The impact of offshore wind in the society

Hywind Tampen ripple effect analysis

Sepember 12th 2019, UiB

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RAPPORT

Hywind Tampen - Samfunnsmessige ringvirkninger

OPPDRAGSGIVER
Equinor

EMNE
Konsekvensanalyse

DATO / REVISJON: 21. februar 2019 / Endelig
DOKUMENTKODE: 10209499-TFP-REA-RAP-001

THEMA CONSULTING GROUP Multiconsult FUTURE TECHNOLOGY

2,3 billion NOK From ENOVA

Agenda

- **Executive summary**
- The Hywind Tampen Project
- Ripple effects – Hywind Tampen
- Ripple effect scenarios for future floating offshore wind markets
- Cost-benefit analysis – Hywind Tampen
- Conclusions

Hywind Tampen will have a positive impact on the Norwegian industrial clusters chances of taking a larger share the growing offshore wind market

Ripple effects
Given assumptions on investment volumes, O&M cost and the share of contracts awarded to Norwegian suppliers, we estimate that Hywind Tampen could contribute to between **1,550 and 3,000 full-time equivalents (FTEs) and a contribution to national GDP** of between **1.8 - 3.5 billion NOK** in total over the lifetime of the project. The lion's share of this would result from the project's construction phases when most investments are made.

Impact of Hywind Tampen on position in future Floating Offshore Wind market
Depending on the share of contracts captured by Norwegian firms, a 1 GW Norwegian market by 2030 could mean economic ripple effects of between **8,000 and 15,000 FTEs** and a **contribution to national GDP ranging between 9.4 - 17.6 billion NOK**. Likewise, an 11 GW market by 2030 outside Norway could mean ripple effects in **FTE and GDP contribution of 8,000-28,000 FTEs and 9 - 31 billion NOK, respectively**.

Cost-benefit analysis
Our cost-benefit analysis implies that the net present value is in the range of **-2.3 and +1 billion NOK**, depending on assumptions on project lifetime, discount rate and the carbon price trajectory. This value does not account for ripple effects in FTEs and GDP contribution.

Conclusion
In conclusion, Hywind Tampen is **likely to yield innovation and learning effects** that contribute to commercialising floating offshore wind technology. Participation in the project by Norwegian suppliers could **strengthen the competitive positioning** of these in the broader national and international market. **This should be given considerable weight in evaluations of the project** by whomever it may concern.

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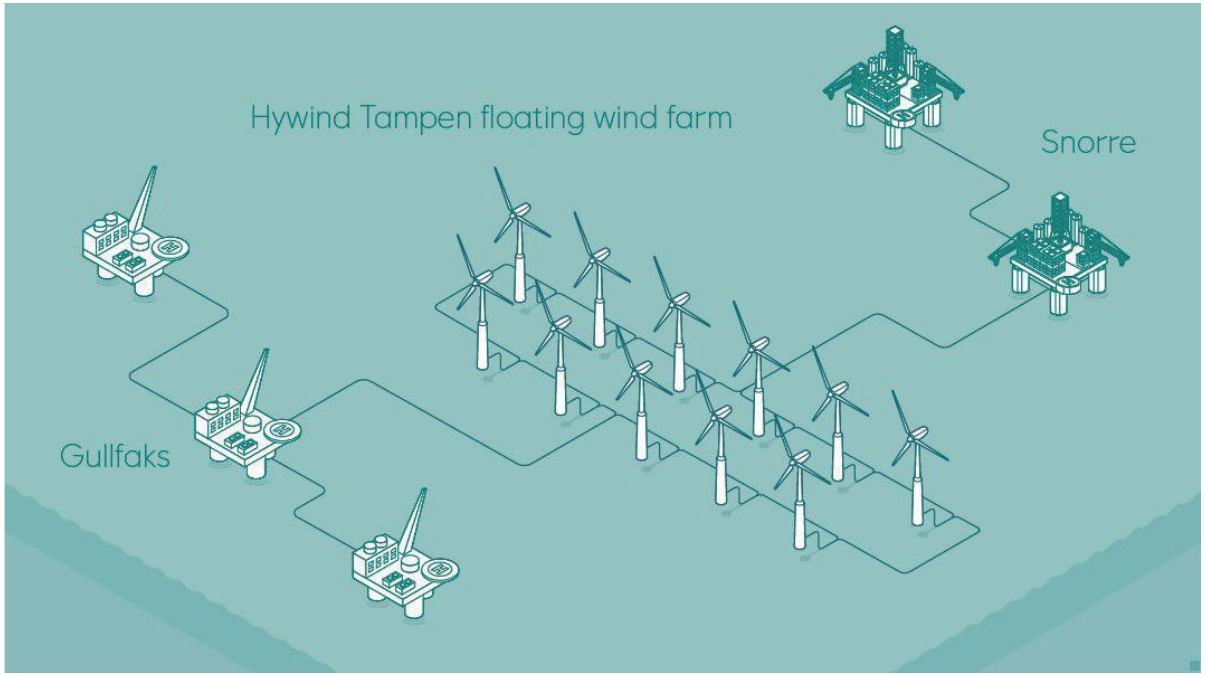
The Hywind Tampen project



- The 88 MW Hywind Tampen, is slated to become the worlds largest offshore floating wind farm if commissioned in 2022.
- Wind turbines will supply the five Gullfaks and Snorre platforms with wind-energy produced electricity, yielding annual CO_2 reductions of at least 200 000 tonnes on average.
- Partners in these licenses are Equinor, Petoro, Exxon Mobil, Idemitsu, DEA Norge, Point Resources and OMV. Equinor is developing the project on behalf of these firms.

