



Hav-vind - redning for norsk natur? – og en bro til
fremtiden for Agders offshoreindustri?
Kristiansand 27.08.2019

Kan havvind bidra til at Norge når klimamålene?

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Bergen Offshore Wind Centre

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De store utfordringene



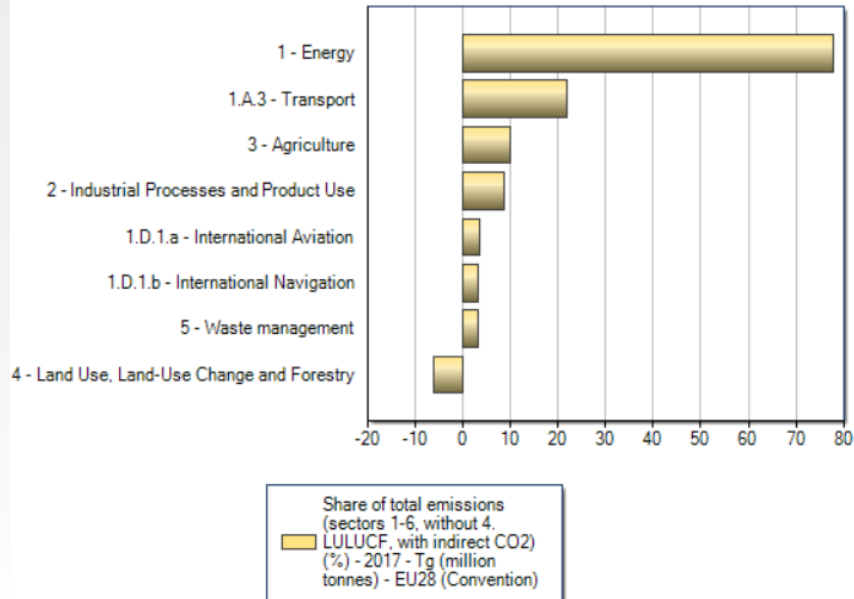
Sustainable Development Goals



Utslipp av drivhusgasser

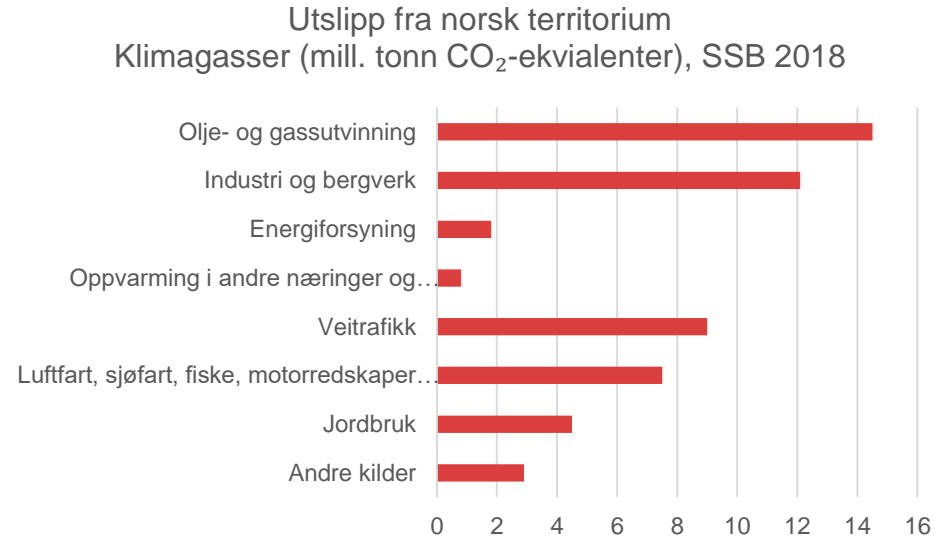


EU-28, 2017



<https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer>

Norge, 2018



<https://www.ssb.no/natur-og-miljo/statistikker/klimagassn/aarforelopige/2019-06-03?fane=tabell&sort=nummer&tabell=388501>



