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Tyndall°Centre
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ACCSEPT Survey on CO₂ Capture and Storage (CCS): Resume of Key Findings and Implications

Simon Shackley

University of Manchester

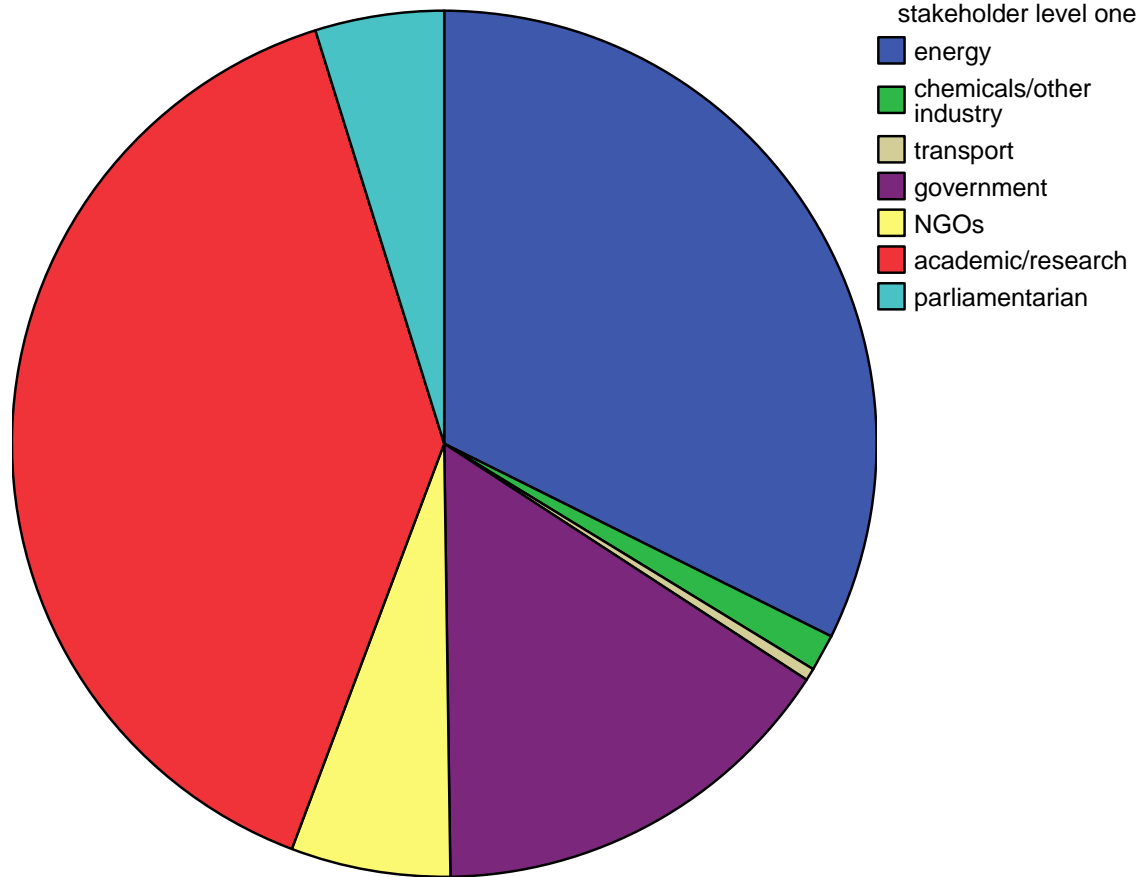
ACCSEPT Meeting, Bonn
May 10 & 11th 2007



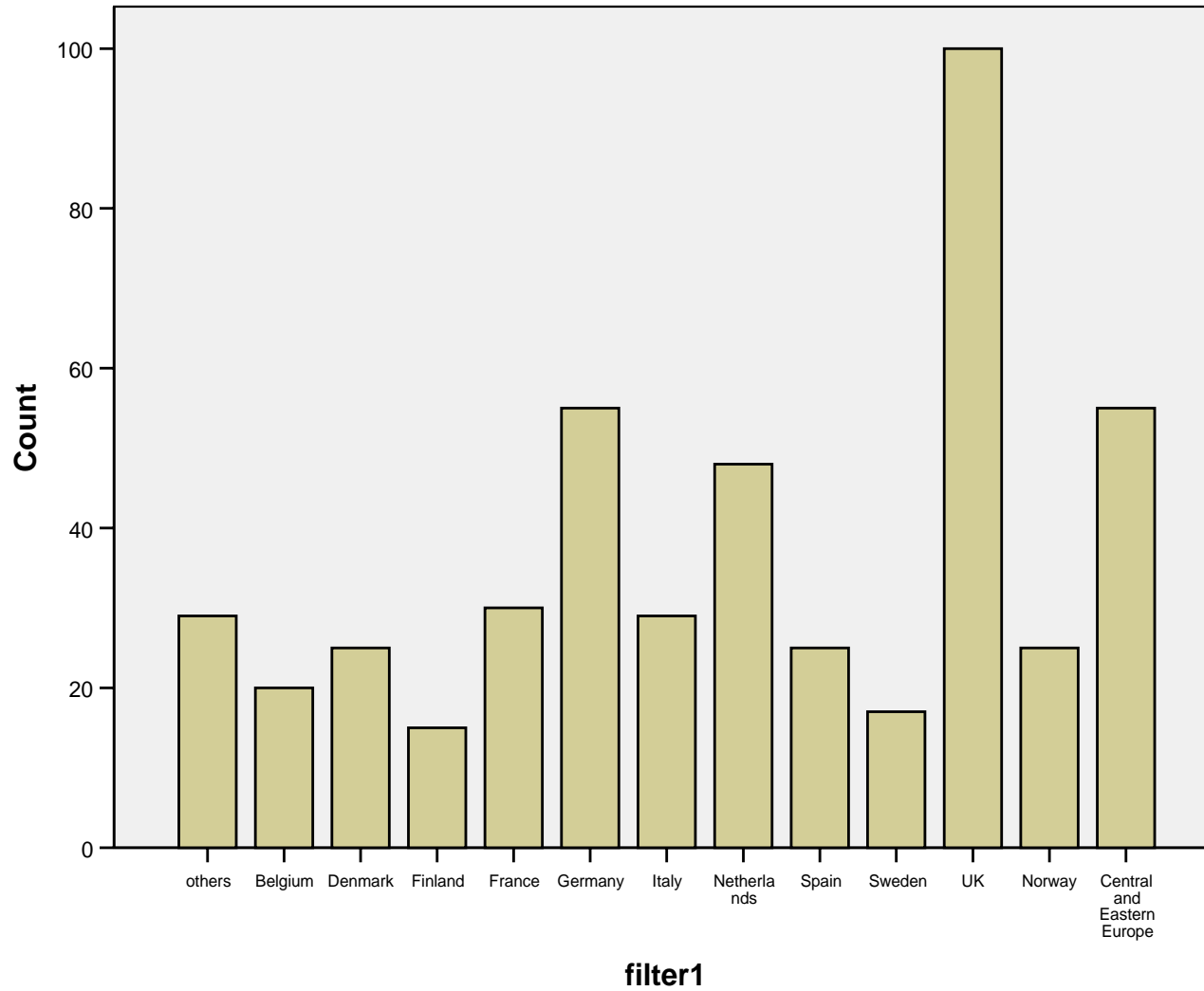
Respondents

- 512 respondents
- Most commonly represented are academics / researchers (34%) and commercial energy sector (28%)
- Government respondents 13%, NGOs 5% and parliamentarians 4%

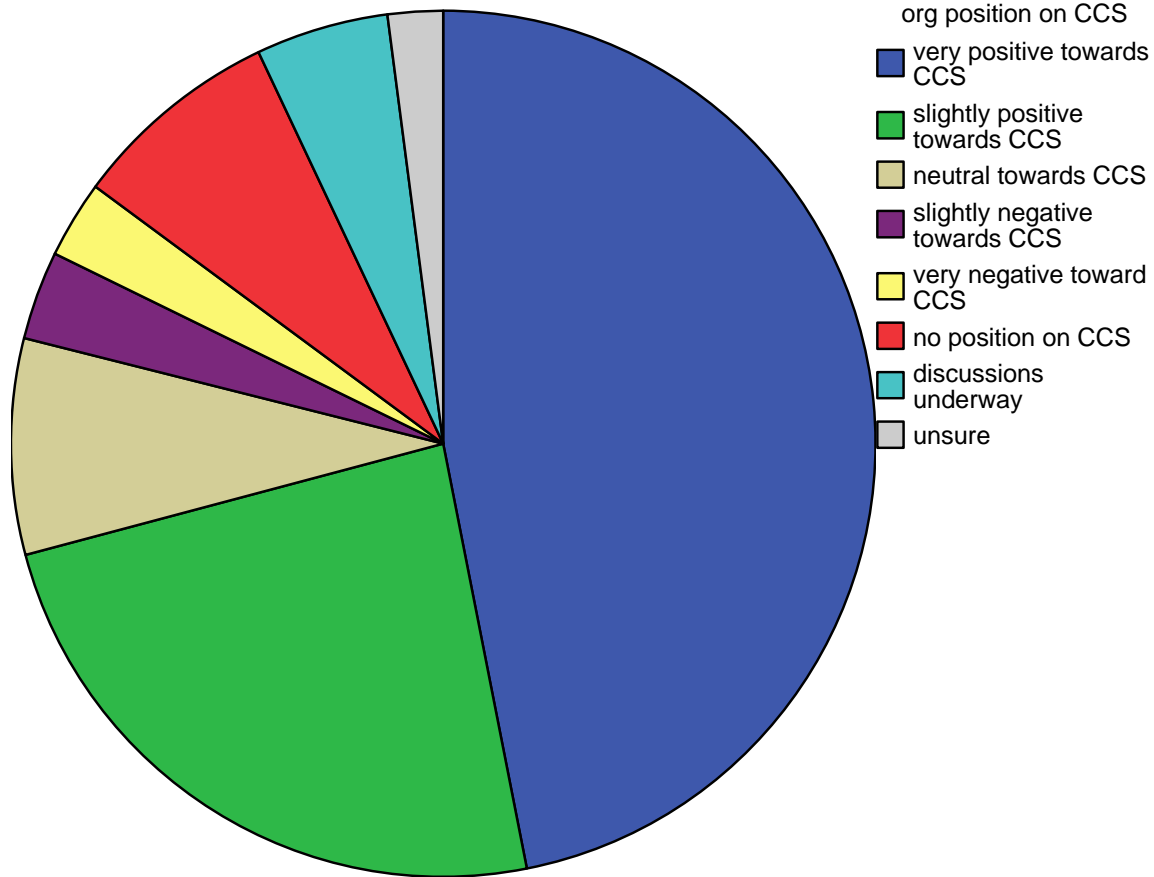
Breakdown of respondents by stakeholder type



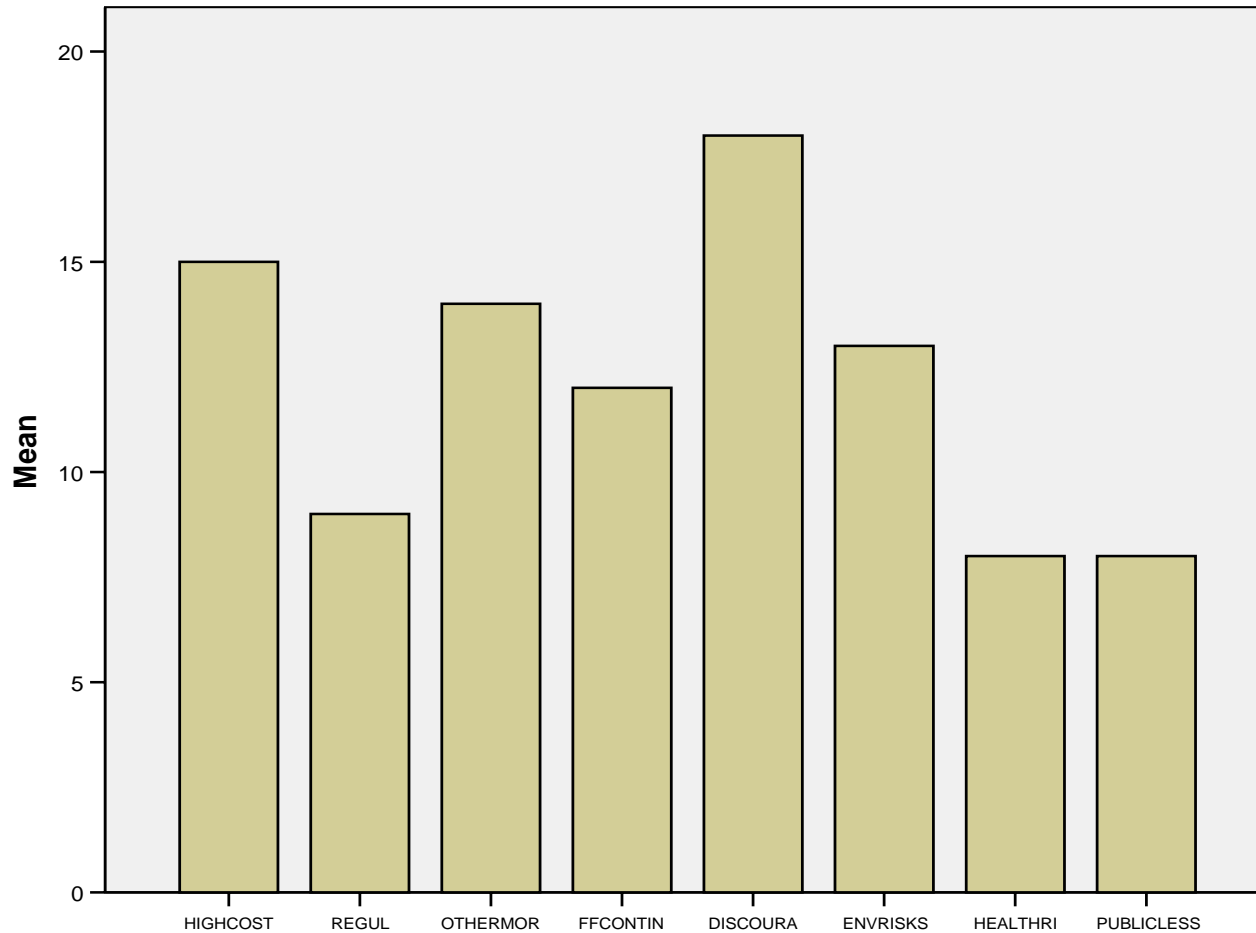
Breakdown of respondents by country



Organisational positions on CCS (Q6)



