Bifrost: Social acceptance and preference for CCS – the influence of information and knowledge

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Danish Offshore Technology Conference 2022, November 30, 14.20-14.50: Is CCS acceptable? New Bifrost survey about the public perception of CCS

Overview of presentation

1. Introduction
2. Information and knowledge
3. Survey
4. Acceptance
5. Preferences and willingness to pay
6. Conclusion

Introduction – becoming CO2 neutral in 2050

Globally, governments have increased the focus on the newer technology CCS and made many billion $ investments in demonstration projects.

These investments are backup by IPCC (IPCC 2022).

Denmark follows this trend and has invested in the two storage demonstration projects Bifrost and Greensand

Experience with technology and energy infrastructure emphasise the need for high levels of acceptance to ensure a fast, smooth and efficient technology use.

Furthermore, detailed information on the preferences for the level of CCS use is crucial for our understanding of the populations demand for CCS use.

As part of Bifrost, data on Danish households' CCS acceptance and preference is gathered and analysed

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CCS acceptance, knowledge and information

Significant effects between knowledge and information effects are found in the literature.

Review ´by Zuch & Ladenburg (2022) suggests that climate change information and information about CCS characteristics influence CCS acceptance and perceptions.

However, the majority of the study are not Random Trial and Control (RTC)experiments, which questions are the causal effects of information.

Information and knowledge policy recommendations are thus vague.

Bifrost Survey

Data collected in the period 27th of June to 31st of August via E-Boks (digital mailbox where individuals receive letters/emails from the public authorities, insurance companies, bank etc).

Response rate of 22.5%

Data weighted to be national representative in terms of gender, age, civil status and geographical area of residence.

3,879 answers on acceptance of CCS

3,851 answers on willingness to pay

Three RTC information experiments included in the acceptance and willingness to pay questions

Information scenarios

Baseline information:

CO2 capture and storage (CCS) is a technology where CO2 is captured at power plants or industries. The CO2 is transported via pipes/by ship to the storage site, and pumped deep into the subsoil, where nature itself ensures that the CO2 stays there. In Denmark, we are already testing the possibilities of capturing CO2 and storing it in two large old oil/gas fields in the North Sea.

Information I:

CO2 capture and storage (CCS) is a technology where CO2 is captured at power plants or industries. The CO2 is transported via pipes/by ship to the storage site, and pumped deep into the subsoil, where nature itself ensures that the CO2 stays there. The technology has been used abroad for almost 40 years and in Denmark the possibilities of capturing CO2 and storing it in two large old oil/gas fields in the North Sea are being tested.

Information II:

CO2 capture and storage (CCS) is a technology where CO2 is captured at power plants or industries. The CO2 is transported via pipes/by ship to the storage site, and pumped deep into the subsoil, where nature itself ensures that the CO2 stays there. The technology has been used abroad for almost 40 years and in Denmark the possibilities of capturing CO2 and storing it in two large old oil/gas fields in the North Sea are being tested.

Gas storage is not a new technology in Denmark. Since the mid-80s and 90s, millions of cubic meters of natural gas have been stored and extracted annually underground in Jutland (Lille Torup) and Zealand (Stenlille).