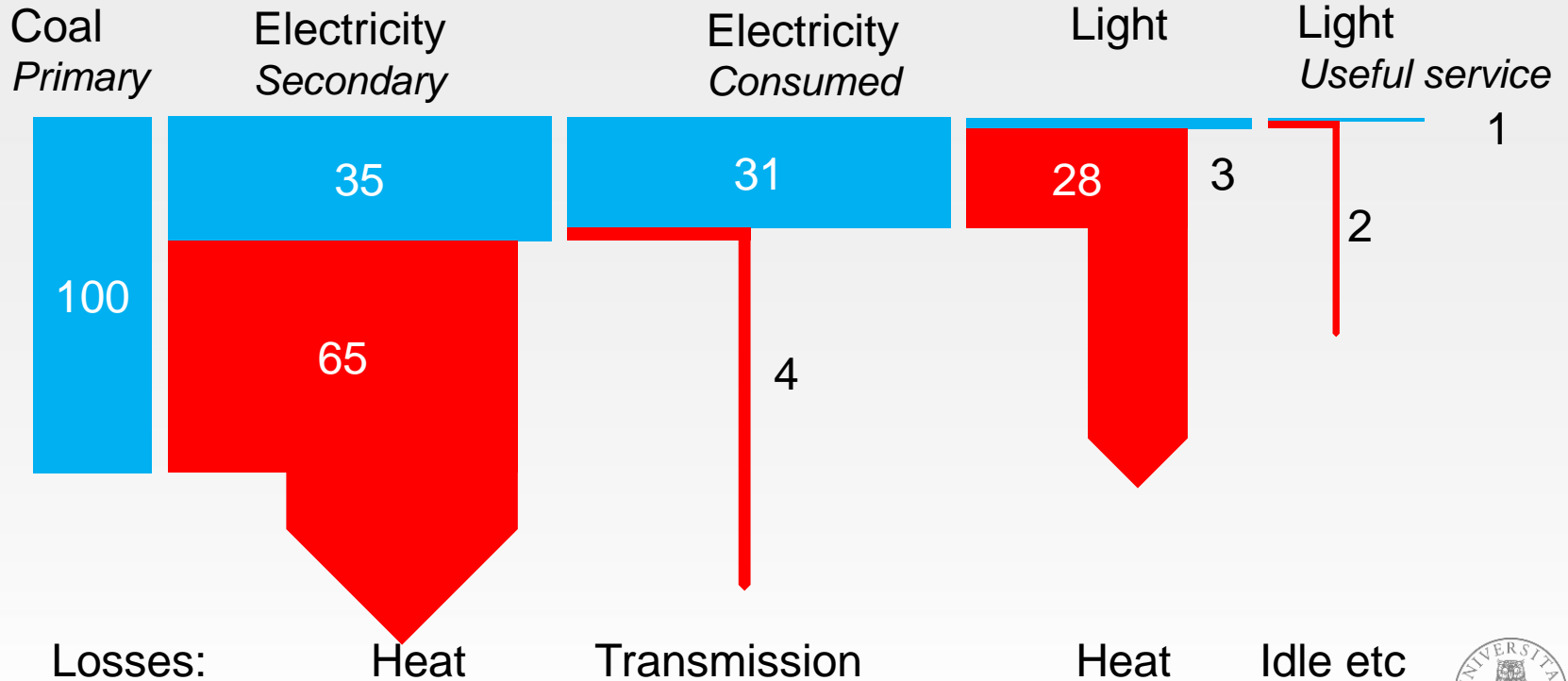
Reduksjon av utslipp



- Verdens energiproduksjon og -bruk må legges om
 - Fornybar energi
 - Energieffektivisering
 - Elektrifisering
- Karbonnøytralt EU i 2050?
- Norge
 - Trenger 30 – 50 TWh/år ny fornybar energi



From coal to light - incandescent light bulb



Primær energi eller energitjenester?



Kullkraft →
glødelyspære

100

Fornybar →
glødelyspære

35

Samme tjeneste!



Fornybar →
LED lys

7

Vind og sol øker mest globalt



FIGURE 34. Wind Power Global Capacity and Annual Additions, 2007-2017

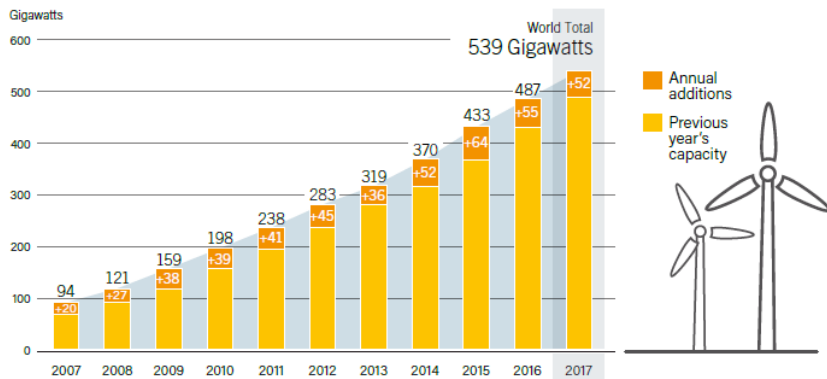
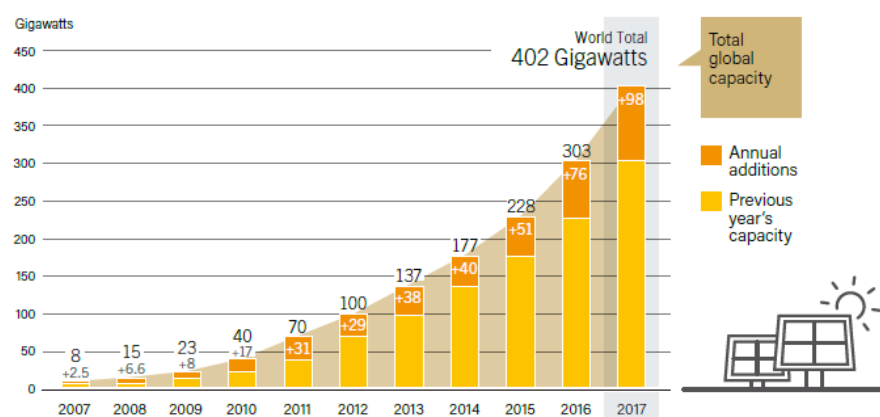


FIGURE 24. Solar PV Global Capacity and Annual Additions, 2007-2017



Note: Data are provided in direct current (DC). Totals may not add up due to rounding.