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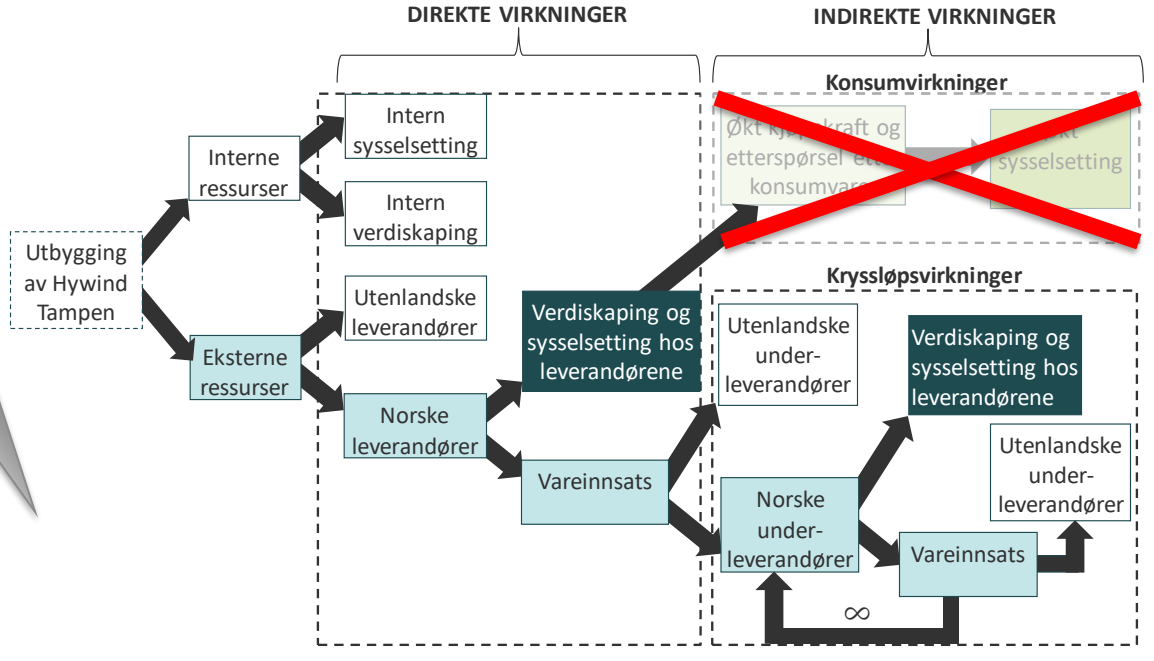
How we calculate ripple-effects

We use input from Equinor, segment it and calculate impact of the activity on the impulse to GDP and to additional jobs (Full Time Equivalents - FTEs)

Input from Equinor on value of contracts and on range of Norwegian contract share

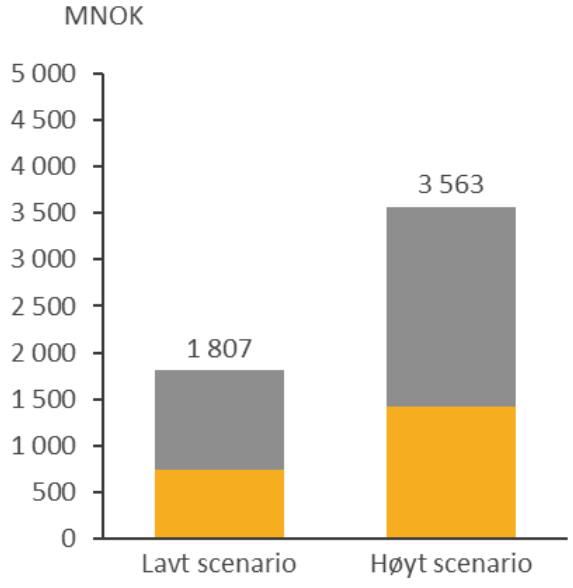
Segmentation by Future Technology (now ÆGE) into different NACE-codes to use in Thema's Ripple Effects model