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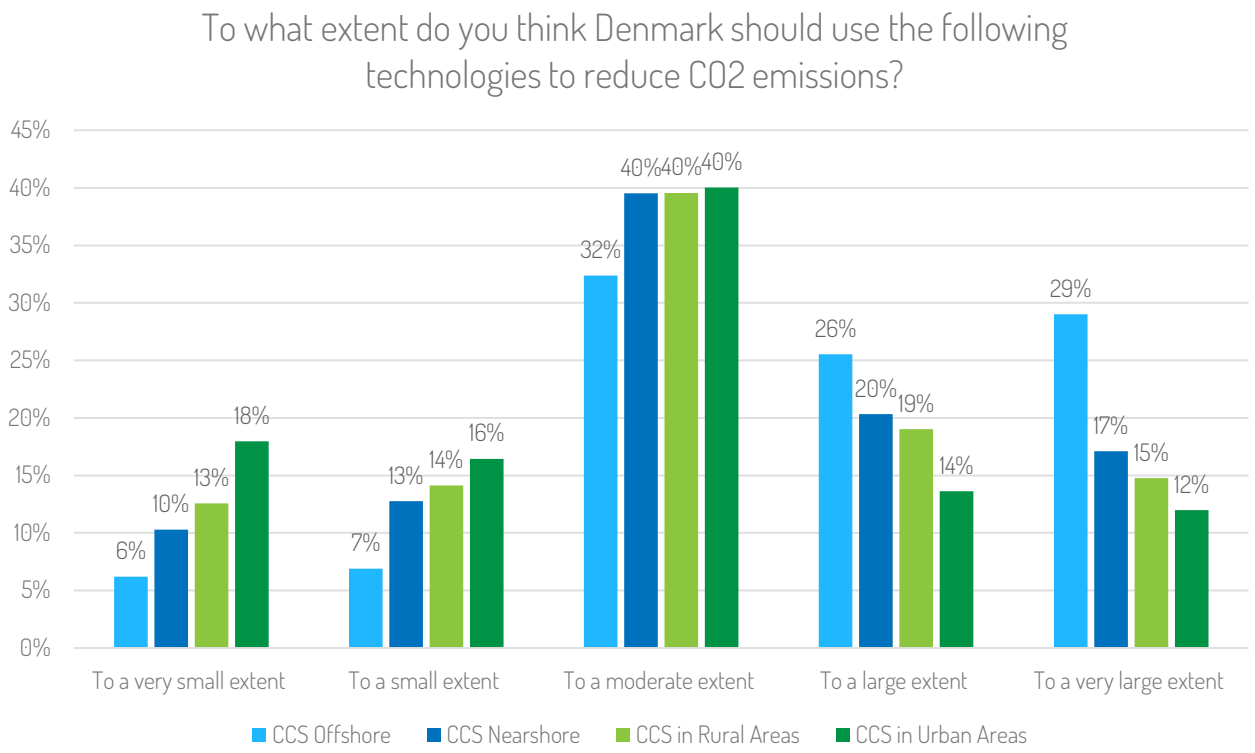
Acceptance questions

- "To what extent do you think Denmark should use the following technologies to reduce CO2 emissions?"
- "To a very large extent", "To a large extent", "To a moderate extent", "To a small extent", and "To a very small extent".

  - CCS onshore urban areas
  - CCS onshore rural areas
  - CCS nearshore/coastal
  - CCS offshore

- Very simple and non- consequential questions
- We do not frame the potential of CCS in terms of storage capacities
- More elaborated CCS acceptance questions will be included in our coming survey.

