



# ACCSEPT Survey on CO<sub>2</sub> Capture and Storage: Resume of Key Findings and Implications

David Reiner

University of Cambridge

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# Respondents



- 512 respondents from June-December 2006
- 40% response rate (excluding parliamentarians)
- Most commonly represented are academics / researchers (34%) and energy sector (28%)
- Government respondents a further 13%, NGOs 5% and parliamentarians 4%



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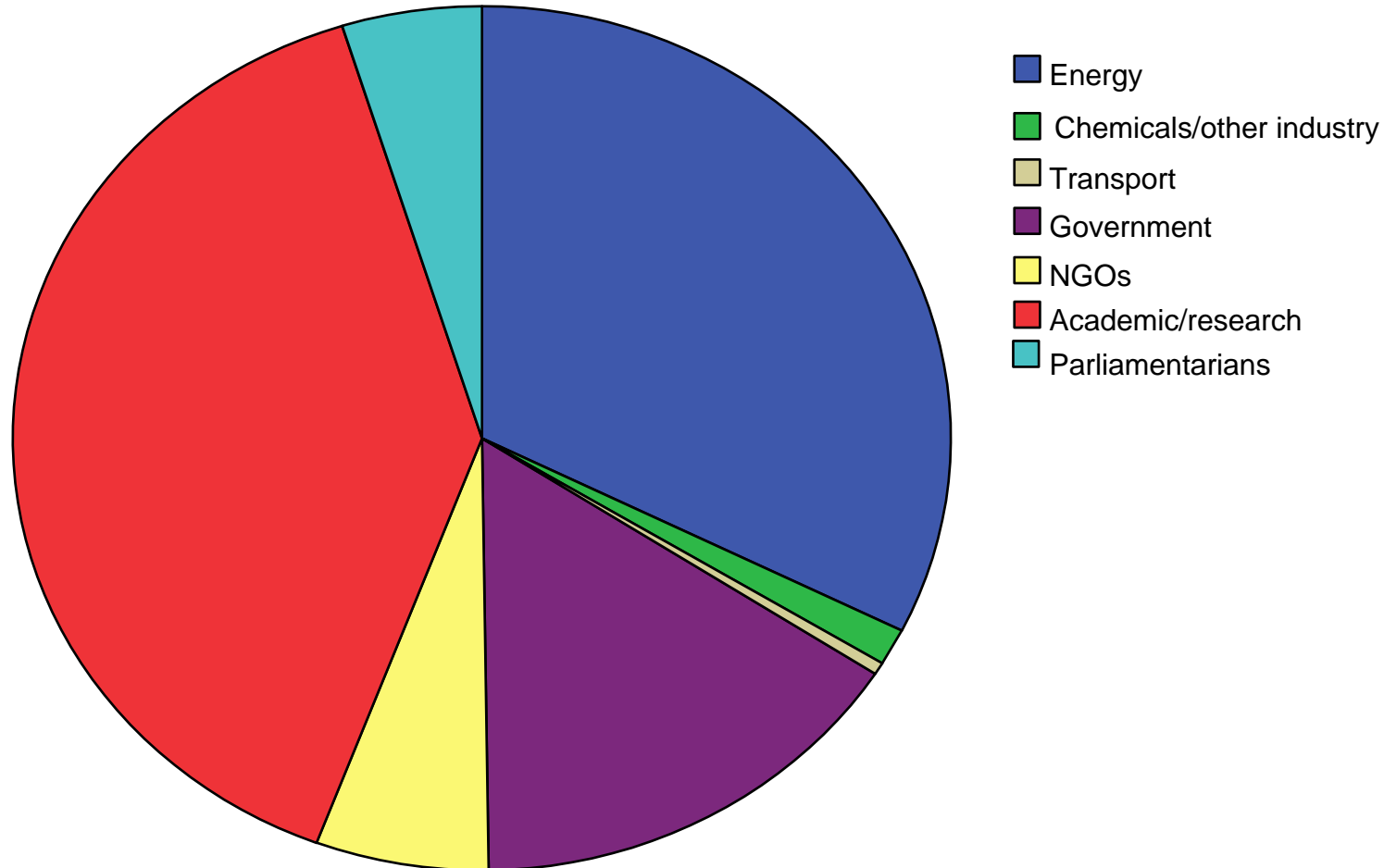
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# Breakdown of respondents by stakeholder type



# Respondents by Country



- 20% from the UK
- 11% from Germany
- 9% from Netherlands
- 6% from France and Italy
- 5% from Denmark, Spain and Norway
- 4% from Belgium
- 3% from Finland and Sweden
- Statistical analysis restricted to UK, Germany, Denmark, Netherlands, Norway, Belgium, Sweden and Finland (based upon number of respondents per capita)



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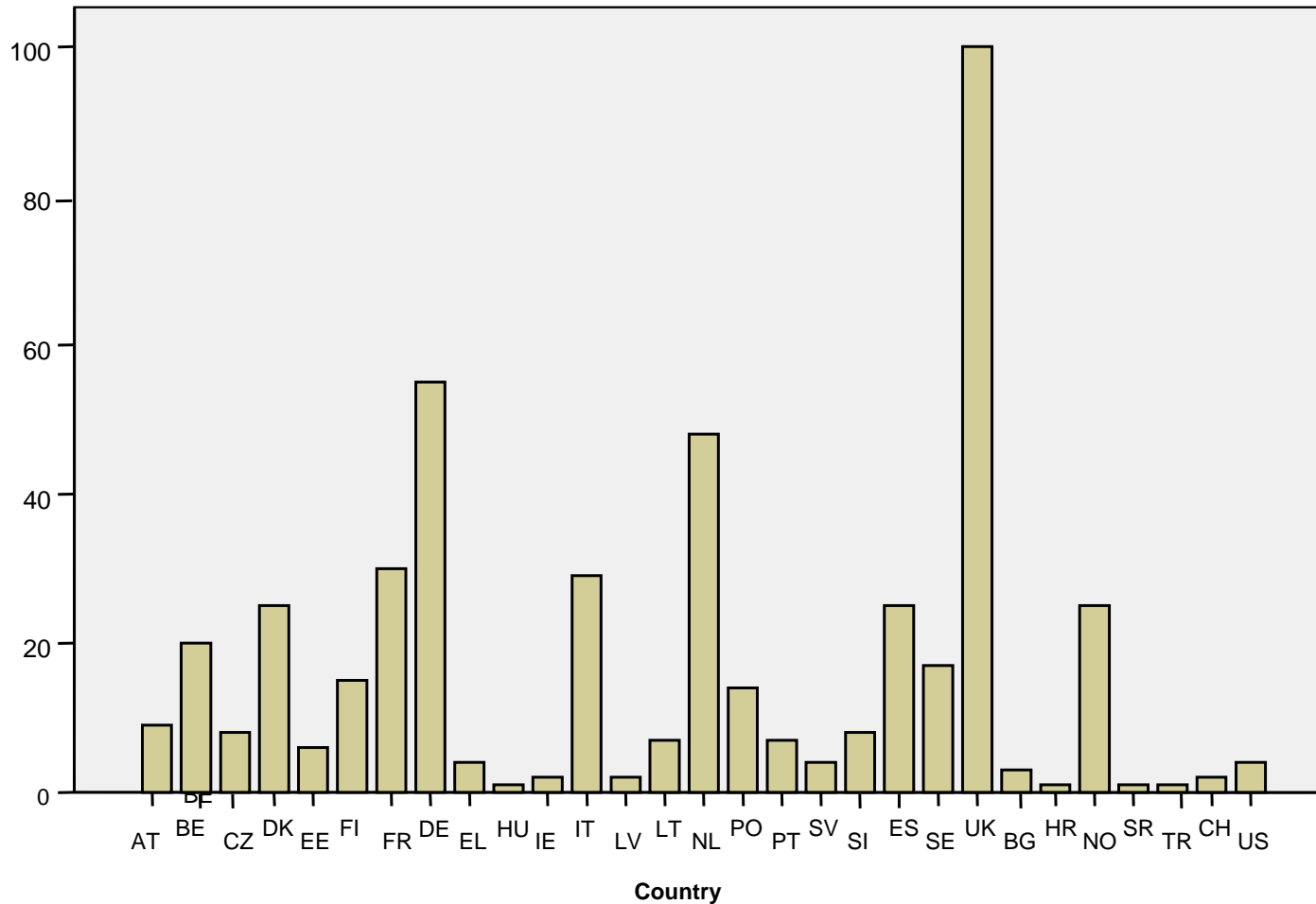
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# Breakdown of respondents by country



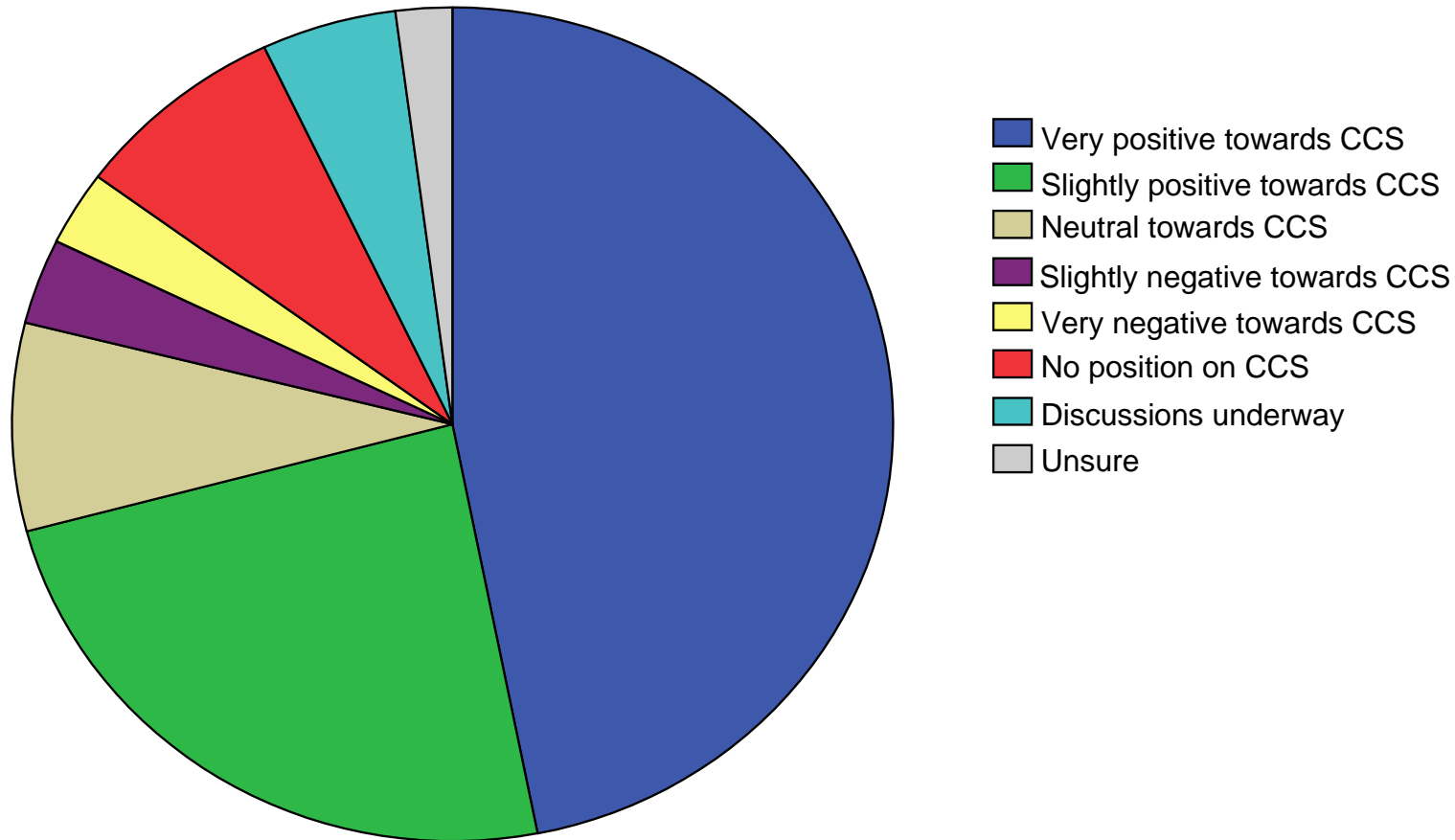
# Statistical analysis: Organisational positions on CCS and underlying reasons



