

Energy transition Norway

Where are we – and where are we going?

Managing Director Frank Emil Moen, Energy Innovation
Communication Manager
Norwegian Offshore Wind Cluster



www.energyinnovation.no



www.offshore-wind.no

The Greater Stavanger area

SOUTH WEST NORWAY

- The Energy Capital of Europe
- Strong maritime, marine and Oil & Gas traditions
- 360.000 inhabitants
- 190.000 employed
- A highly international business region – 189 nationalities represented
- Strong international airline connections



Egersund – a small town with 15.000 inhabitants – 80 km south of Stavanger



Egersund – built on fish, production of porcelain and Oil & Gas

Very dependent on
Oil & Gas
Unemployment rate
«sky high» in 2016:
approx. 6 %
Now 2020: 1,8%

Marine technology companies



Pelagic fish protein factories



Oil&Gas yard



Egersund Group – Production of fish-
and aqua culture equipment



Pelagic fish industry



Entrepreneur & concrete prefabrication



Egersund - Tailor-Made Offshore Yard

At top activity approx. 2500 people working on the yard

Assembly halls
Painting halls

Prefabrication halls
Assembly and test halls

Assembly site

Load out quays

Storage

Engineering offices
Subsea facilities



LANGHOLMEN



Egersund town centre



EGERSUND HARBOR

Back up cable for the North Sea Link - the longest Sub Sea interconnector - between South West Norway and Blyth





EGERSUND ENERGY HUB

Business network on- and offshore wind



Centre for development, O&M and training for renewable energy, onshore and offshore

HSE and technical education and training centre

Innovation projects

Research and development

Public education
Dalane College

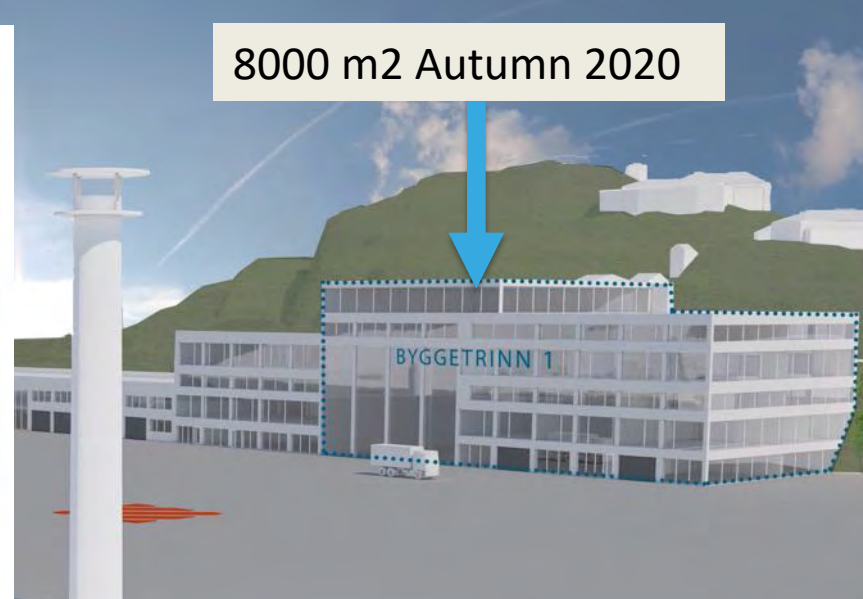
Commercial training/courses

Projects that can realise the potential of a renewable energy cluster

Operation and maintenance of renewable energy



8000 m2 Autumn 2020



Through the business network Egersund Energy Hub 10+ companies are cooperating offering services for a fast growing onshore (and offshore) wind market