Acceptance of CCS: Main results



Highest support for offshore CCS, followed by nearshore, rural and urban CCS

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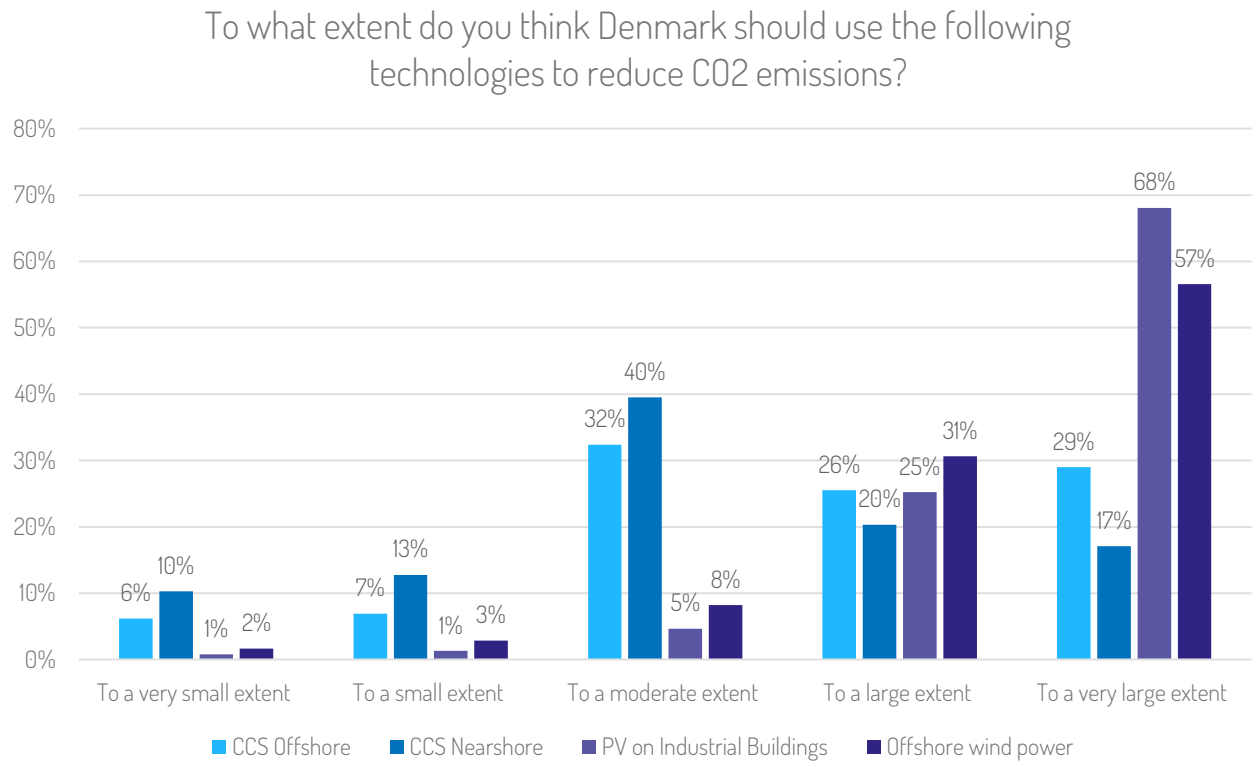
Acceptance of CCS relative to other technologies



Higher support for PV on industrial roofs and offshore wind power.

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Information and knowledge effects

- Acceptance of offshore CCS:
- Knowledge and information have no influence on offshore CCS acceptance

- Acceptance of nearshore CCS:
- Knowledge about CCS increases acceptance of nearshore CCS.
- Information I increases acceptance among respondents with no knowledge

- Acceptance of onshore rural CCS:
- Knowledge about CCS increases acceptance of rural CCS – however, not if they receive information I
- Information I and II increase acceptance of rural CCS among respondents with no knowledge

- Acceptance of onshore urban CCS:
- Knowledge about CCS increases acceptance of urban CCS – however, not if they receive information I
- Information I increases acceptance of urban CCS among respondents with no knowledge

Willingness to pay for offshore CCS

Acceptance questions give ordinal indication of the level of support – but no direct economic and policy measure

An alternative approach is to ask people about the preferences for CCS – how much are they willing to pay for reducing CO2 emissions via CCS?

We applied the economic valuation method Contingent Valuation

People are given a more thorough introduction to CCS

Willingness to pay for offshore CCS

Denmark must reduce the CO2 emissions by 70 percent in 2030. This corresponds to us missing to reduce our annual emissions by approx. 21.5 million tons of CO2/year. Imagine that Denmark government wants to capture and transport CO2 and store it in the North Sea several hundred km from the west coast of Jutland. The financing of CO2 capture and storage will take place through an annual CO2 capture tax for each household. You will now be asked what you will pay on behalf of your household to capture and store

(50% of the respondents) 5 tons of CO2 / year in Denmark from 2030, corresponding to approx. 23% of our reduction needs

(50% of the respondents) 10 tons of CO2 / year in Denmark from 2030, corresponding to 47% of our reduction needs.

Note that your answers may influence the decision on how we will use CO2 capture and storage. Also note that there is a tendency to overestimate one's willingness to pay in willingness to pay studies like this. Therefore, carefully consider how much your household is willing to pay per year when you take into account your budget and spending.