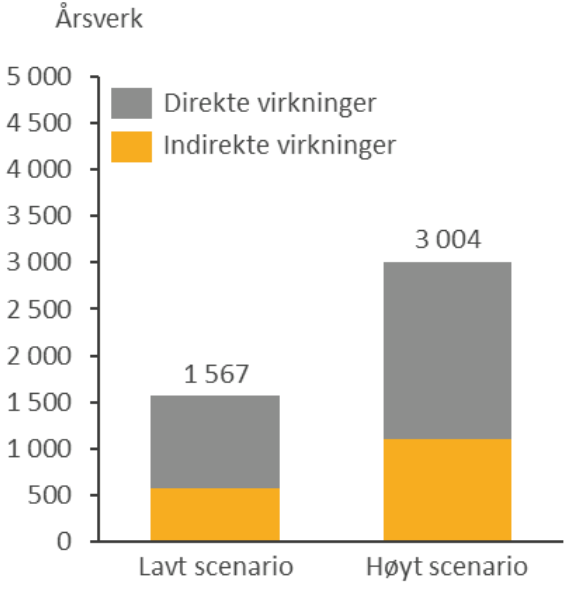
Hywind Tampen investments and operation generates impulse to GDP and job creation

We use Equinor's own figures for high and low Norwegian market share (tbd)

Hywind Tampen's contribution to GDP



Hywind Tampen's contribution to job creation (FTE's)



Dependant on the Norwegian industry's share of the contracts, the contribution is:

- 1800-3600 Million NOK to GDP
- 1550-3000 jobs (FTEs)

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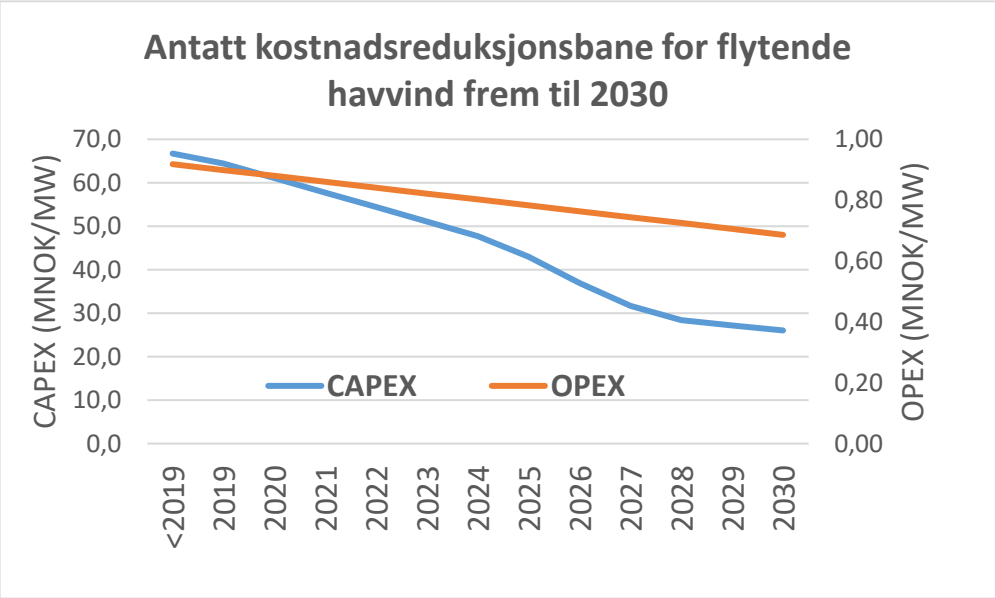
Cost is coming down for floating offshore wind

-but the estimates for how much varies greatly

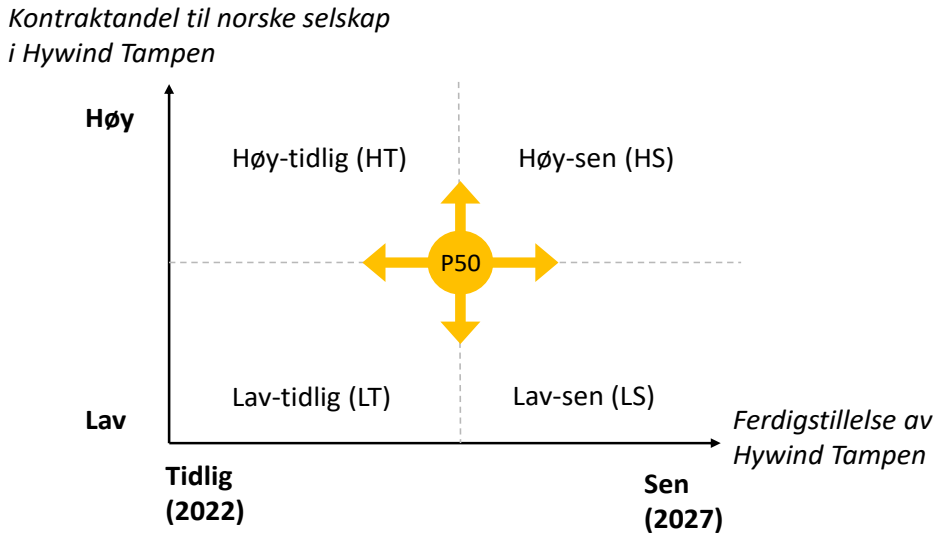


Based on analysis by BVG and Catapult, we estimate a price forecast for CAPEX and OPEX for floating offshore wind towards 2030

Different scenarios for Norwegian share of a future market

There is no current methodology for estimating the significance of individual projects on the supply-industry's future growtth and opportunities.