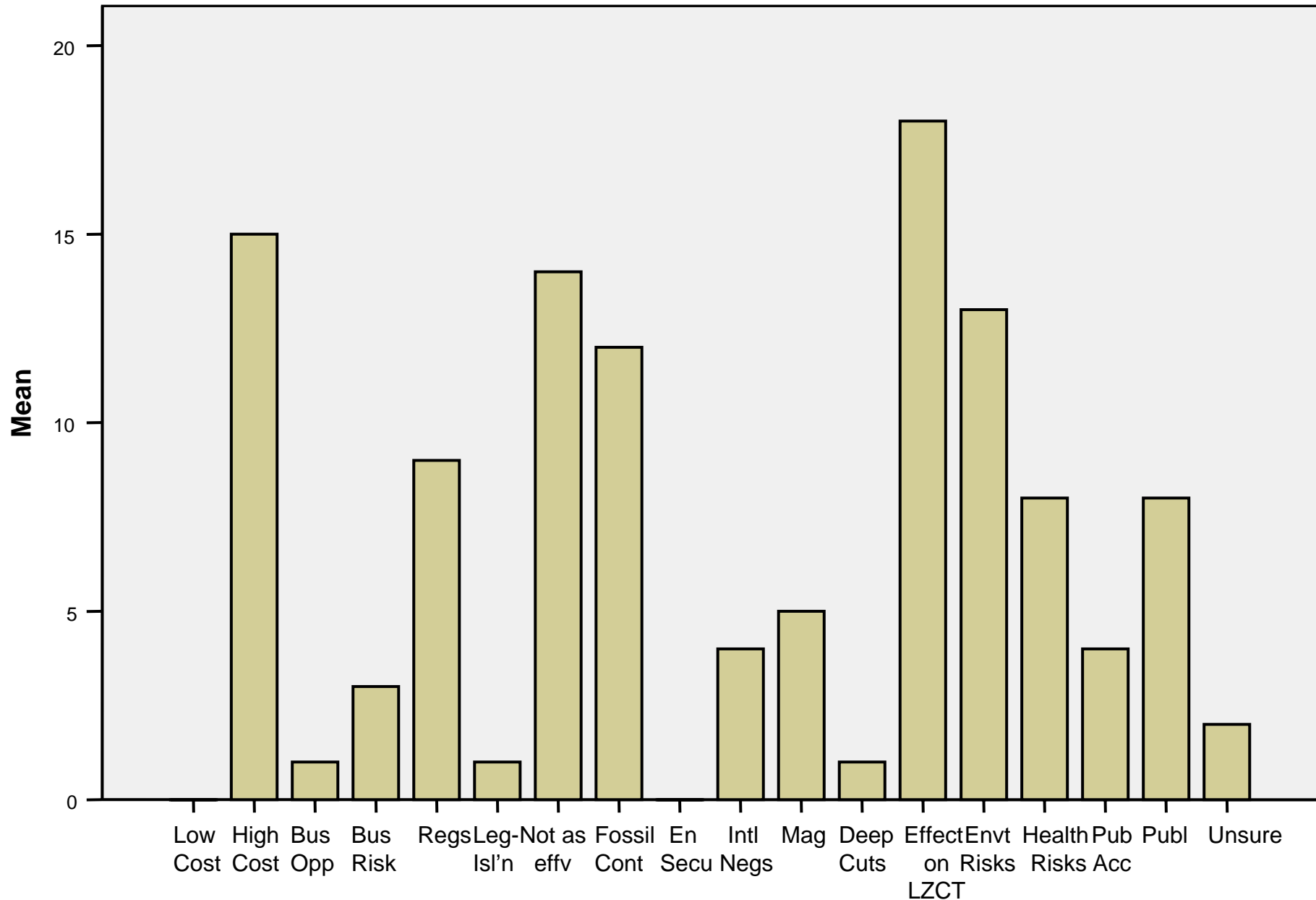
- Comparison of means for countries, stakeholder groups, regional groupings, fossil fuel status, etc., to test for significance using independent t-test (p value of 0.05)
- Comparison of correlation between variables using Pearson's coefficient (p value of 0.01 or 0.05)
- Nearly half of respondents reported that their organisation was 'very positive' towards CCS and a further quarter were 'slightly positive'.
- Most frequent reasons given: potential to continue use of fossil fuels, potential magnitude of CO<sub>2</sub> emission reductions and potential for rapid cuts, and business opportunities



# Organisational positions on CCS



# Reasons for position by slightly or very negative organisations





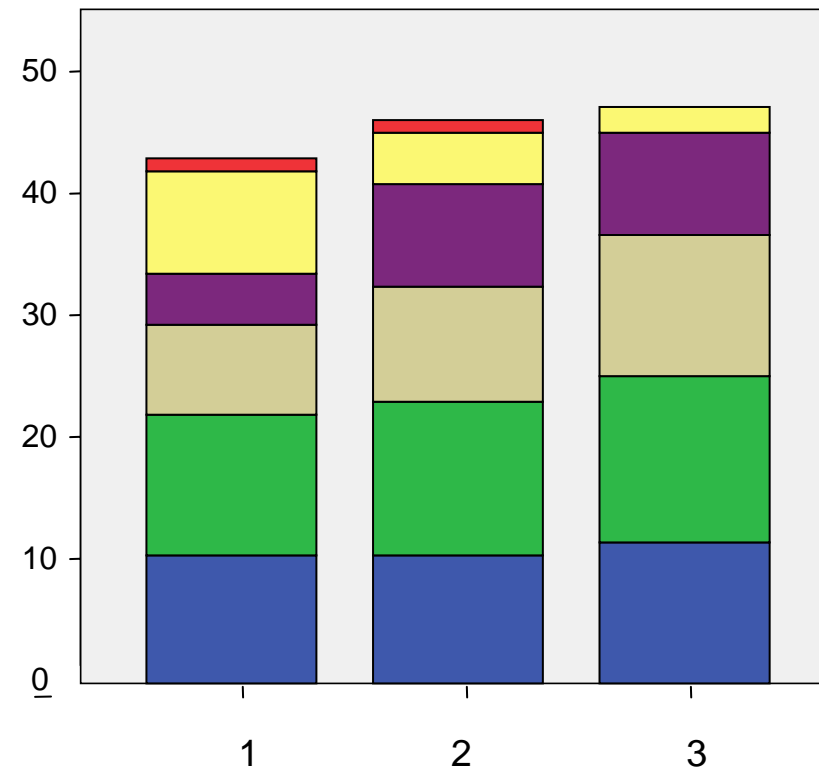
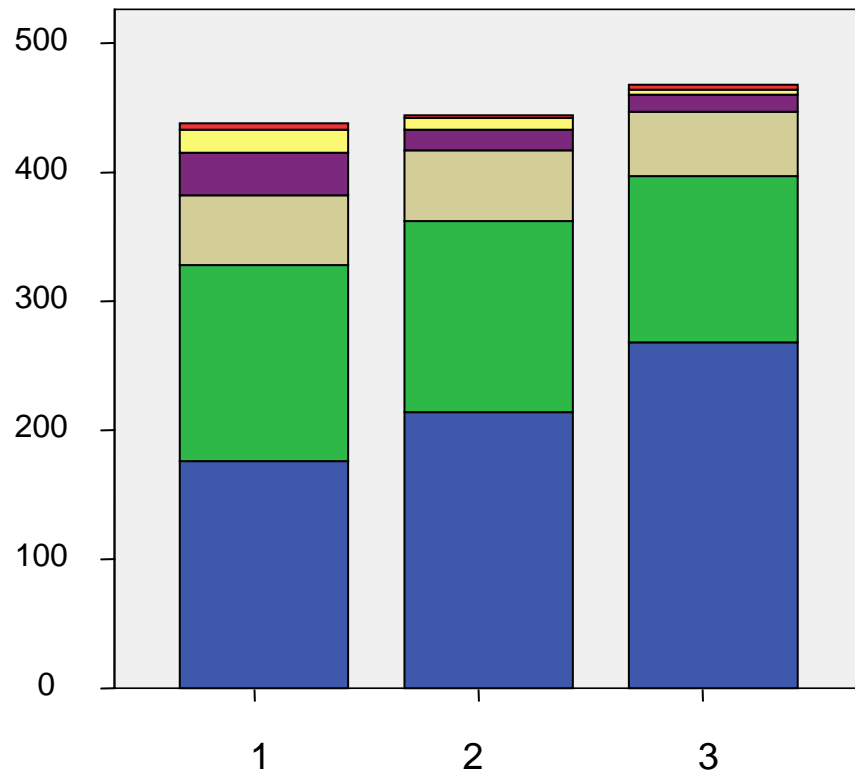
# Perceived need for CCS in own country, EU and globally



- A large percentage of respondents believe that CCS is definitely or probably necessary, increasing from own country, to EU to global scale
- Respondents from Norway, UK and Netherlands stand out as most enthusiastic about role of CCS
- Finland, Sweden and respondents from Central and Eastern European countries are the least supportive of CCS, but are still on balance in favour of a role for CCS
- Energy, government and research stakeholders strongly supportive of CCS
- NGOs are more ambivalent regarding CCS, with parliamentarians largely supportive but with some scepticism



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



■ Definitely necessary      ■ Probably not necessary  
■ Probably necessary      ■ Definitely not necessary  
■ Only necessary if      ■ Unsure



# (Changing) Role of CCS in the National Debate



- CCS is perceived to play a large or moderate role in the current national debate (57%)
- Significantly larger role of CCS in debate in Norway, followed by Netherlands, UK, Germany.
- Smaller role in debates in Denmark, Finland, Sweden
- Role of CCS is generally increasing
- The role of CCS is increasing most in Norway, Germany, Netherlands and UK (i.e. in those countries in which it is already important)



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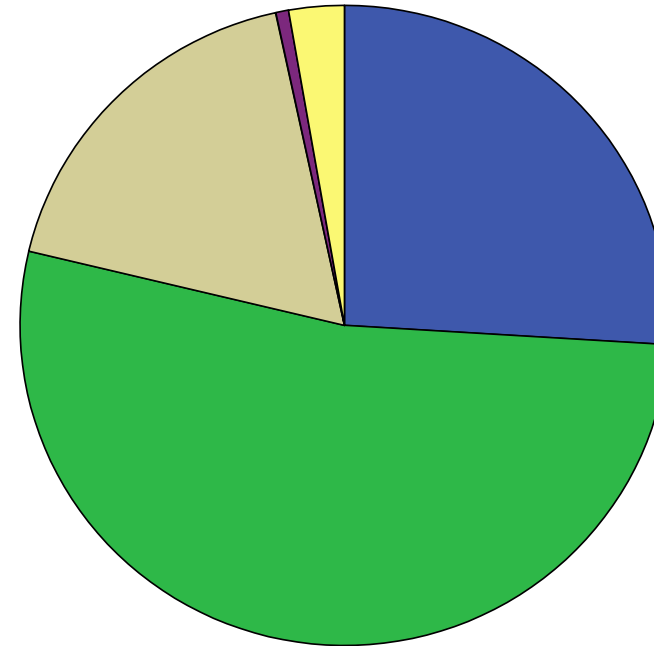
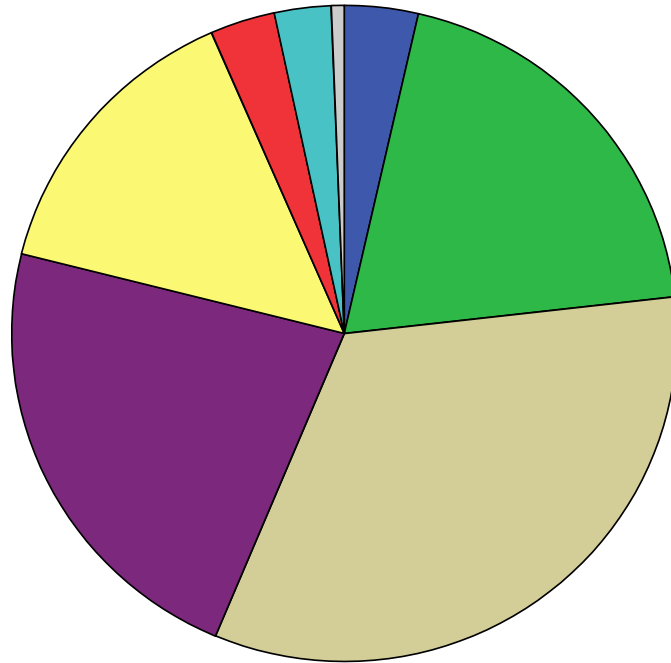
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# Role of CCS in national debate (left) and how it is changing (right)