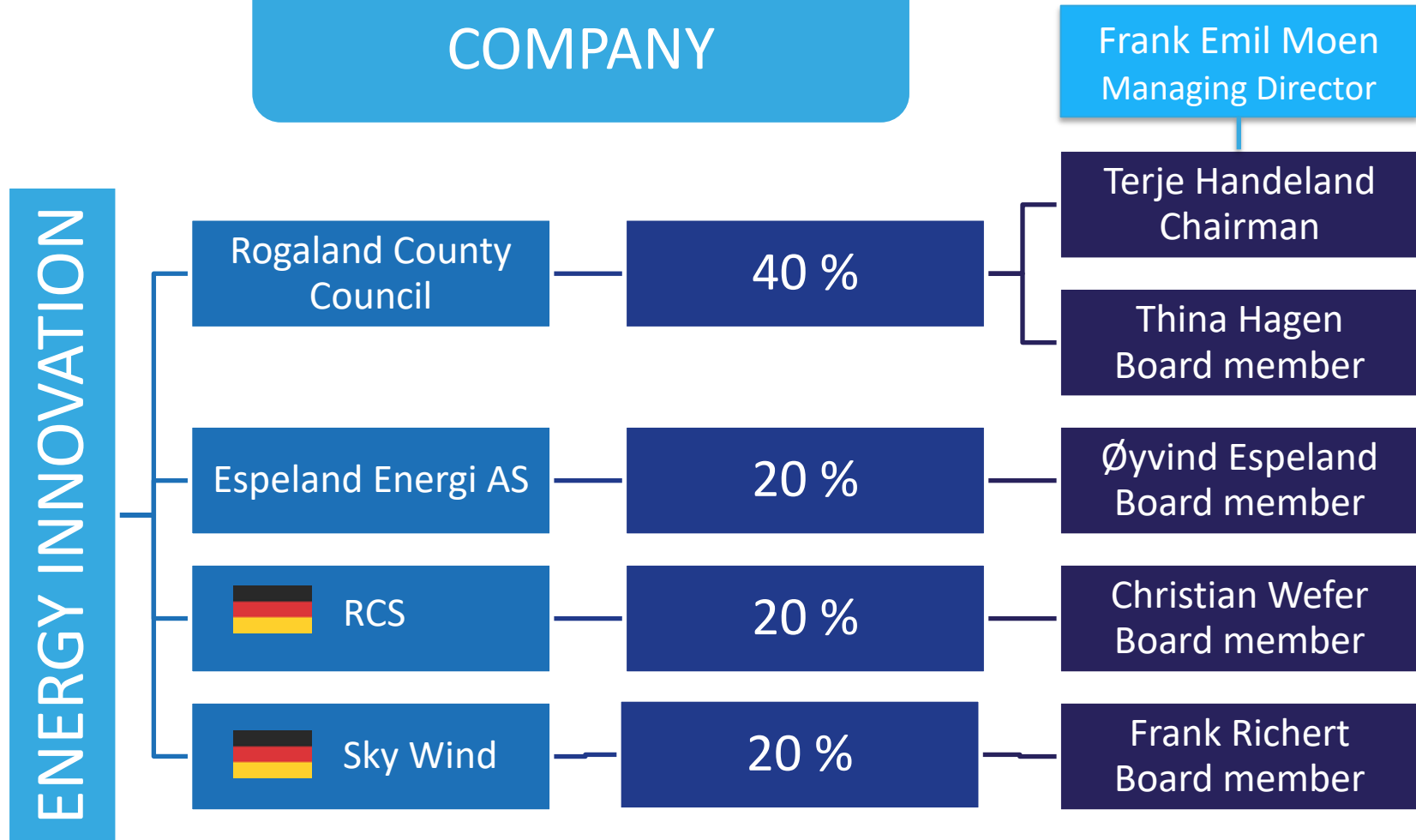
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PRIVATE – PUBLIC & INTERNATIONAL COMPANY



ENERGY INNOVATION

Situated at Langholmen – Egersund Harbor



SERVICES ON- and OFFSHORE VIND and Green Tech

- GWO Certification – HSE (+ Technical courses from 2020)
- R&D Renewable / greentech
- Maintenance & Operations, blade repair, inspections
- Fundamentation, Rock-adapter inst.
- Workshop for main component shifts on nacelles
- Close cooperation and co-location with the only national public education of wind technicians
- EU-project VETWind II – Training offshore Wind
- Business Network - Innovation Norway