Distribution of Norwegian value of different future market segments

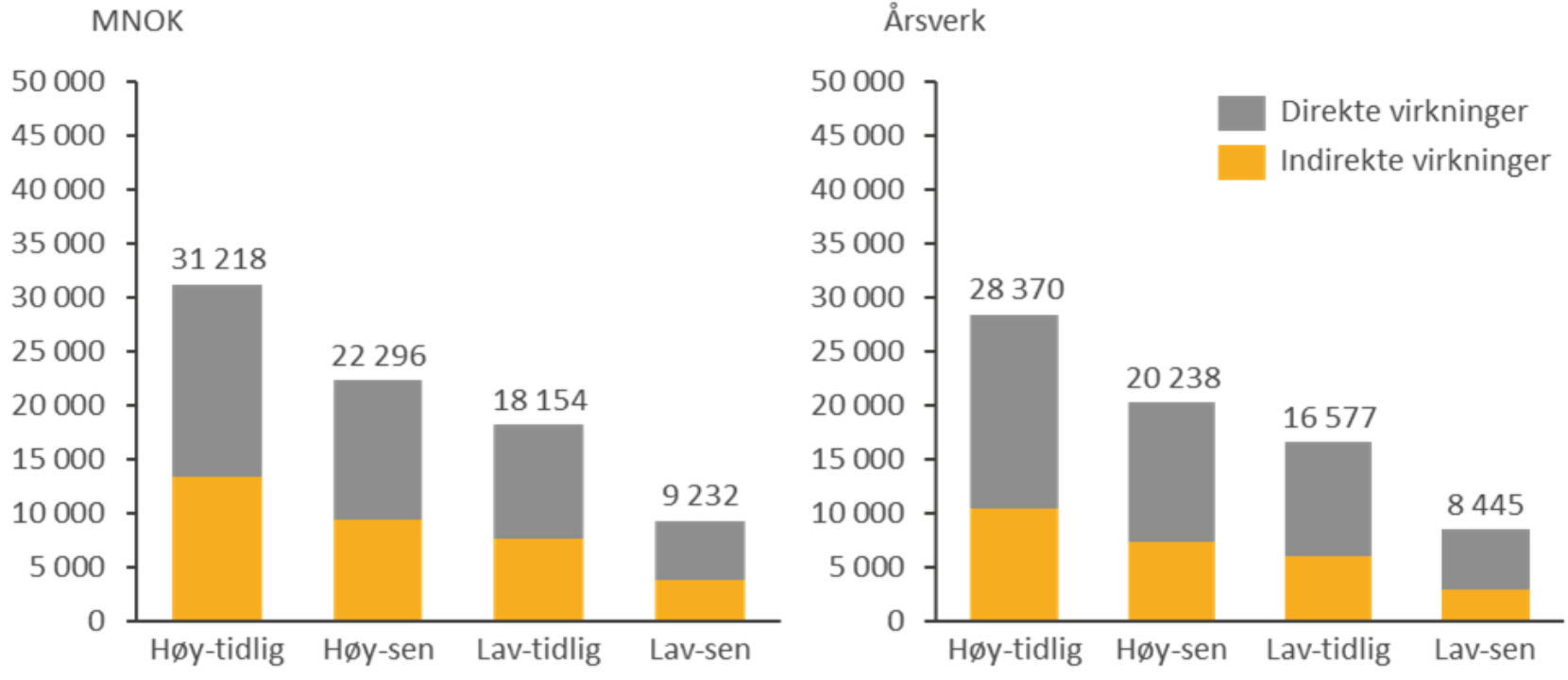


Stepwise approach

1. Estimate marke share of Norwegian supply industry in different market segments Norwegian and inernational
2. Use the approach to develope a P50 scenario for the Norwegian 1 GW scenario and the International 11 GW scenarioes
3. Estimate high-low deviation for the individual market segment (uncertainty)
4. Estimate the impact of early (2022) og late (2027) establishment of Hywind Tampen in the individual market segments
5. Use the deviations to calculate the results in high-low and early-late scenarioes

Given an 11 GW inernational market by 2030

We conclude that there are large gains in being first movers in the developming floating offshore wind market



