Public support and opposition toward floating offshore wind power development in Norway

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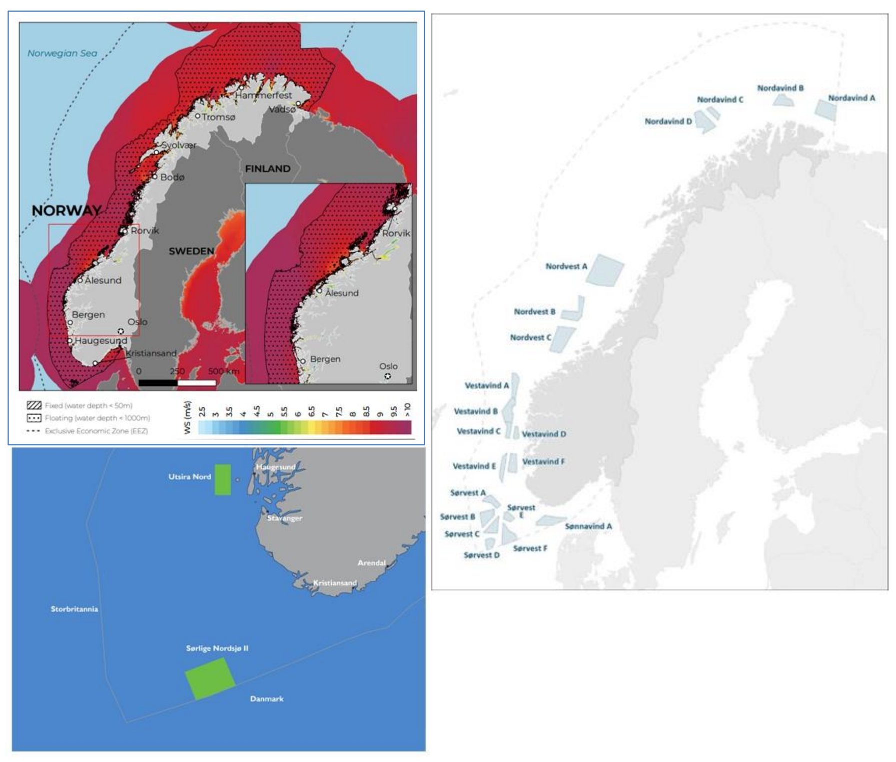
Introduction

Offshore wind power: **Global** potential: 71,000 GW for both floating and fixed-bottom (World Bank, 2022). **Norway** potential: **Floating** (1,416 GW) and Fixed (60 GW) (GWEC 2021). Target 30 GW by 2030. Rich wind power resources, but **deep waters** (average water depths: Norwegian Sea: 1600m, Barents Sea 230m, North Sea 60m).



Top left: Offshore wind power resources in Norway Source: GWEC, 2021). Top right: Recently (2023) opened new ocean areas for wind power, and bottom; Ocean areas opened in June 2020.

Floating wind power technology types Source:Equinor

Contribution: Elicits willingness to pay(WTP) for floating offshore wind power.

Introduces two **novel attributes;** (i) Share of Norwegian technology, and (ii) reduction in technology costs by 2030.

Methods

Survey

Sampling conducted at a **national level**, data was collected by survey, company Kantar

Respondents randomly split into two sub-samples, Electricity or Climate.

Results from **two sample t-tests** and **chi-square** tests indicate that the subsamples are not different

Subsequent analyses based on 1,011 respondents

Attributes	Levels
Project size	500MW, 1000MW, 1500MW
Share of Norwegian technology	25%, 50%, 75%
Reduction in technology costs in 2030	10%, 20%, 30 %
Use of electricity	Norway, Oil and gas, Other countries
Increase in household's electricity bill for three years	10%, 15%, 20%, 25%, 30%, 35%

Attributes and Levels

		Samples			Population
Variable		Electricity	Climate	Pooled	Norway
Gender	Male	56%	56%	56%	49%
	Female	44%	44%	44%	51%
Age	18-29	13%	15%	14%	20%
	30-44	23%	21%	22%	26%
	45-59	24%	28%	26%	26%
	60-89	40%	36%	38%	29%
Education	University degree	38%	38%	38%	35%

Socio-demographics of samples and population

Design of choice tasks : D-efficient design using Ngene software (Choice Metrics, 2021).