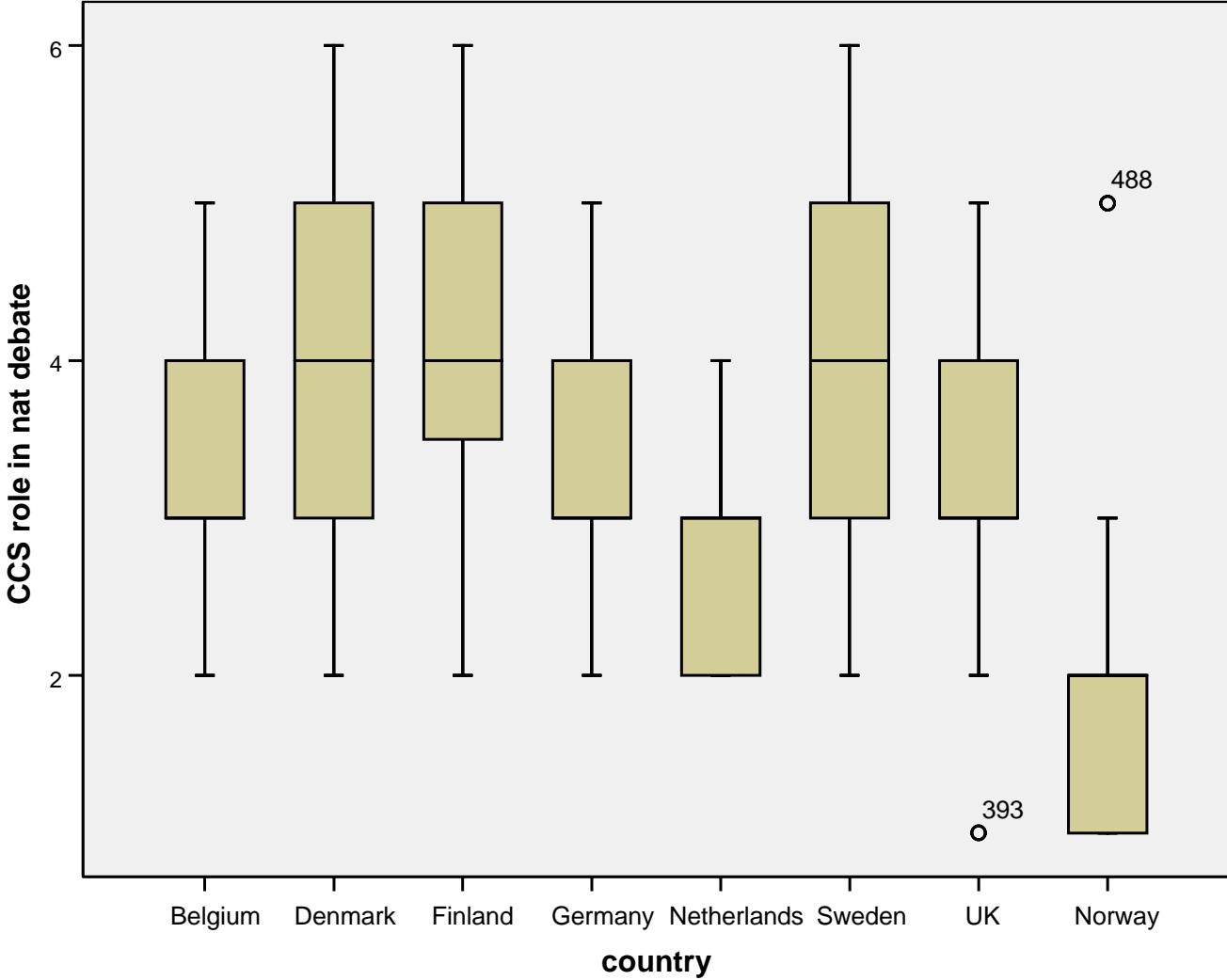


- Very Large
- Large
- Moderate
- Small
- Very small
- None
- No debate in country
- Unsure

- Increasing substantially
- Increasing slightly
- Staying the same
- Decreasing slightly
- Unsure



# The changing role of CCS in the national debate in the eight selected countries



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# The Enabling Context for CCS in Home Country

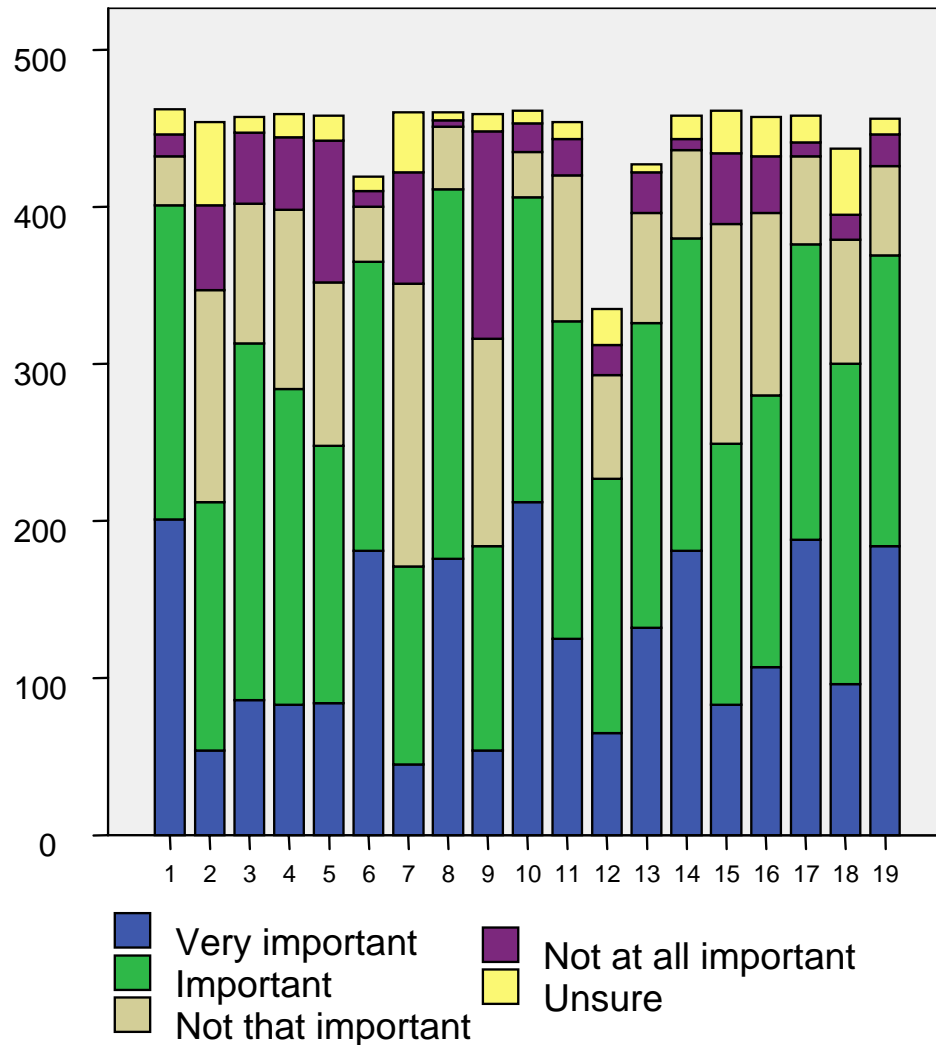


The most important factors influencing the development of CCS are (in descending order):

- availability of suitable geological storage sites,
  - price of carbon under the EU ETS
  - reduction in costs of CO<sub>2</sub> capture
  - development of R&D base
  - a post-Kyoto phase with tighter national emission reduction requirements
  - development of legal & regulatory basis for CCS and
  - public perceptions of CCS
- Least important: availability of venture capital, development of H<sub>2</sub> economy, availability of domestic supplies of coal.
  - Countries with own coal (e.g. Poland, Germany, UK) tend to regard this as more important factor, whilst those with oil and/or gas (Norway, UK, Netherlands, Denmark) tend to regard enhanced hydrocarbon recovery as more important.
  - NGOs and parliamentarians regarded public perceptions as less important enabling factor



# Importance of factors in the development of CCS in own country



- 1: price of carbon under the EU ETS
- 2: availability of venture capital
- 3: concerns about energy security
- 4: need to replace aging power plant
- 5: opportunities for EOR/EGR 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 geologic 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 & policy of the USA
- 16: negotiating stance & policy of China & India
- 17: development of legal and regulatory basis for CCS (e.g.accounting, monitoring, liability)
- 18: eligibility of CCS for CDM and/or JI
- 19: public perceptions of CCS



# Provision of financial incentives for CCS



- 39% think CCS should be given similar incentives as renewables, 33% think lower than renewables, 11% think higher than renewables. 12% think incentives for CCS are not needed.
- NGOs and parliamentarians least enthusiastic about generous incentives for CCS. 52% and 38% of respondents respectively doubtful that incentives are needed at all
- Danish, British and Dutch respondents most in favour of more generous incentives.



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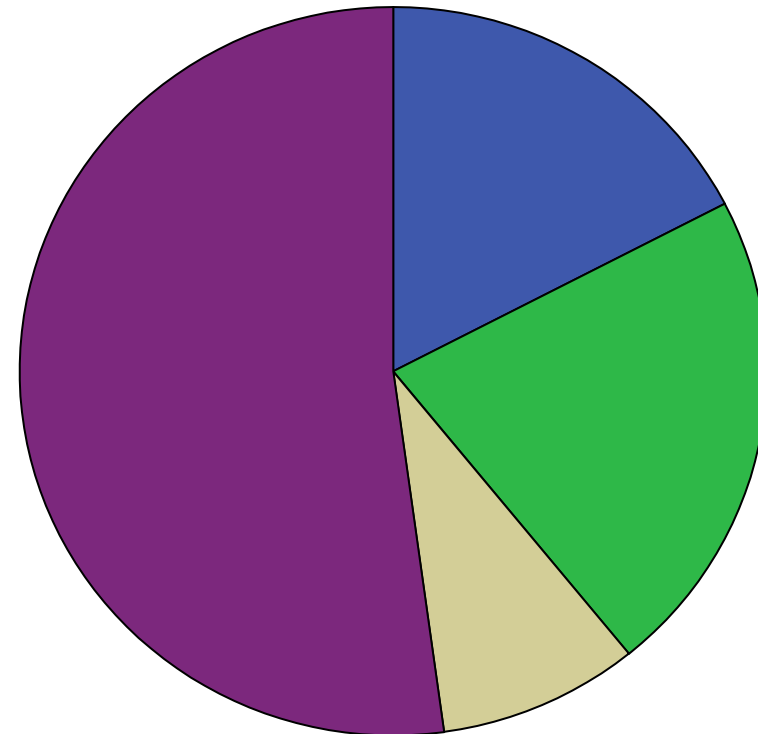
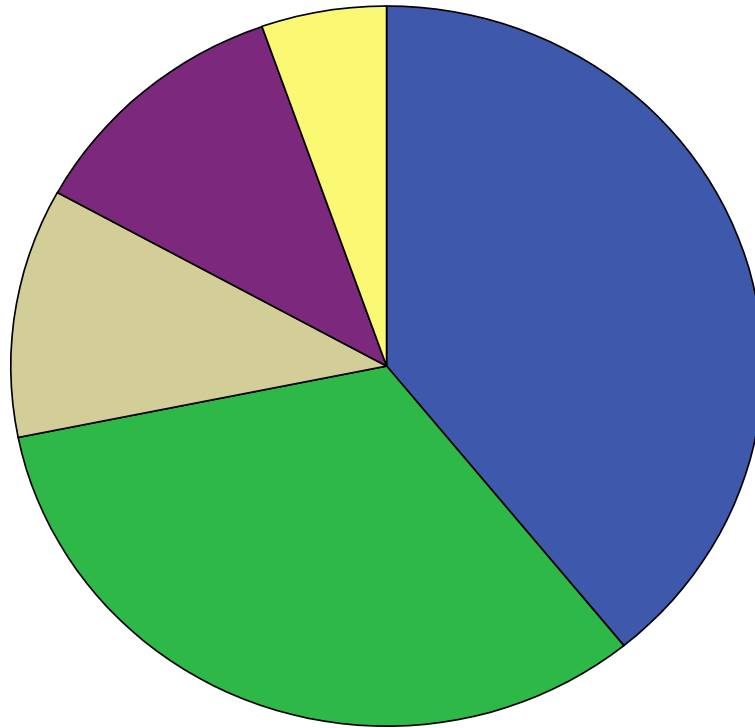
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# Provision of financial incentives for CCS (left) and NGO views on incentives (right)



- Are needed comparable level to renewables
- Are needed, lower level than renewables
- Are needed, at higher level than renewables
- Are not needed
- Unsure



# Opinion on type of financial incentives for CCS



- Most popular is RD&D (over 90% in favour)
- Followed by early commitment to extend the EU ETS with tighter emission caps (77% in favour, 8% against)
- Third most popular is requirement for electricity generators to supply a given % of zero- or low-carbon electricity
- Least popular is guaranteed feed-in tariff for CCS electricity (though still more in favour than against)
- Substantial minorities of all stakeholder groups opposed to CCS electricity requirement or feed-in tariffs
- All stakeholders appear to support an early commitment to extension of the EU ETS with tighter national emission caps.