8000 m2 aug/sept 2020

Possibility for training pool and training hall for helicopter rescue training – 21 meter high

New fire station

SYNERGIES

Education

Innovation

Development

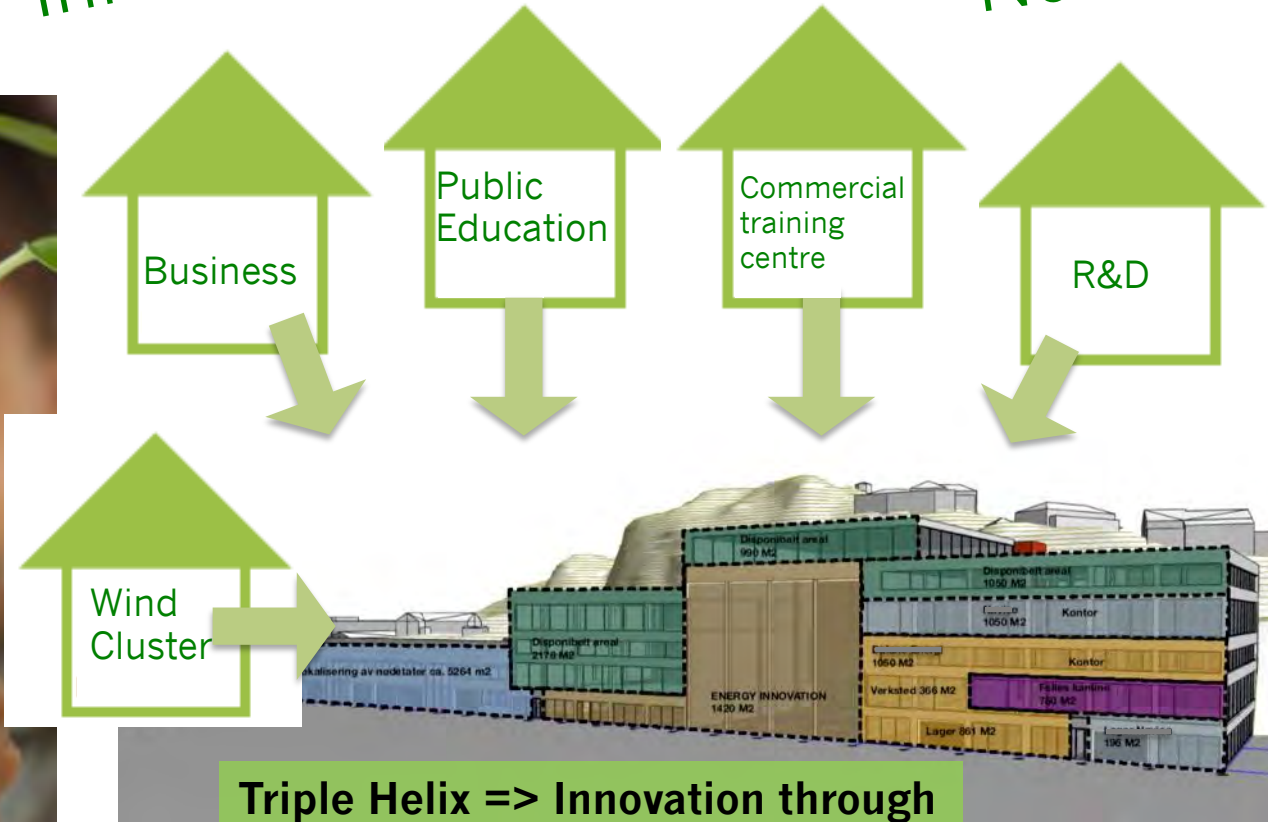
Networking

Competence

Technology

Cooperation

Internationalization

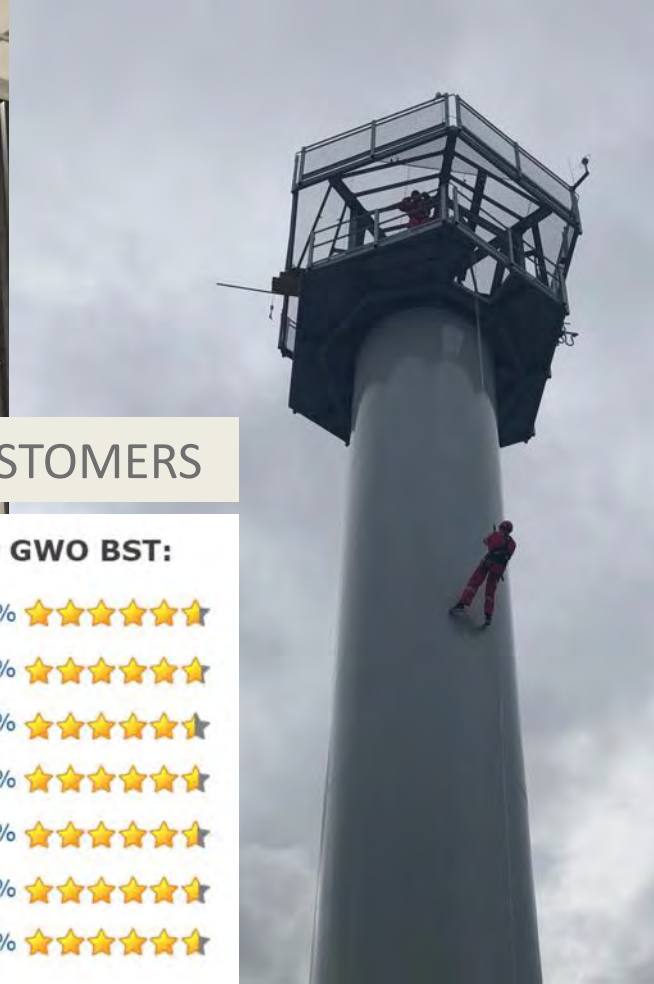


Triple Helix => Innovation through collaboration, development and interaction between business, R&D, education and government.

Opening of the training centre 13. SEPT. 2018







SATISFIED CUSTOMERS

Tilbakemeldinger GWO BST:

- Presisering av mål: 95% ★★★★★★
- Kvalitet på instruktør: 96% ★★★★★★
- Lokaler og utstyr: 92% ★★★★★★
- Kvalitet på lunsjen: 94% ★★★★★★
- Fordelig teori og praksis: 94% ★★★★★★
- Mottatt kompetanse: 94% ★★★★★★
- Samlet vurdering: 94% ★★★★★★