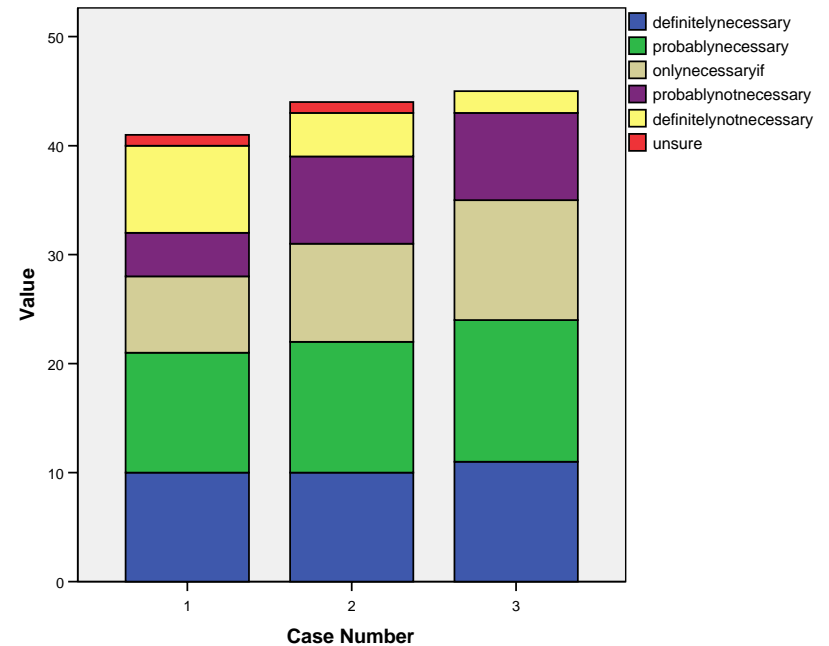
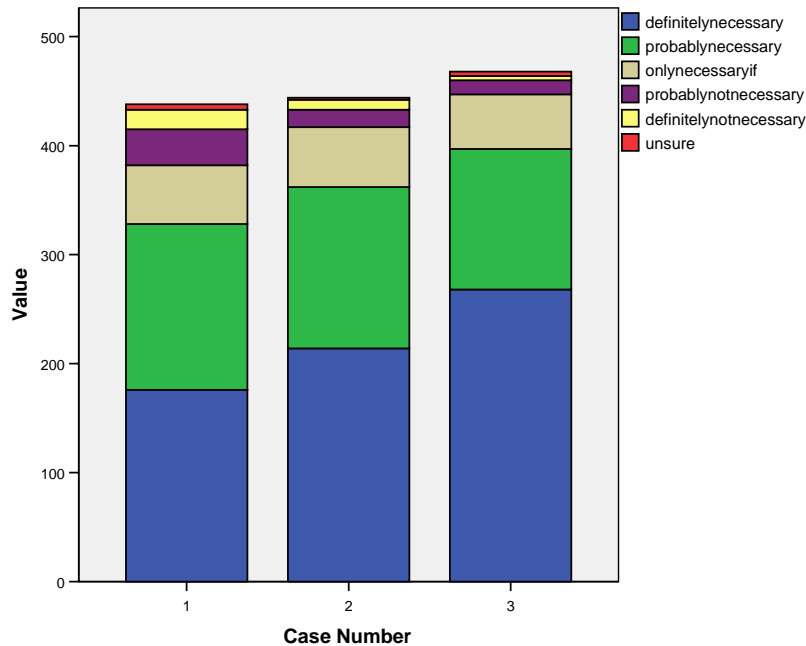
Main reasons for position on CCS by **slightly or very negative** organisations (Q7)



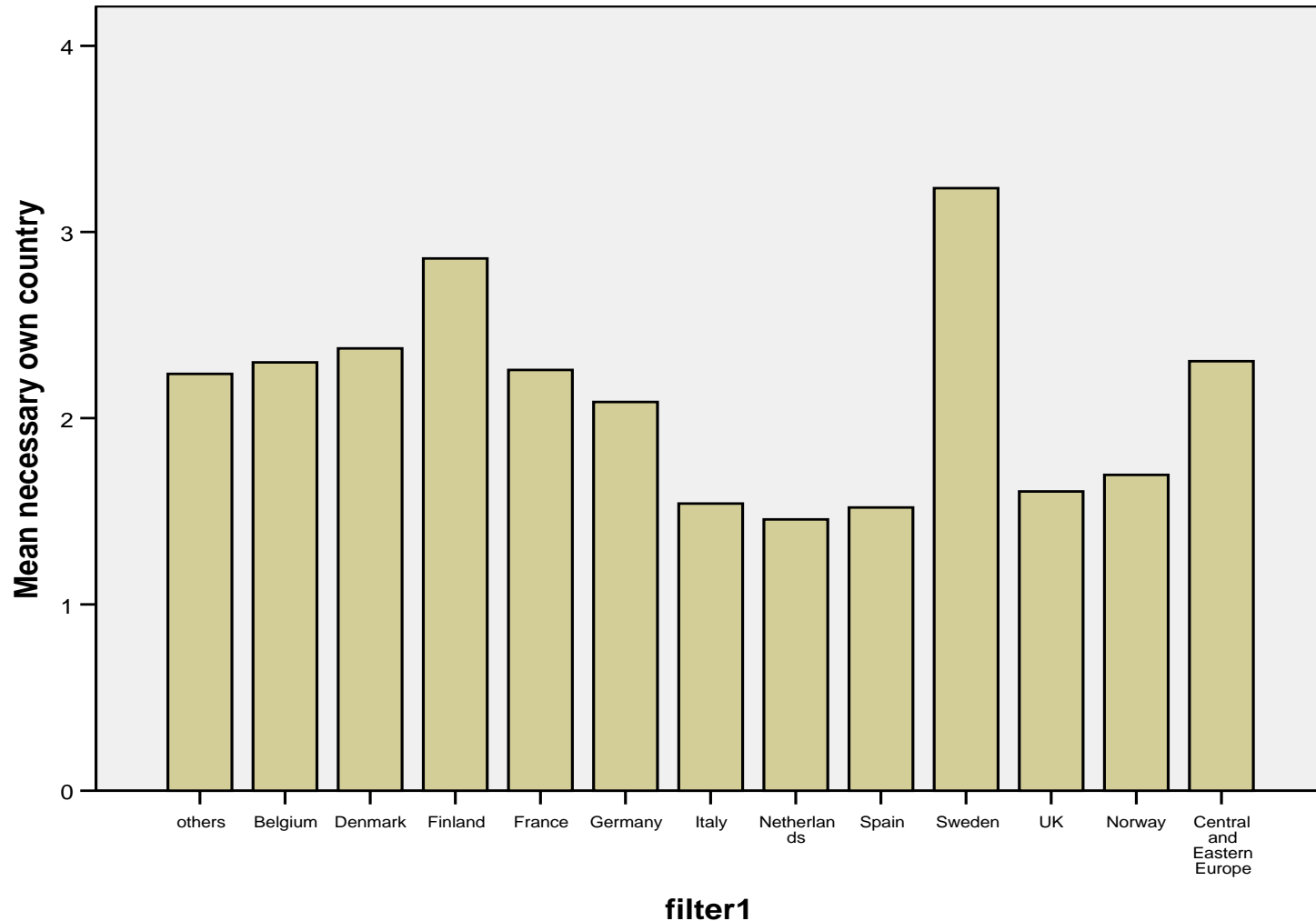
Perceived need for CCS in own country, EU and globally (Q8)

- A large percentage of respondents believe that CCS is definitely or probably necessary
- Increasing from own country, to EU to global scale
- Norway, UK and Netherlands most enthusiastic
- Finland and Sweden least supportive (but still on balance in favour)
- Energy, government and research stakeholders strongly supportive
- NGOs ambivalent
- Parliamentarians in between

Perceived need for CCS in own country (1), EU (2) and globally (3) (Q8) full sample (left) and for NGO & parliamentary respondents only (right)



Perceived need for CCS by country (Q8, part 1) (1 indicates 'definitely necessary', 2 'probably necessary', 3 'only necessary if other options fail to live up to current expectations', 4 'probably not necessary' and 5 'definitely unnecessary')

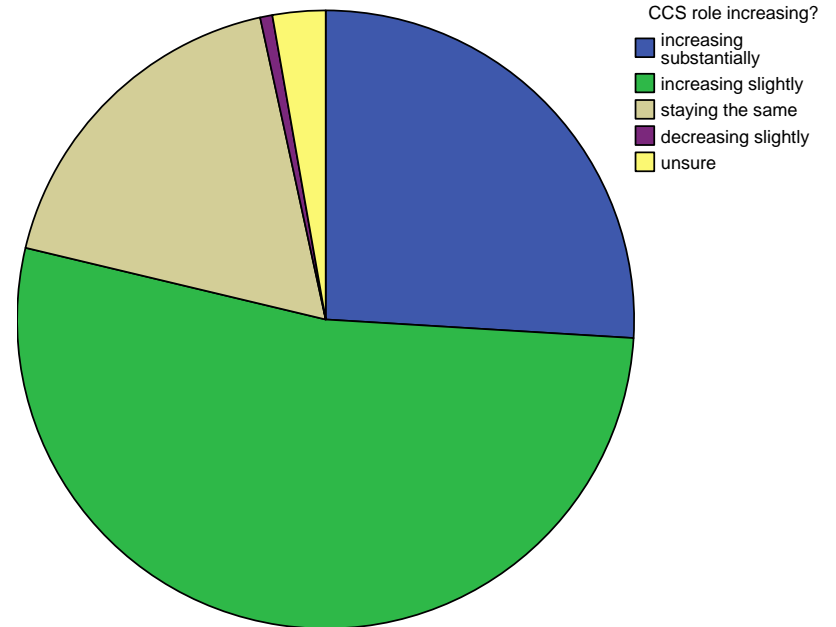
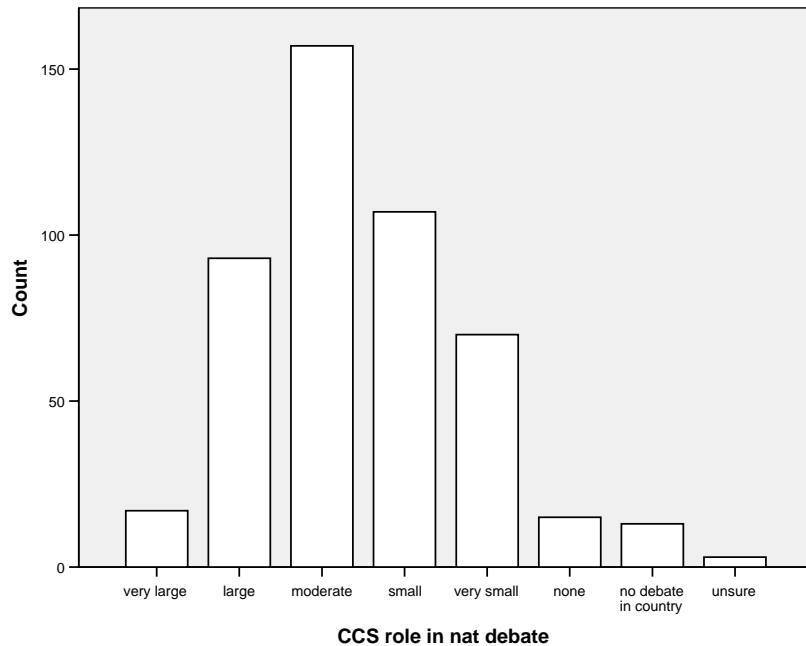