Willingness to pay for offshore CCS

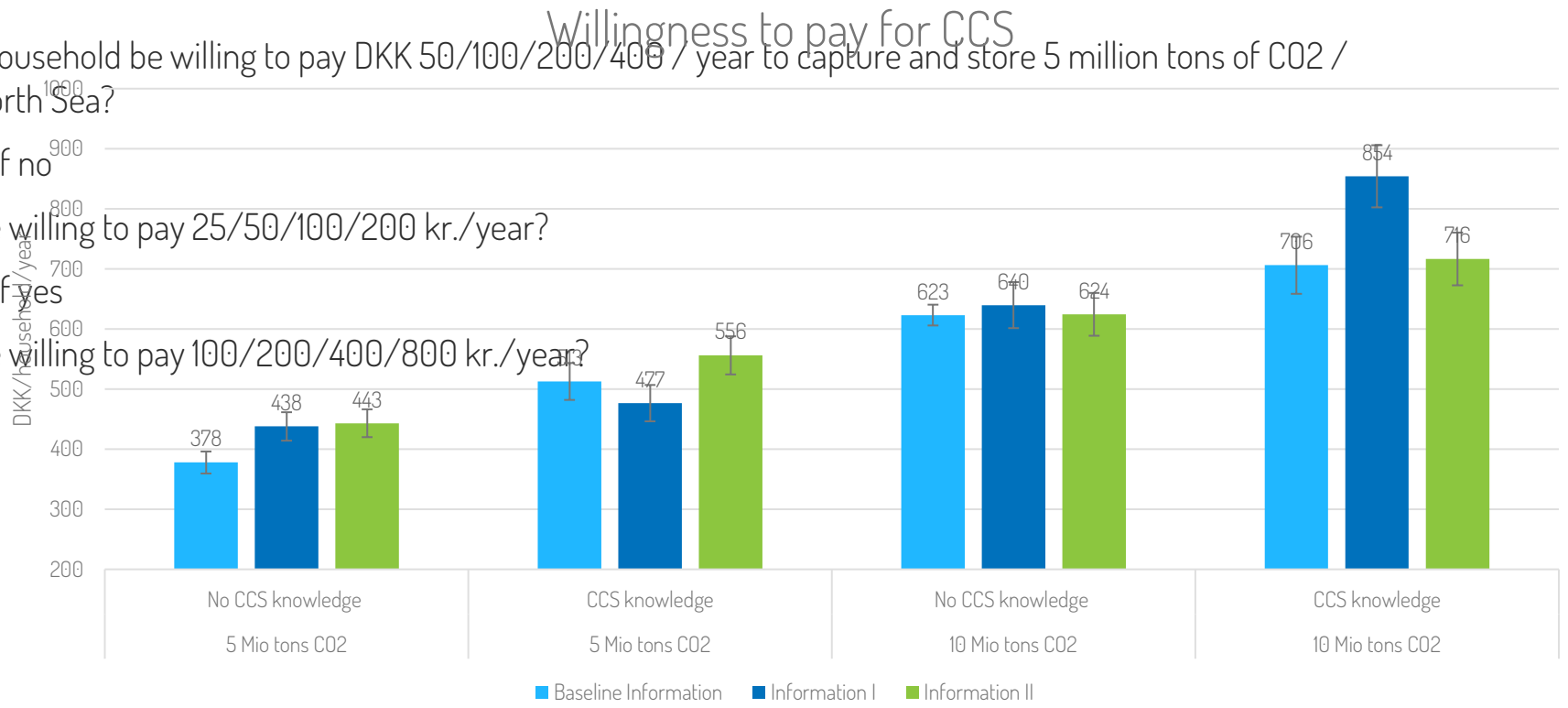
Would your household be willing to pay DKK 50/100/200/400 / year to capture and store 5 million tons of CO2 / year in the North Sea?

If no

Would you be willing to pay 25/50/100/200 kr./year?

If yes

Would you be willing to pay 100/200/400/800 kr./year?



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Conclusion

Relative good acceptance of CCS, particularly offshore

Though less than offshore wind power and PV on industrial rooftops.

Significant and positive WTP for CCS offshore in the range 378-556 DKK and 623-854 DKK/Household/year for 5 Mio. and 10 Mio tons. CO_2 respectively

CCS Knowledge and information are positive significant determinants of acceptance and willingness to pay

Coming survey in 2023 will focus on

- more elaborate CCS information
- risk perceptions
- preferences for offshore vs. nearshore and onshore CCS

Thank you

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References

Zuch, Matteo and Jacob Ladenburg (2022): Information effects on public acceptance and perceptions of CCS: A literature review. Paper submitted to Renewable Sustainable Energy Reviews.