The design used Multinomial Logit model (MNL) with zero priors (Bliemer & Collins, 2016).

18 choice tasks created and split into **three** blocks, and each choice task had **two project** alternatives and a **none-of-these** alternative

Each respondent is presented to **six** choice tasks

Discrete choice experiment

Electricity demand	Climate objectives
According to the Norwegian Water Resources and Energy Directorate (NVE), the demand for electricity in Norway is expected to increase by 15% by 2040. Similar increase in electricity demand is expected in neighbouring countries. In 2020, the Norwegian authorities decided to open the sea areas Utsira Nord and Sørlige Nordsjøen II for the development of wind power projects. The wind projects built where the oceans are deep will use new floating offshore wind power technology. The Norwegian government will give economic support for the development of these projects in the transition phase . The floating offshore wind power projects will help us meet the increasing electricity demand, but critics say the projects could affect the coast and seascapes, other industries, birds, and marine life.	Norway is one of 197 countries that signed the Paris Agreement to reduce carbon emissions. Norway is committed to reducing its emissions substantially in the years to come. To achieve net-zero emissions by 2050, countries must replace polluting energy sources with renewable energy sources In 2020, the Norwegian authorities decided to open the sea areas Utsira Nord and Sørlige Nordsjøen II for the development of wind power projects. The wind projects built where the oceans are deep will use new floating offshore wind power technology. The Norwegian government will give economic support for the development of these projects in the transition phase . The floating offshore wind power projects will help us meet the climate objectives, but critics say the projects could affect the coast and seascapes, other industries, birds, and marine life.

Framing text

	OFFSHORE WIND 1	OFFSHORE WIND 2	NONE OF THESE
Project size	1500 MW	1000 MW	No new Norwegian offshore wind projects before 2030
Share of Norwegian technology	25%	75%	
Reduction in technology costs by 2030	30%	30%	
Use of electricity	Norwegian oil and gas sector	Transport to Norwegian mainland	
Increase in household's electricity bill	20%	15%	

Sample of Choice Card

Results

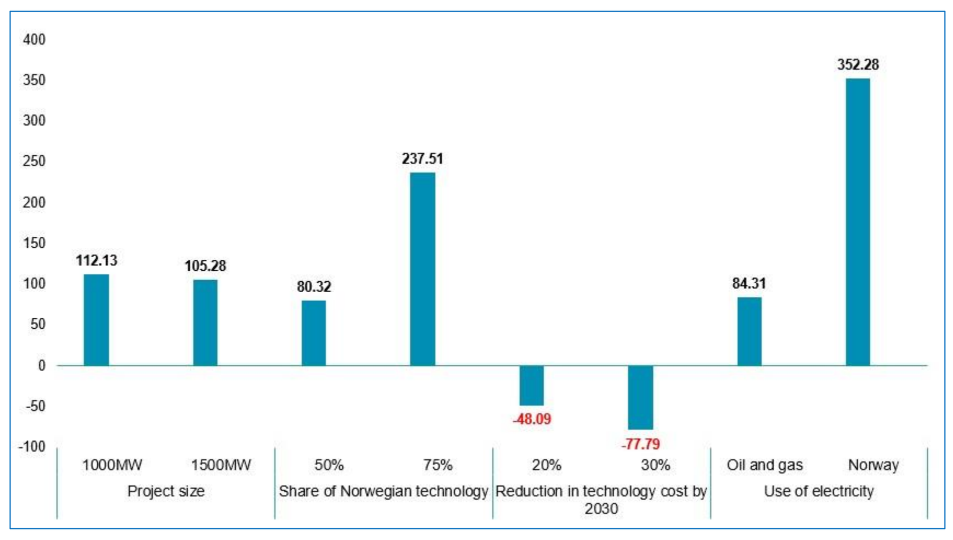
Marginal WTP estimates.

Preference for medium-sized, 1000MW to large, 1500MW.