Given an 11 GW international market by 2030

The Norwegian supply industry's market value in different market segments

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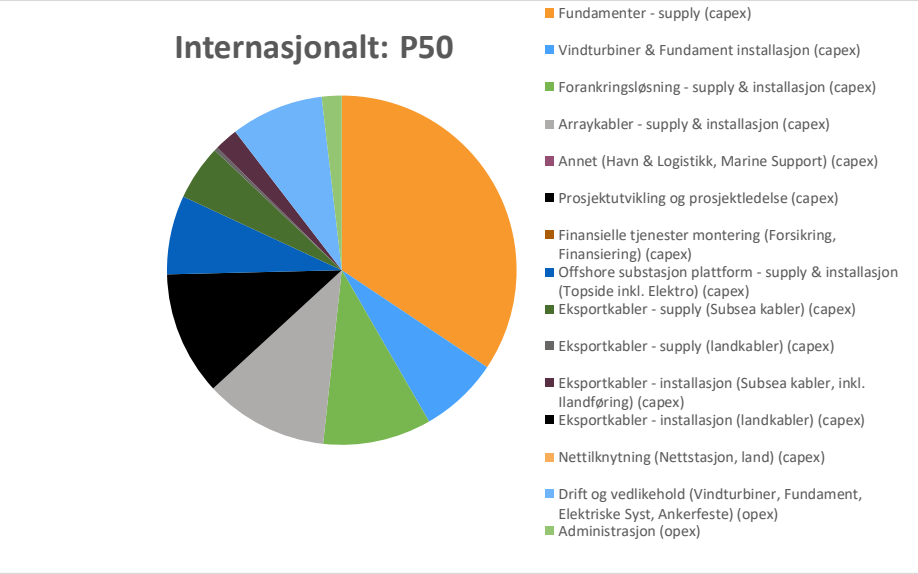

Large market opportunities – although a small player

Larges markets in value for Norwegian supply industry are:

- Fundament supply
- Array cables
- Project development
- Anchoring

Given a 1 GW Norwegian marke by 2030

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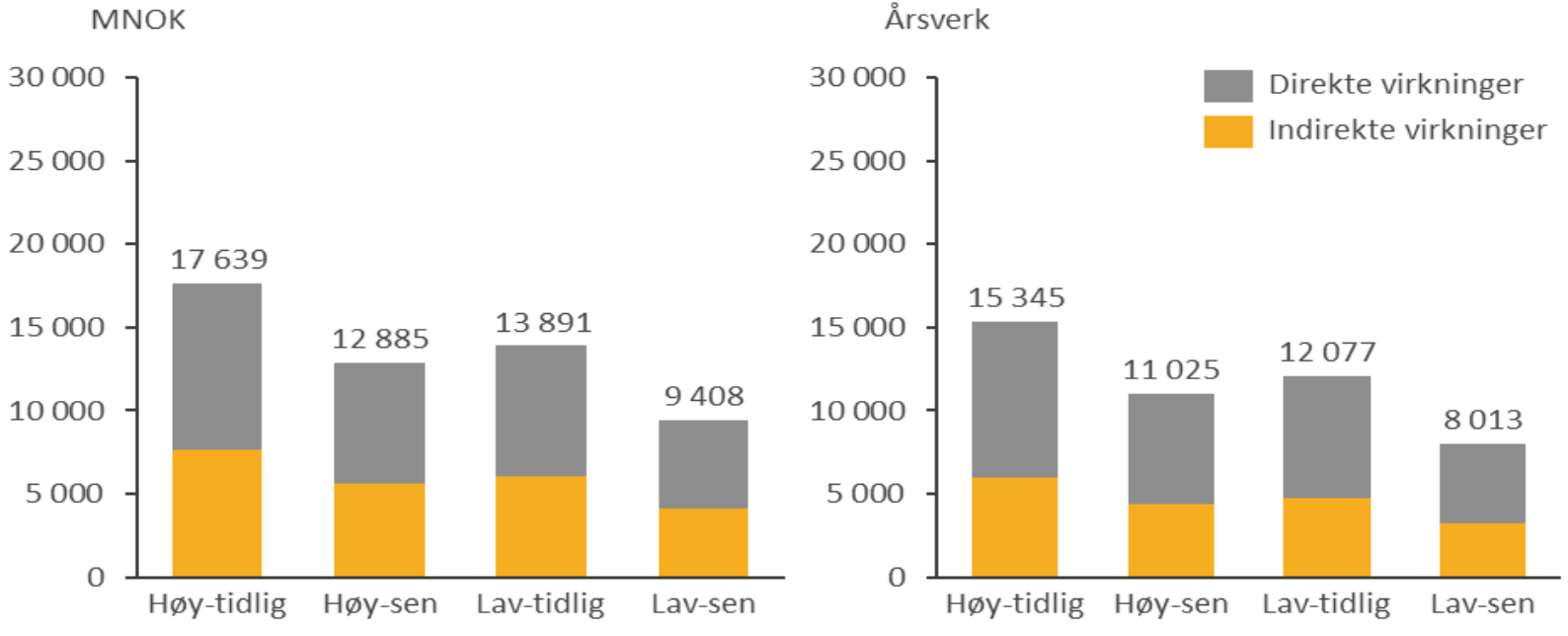