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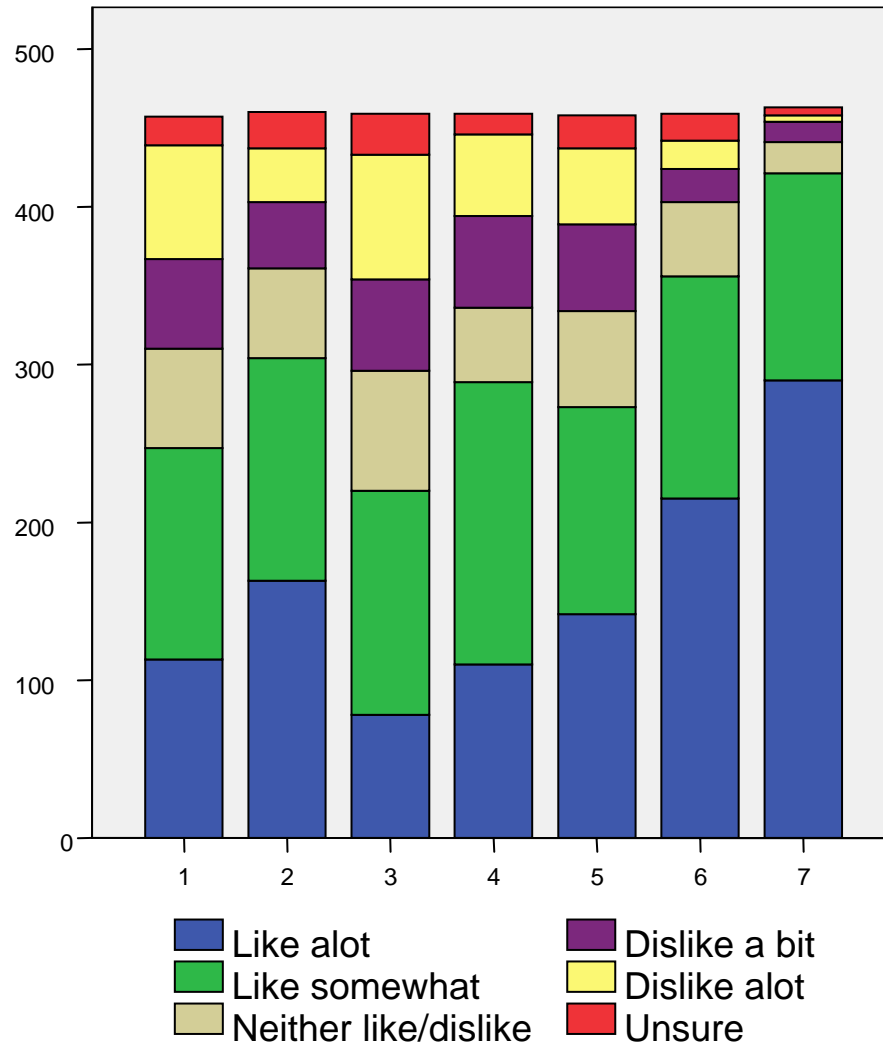
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# Opinion on financial incentives



- 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



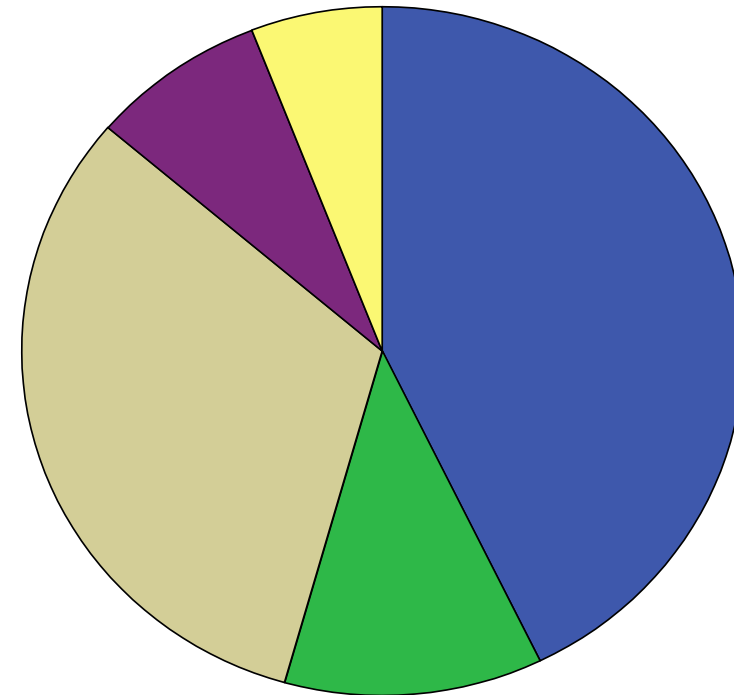
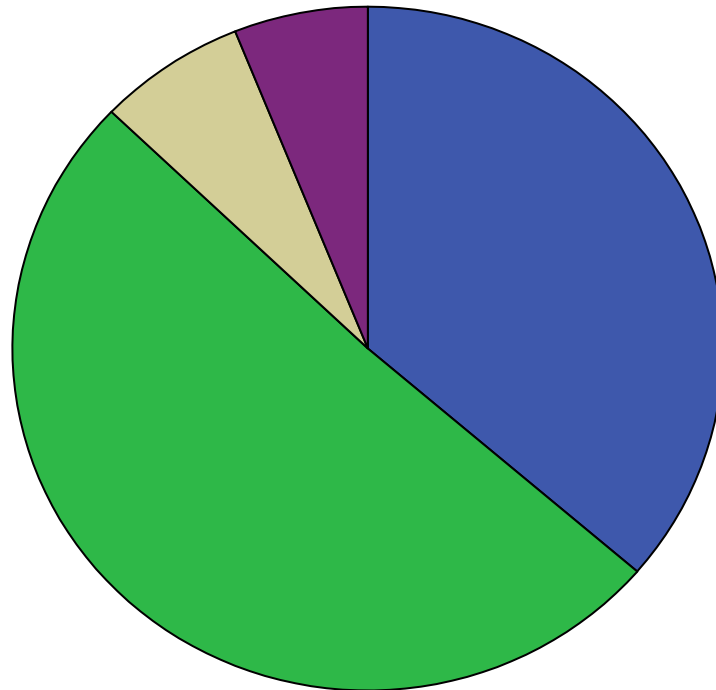
# Implementation of incentives & how CCS should be regulated



- Respondents somewhat favoured a common price for CO<sub>2</sub> through EU ETS plus additional national incentives (50%)
- A common incentives structure across EU without any additional national incentives was also supported (36%)
- All stakeholder groups except for NGOs favoured EU ETS plus additional national incentives
- Very few supported phasing out of the EU ETS and passing over responsibility to member states.
- The most popular option for regulating CCS was an internationally agreed set of standards (43%) followed by EU wide standardisation with national implementation (32%).
- Least popular is a system of information sharing (8%) and regulation through an agency of the EU Commission (2%)
- NGO respondents are most sceptical about EU wide harmonisation, and are more in favour of an international set of standards (57%)



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



- Same incentives across EU
- Common price for C but additional left to member states
- Left to national government, phase out EU ETS
- Unsure

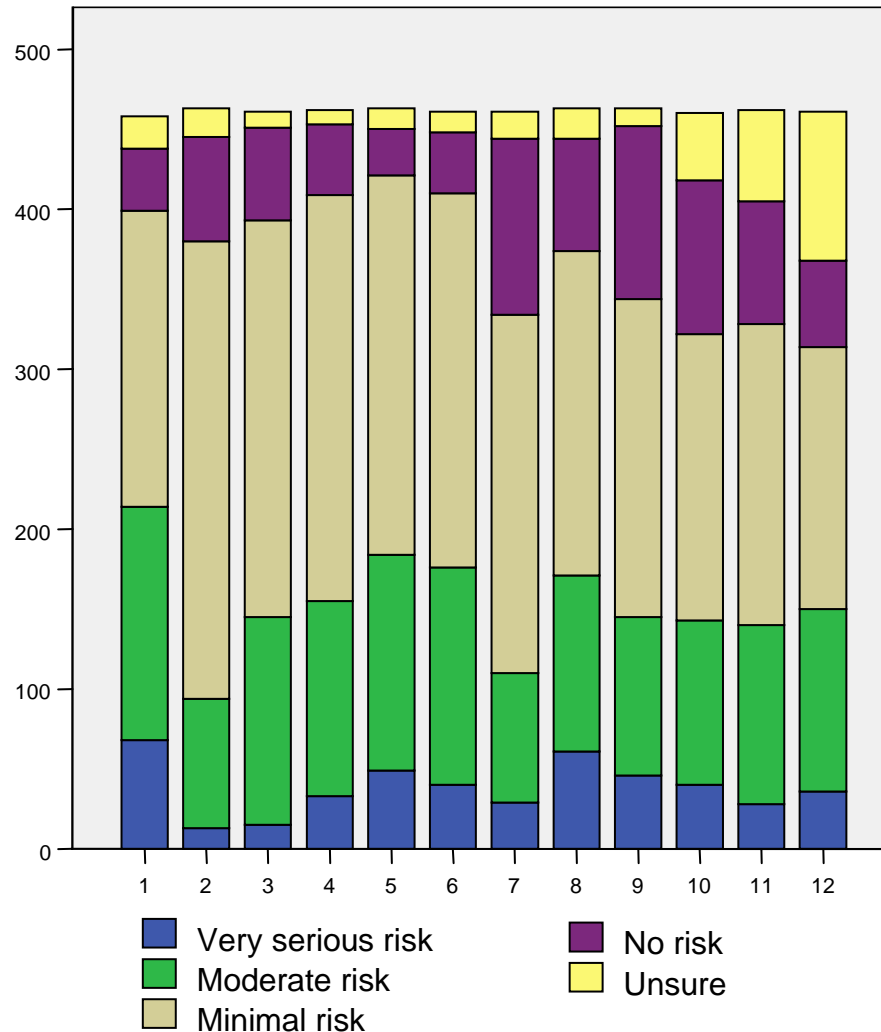
- International set of standards
- Agency of EU Commission
- EU wide standardisation but implement nationally
- Information sharing between states
- Unsure