(Changing) Role of CCS in the National Debate

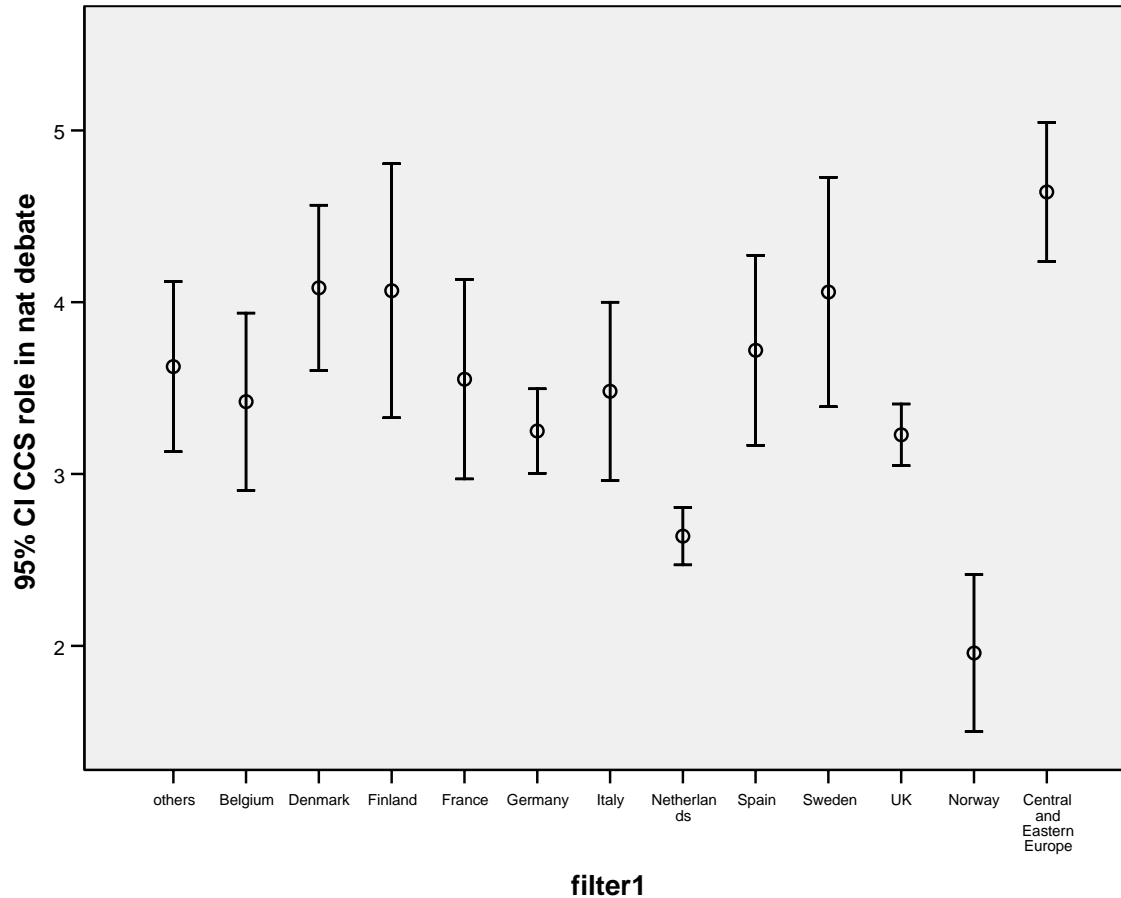
(Qs 9 &10)

- CCS has large or moderate role in the current national debate (57%)
- Significantly larger role in Norway (Netherlands, UK, Germany)
- Smaller role in Denmark, Finland, Sweden
- Role of CCS is generally increasing
- Increasing most in Norway, Germany, Netherlands and UK

Role of CCS in national debate (Q9)(left) and how it changing (Q10, right)



The role of CCS in the national debate by country (Q9) in the eight selected countries (1 indicates 'very large', 2 'large', 3 'moderate', 4 'small', 5 'very small', 6 'none', and 7 'there is no debate')

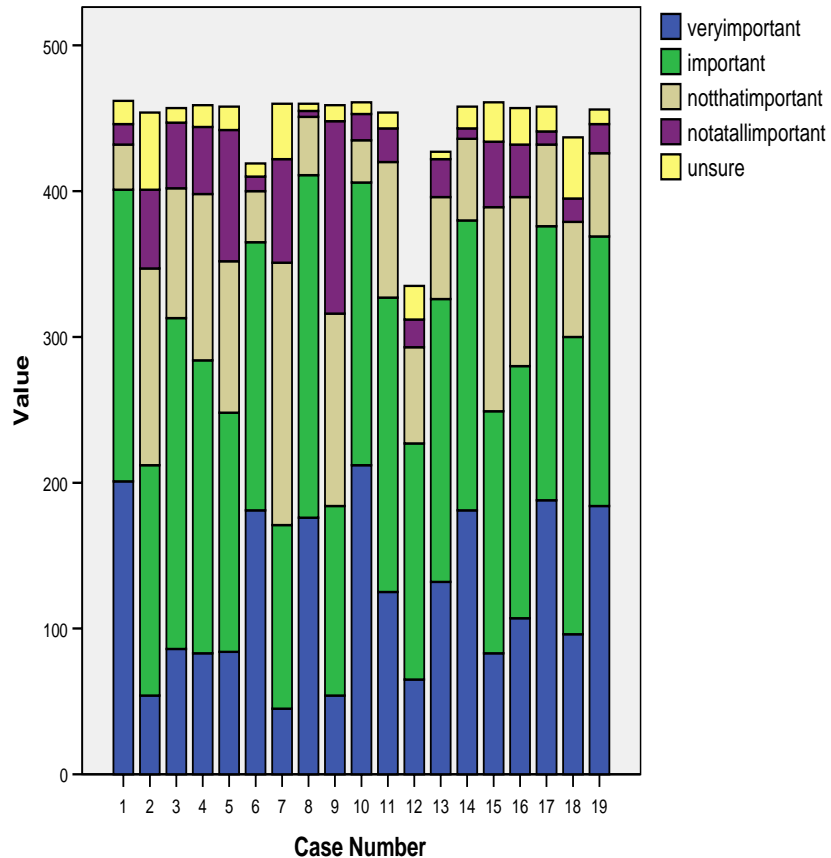


The Enabling Context for CCS in Home Country (Q11)

in descending order of importance:

- availability of suitable geological storage sites
- price of carbon under EU ETS
- reduction in costs of CO₂ capture
- development of R&D base
- a post-Kyoto phase with tighter national emission reduction requirements
- development of legal & regulatory basis
- public perceptions
- *Least important:* venture capital, H₂ economy, domestic supplies of coal
- coal countries (e.g. Poland, Germany, UK) regard this as more important factor
- Oil and/or gas (Norway, UK, Netherlands, Denmark) regard enhanced hydrocarbon recovery as more important
- NGOs and parliamentarians regard public perceptions as **less** important enabling factor

Importance of factors in the development of CCS in own country (question 11)

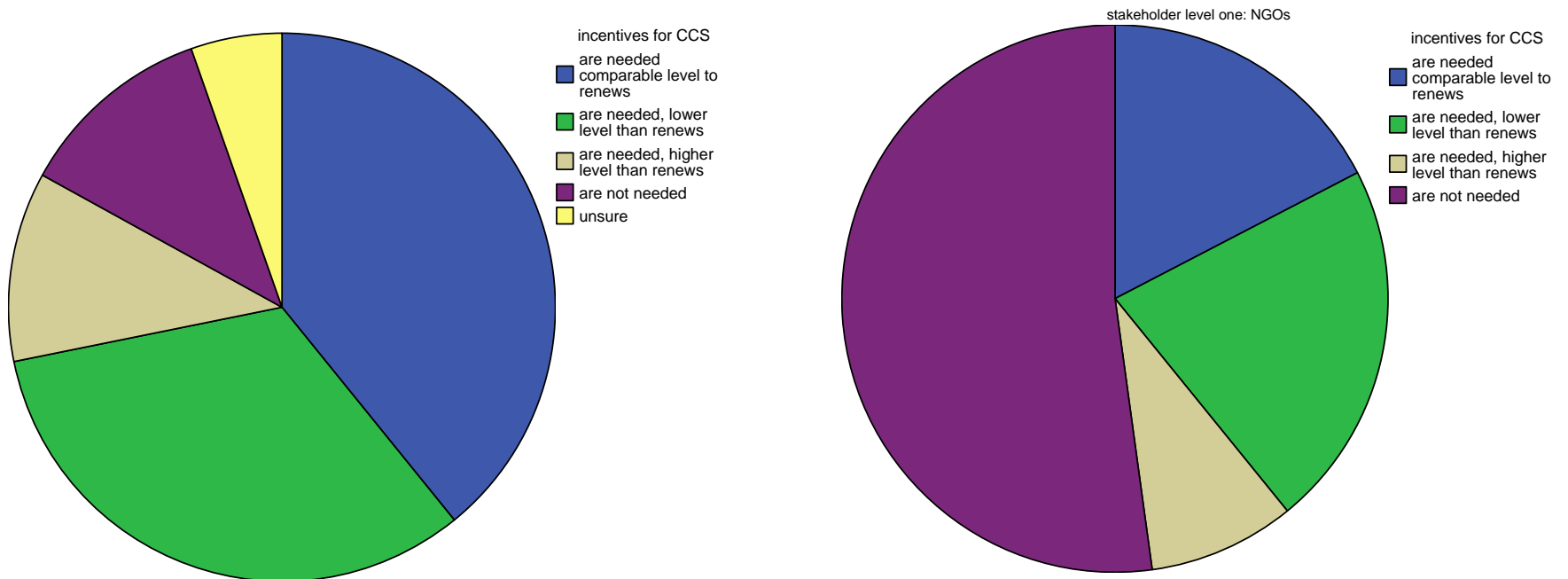


- 1: price of carbon under the EU Emissions Trading Scheme
- 2: availability of venture capital
- 3: concerns about energy security
- 4: need to replace aging power plant
- 5: opportunities for Enhanced Oil / Gas Recovery with CO₂
- 6: reduction in costs of CO₂ capture
- 7: development of the H₂ economy
- 8: development of the research and technological based for CCS
- 9: availability of domestic supplies of coal
- 10: availability of suitable geological storage sites
- 11: development of other zero- or low-carbon energy generation technologies
- 12: existence of relevant skills base
- 13: Kyoto Protocol commitments
- 14: a post-Kyoto phase with tighter national emission reduction requirements
- 15: negotiating stance and policy of the USA
- 16: negotiating stance and policy of China and India
- 17: development of legal and regulatory basis for CCS (including accounting, monitoring and liability)
- 18: eligibility of CCS for the Clean Development Mechanism (CDM) and / or Joint Implementation
- 19: public perceptions of CCS

Provision of financial incentives for CCS (Q12)

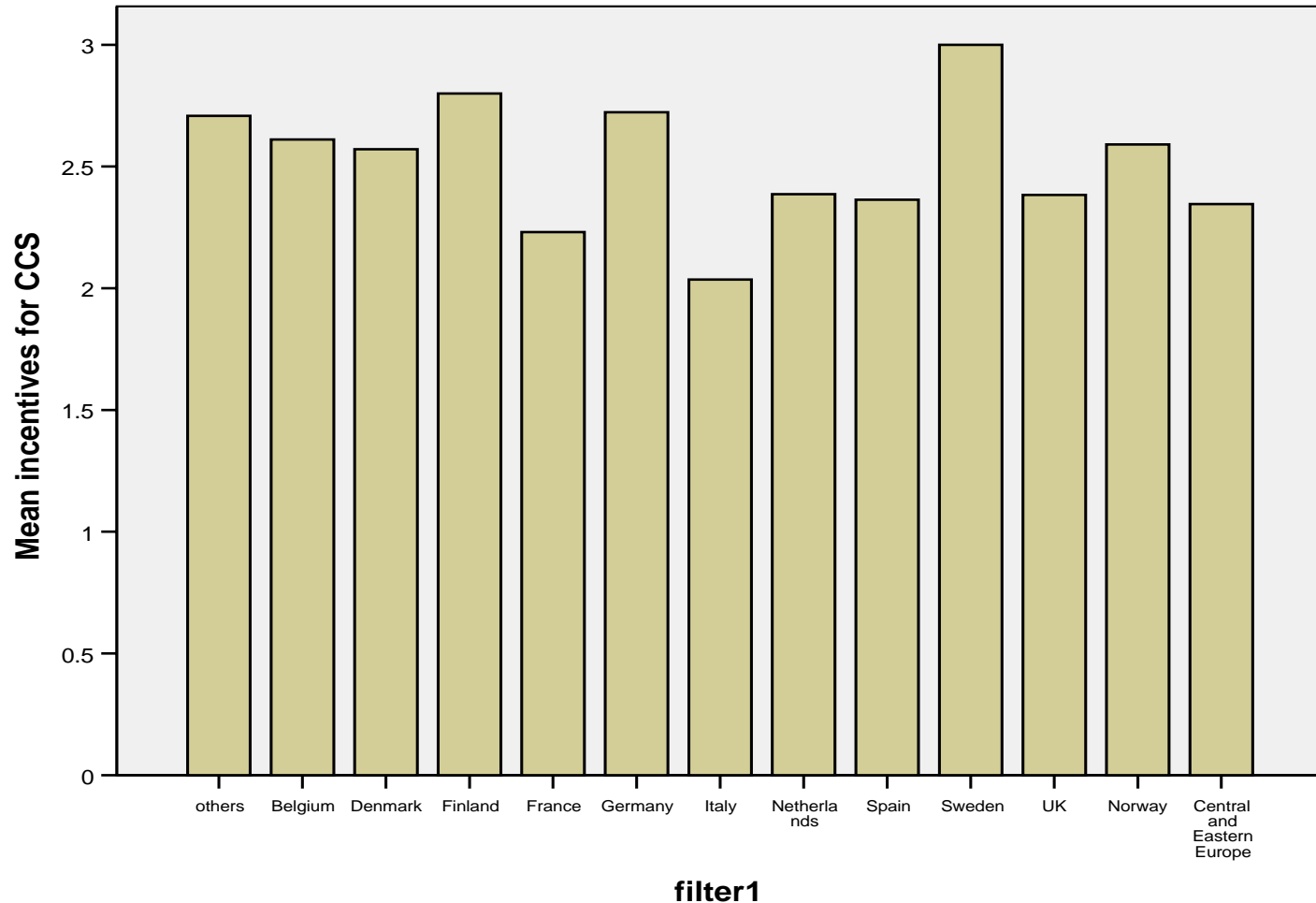
- Half want incentives equal to renewables (39%) or higher (11%). 33% want lower incentives and 12% want no incentives
- NGOs and parliamentarians least enthusiastic about generous incentives
- Danish, British and Dutch respondents most in favour of more generous incentives.

