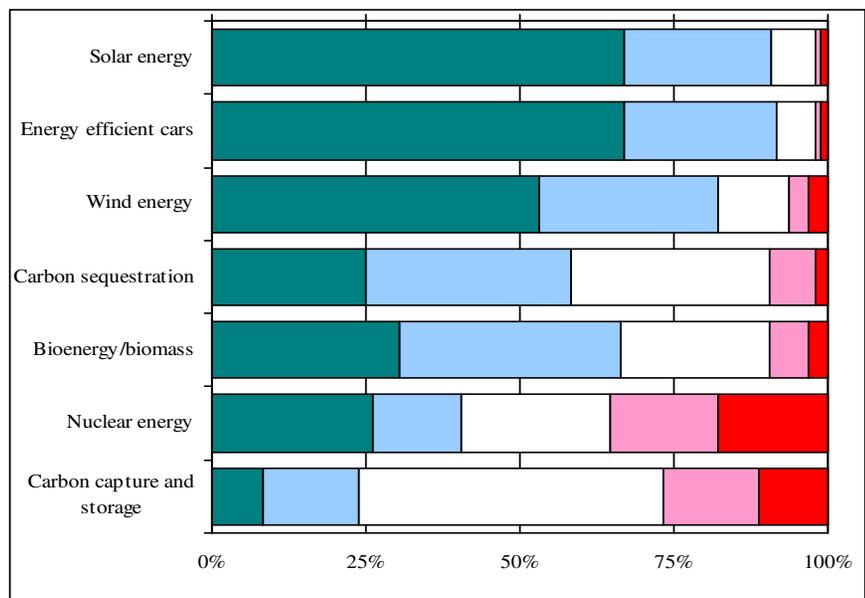
US 06

# Preferred Energy Technology to Address Global Warming

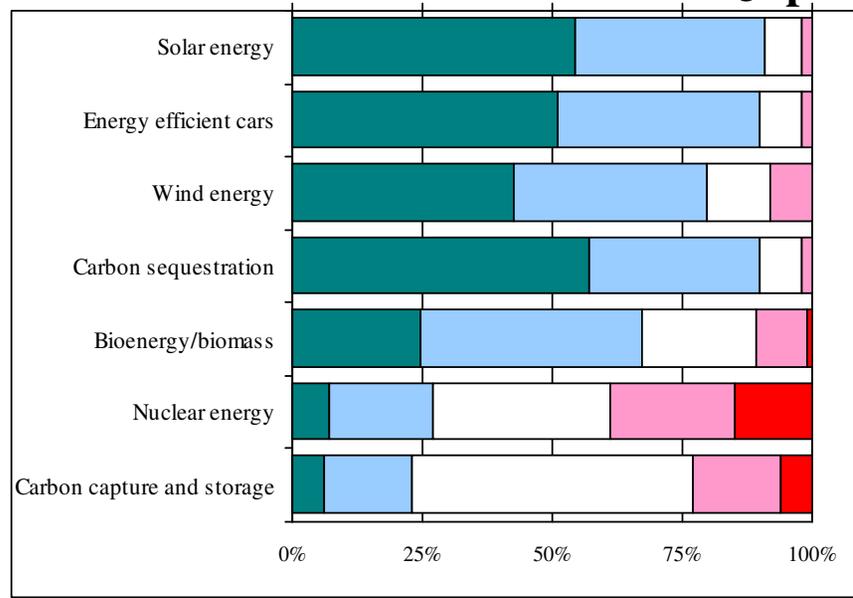
UK 04



Sweden

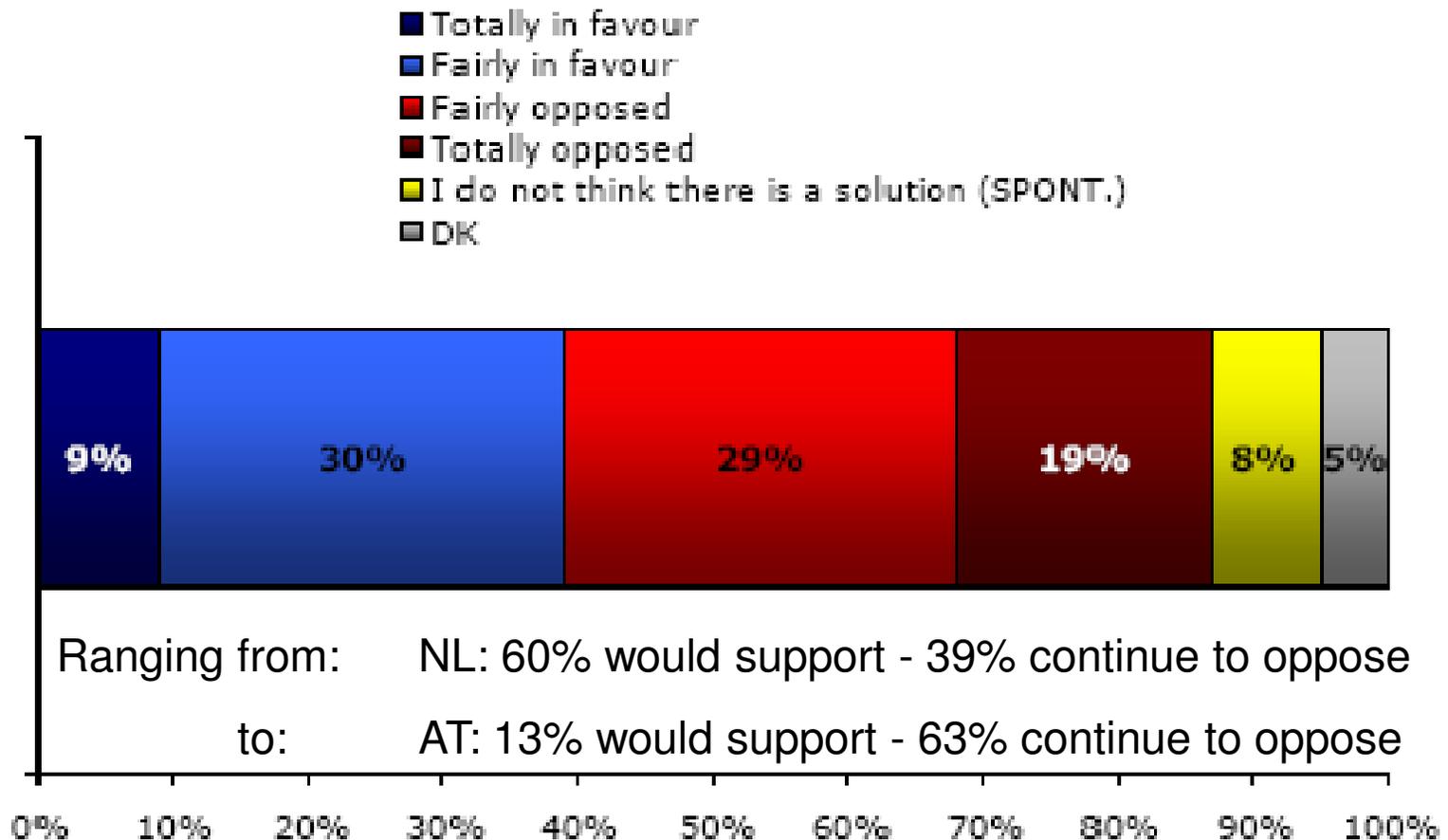