# Potential risks of CCS

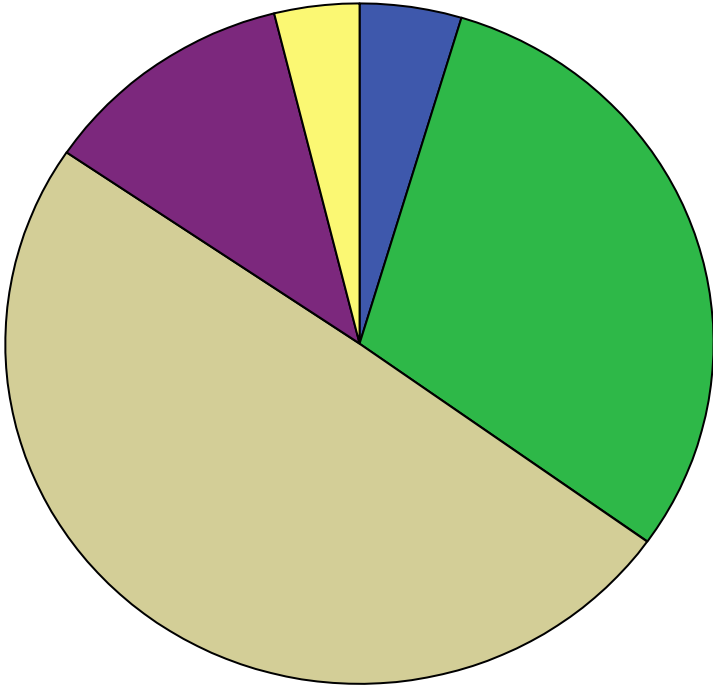
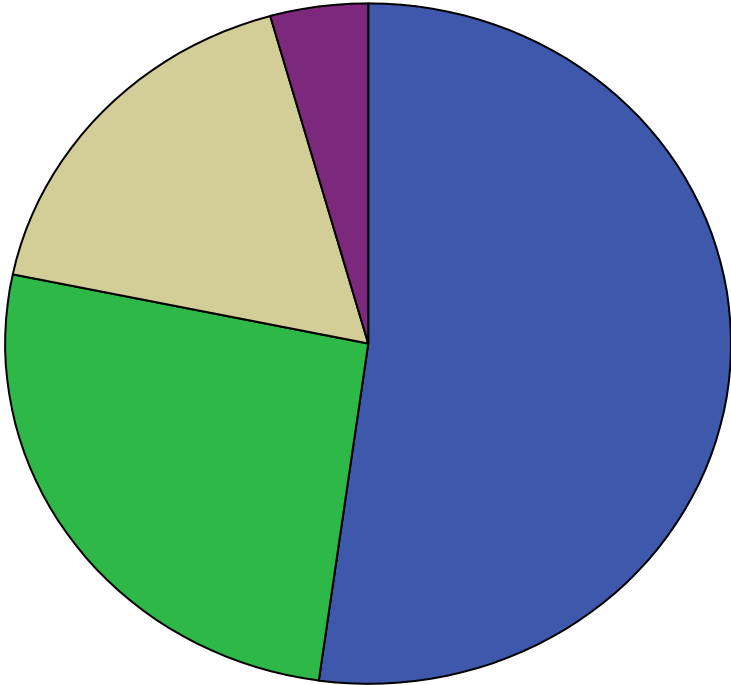
- Risk perceptions are not large – the most common response is ‘minimal risk’
- Highest risks identified: additional fossil fuel use from energy penalty, human health & safety and environmental damage from onshore CO<sub>2</sub> storage and environmental damage from offshore CO<sub>2</sub> storage
- Lowest levels of perceived risk associated with accidents arising from inclusion of CO<sub>2</sub> capture at power stations and human health & safety risks from offshore CO<sub>2</sub> storage site leakage
- NGO respondents – and to a lesser extent parliamentarians - far more concerned about potential risks than other respondents (e.g. 52% identifying energy penalty as ‘very serious risk’, cf. parliamentarians at 30%, energy sector 5%, 10% researchers, 16% government)

# Potential risks of CCS



- 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: NGOs (left), energy sector (right)

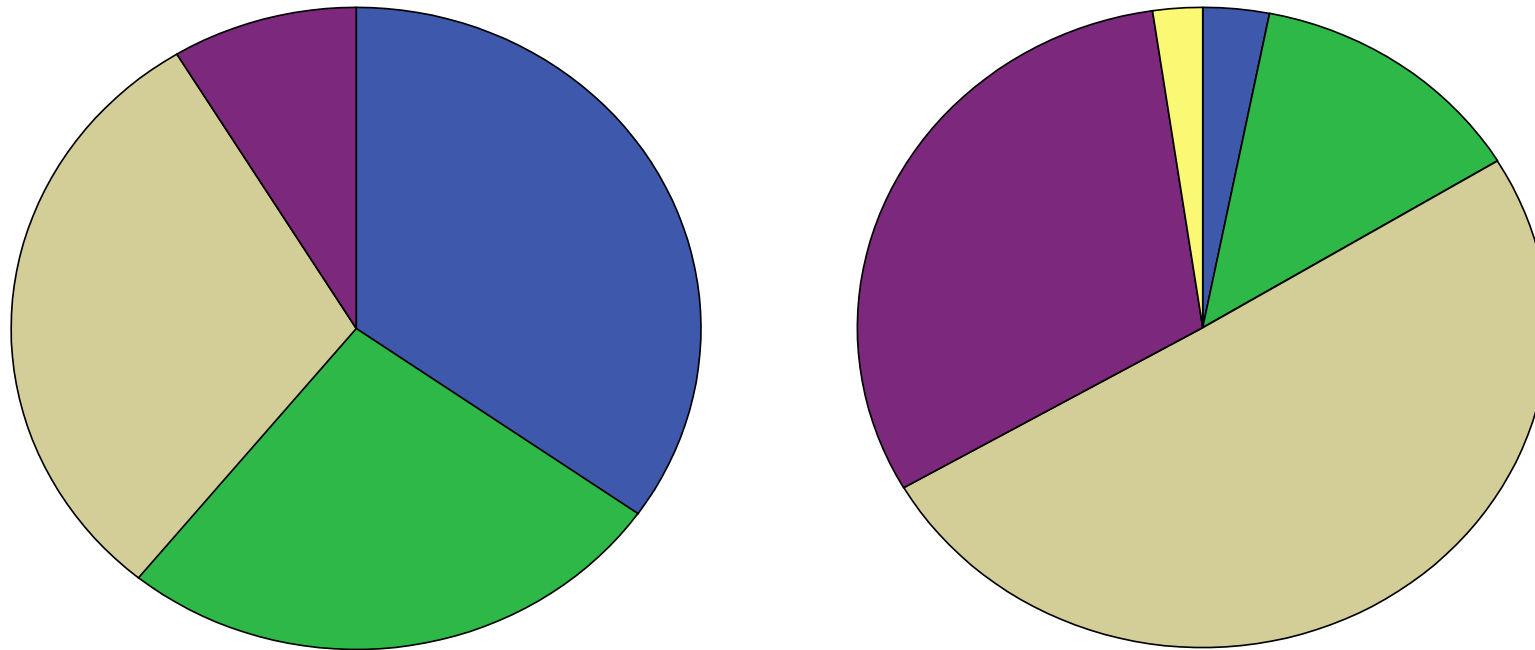


- Very serious risk
- Moderate risk
- Minimal risk
- No risk
- Unsure





# Impacts arising from global impacts of leakage: NGOs (left), energy sector (right)



- Very serious risk
- Moderate risk
- Minimal risk
- No risk
- Unsure

# Impacts of CCS investment upon investment in other LZCTs in own country



- Sample is split between those who believe that CCS has a negative impact upon other LZCTs (44%) and those who do not or see it as potentially positive (51%)
- NGOs are most concerned about impact of CCS upon other LZCTs (65% significant negative impact, 22% minor negative impact)
- Energy stakeholders are least concerned (5% significant negative impact, 33% minor negative impact, 40% no impact, 18% positive impact)



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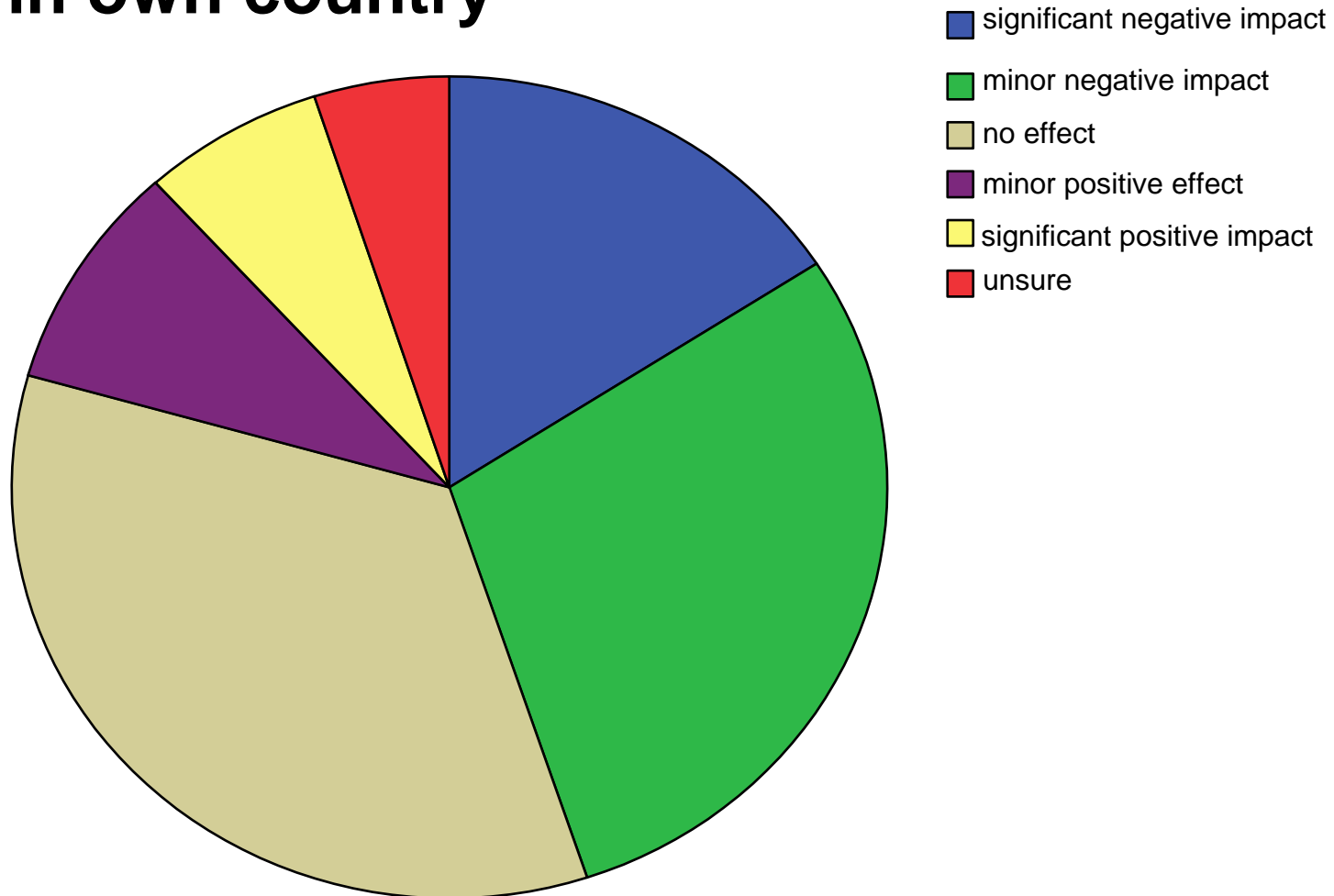
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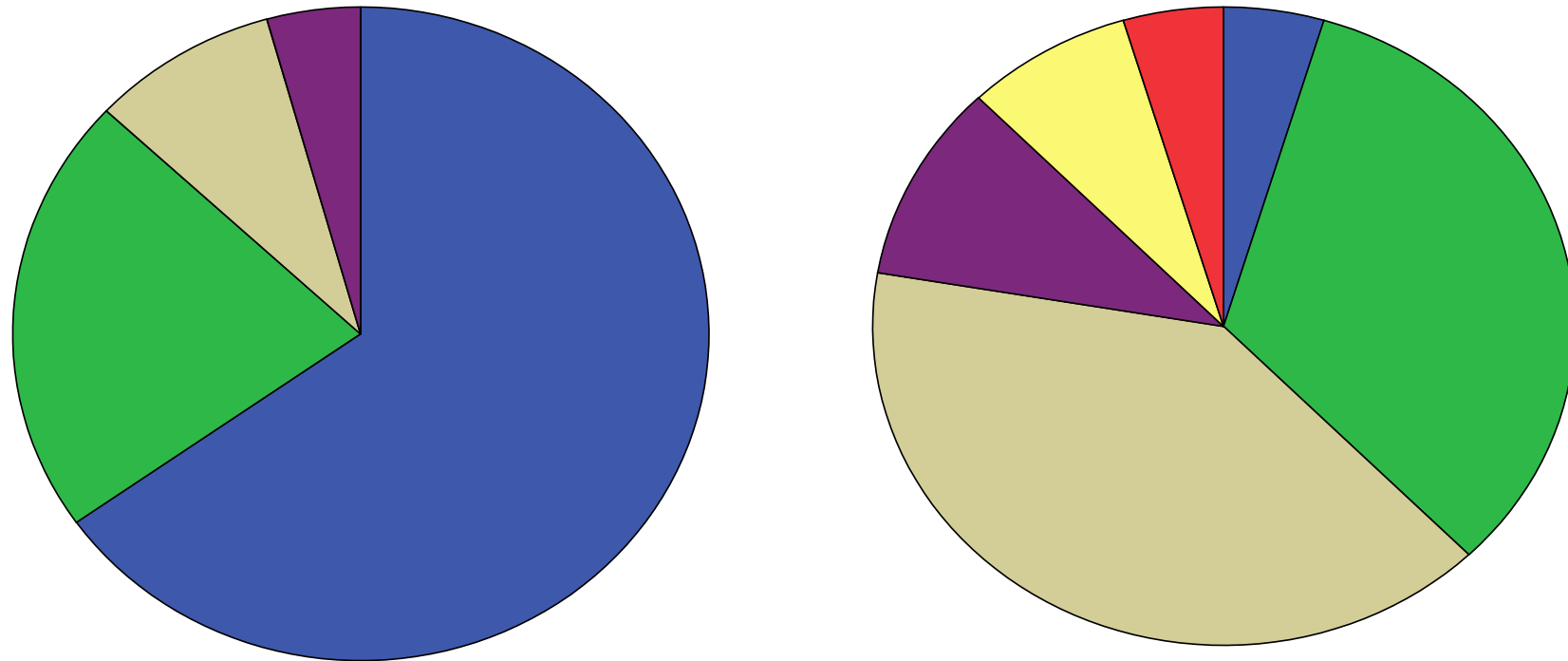