Provision of financial incentives for CCS (left) and NGO views on incentives (right) (Q12)



Provision of financial incentives for CCS (Q12): selected countries

(1 indicates that incentives 'are needed, but at a higher level than for renewables', 2 'are needed at a level comparable to renewables', 3 'are needed but at a lower level than for renewables' and 4 'are not needed')



Opinion on type of financial incentives for CCS (Q13)

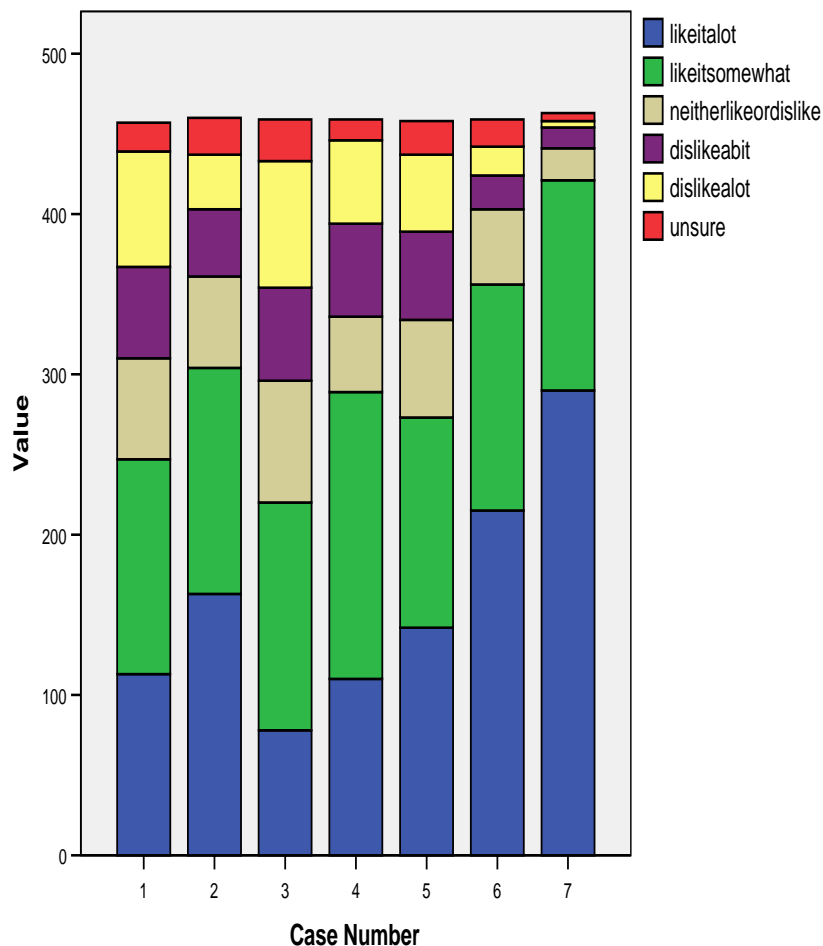
Most popular

1. RD&D (over 90% in favour)
2. early commitment to extend EU ETS with tighter emission caps (77% in favour, 8% against)
3. requirement for electricity generators to supply a given % of zero- or low-carbon electricity (any source)

Least popular

1. guaranteed feed-in tariff for CCS electricity
2. All stakeholders support an early commitment to extension of the EU ETS with tighter national emission caps.

Opinion on financial incentives for CCS (Q13)



- 1: a requirement for electricity generators to supply a given % of zero- or low-carbon electricity through CCS
- 2: a requirement for electricity generators to supply a given % of zero- or low-carbon electricity (all sources)
- 3: a guaranteed feed-in price for electricity produced by CCS
- 4: a capital subsidy scheme to support construction of CCS plant
- 5: an economy-wide carbon tax
- 6: an early commitment to extend the EU ETS beyond 2012 with tighter emission caps
- 7: support for research, development and demonstration projects

Implementation of incentives and how CCS should be regulated (Qs 14 & 15)

How to implement

- Common CO₂ price through EU ETS plus additional national incentives (50%)
- Common incentives structure across EU but no additional national incentives (36%)
- Very few supported phasing out of the EU ETS

How to regulate

Most popular

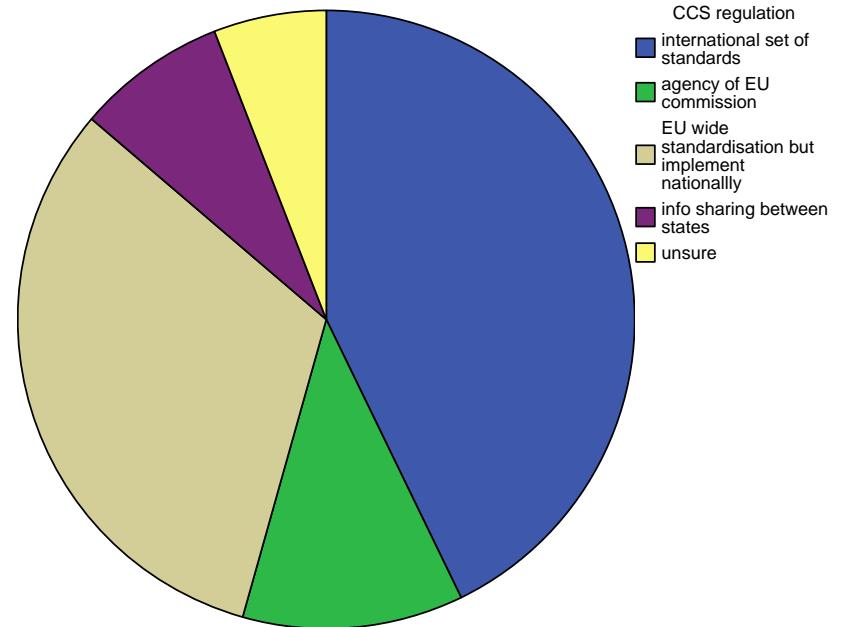
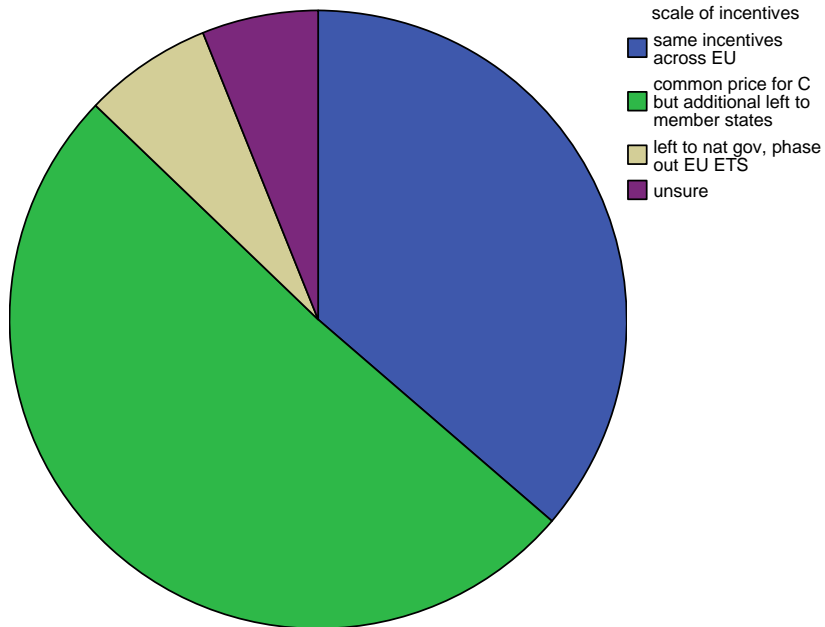
- internationally agreed set of standards (43%)
- EU wide standardisation with national implementation (32%)

Least popular

- information sharing (8%)
- an agency of the EU Commission (2%)

NGOs favour an international set of standards (57%)

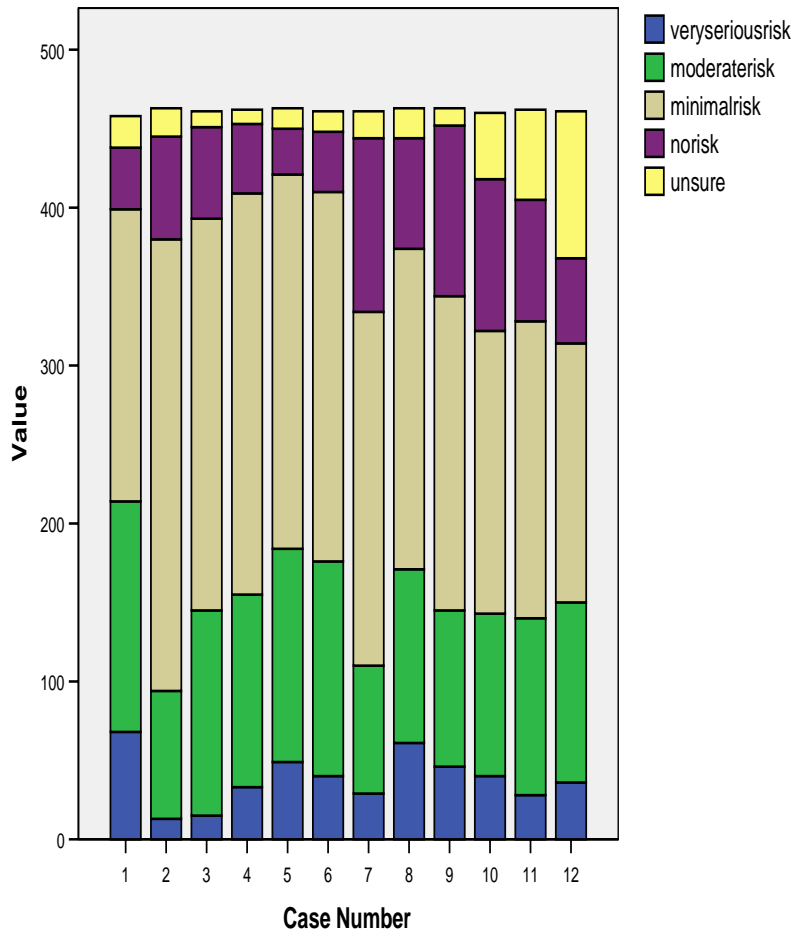
Implementation of incentives for CCS (Q14) (left) and on how CCS should be regulated (Q15) (right)



Potential risks of CCS (Q16)

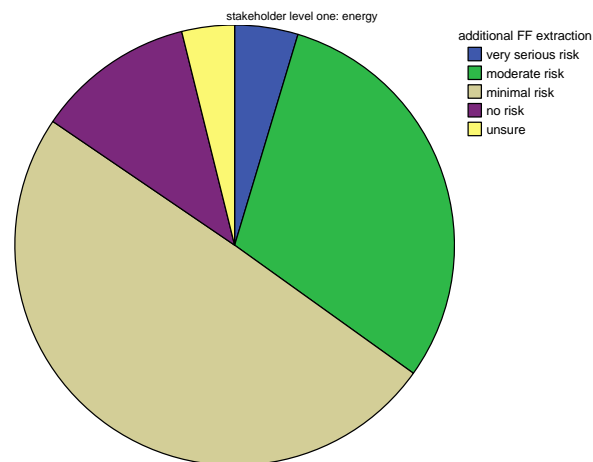
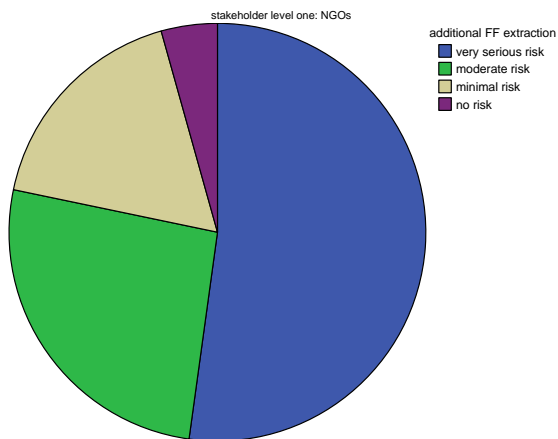
- Risk perceptions not large – most common response is ‘minimal risk’
- *Highest risks identified:* energy penalty, human health & safety and environmental damage from onshore CO₂ storage and environmental damage from offshore CO₂ storage
- *Lowest levels of perceived risk:* accidents at power stations and human health & safety risks from offshore CO₂ storage site leakage
- NGO (parliamentarians) much more concerned about potential risks than other respondents