Source: IEA PVPS. See endnote 3 for this section.

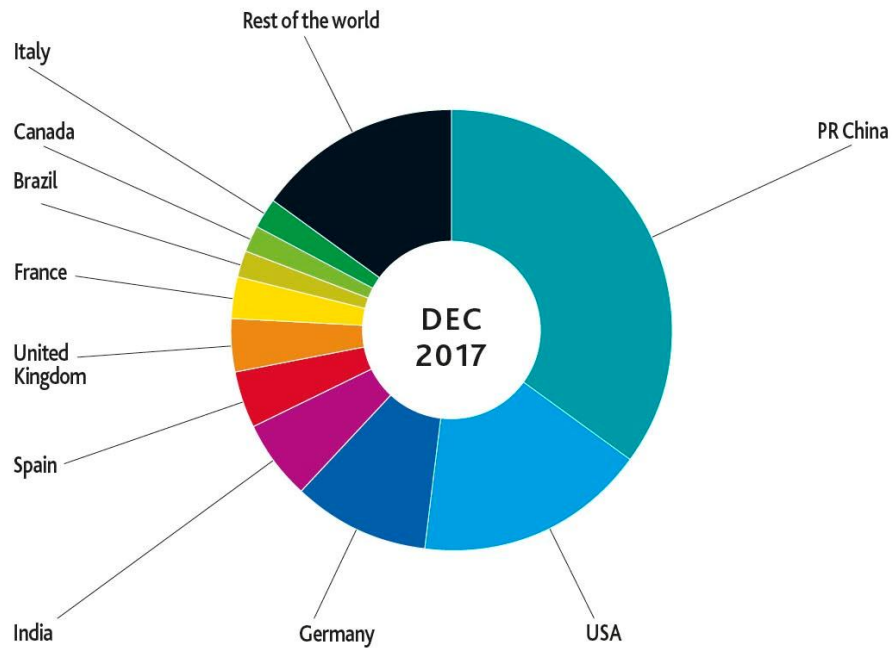
Norske vannkraftsystemet: 34 GW



Vindenergi i verden (2017)