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# Impacts of CCS investment upon investment in other LZCTs in own country



# Impacts of CCS investment upon investment in other LZCTs in own country: NGOs (left), energy sector (right)



- significant negative impact
- minor negative impact
- no effect
- minor positive impact
- significant positive impact
- unsure

# Impacts of CCS investment upon investment in own country



- Overall response to impacts on energy efficiency and demand reduction similar to impacts on other LZCTs, but with slightly fewer negative impacts anticipated. Positive impacts also anticipated more frequently.
- NGOs are much more concerned about the impacts upon energy efficiency / demand reduction than other stakeholders. Energy and government stakeholders saw more positive impacts for efficiency.
- 14% of respondents perceived very negative impact arising from CCS for decentralised generation; a further 33% perceived 'slightly negative' effect; 24% thought there would be no effect and 10% a positive impact.



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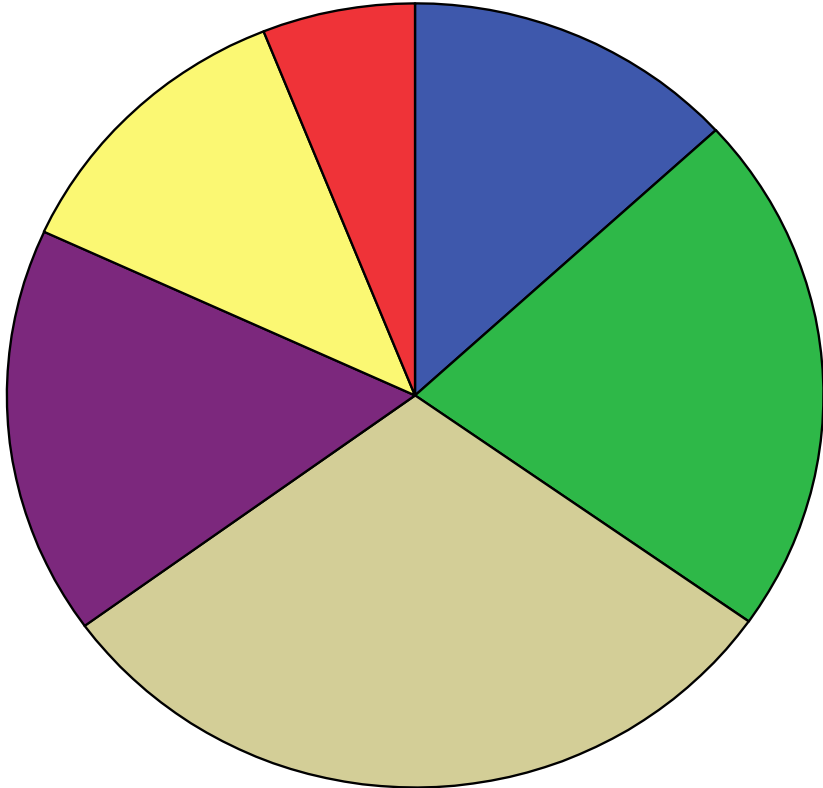
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# Impacts of CCS investment upon investment in energy efficiency and energy demand reduction in own country



- significant negative impact
- minor negative impact
- no effect
- minor positive impact
- significant positive impact
- unsure



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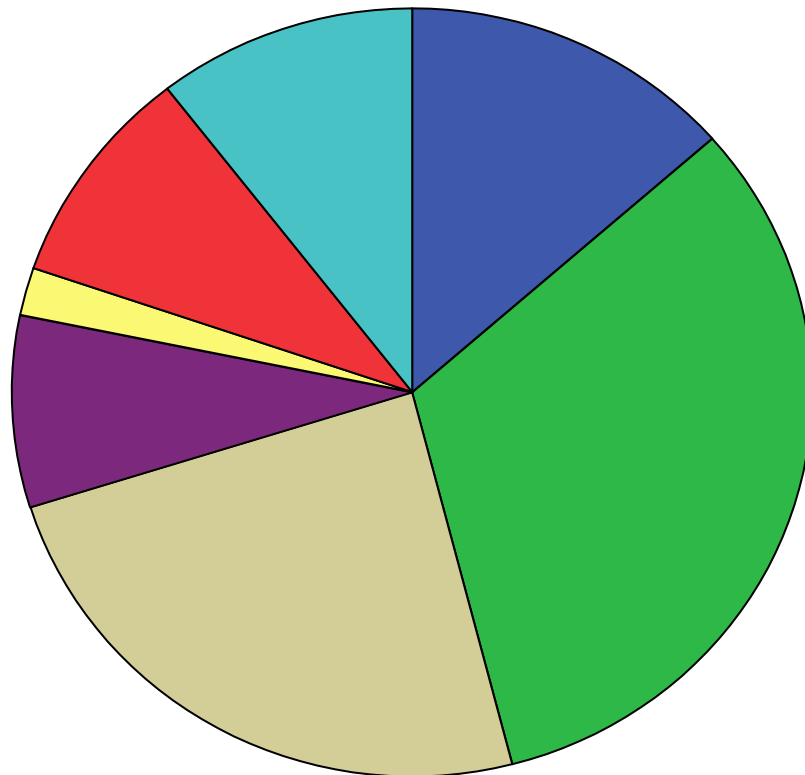
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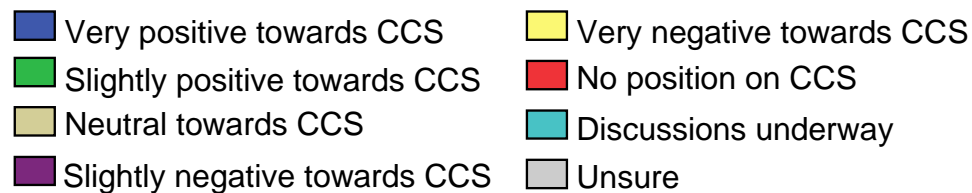


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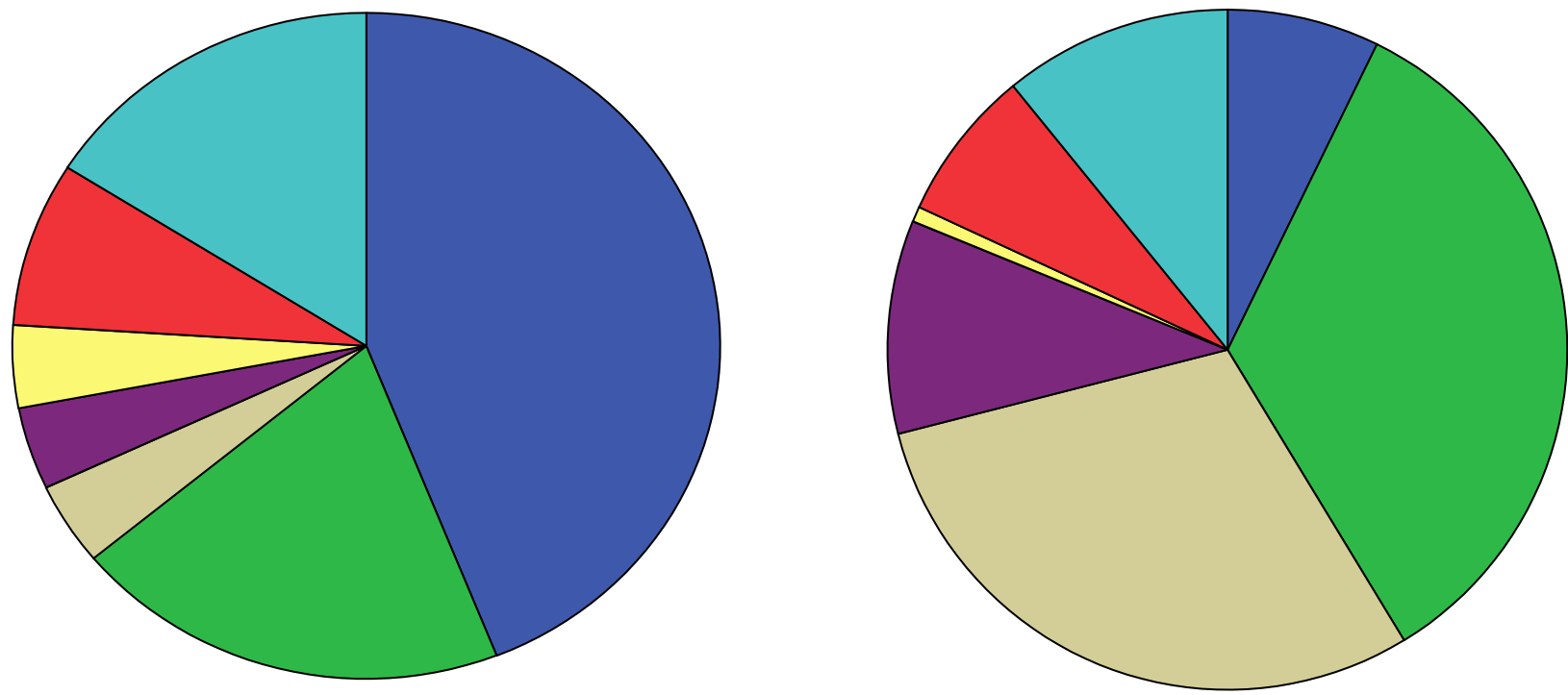
# Extent to which CCS might increase dependency upon centralised power system



- Energy, government and academic stakeholders do not perceive a very negative impact of CCS upon distributed generation
- NGOs and parliamentarians regard the risk as much greater.
- Nearly half of stakeholder groups do acknowledge a slightly negative impact of CCS upon distributed generation



# Extent to which CCS might increase dependency upon centralised power system: NGOs (left), energy sector (right)



- Very negative impact on DG
- Very positive impact on DG
- Slightly negative impact on DG
- Unsure
- No impact on DG
- Other
- Slightly positive impact on DG





# Impacts of CCS upon energy security in the EU



- Most frequent response is that coal with CCS will improve energy security in the EU (44%), whilst 28% think that there will be no impact.
- Sample more concerned about risks to energy security from gas with CCS. 37% think that there would be a reduction in energy security, whilst 27% think there will be no impact, and 18% think energy security will be enhanced.
- NGOs and parliamentarians are most concerned about impact upon energy security from gas with CCS, but the differences with other stakeholder groups are not large.