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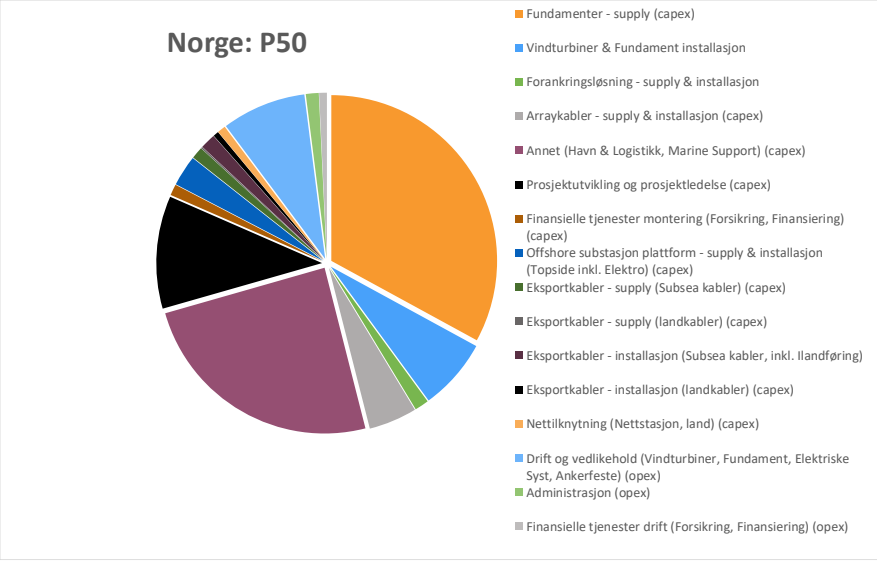

Somewhat different market opportunities

Larges markets in value for Norwegian supply industry are:

- Fundament supply
- Port and logistic services
- Turbine and fundament installation
- Offshore substation supply and installation

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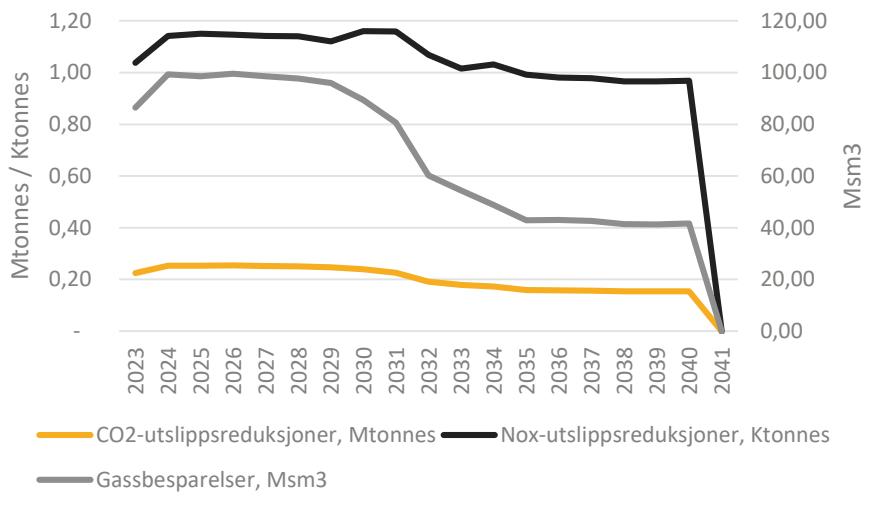
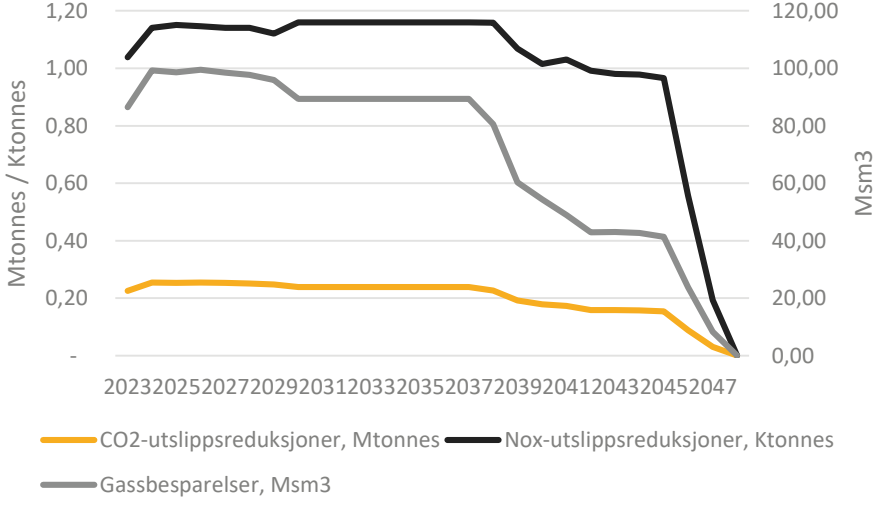
Reduction in emissions of CO_2 and NO_x