Preference for higher shares of Norwegian technology

Positive WTP for use of electricity in Norway and offshore oil and gas platforms.

Negative WTP for reduction in technological costs by 2030

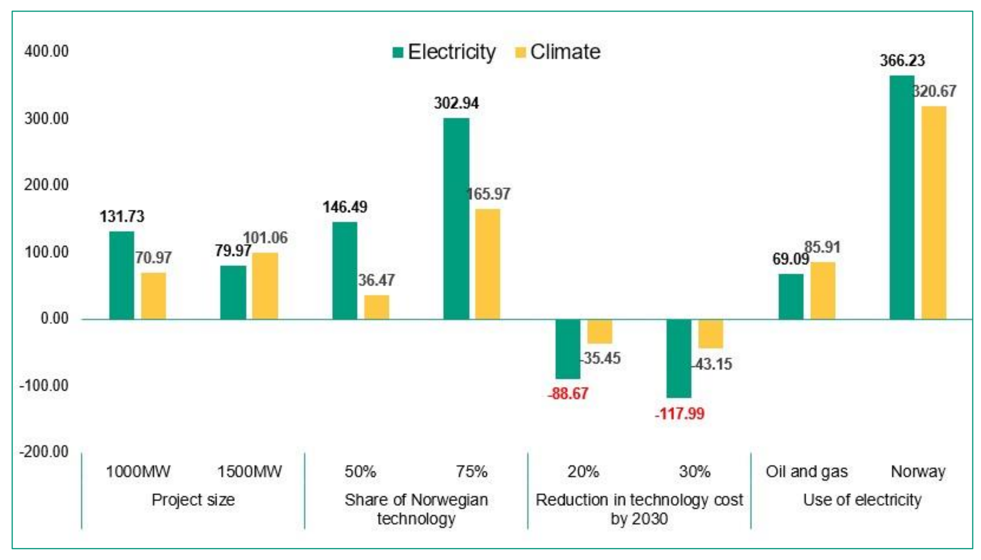


Marginal WTP for Pooled sample
Note: WTP calculated relative to base levels. The attribute base levels are *project size, 500 MW, share of Norwegian technology, 25%, reduction in technology costs by 2030, 10%, and use of electricity, in other countries.*

Differences in WTP due to framing

Using the complete combinatorial test of difference in empirical WTP distributions (Poe et al., 2005), we test for WTP differences due to framing

The results suggest that WTP estimates for the **share of technology attribute**, specifically 50%, differ significantly between the framings (p<0.05)



Marginal WTP for the Electricity and Climate subsamples
Note: WTP calculated relative to base levels. The attribute base levels are *project size, 500 MW, share of Norwegian technology, 25%, reduction in technology costs by 2030, 10%, and use of electricity, in other countries.*

Discussion

- ❑ Like other studies (e.g., Navrud & Bråten, 2007), our findings from the pooled sample indicate that respondents prefer medium-sized wind power projects. This preference may be linked to a desire to increase energy production whilst minimizing the environmental footprint and the cost implications
- ❑ Individuals often prefer local electricity consumption over export (Paasi, 2003; Navrud and Bråten, 2007; Brennan, 2017; Bidwell et al., 2022; Linnerud et al., 2022). This preference for local resource use may stem from a sense of regionalism.
- ❑ Our study introduces two novel attributes linked to technology development. Respondents favour domestic technology , which may indicate that they would like to establish a local offshore industry.
- ❑ By contrast, respondents have negative WTP for reduction in technological costs shows that they are reluctant to subsidize projects today, maybe because of risk aversion, or due to unequitable distribution of costs and benefit.
- ❑ The type of policy framing matter.

Conclusion

- ❑ Energy supply to Norway or oil and gas platforms , and the use of Norwegian technology should be prioritized when planning offshore wind policy packages
- ❑ People prefer medium-sized projects to large projects
- ❑ Decision makers may need to weigh siting options, electricity production capacity and the final costs for optimal project deployment.
- ❑ Respondents in the climate frame have lower WTP values compared to those in the electricity frame
- ❑ Concisely, the way energy policies are designed and presented to the public is critical for social acceptance.