Japan



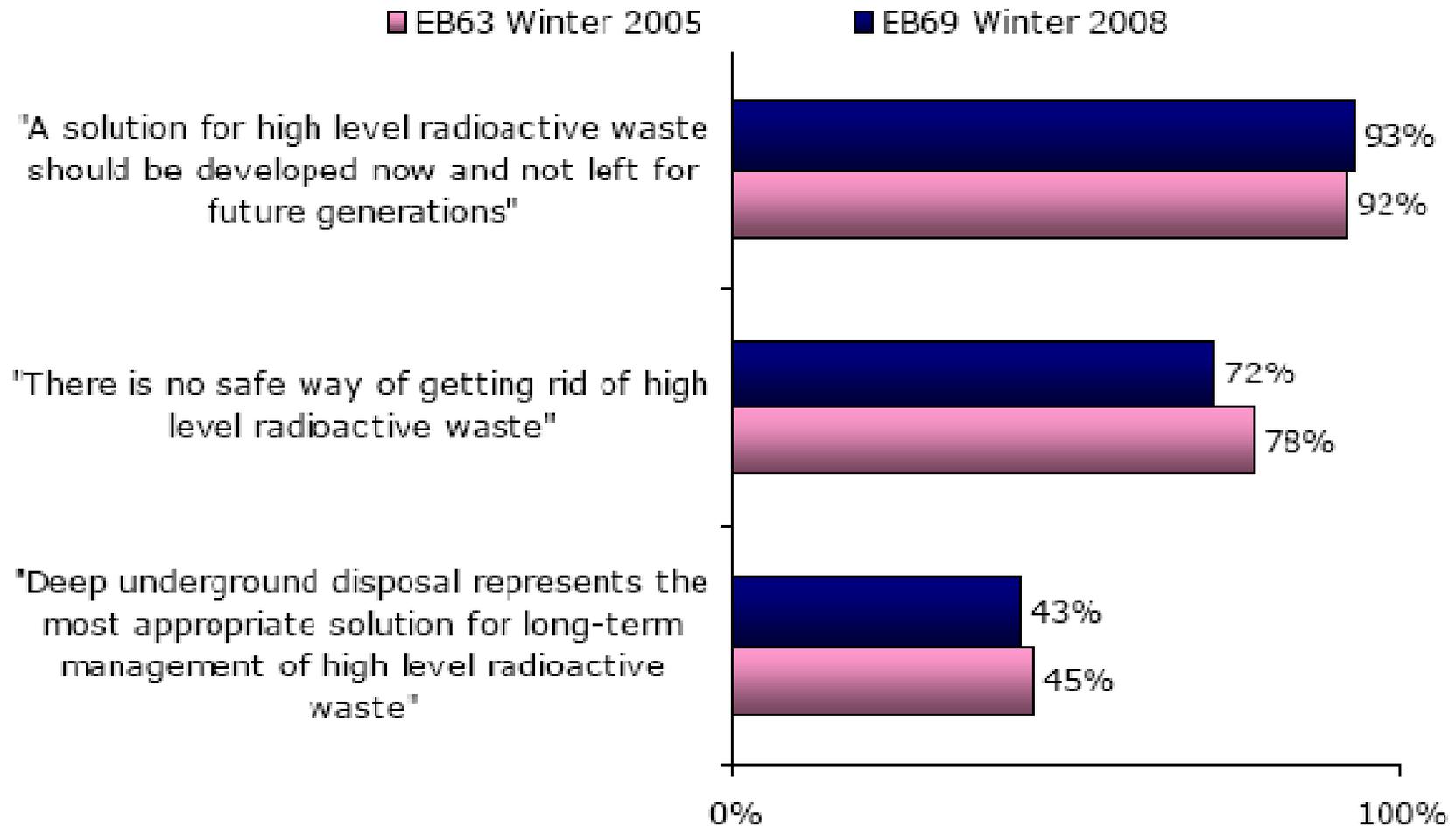
Definitely use
  Probably use
  Not sure
  Probably not use
  Definitely not use

**Q: And if there was a permanent and safe solution for the management of radioactive waste, would you then be [...] in favour or [...] opposed to energy production by nuclear power stations? [Asked of those that are opposed to nuclear energy production]**