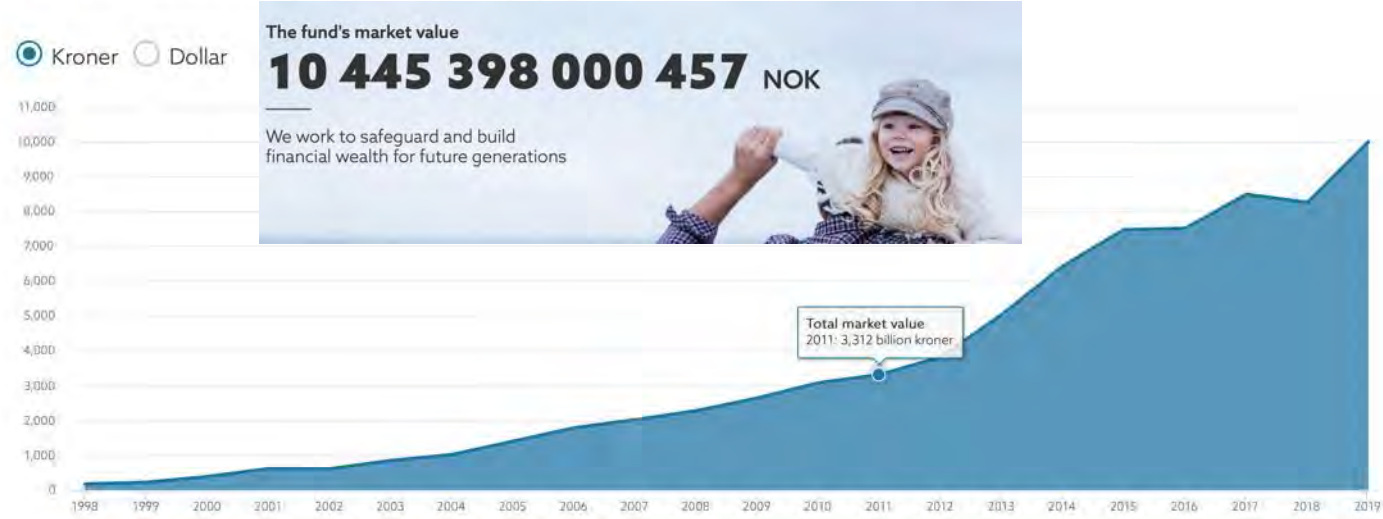
WORKING AT HEIGHTS ADVANCED RESCUE





The fund's development

Since 1996, the fund's market value has grown from nothing to 10,000 billion kroner. Returns on the fund's investments account for more than half of the fund's market value. Inflows from the government make up about a third. Fluctuations in the krone lie behind the remainder.



Market value

The fund's market value is affected by investment returns, capital inflow and withdrawals, and exchange rate movements.

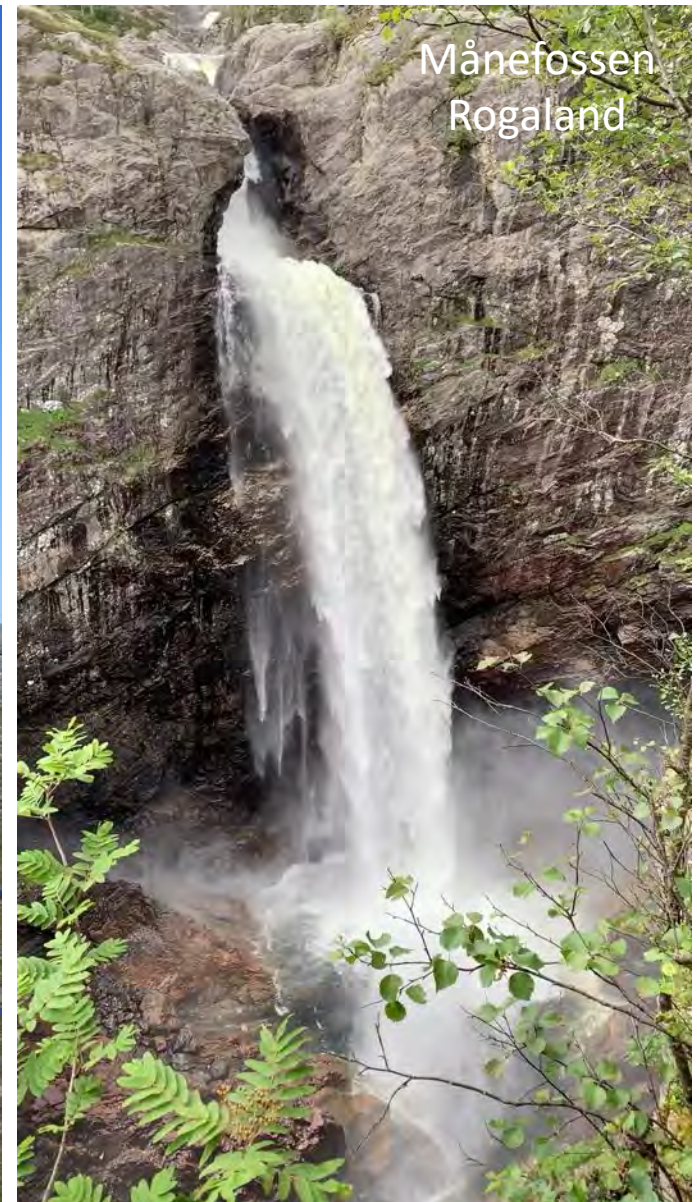
Return

Since 1998 the fund has generated an annual return of 5.9 percent, or 4,897 billion kroner.