TOP 10 CUMULATIVE CAPACITY DEC 2017



Installert på land: 495 GW

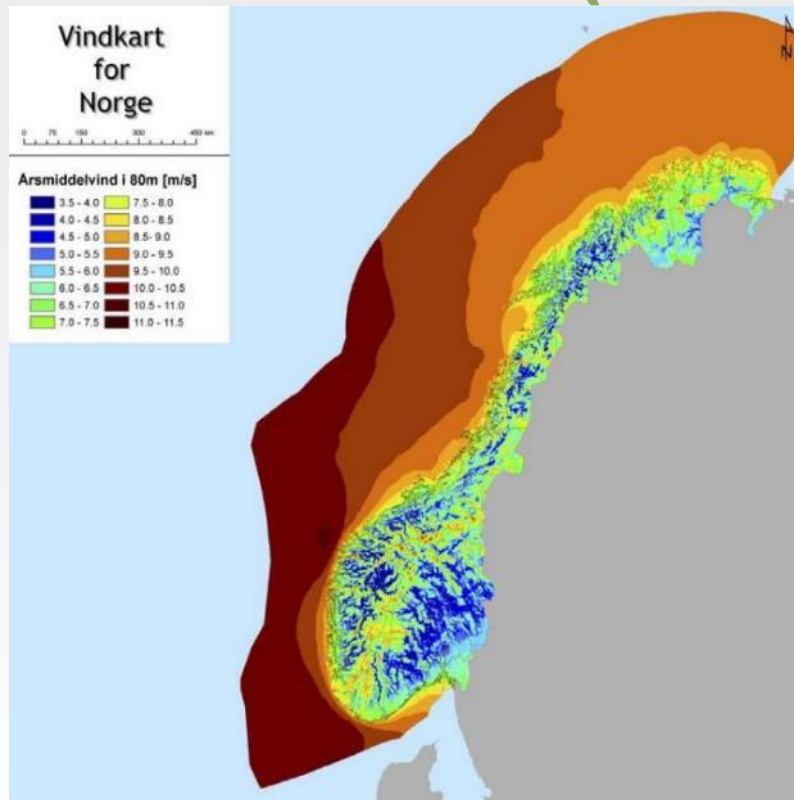
Havvind: 19 GW

Kjernekraft (globalt): 392 GW

Norsk vannkraftsystem: 34 GW



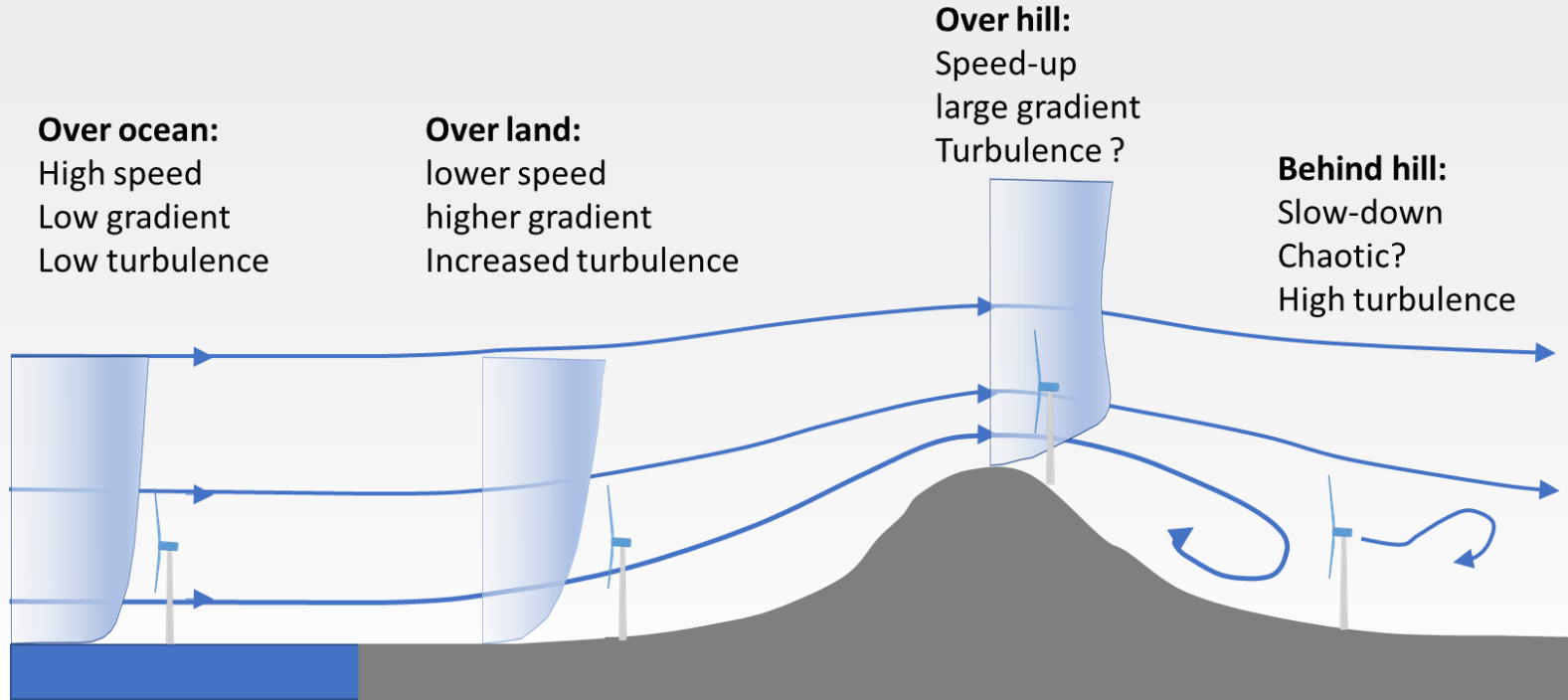
Vindressurser (80 m høyde)



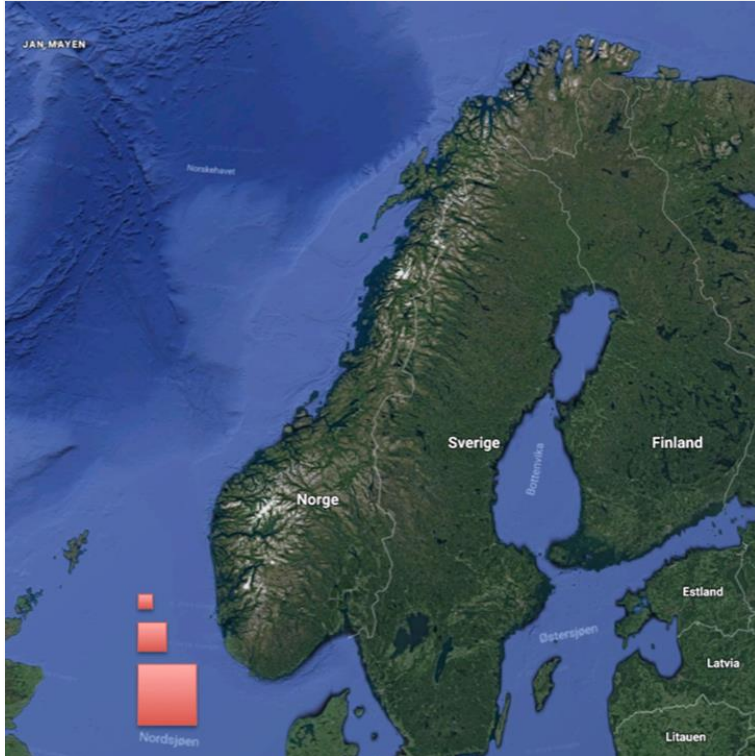
<http://www.nve.no/Global/Publikasjoner/Publikasjoner%202009/Oppdragsrapport%20A%202009/oppdragsrapportA9-09.pdf>



Wind from sea to land



Arealbehov



- 40 x 40 km: All planlagt vindkraft på land (ca. 47 GW)
- 70 x 70 km: All Norsk vannkraft
- 140 x 140 km: Erstatte all Norsk gass eksport (hensyntatt energikvalitet)

Map: Google Maps.