Potential risks of CCS (question 16)

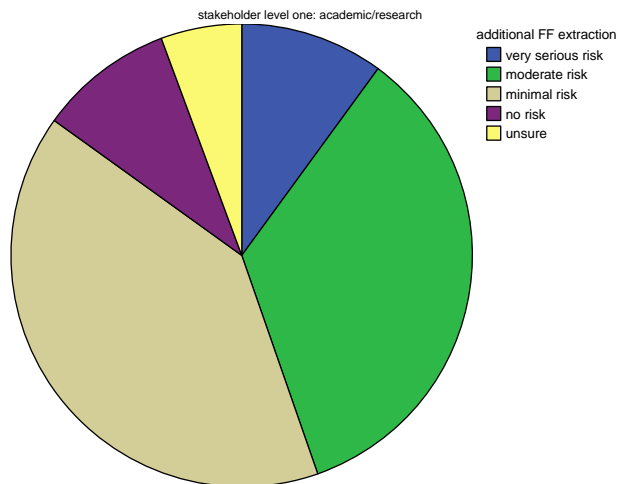


- 1: impacts arising from additional extraction of fossil fuels to compensate for the energy penalty associated with CO2 capture
- 2: accidents arising from inclusion of CO2 capture at power stations
- 3: impacts of new CO2 pipeline network on landscape and environment
- 4: human health and safety risks from leakage from CO2 pipelines
- 5: human health and safety risks from **onshore** CO2 storage site leakage
- 6: local environmental damage from **onshore** CO2 storage site leakage
- 7: human health and safety risks from **offshore** CO2 storage site leakage
- 8: local environmental damage from **offshore** CO2 storage site leakage
- 9: global climate impacts from CO2 storage site leakage
- 10: global climate impacts due to additional greenhouse gas emissions resulting from enhanced hydrocarbon recovery
- 11: impacts of CO2 storage upon drinking water reservoirs
- 12: impacts of CO2 storage upon micro-organisms within the storage site

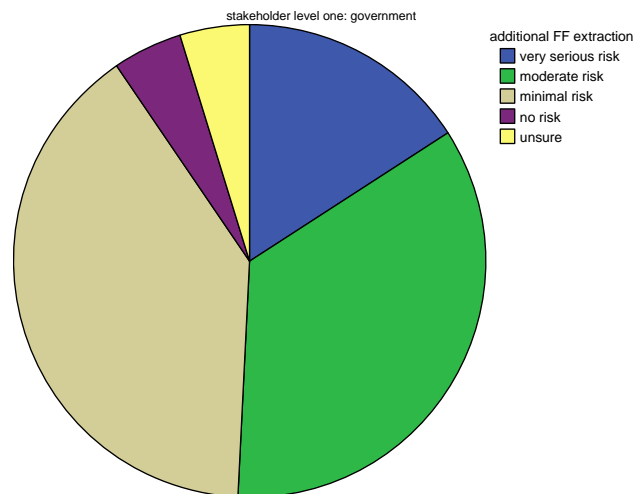
Impacts arising from energy penalty (Q16, part 1): NGOs (top left), energy sector (top right), researchers (bottom left), government (bottom right)



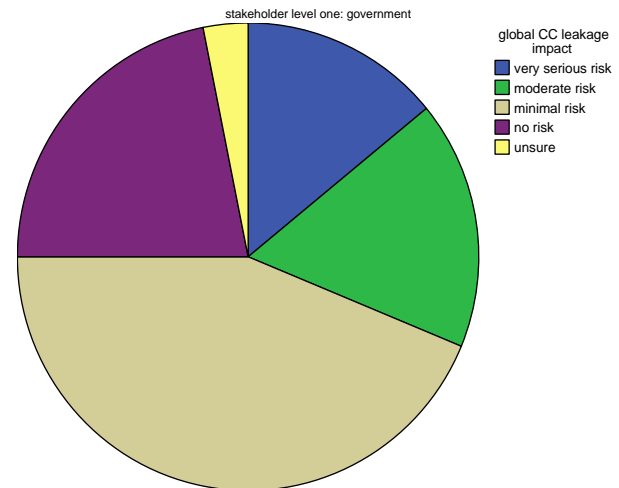
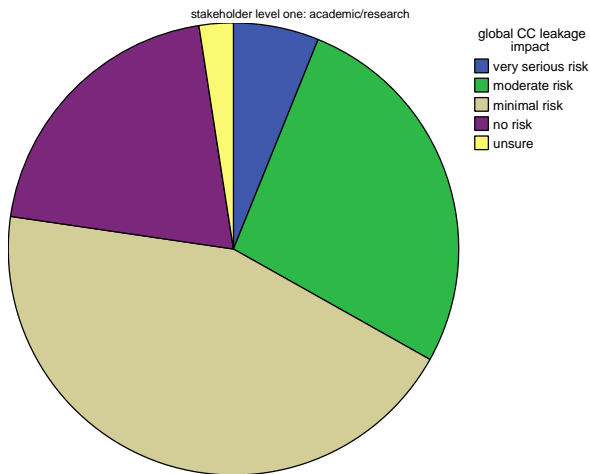
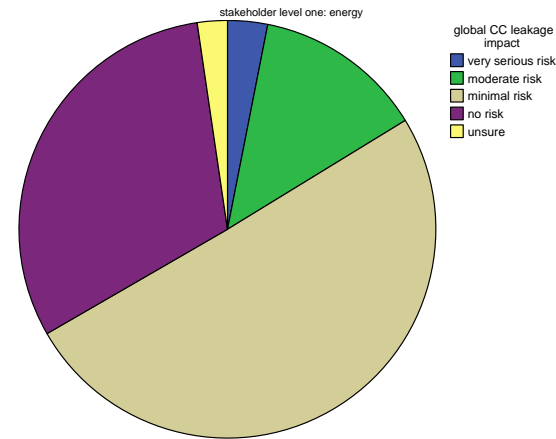
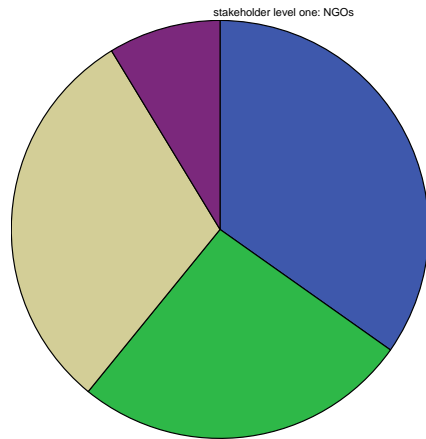
research



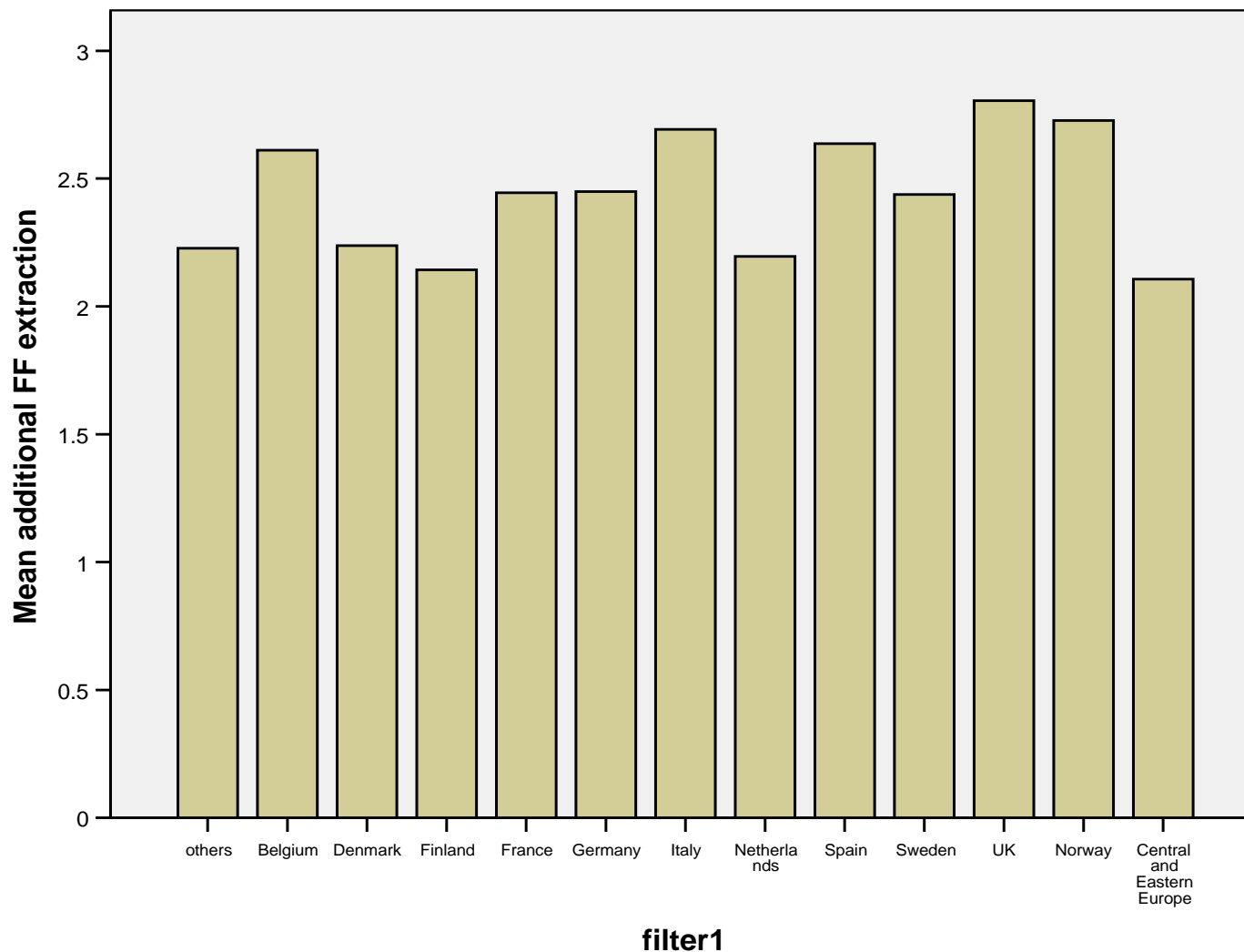
government



Impacts arising from global impacts of leakage (question 16, part 9): NGOs (top left), energy sector (top right), researchers (bottom left), government (bottom right)



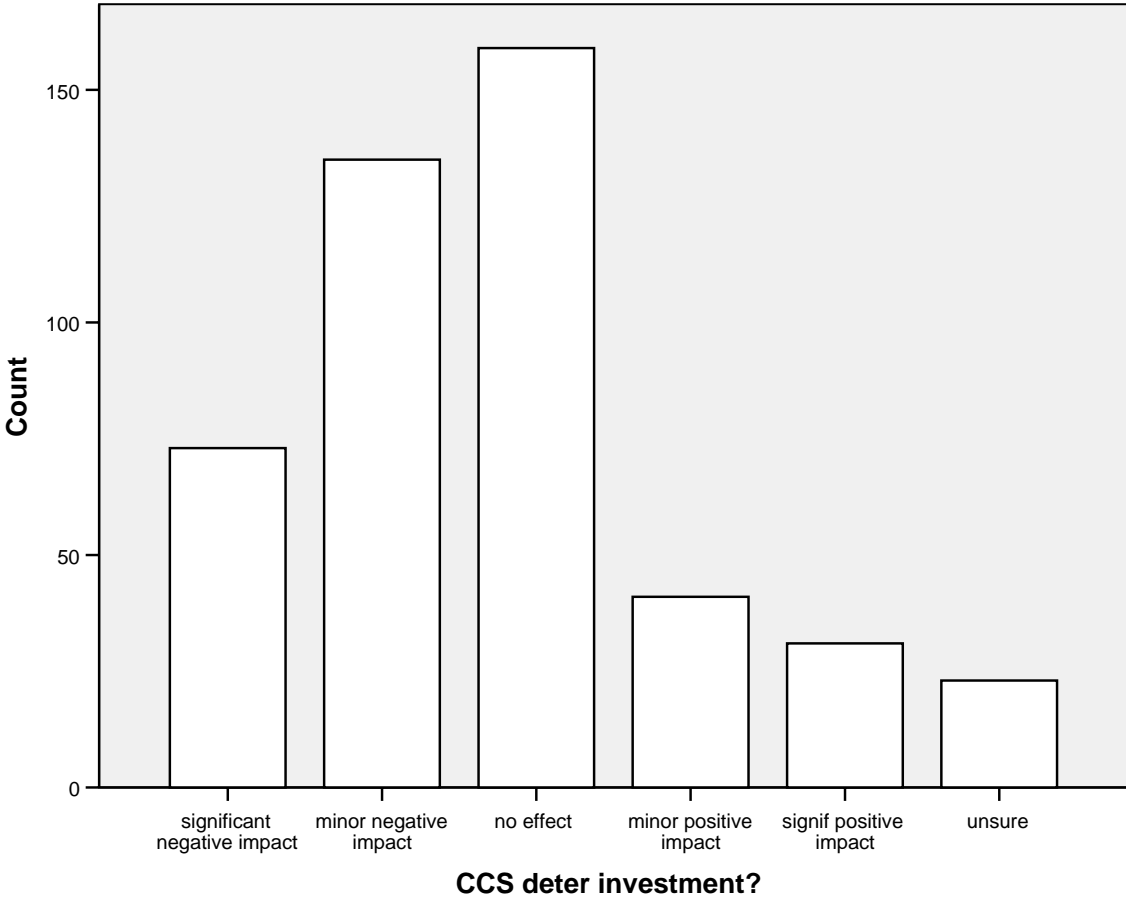
Impacts arising from energy penalty (Q16, part 1) in selected countries (1 'very serious risk', 2 'moderate risk', 3 'minimal risk', 4 'no risk')