Ulla-Førre
2.100 MW



Månefossen
Rogaland



10 Largest Hydro Power Stations in Norway

Navn	Eier	Ytelse MW	Produksjon GWh	Start
Tonstad kraftverk	Sira-Kvina Kraftselskap	960	3600	1968
Kvilldal kraftverk	Statkraft m.fl.	1240	3516	1986
Svartisen kraftverk	Statkraft	600	2200	1993
Tokke kraftverk	Statkraft	430	2140	1961
Aurland I kraftverk	E-CO Energi	840	2015	1973
Rana kraftverk	Statkraft	500	1975	1968
Nedre Røssåga kraftverk	Statkraft	250	1827	1955
Lang-Sima kraftverk	Statkraft	500	1640	1980
Aura kraftverk	Statkraft	290	1623	1953
Tyin kraftverk	Norsk Hydro	374	1460	2004

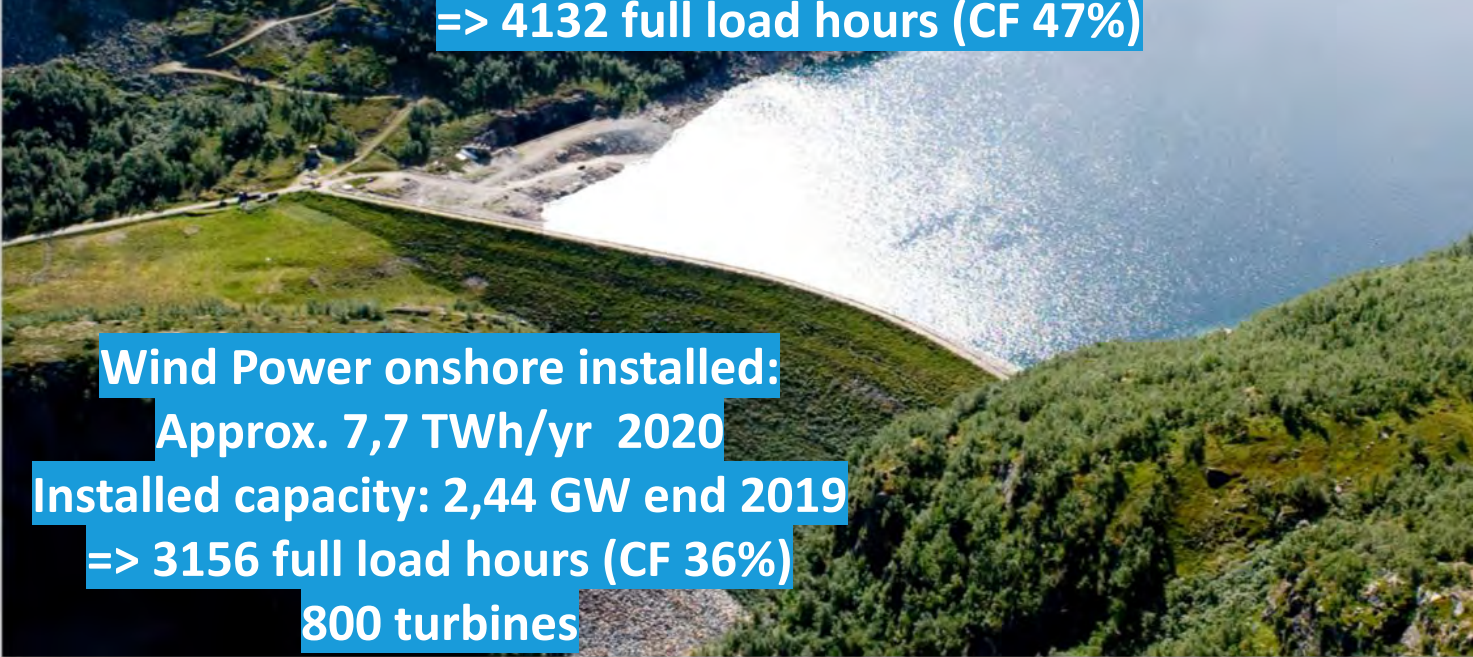
50% of the European Hydro Power capacity
Clean – cheap, and covers 93% of national electricity