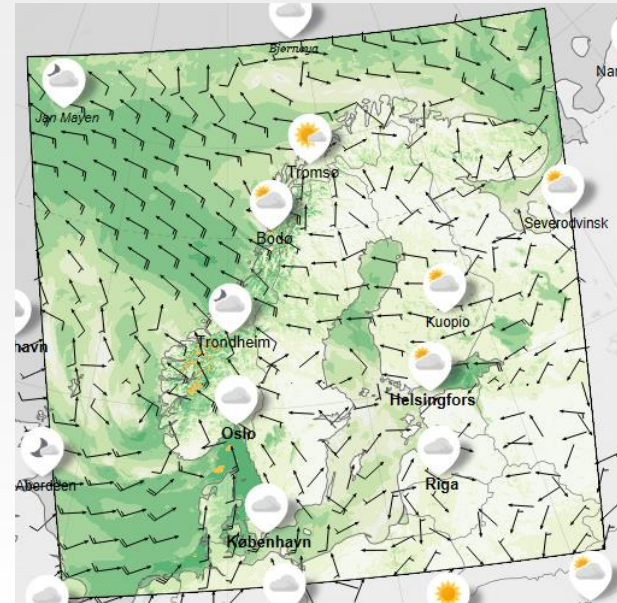
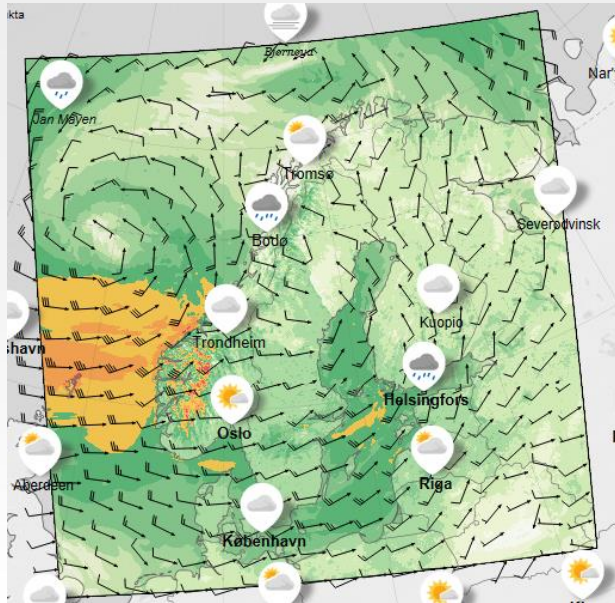