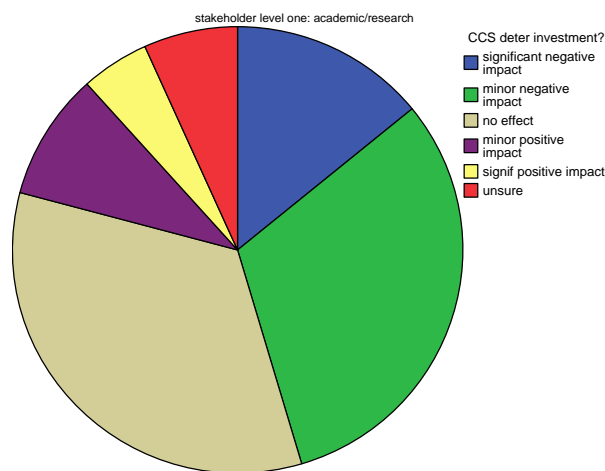
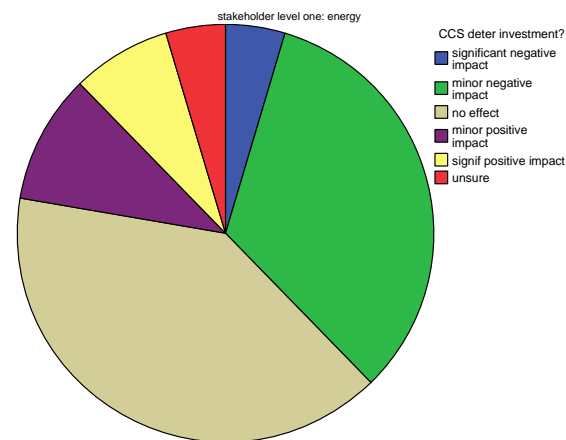
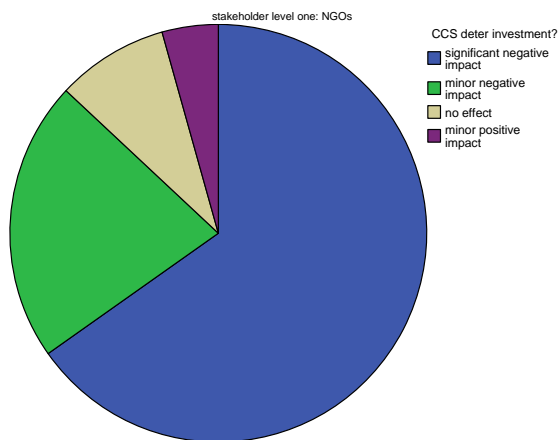
Impacts of CCS investment upon investment in other LZCTs in own country (Q17)

- Split between those who see a negative impact upon other LZCTs (44%) and those who do not or see it as positive (51%)
- NGOs most concerned about impact of CCS upon other LZCTs (65% 'significant negative impact')
- Energy stakeholders are least concerned (5% significant negative impact, 40% no impact)

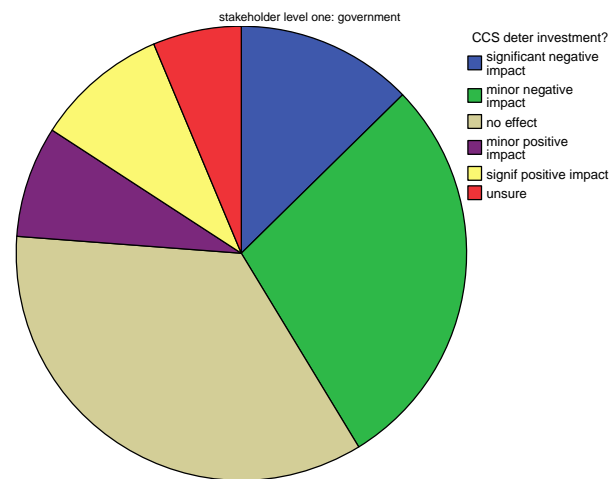
Impacts of CCS investment upon investment in other LZCTs in own country (Q17)



Impacts of CCS investment upon investment in other LZCTs in own country (Q17): NGOs (top left), energy sector (top right), researchers (bottom left), government (bottom right)



gov



Impacts of CCS investment upon investment in energy efficiency and energy demand reduction in own country (Q18) and upon moves to decentralised power generation system (Q19)

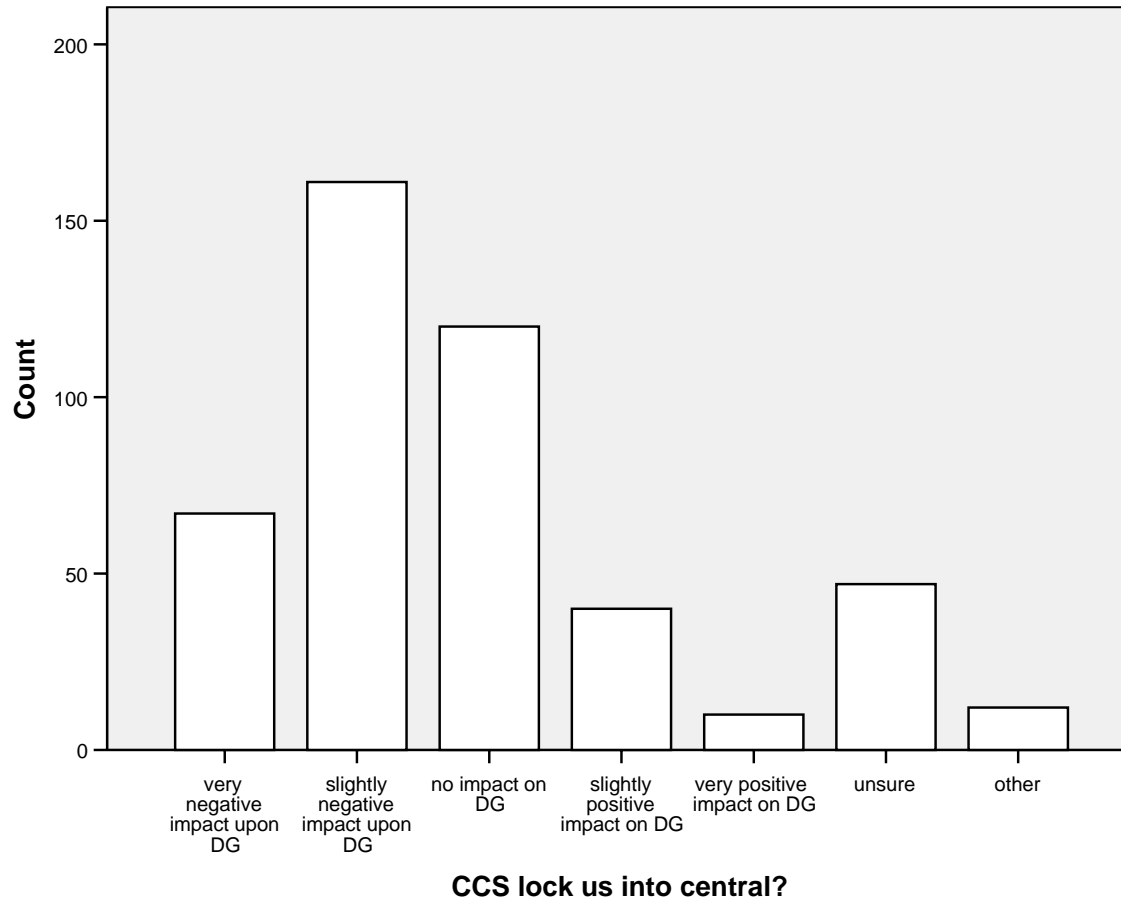
Energy efficiency

- Similar to last question but fewer negative impacts and more positive impacts
- NGOs most concerned
- Energy and government stakeholders see more positive impacts

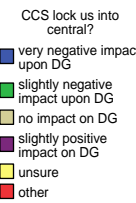
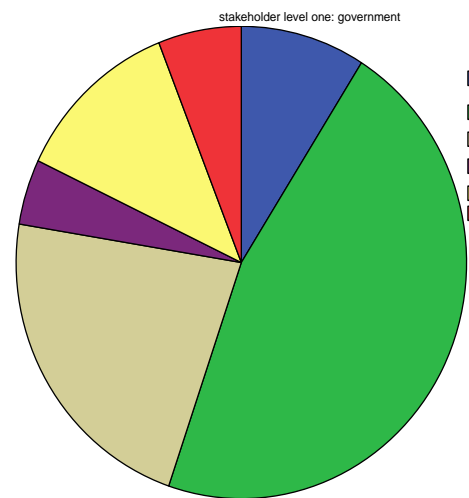
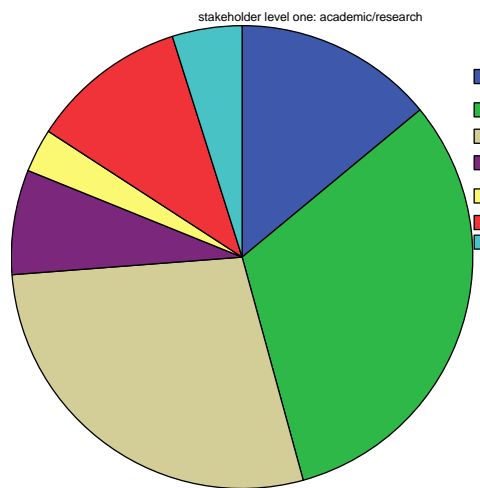
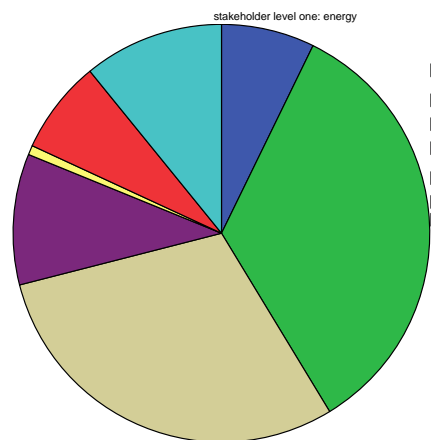
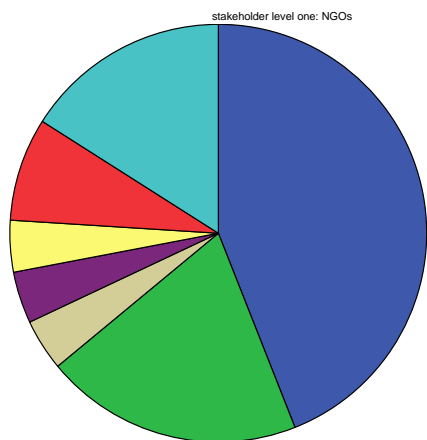
Decentralised power generation

- 'Very negative impact' (15%), 'slightly negative' (35%), 'no effect' (26%), 'positive' (11%)
- NGOs perceive risks to be greater

Extent to which CCS might increase dependency upon centralised power system (Q19)