POWERFUL BATTERY

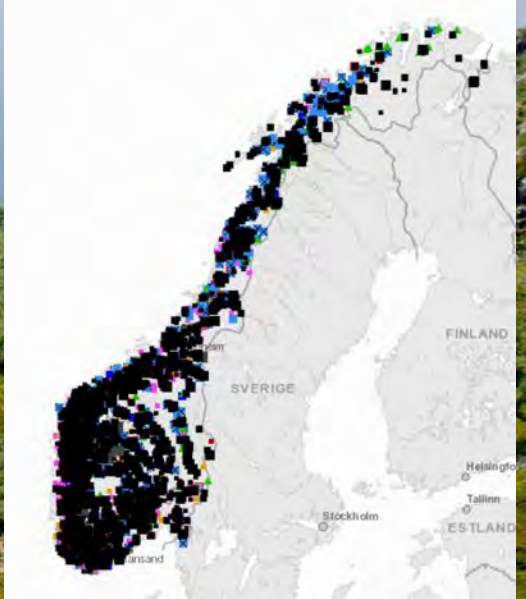
Hydro Power Norway:
Approx. 135 TWh/yr - 2019
Installed capacity: 32,67 GW feb. 2020
=> 4132 full load hours (CF 47%)

Possible upgrading:
Only 4 – 6 TWh

Total offshore wind in the world installed end 2019, **27,2 GW**



Wind Power onshore installed:
Approx. 7,7 TWh/yr 2020
Installed capacity: 2,44 GW end 2019
=> 3156 full load hours (CF 36%)
800 turbines



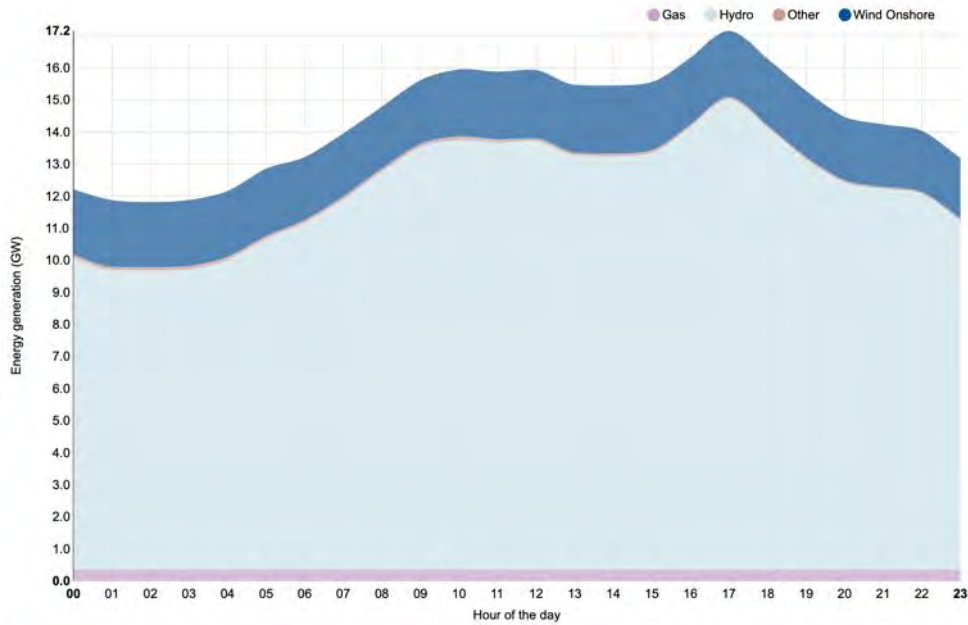
Hourly electricity mix



Select your country

- DAILY WIND ENERGY
- YESTERDAY'S TOP 20 COUNTRIES
- HOURLY ELECTRICITY MIX
- HOURLY WIND ENERGY GENERATION
- CAPACITY FACTORS