Norwegian and mid-European winds have low correlation



- 19.06.2018 kl 11:00

9.09.2018 kl 06:00

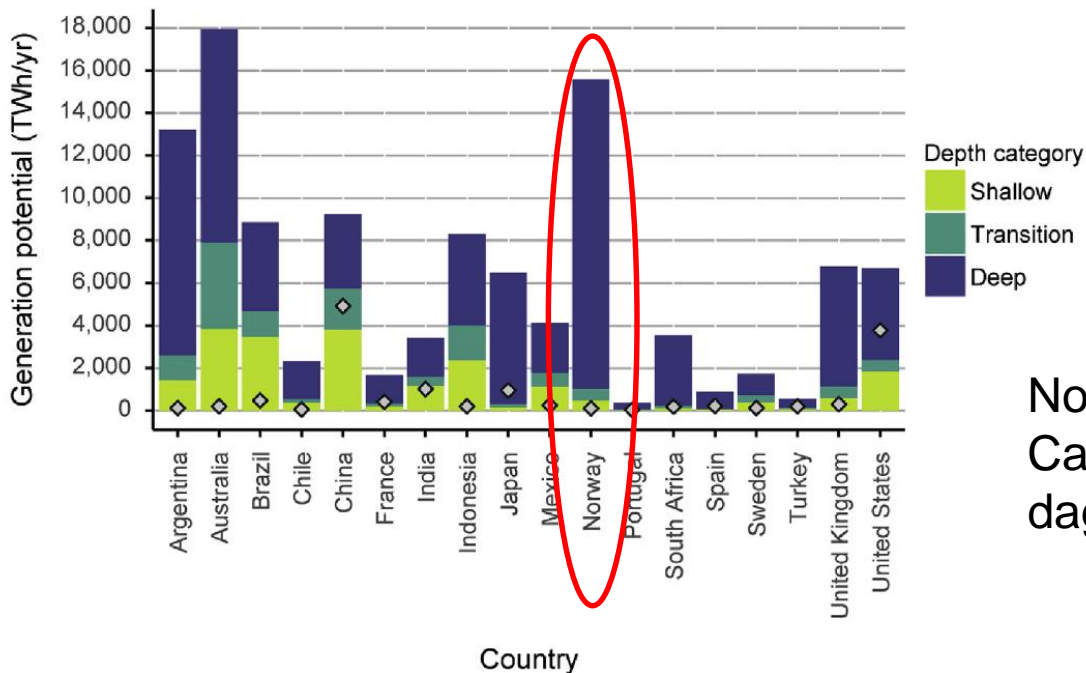


Havvindressurser



J. Bosch et al. / Energy 163 (2018) 766–781

775



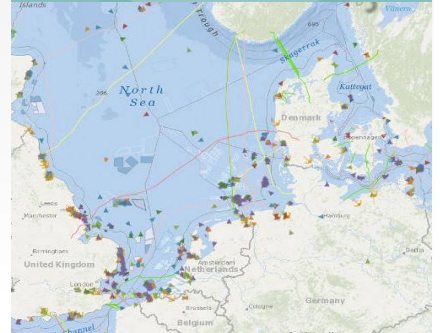
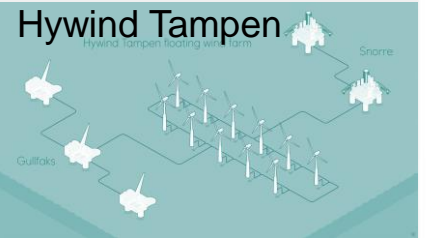
Norsk potensial:
Ca. 100 ganger
dagens vannkraft

Fig. 7. Annual average energy production (AEP) potential of offshore wind farms for different depth categories for a selection of high producing countries (shown in alphabetical order). Depth categories are Shallow (0–40 m), Transitional (40–60 m) and Deep (60–1000 m). The estimated AEP is the average generation over all time slices, summed over all feasible areas of the country Exclusive Economic Zone, up to the prescribed depth limit. The overlaid point on each bar is the electricity generation in 2015 from Ref. [71] for comparison.

Havvindens rolle for Norge



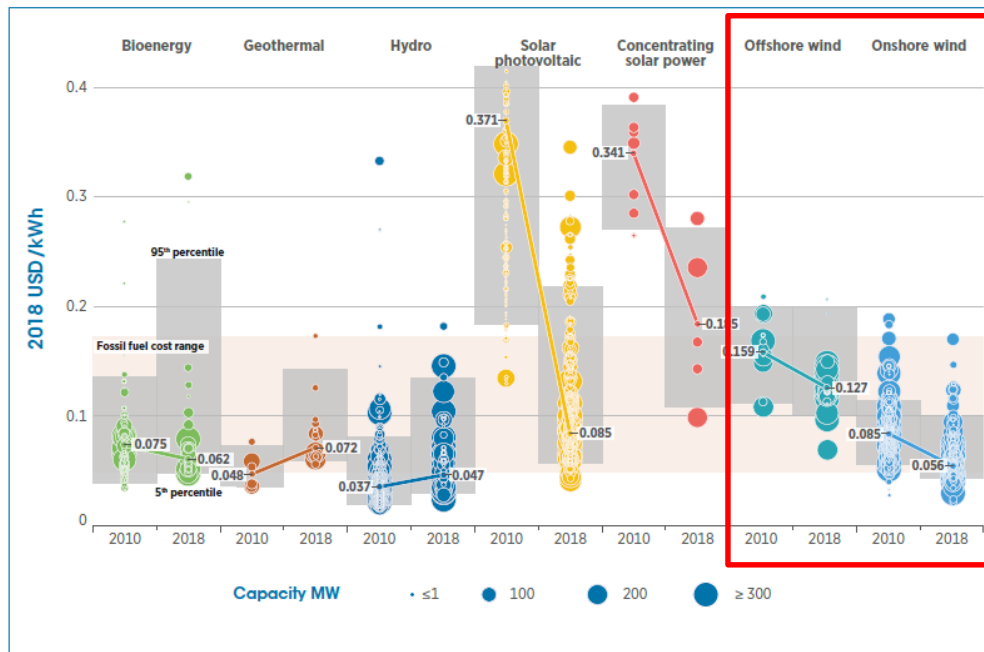
- Nye industrielle muligheter – vi har kompetansen.
- Redusere norske utslipp.
- Bidra i et fremtidig europeisk fornybart energimarked.