Petroleum field produce until 2041



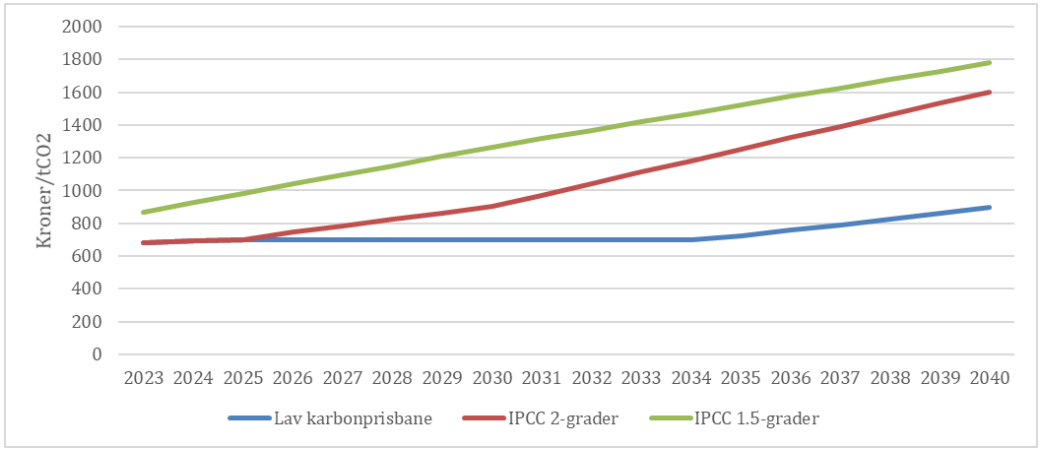
Petroleum field produce until 2047



The impact of the carbon price chosen is significant

The gap between choosing a low carbon price trajectory and a low 1,5°-trajectory makes a difference

Different carbon price trajectories. Note: The IPCC 1,5 is a «lowest» price - «Highest» is 14 times higher



Bør sette en CO2-pris for norske investeringer

Heller ikke i revidert nasjonalbudsjett gir Finansdepartementet en anbefalt CO2-pris for samfunnsøkonomiske analyser. Den bør komme – og være i tråd med Parisavtalen.

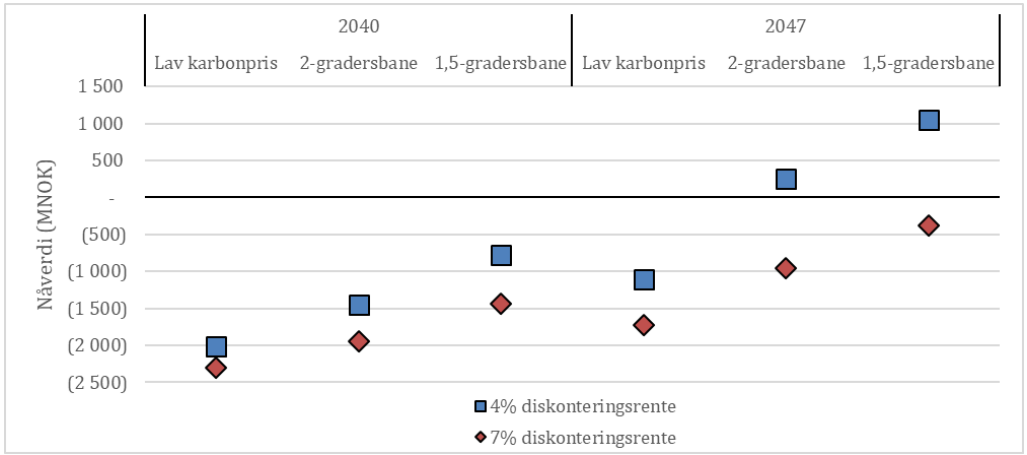
2 min Publisert: 15.05.19 – 19.55 Oppdatert: 13 dager siden

Dersom vi ikke vurderer kommende prosjekter basert på CO2-priser som tar utgangspunkt i Parismålet, vil prosjekter som ikke burde blitt realisert likevel bli det. Da blir det vanskeligere og dyrere å nå klimamålene senere. (Foto: Aleksander Nordahl)

The cost-benefit of the project

Depend on how long the petroleum fields are going to be operated and the cost of CO_2-emissions

Cost-benefit analysis ranging from -2,3 bn to +1bn NOK



Three varialbles

- Cost of capital: 4% is for the State's environmental investment. 7% is reccomended for normal industrial investments
- Lifespan of the operations: 2040 is current decisions, 2047 is a not unlikely outcome
- Carbon price is measured in a low ETS+tax alternative, IPCCs estimated 2° CO_2-trajectory, and the lowest alternative in a 1,5 °-trajectory.