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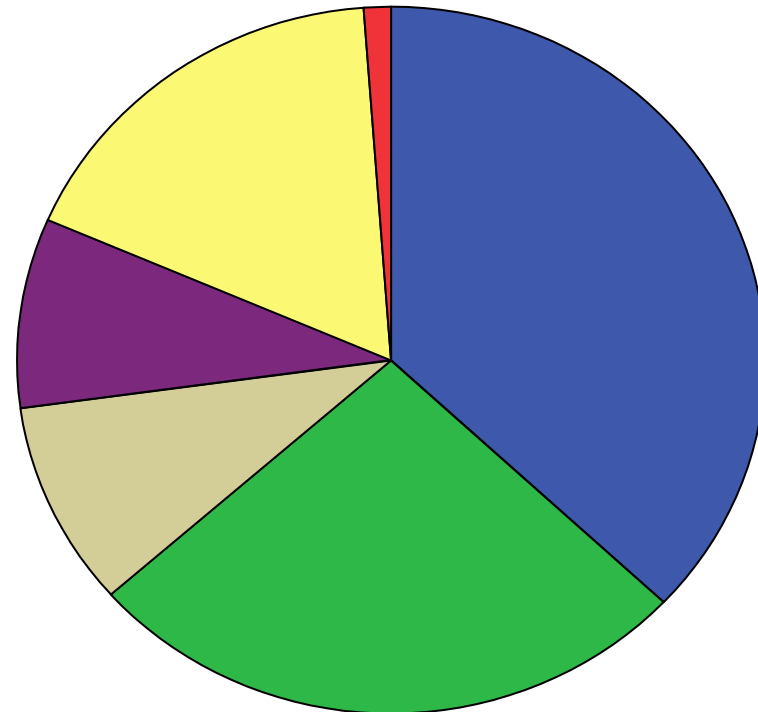
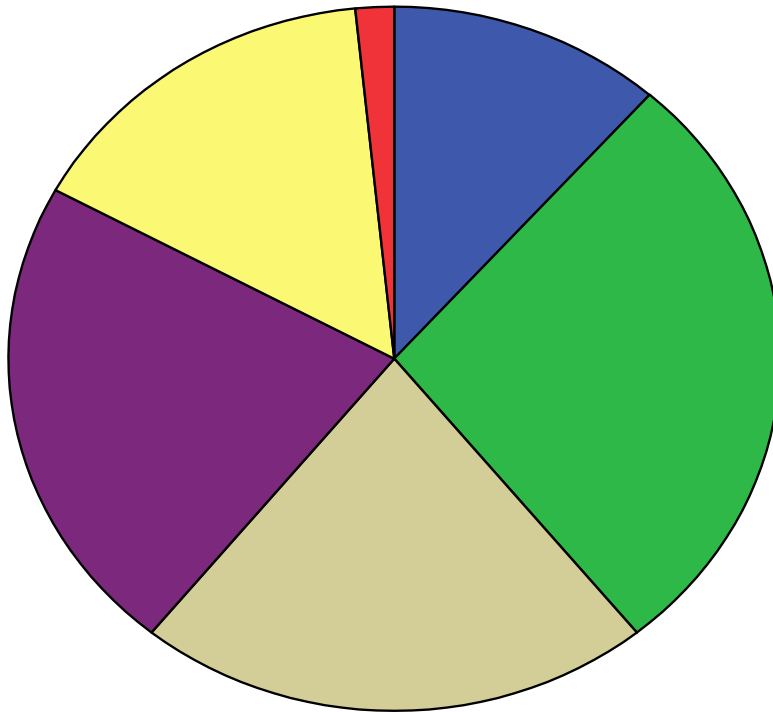
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# Impact upon energy security in EU of CCS with coal (left) and gas (right)



- Increase reliance from unstable countries
- No impact on energy security
- Increase reliance from stable countries
- Reduce reliance from unstable countries
- Unsure
- Other



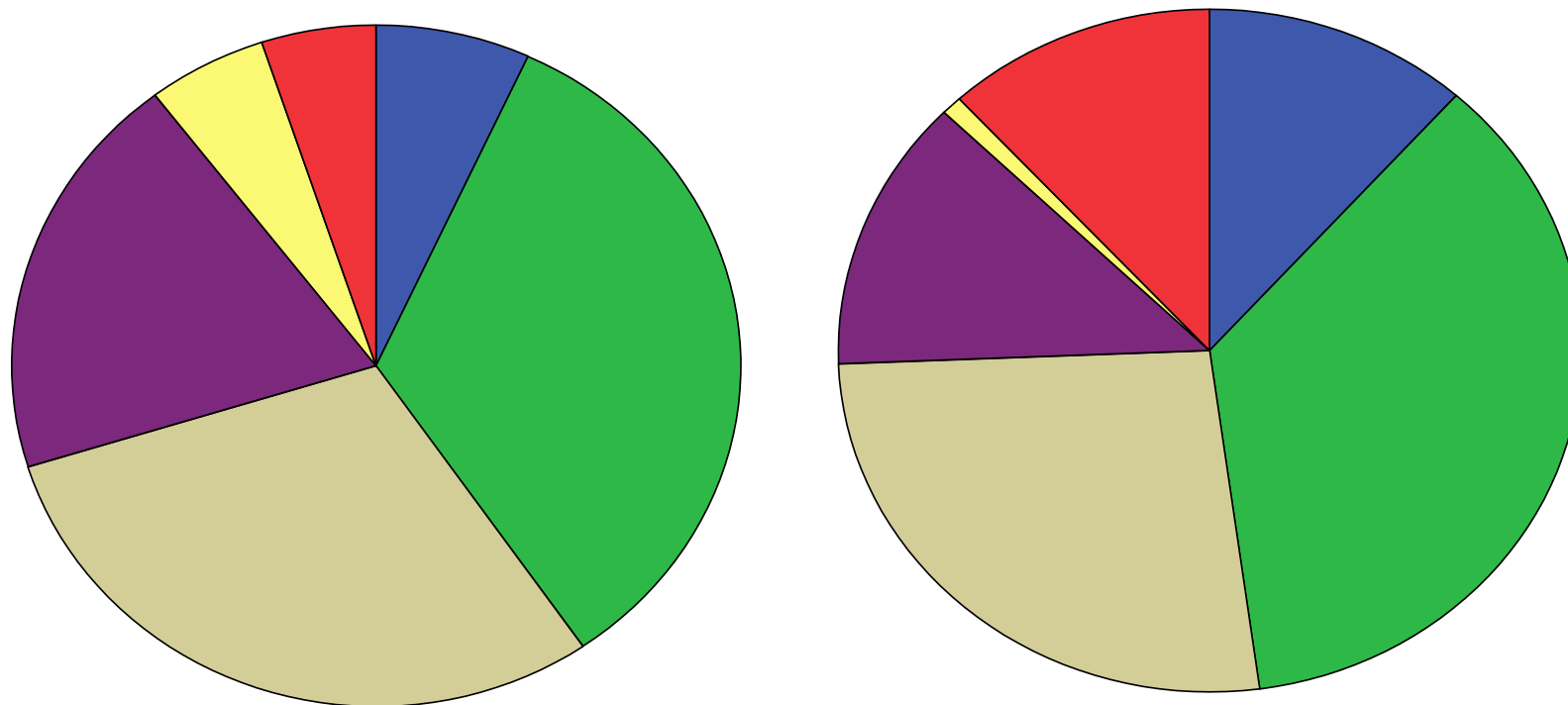
# Public perceptions of CCS in own country and in EU



- Most frequent response is that the public will 'moderately support' CCS (34%) in own country, followed by 'neutral' (30%). Only 4% think the public would be 'strongly opposed', and a further 19% think the public will be 'moderately opposed'. Only 5% think public will be 'strongly supportive'
- On balance, public support for CCS greater than opposition (40% vs. 25%).
- Norwegian respondents perceive strongest support for CCS (45% 'strongly supportive') and further 39% 'moderately supportive'.
- UK and Netherlands also see public as more positive than sample average, whilst Germany and Denmark see public as less positive than average.
- NGOs and parliamentarians least convinced that the public will be supportive, none selecting the 'strongly supportive' option. They see public as 'neither positive nor negative' most frequently.
- Respondents think that the public will be more supportive of CCS at the EU scale than in their own countries.

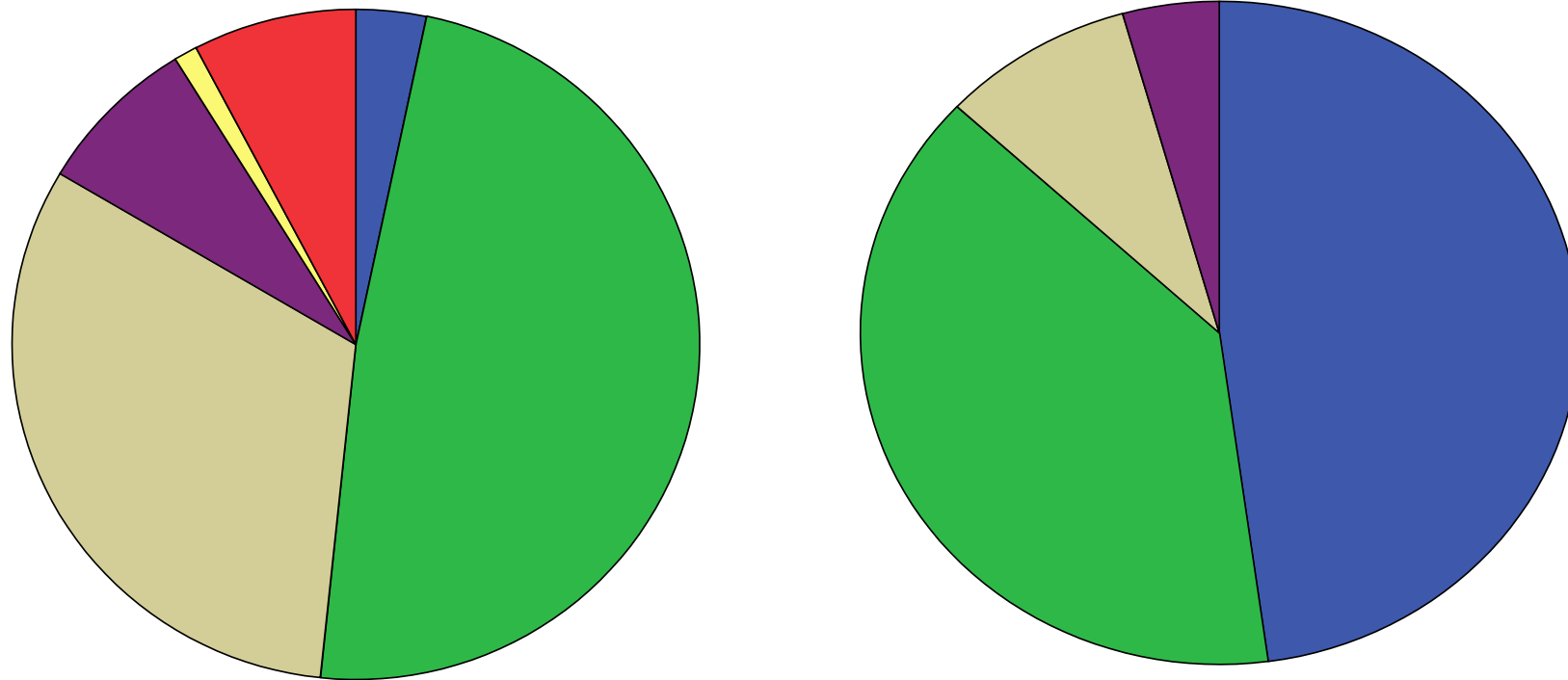


# Public perceptions of CCS in own country (left) and in EU (right)



- Strongly supportive
- Moderately supportive
- Neither positive or negative
- Moderately opposed
- Strongly opposed
- Unsure