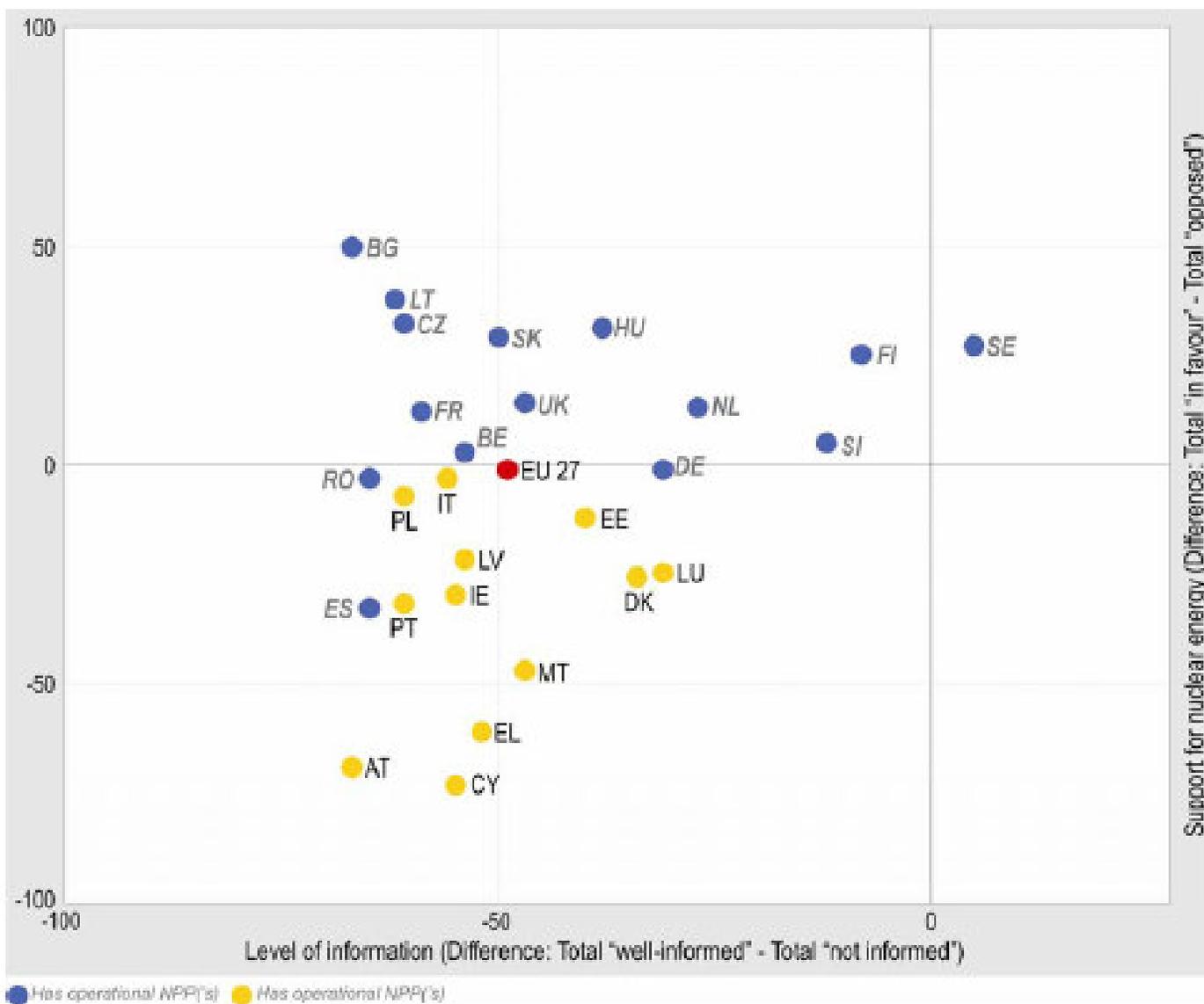
Source: Eurobarometer 297, June 2008

# Attitudes toward RW Disposal

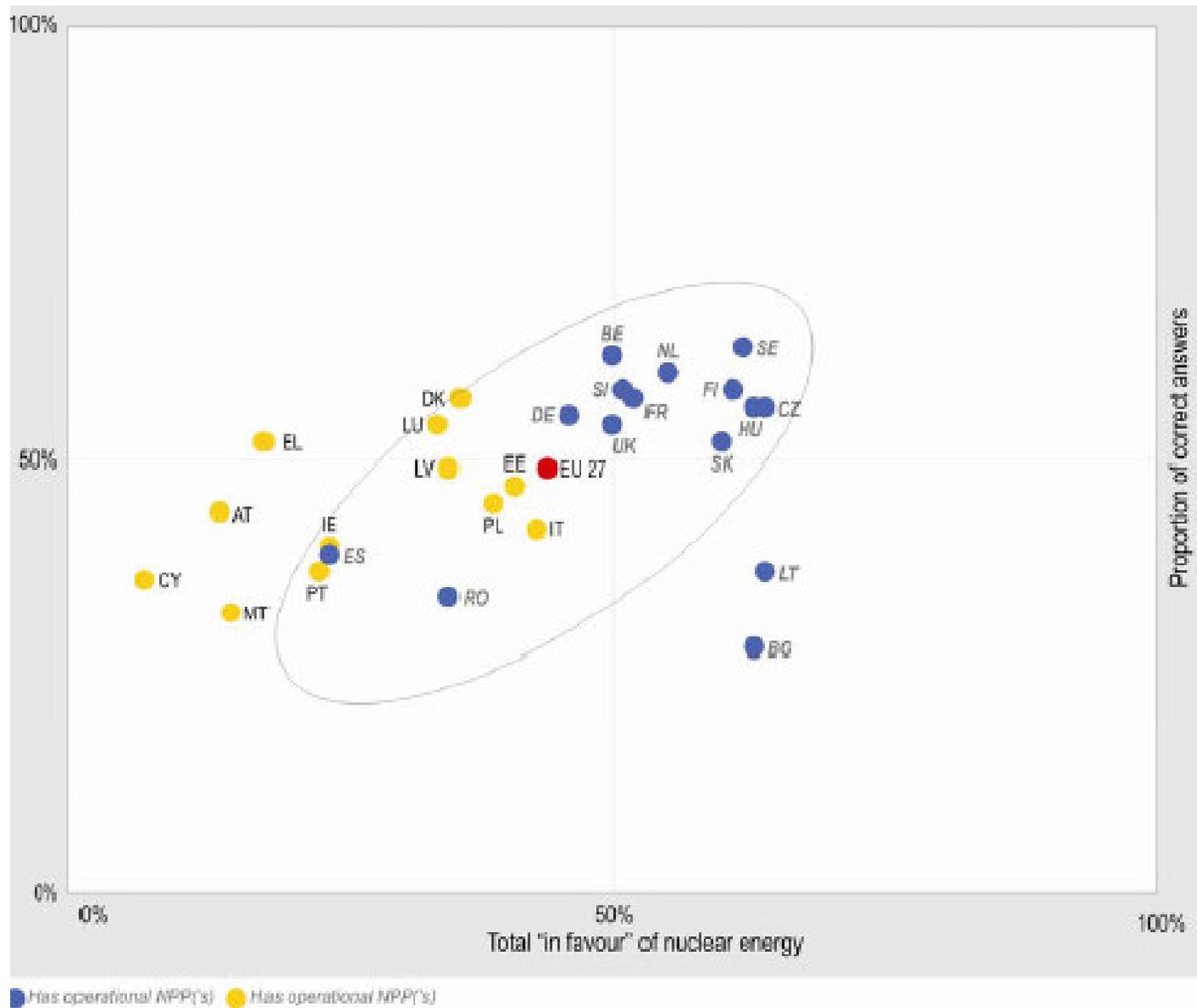


Source: Eurobarometer 297, June 2008

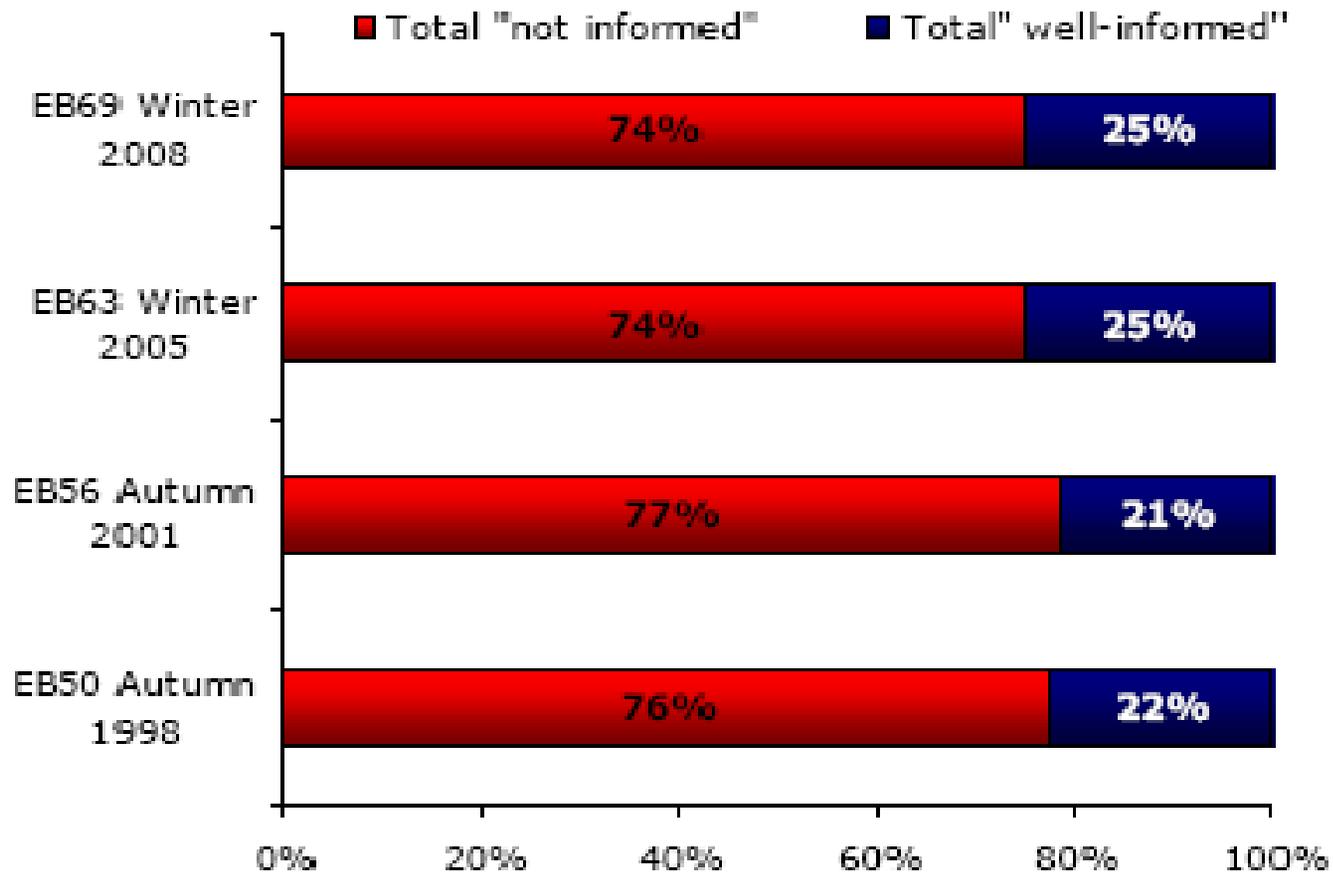
# Informed vs In Favour?



# Knowledgeable vs In Favour?



# How well informed do you think you are about radioactive waste?



Source: Eurobarometer 297, June 2008

# Protest

‘One of the primary early targets of ecological activism was the nuclear power industry. In fact, of all forms of environmental politics, the antinuclear movement was the most directly reminiscent of Sixties activism. With citizens’ referenda, lobbying, litigation, and administrative intervention; civil disobedience and other forms of direct action; and mass rallies aglow with countercultural trappings, the antinuclear movement recalled the antiwar movement that had just ended. In its early days, it was largely populated by former peace activists as well as feminists, assorted environmentalists, and counterculture communards.’  
(Morgan 1991: 244 )

# History repeating itself?



In *Bomb Culture* (1968) Jeff Nuttall described one CND Aldermaston march as 'A carnival of optimism'. 'Protest was associated with festivity.'

# Camp for Climate Action



# Public Protest on CO<sub>2</sub> Storage: Barendrecht, the Netherlands



# Public Protest on CO<sub>2</sub> Storage: Beeskow, Germany



# Any softening of position?

The anti-nuclear disposition of most NGOs has remained steadfast in the face of growing concerns over climate change.

# Lessons for CCS from the Nuclear Experience

- Many advocates of CCS are hostile to any comparisons to nuclear power in spite of obvious technical as well as social and political similarities
- Even acknowledging the important differences, proponents of CCS should have much to learn from the experience with nuclear power and they ignore it at their peril