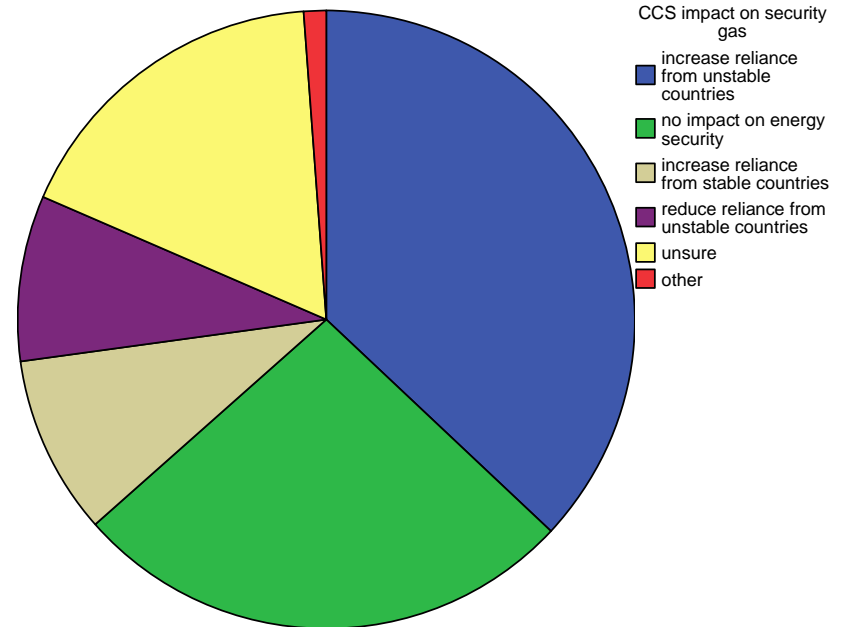
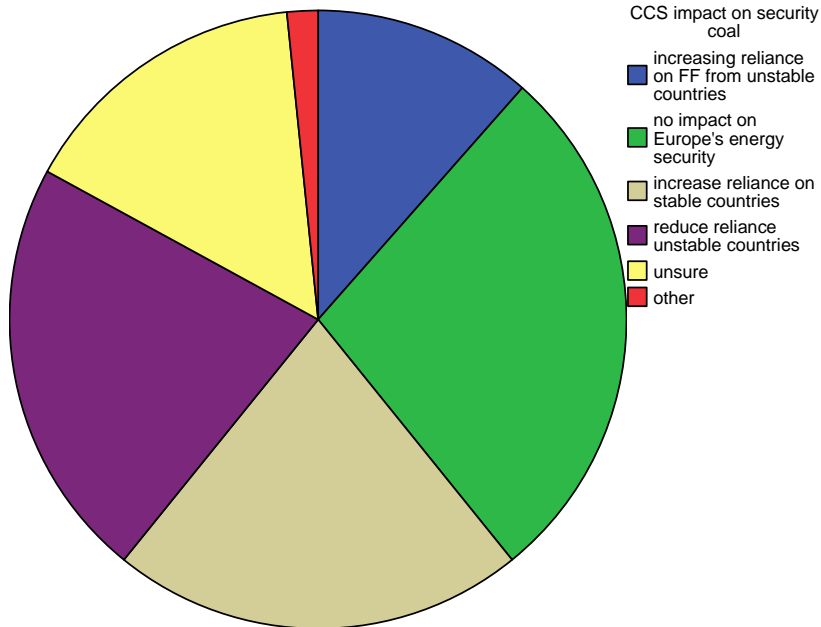
Extent to which CCS might increase dependency upon centralised power system (Q19): NGOs (top left), energy sector (top right), researchers (bottom left), government (bottom right)



Impacts of CCS upon energy security in the EU (Q20)

- Coal with CCS will *improve* energy security in the EU (44%), or no impact (28%)
- Natural gas with CCS will *reduce* energy security (37%), or no impact (27%)
- NGOs and parliamentarians are most concerned about energy security from gas with CCS
- Differences between stakeholder groups not large

Impact upon energy security in EU of CCS with coal (left) and gas (right) (Q20)



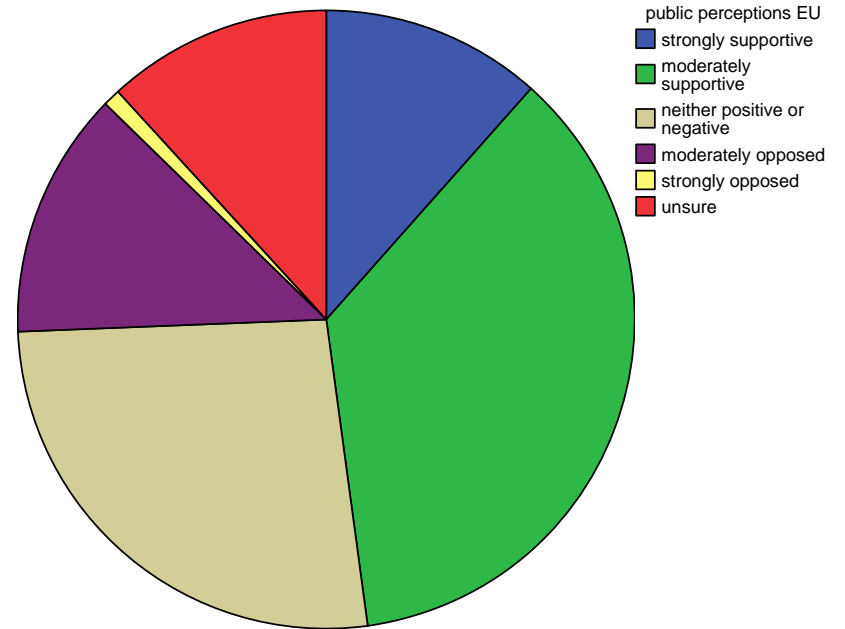
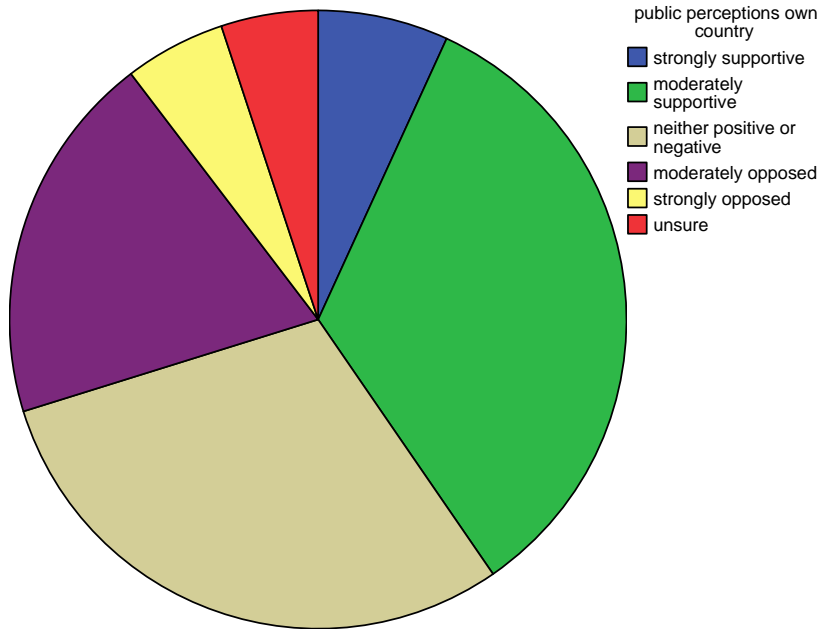
Public perceptions of CCS in own country (left) and in EU (right) (Q21)

- Public 'moderately supportive' (34%) in own country, followed by 'neutral' (30%)
- 'moderately opposed' (19%)
- 'strongly opposed' (4%) and 'strongly supportive' (5%)

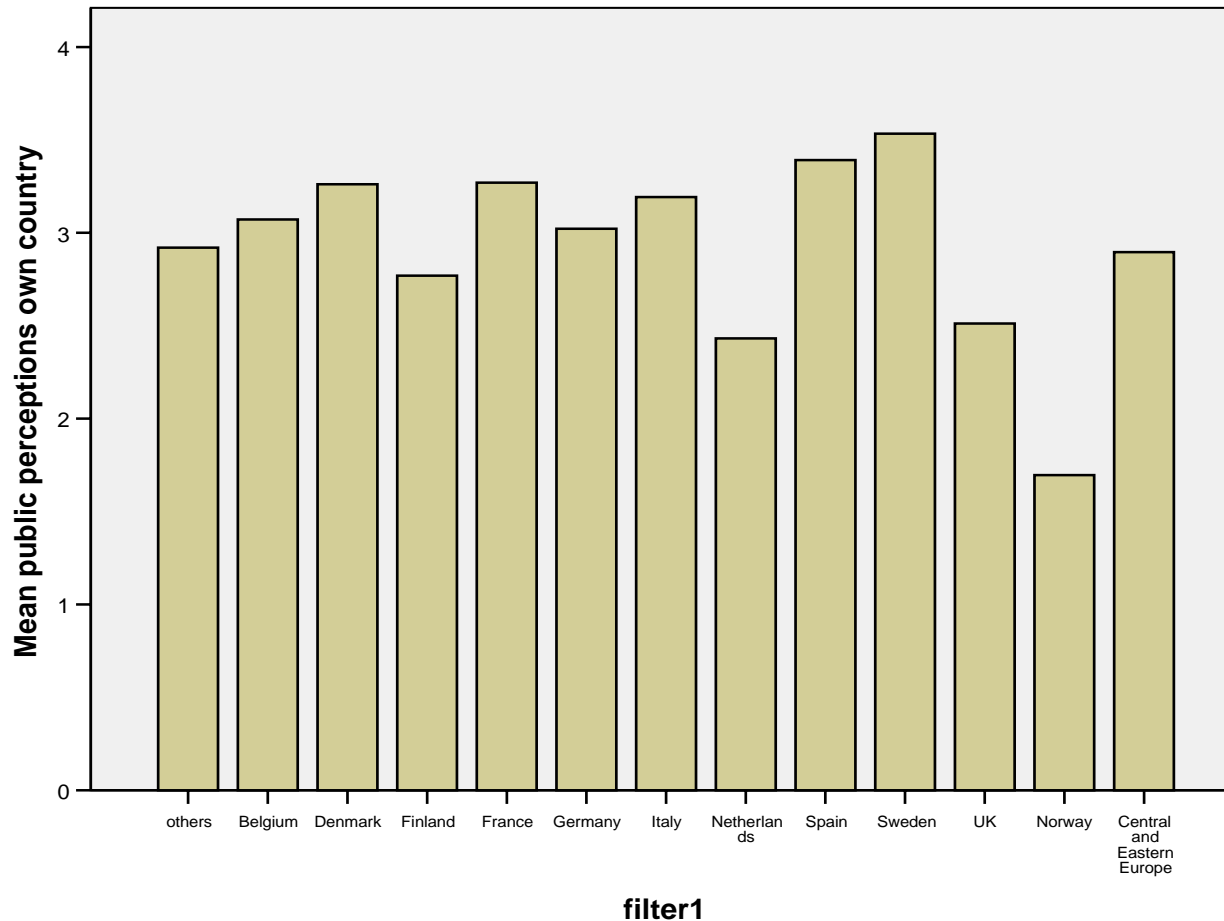
- Strongest support perceived in Norway
- UK and Netherlands more positive than average
- Germany and Denmark less positive than average

- NGOs and parliamentarians most frequently see public as 'neither positive nor negative'
- Public more supportive of CCS at the EU scale than in their own countries.

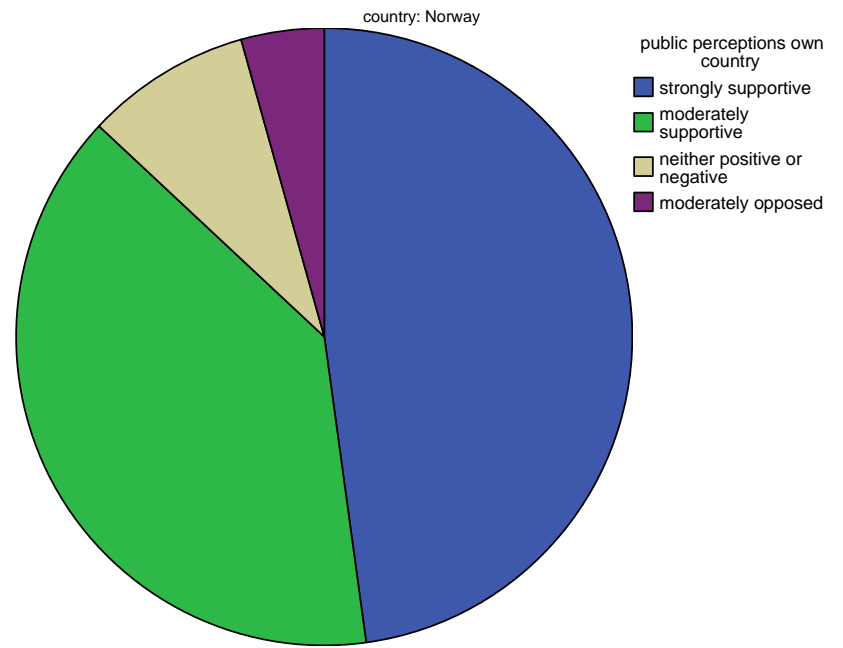
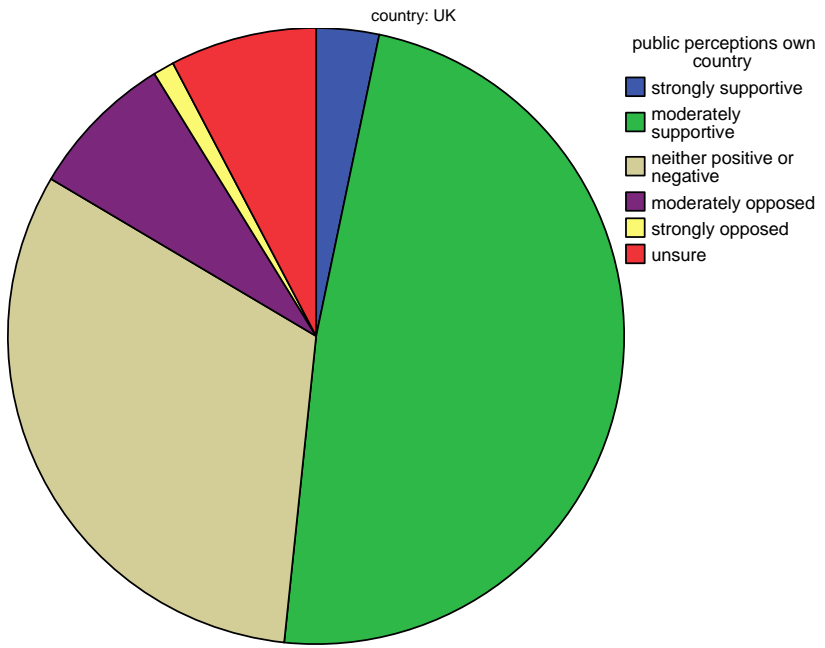
Public perceptions of CCS in own country (left) and in EU (right) (Q21)