Energikostnader 2010 – 2018



Figure S.1 Global LCOE of utility-scale renewable power generation technologies, 2010-2018

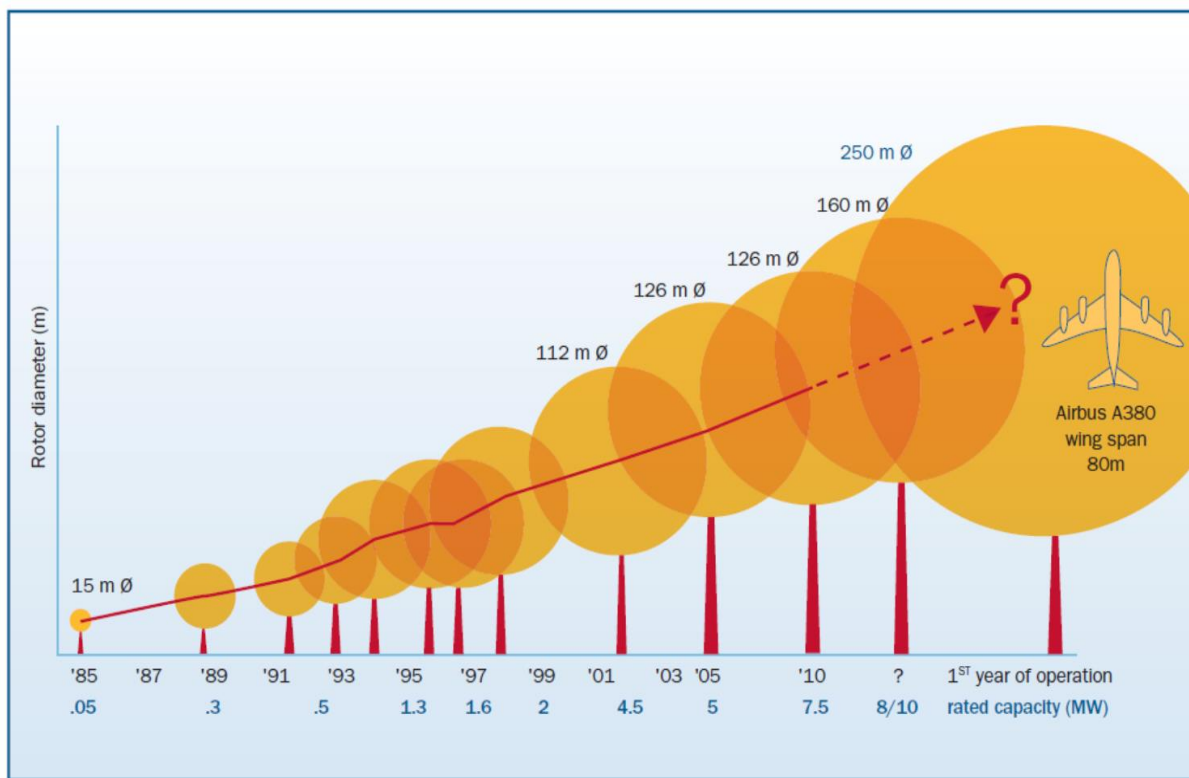


Kilde:
<https://www.irena.org/publications/2019/May/Renewable-power-generation-costs-in-2018>

Note: This data is for the year of commissioning. The diameter of the circle represents the size of the project, with its centre the value for the cost of each project on the Y axis. The thick lines are the global weighted-average LCOE value for plants commissioned in each year. Real weighted average cost of capital (WACC) is 7.5% for OECD countries and China and 10% for the rest of the world. The single band represents the fossil fuel-fired power generation cost range, while the bands for each technology and year represent the 5th and 95th percentile bands for renewable projects.



Vindturbiners størrelse



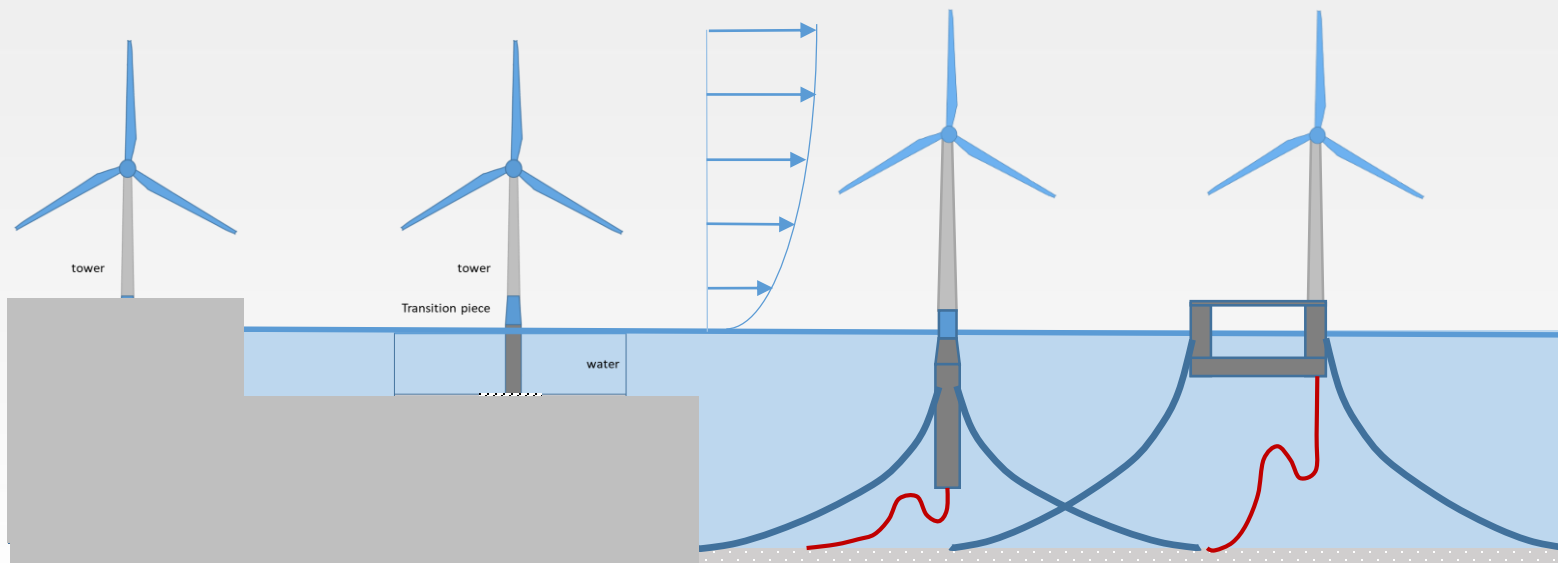
Mars 2018:

GE lanserer 12 MW, 220m offshore turbin

16.01.19:

Siemens Gamesa lanserer 10MW 193m offshore turbin

Dypt vann – nye løsninger



Hywind Scotland



Photo: Ørjan Richardsen, Wordcam/Equinor



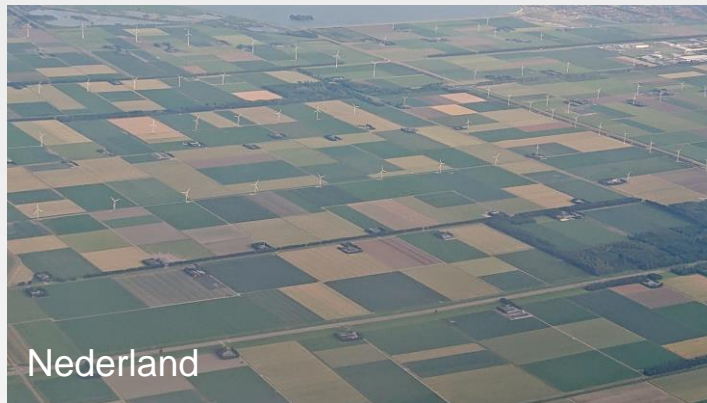
Nye utfordringer



Horn's rev, Danmark



Source: *Ingeniøren*, DK March 2009



Nederland

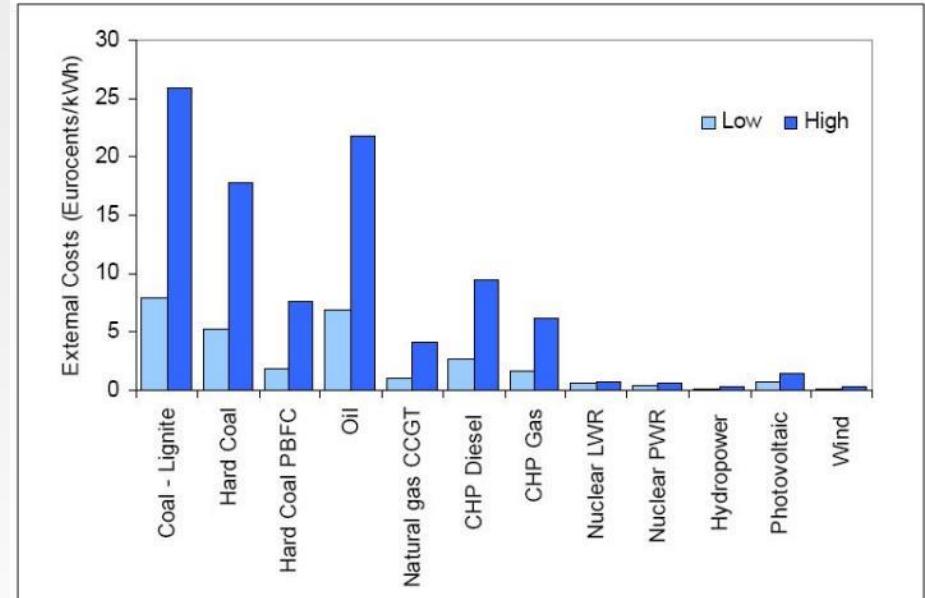


Midtfjellet, Fitjar

Eksterne kostnader



- Hva skal inkluderes?
 - Klimaeffekter
 - Helseeffekter
 - Biologisk mangfold
 - Konflikter i arealbruk
 - ...
- Hvordan verdisette og veie ulike hensyn?
- Se f.eks.
 - European Env. Agency
<http://www.eea.europa.eu/data-and-maps/indicators/en35-external-costs-of-electricity-production-1>
 - IPCC SREEN, Special report on renewable energy (2011)





Oppsummert

- Klimamålene krever mer fornybar energi
- Norge har en unik havvindressurs
- Havvind kan bidra til norske utslippsreduksjoner og i et Europeisk energisystem
- Norge har kompetanse til å ta et internasjonalt lederskap på dypt vann.
- Kan ikke vente.





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Kostnad flytende havvind



– grovt overslag