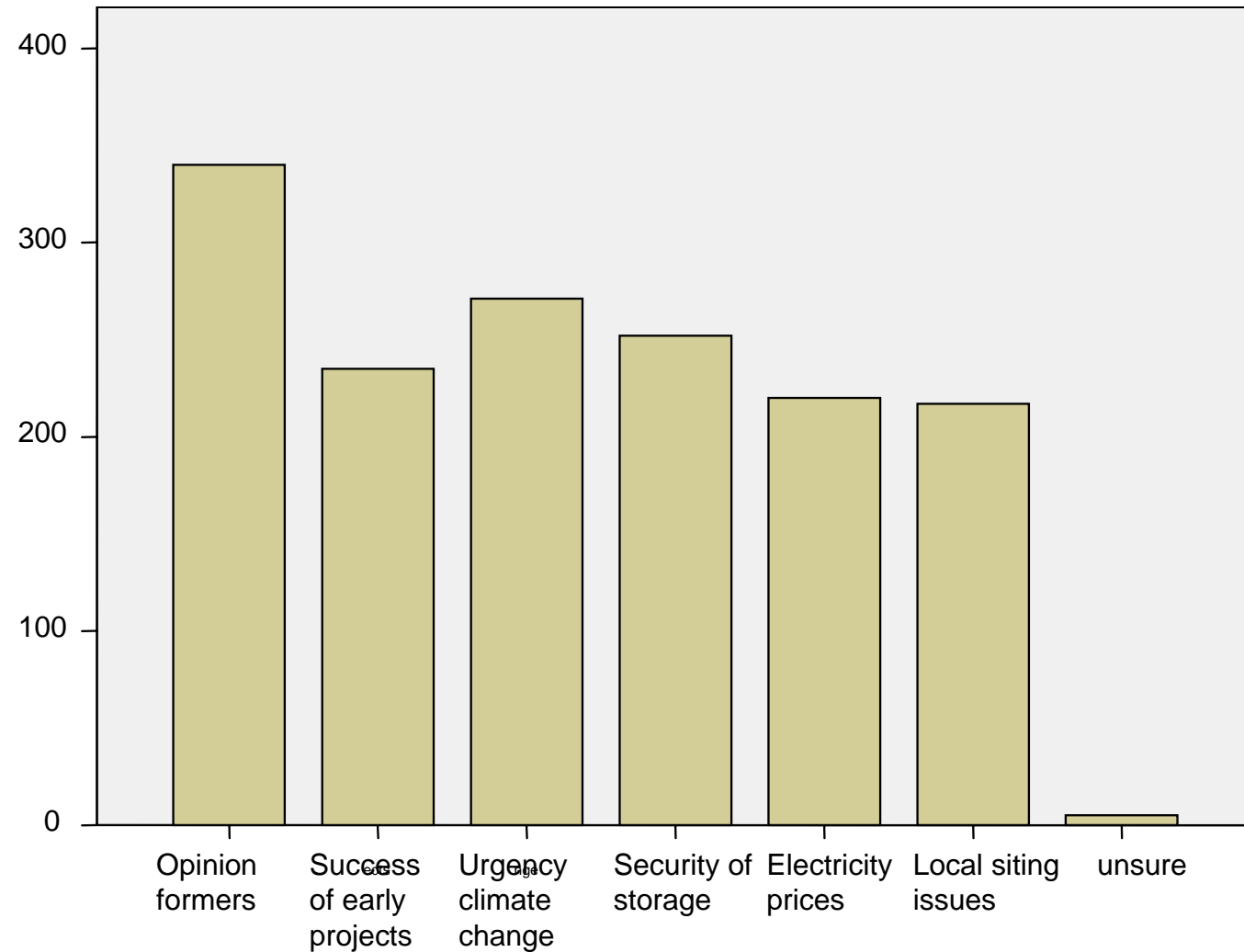
# Public perceptions of CCS in own country: UK (left), Norway (right)



- Strongly supportive
- Moderately supportive
- Neither positive or negative
- Moderately opposed
- Strongly opposed
- Unsure



# What factors are most likely to influence public perceptions of CCS?



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# Correlations



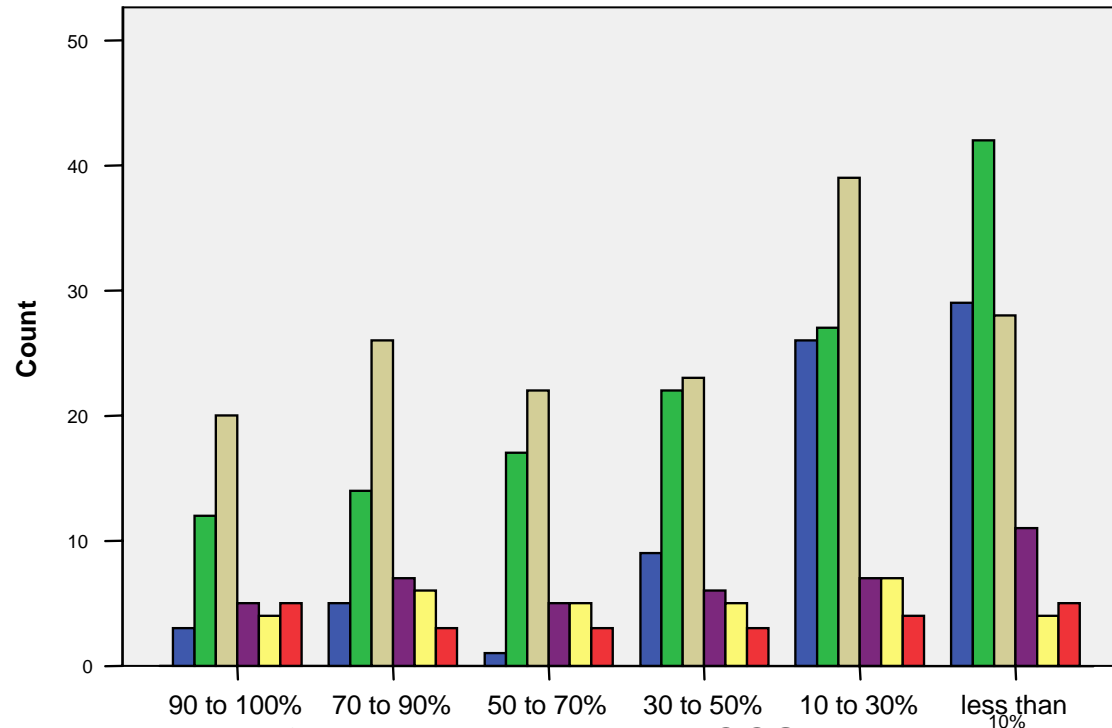
- Significant positive correlations, e.g. Between organisational position on CCS and perceived need for CCS in own country; there is stronger support for generous incentives for CCS from respondents who perceive a larger role for CCS. Risks perceptions correlate with perceived need for CCS.
- To some extent correlations support hypothesis that those most closely involved in CCS work have a tendency to perceive the potential negative aspects as smaller and the potential positive dimensions as larger.
- This is only confirmed for that part of sample which devotes less than 50% of work time to CCS.
- For those who work more than 50% of time on CCS there is rarely any significant correlation.
- Suggests that those most closely involved in CCS do not allow this to unduly bias their perceptions of CCS as a carbon mitigation option.



# Correlation between fraction of work time spent on CCS and belief that CCS will deter investment in LZCTs

whole sample -0.220 correlation (significant).

Over 50% time on CCS no correlation; under 50% time on CCS -0.119 (significant)



## Percent of work time spent on CCS

- significant negative impact
- minor negative impact
- no effect
- minor positive impact
- significant positive impact
- unsure



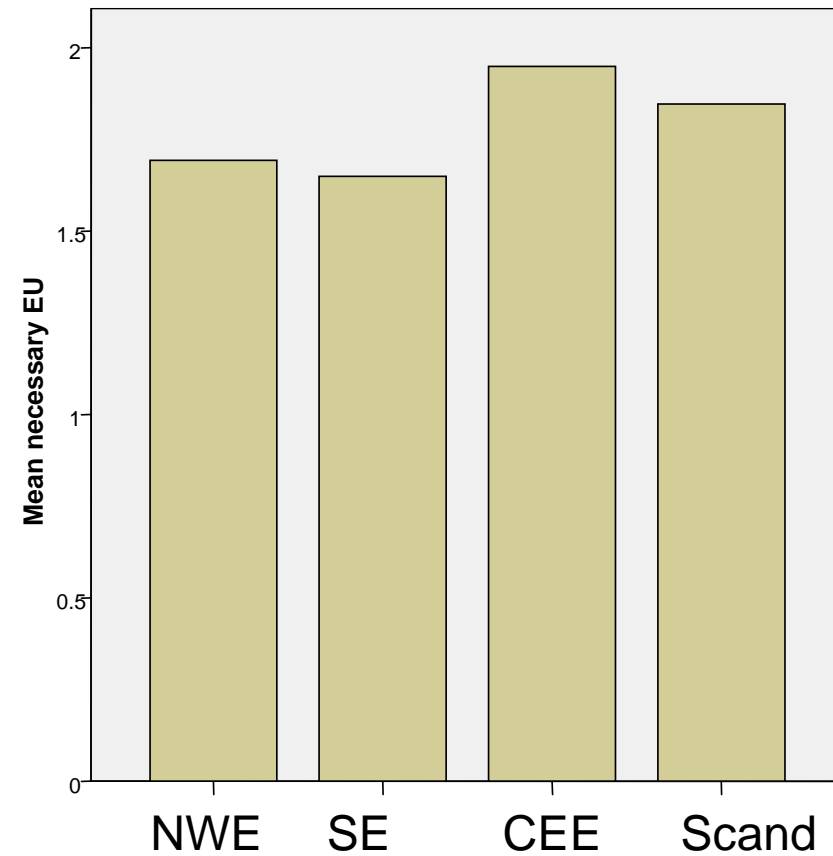
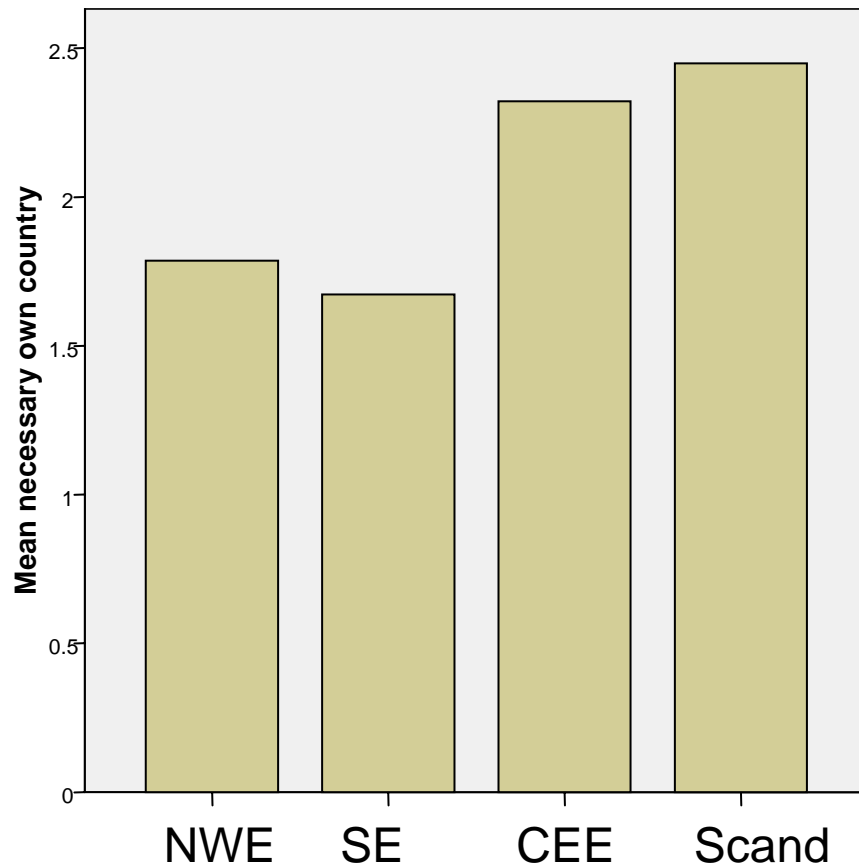
# Analysis by Regions



- North West Europe (NWE) and Southern Europe (SE) keener on CCS in own country than Central & Eastern Europe (CEE) and Scandinavia (Scand)
- Response of Scand conceals a bipolar response between Norway and Finland / Sweden & Denmark
- Role of CCS in national climate change debate in CEE is much less than for other countries
- Support mechanisms: CCS requirement and guaranteed-feed in tariff least liked in Scand, followed by NWE, CEE and SE
- Extension of EU ETS with tighter caps most popular in NWE
- Respondents in Scand and CEE tend to prefer common incentives across EU, whilst NWE and SE tend to prefer EU ETS plus additional national incentives
- Regulation through international standards was most popular in Scand, whilst EU standardisation most popular in NWE and SE



# Perceived need for CCS in own country (left) and EU (right) (lower value indicates greater perceived need)



Country groups



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Country groups



# Analysis by Regions



- Risk perceptions of CCS are greatest for respondents from CEE ..... for each of the twelve factors they rated the risks as higher than other regions
- For a few of the risks, e.g. risks of CO<sub>2</sub> leakage for global climate, Scand respondents regarded as higher than NWE and SE
- CEE and Scand respondents more likely to regard CCS as having negative impact on decentralisation
- Scand regarded CCS with coal as improving energy security in EU more than other groups
- SE respondents thought public perceptions of CCS in own country would be more negative than other groups



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# Analysis by Population Size of 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



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# 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 tended to see risks as lower, especially those associated with infrastructure
- Public perceptions regarded as some what less positive in own country in the 'no fossil fuels' group but no differences with respect to EU scale



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