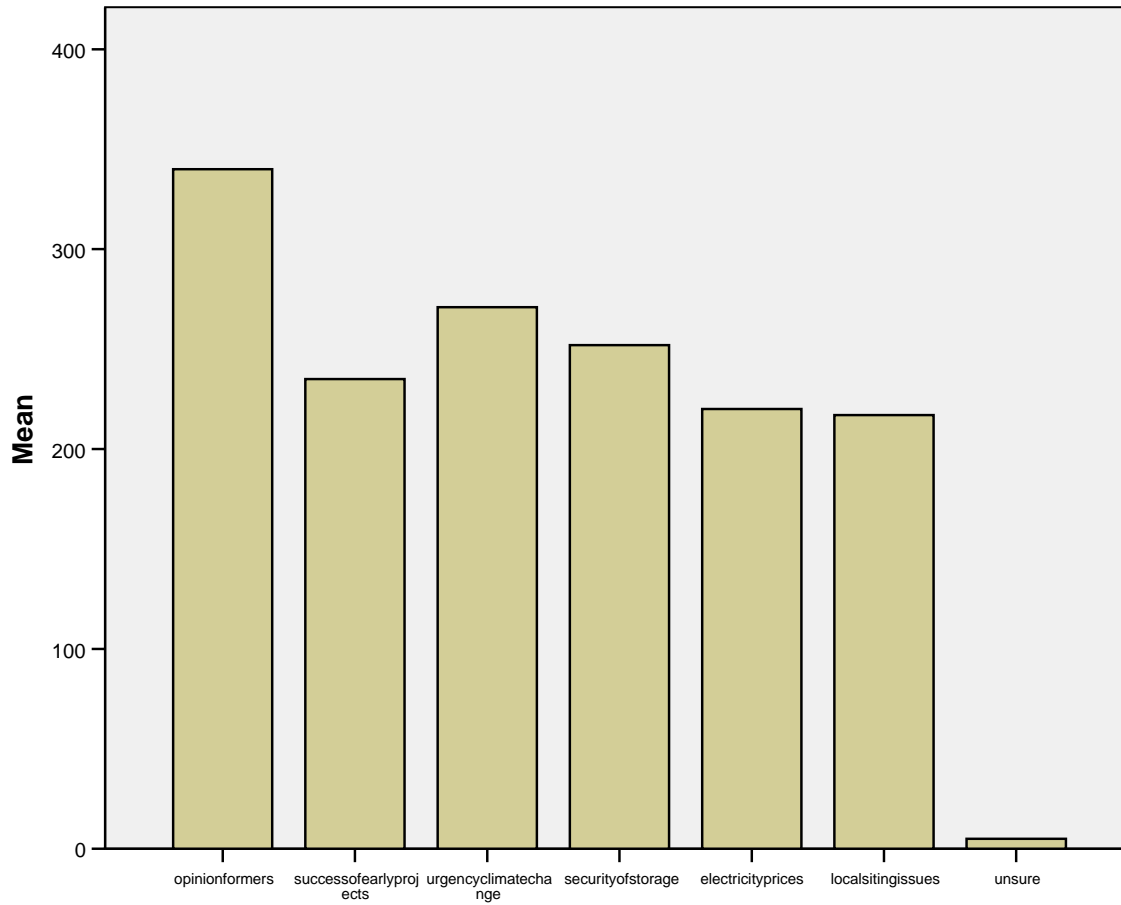
Public perceptions of CCS in own country (Q22): selected countries (where 1 indicates 'strongly supportive, 2 'moderately supportive', 3 'on balance, neither positive nor negative', and 4 'moderately opposed')



Public perceptions of CCS in own country: UK (left), Norway (right)



What factors are most likely to influence public perceptions of CCS in own country (Q22)



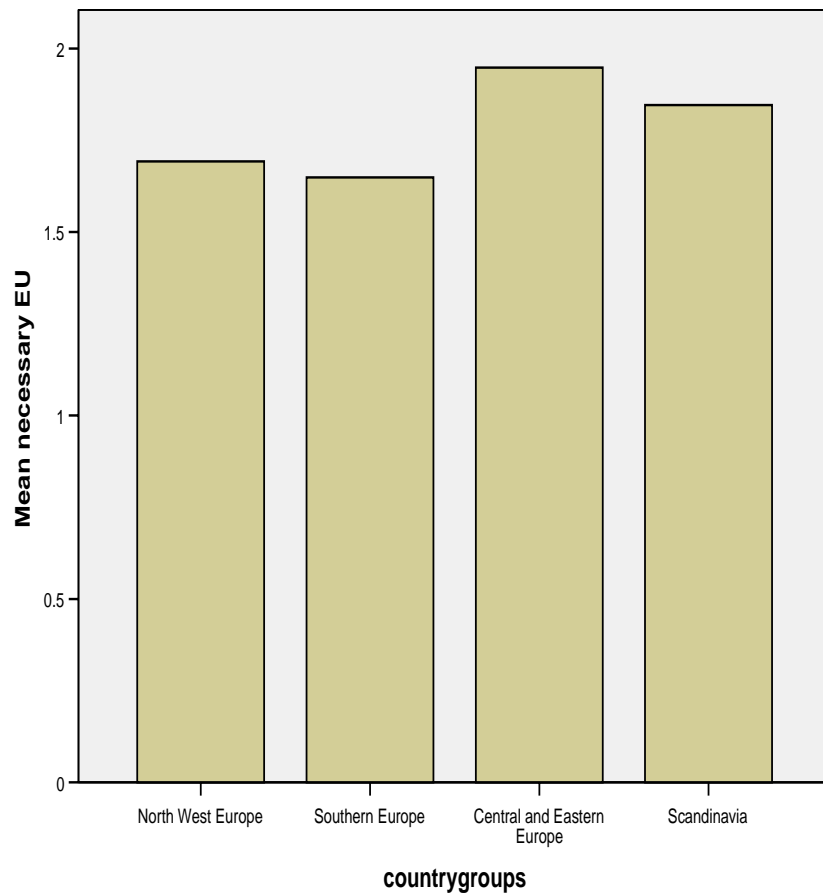
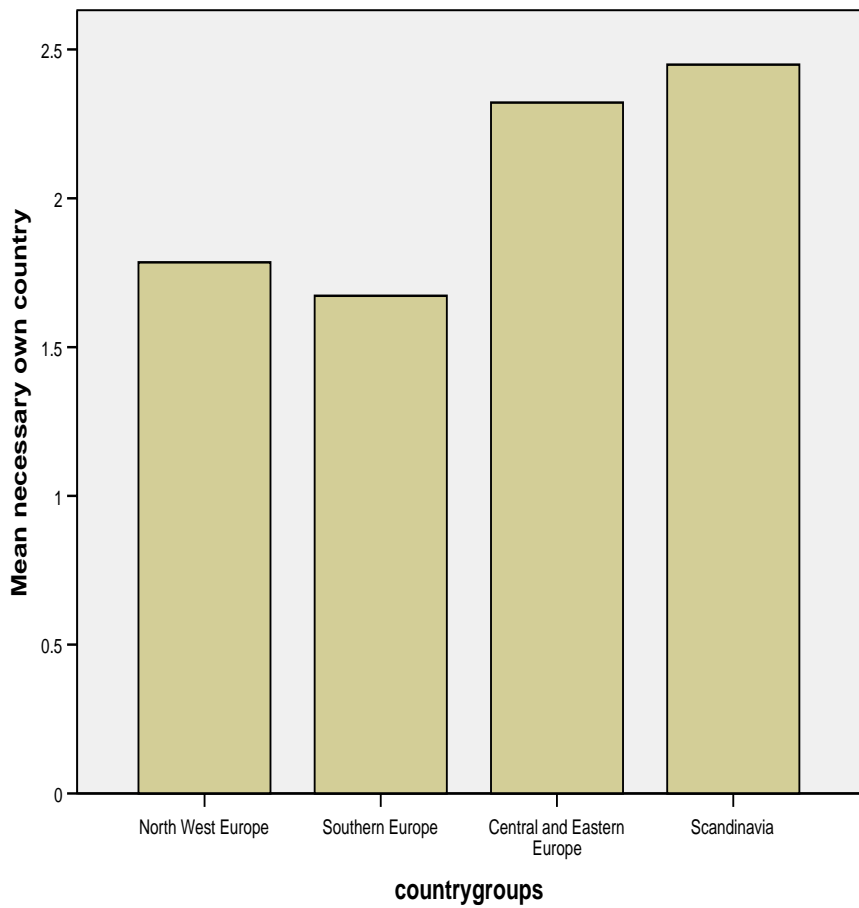
Involvement in CCS and Perceptions of CCS

- Those most closely involved in CCS perceive the potential negative aspects as smaller and the potential positive dimensions as greater
- But **only** for those respondents who devote less than 50% of work time to CCS
- Some one working 90% time on CCS **not** more likely to regard it positively than some one else who works 60% time on CCS
- Suggests degree of independence in evaluating CCS as a carbon mitigation option by those most closely involved

Analysis by Regions

- North West Europe (NWE) and Southern Europe (SE) keener on CCS in own country than Central & Eastern Europe (CEE) and Scandinavia (Scan)
- Bipolar response in Scan
- Smaller role for CCS in national debate in CEE
- Risk perceptions of CCS greatest for CEE
- CEE and Scan more likely to regard CCS as having negative impact on decentralisation

Perceived necessity of CCS in own country (left) and EU by region (right) 1 indicates 'definitely necessary', 2 'probably necessary', 3 'only necessary if other options fail to live up to current expectations'



Analysis by Fossil Fuel Status

- Differences are not large with respect to fossil fuel status of country
- ‘No fossil fuels’ group saw a smaller role for CCS in the national climate change debate
- ‘Oil & gas’, and ‘coal, oil & gas’ groups saw EOR / EGR as more important enabling factor but availability of coal as less important
- ‘Coal’ group less supportive of extending the EU ETS with tighter caps and also preferred same incentives across EU25
- ‘Oil & gas’, ‘coal, oil & gas’ groups saw risks as lower, especially those associated with infrastructure

Analysis by Population Size of the Country and GDP per capita

- In general size of country did not appear to influence responses
- Low GDP per capita group (<\$19,000 per annum) was generally less enthusiastic about CCS than the other groups and it was perceived to be a less important component of the national climate change debate
- Low group were less keen on EU ETS with tighter national caps and on post-Kyoto requirements
- Low group perceived the risks of CCS to be higher than other groups
- Low group perceived more negative impacts upon decentralisation and upon energy security
- Note that the CEE group is the same as 'low GDP per capita' group with exception of inclusion of Austria in CEE group

Conclusions & Recommendations

- Survey confirms that there is **moderate to strong support for CCS** amongst those European stakeholders (who responded) for further development of CCS
- There is a **reasonable degree of consensus on the good and bad features of CCS**, even though there are important differences in opinion between different stakeholders, countries and regions
- **Dialogue and information sharing** between stakeholders and countries is vital, though the aim of achieving a single consensus is not desirable or necessary
- There is a **core of strongly supportive CCS countries**
– Norway, Netherlands and UK

Conclusions & Recommendations

- Just on the outside of this core are other countries which might become core in the next several years – e.g. **Belgium, Germany, Italy, Spain and France**
- Some countries, regions and stakeholders require **more concerted effort to raise awareness and discussion of CCS**, including opportunities which might arise in trading CERs from some European nations (e.g. in **Central and Eastern Europe**) to others (e.g. those struggling to meet their Kyoto targets) through the EU ETS plus national policies. e.g. Austria and Denmark (need -19%), Finland (-14%), Ireland (-10%), Portugal (-13%), Italy (-18.5%) and Spain (-33%).



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Thank you for your attention

Executive & Technical Summary and Main Report available from
www.accsept.org

Paper accepted for publication in *Energy Policy*

Any questions?

ACCSEPT Meeting, Bonn
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