Positive non-calculatable cost-benefits

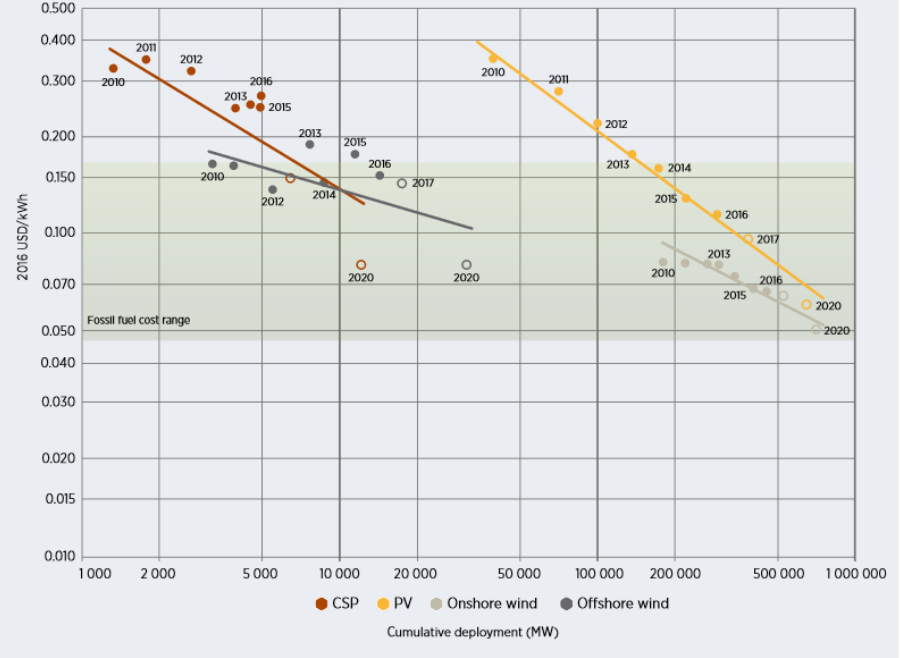
Positive externalities that are difficult to price, like technology development, learning effects, and knowledge spreading

Hywind Tampen is likely to yield innovation and learning effects that contribute to commercialising floating offshore wind technology.

Given an estimated learing rate of 13% for offshore floating wind, the project has a learing effect of 20%.

There is a significant learning effect for involved Norwegian industries involved in the development of Hywind Tampen.

Figure ES.3 Learning curves for the global weighted average levelized cost of electricity from CSP, solar PV and onshore and offshore wind, 2010-2020



Based on IRENA Renewable Cost Database and Auctions Database; GWEC, 2017; WindEurope, 2017; MAKE Consulting, 2017a; and SolarPower Europe, 2017a.

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Thank you for your attention!

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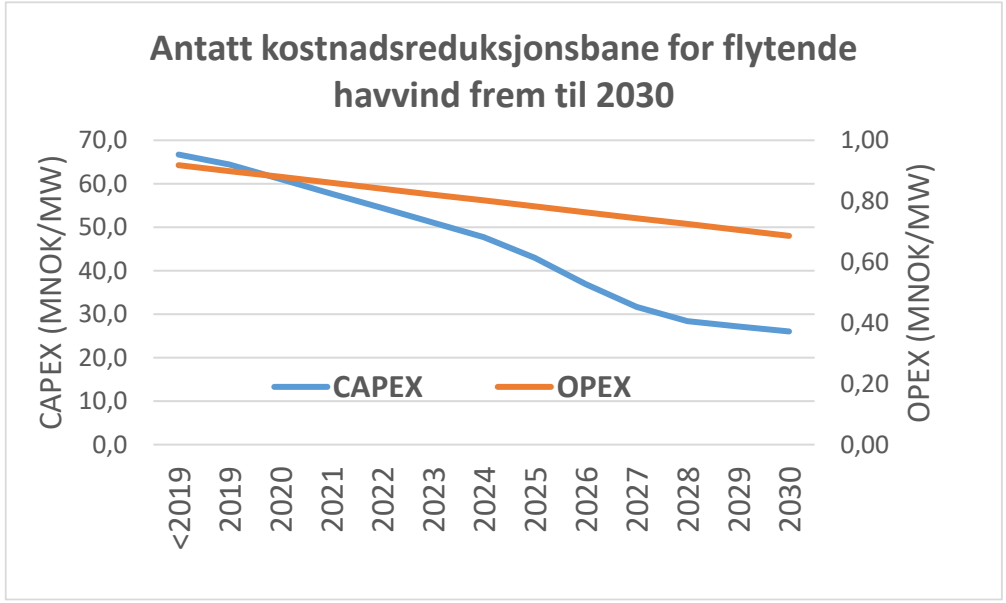

		Grunnlag: BVG	Grunnlag: Catapult	Grunnlag: BVG		
		CAPEX*	CAPEX	OPEX	CAPEX**	OPEX
FID	Idriftsettelse	EURM/MW	EURM/MW	EURM/MW	EURM/MW	EURM/MWh
2016	2018	6,7	7,3	0,10	6,90	0,10
2017	2019	6,2	7,1	0,09	6,67	0,09
2018	2020	5,7	6,9	0,09	6,32	0,09
2019	2021	5,2	6,7	0,09	5,97	0,09
2020	2022	4,8	6,5	0,09	5,63	0,09
2021	2023	4,3	6,3	0,09	5,28	0,09
2022	2024	3,8	6,1	0,08	4,93	0,08
2023	2025	3,3	5,9	0,08	4,45	0,08
2024	2026	2,8	4,8	0,08	3,82	0,08
2025	2027	2,3	3,8	0,08	3,27	0,08
2026	2028	2,3	3,6	0,08	2,94	0,08
2027	2029	2,3	3,4	0,07	2,81	0,07
2028	2030	2,23	3,1	0,07	2,69	0,07
2029	2031	2,20	2,94	0,07	2,57	0,07
2030	2032	2,16	2,72	0,07	2,48	0,07