Norway



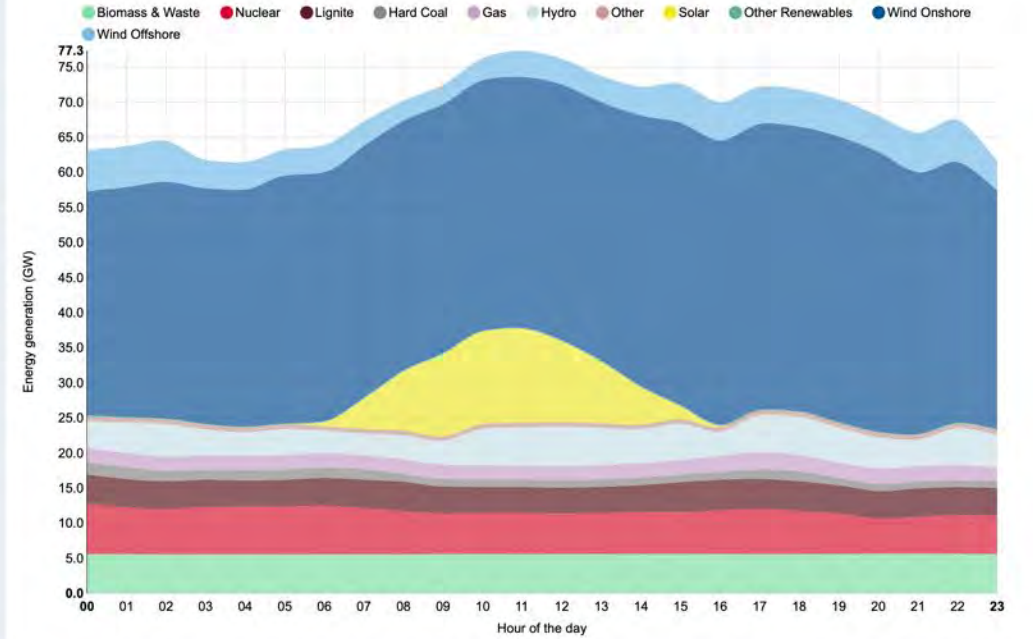
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Germany



16 February 2020

How much wind was in Europe's electricity yesterday?

30.6%

Share of wind energy
in electricity demand



26.9% (2,138 GWh)

onshore wind



3.8% (302 GWh)

offshore wind

Share these figures on:    

TOP 10 COUNTRIES

BY SHARE OF WIND ENERGY

1.  Denmark: 122%
2.  Germany: 76%
3.  Ireland: 67%
4.  Sweden: 40%
5.  United Kingdom: 35%
6.  Austria: 35%
7.  Lithuania: 33%
8.  Spain: 31%
9.  Belgium: 30%
10.  Poland: 30%

BY WIND ENERGY GENERATION

1.  Germany: 936 GWh
2.  United Kingdom: 283 GWh
3.  France: 279 GWh
4.  Spain: 183 GWh
5.  Sweden: 162 GWh
6.  Poland: 119 GWh
7.  Denmark: 114 GWh
8.  Belgium: 63 GWh
9.  Ireland: 56 GWh
10.  Austria: 54 GWh

High winds – low costs:
 LCOE down to 22 €/MWh
 Onshore Capacity factor
 New projects 35% – 48 %,
 offshore 55% - +60%

Onshore Wind Power Norway

Operative: 7,8 TWh

Construction: 5,5 TWh

➔ 2021 14 – 16 TWh

Need of approx. 350 wind technicians onshore in Norway in 2021

OFFSHORE? Need of approx. > 4500 wind technicians in Northern Europe in 2030

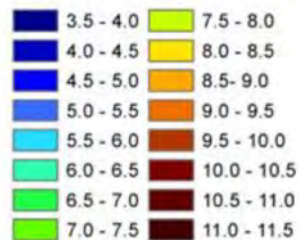
In operation: 2444 MW
 In constr. 2020: 1580 MW
 2021 (est.): 4500 MW
 (L: 4000, C:4500, H: 5000)

Best wind resources in Europe?

Vindkart for Norge

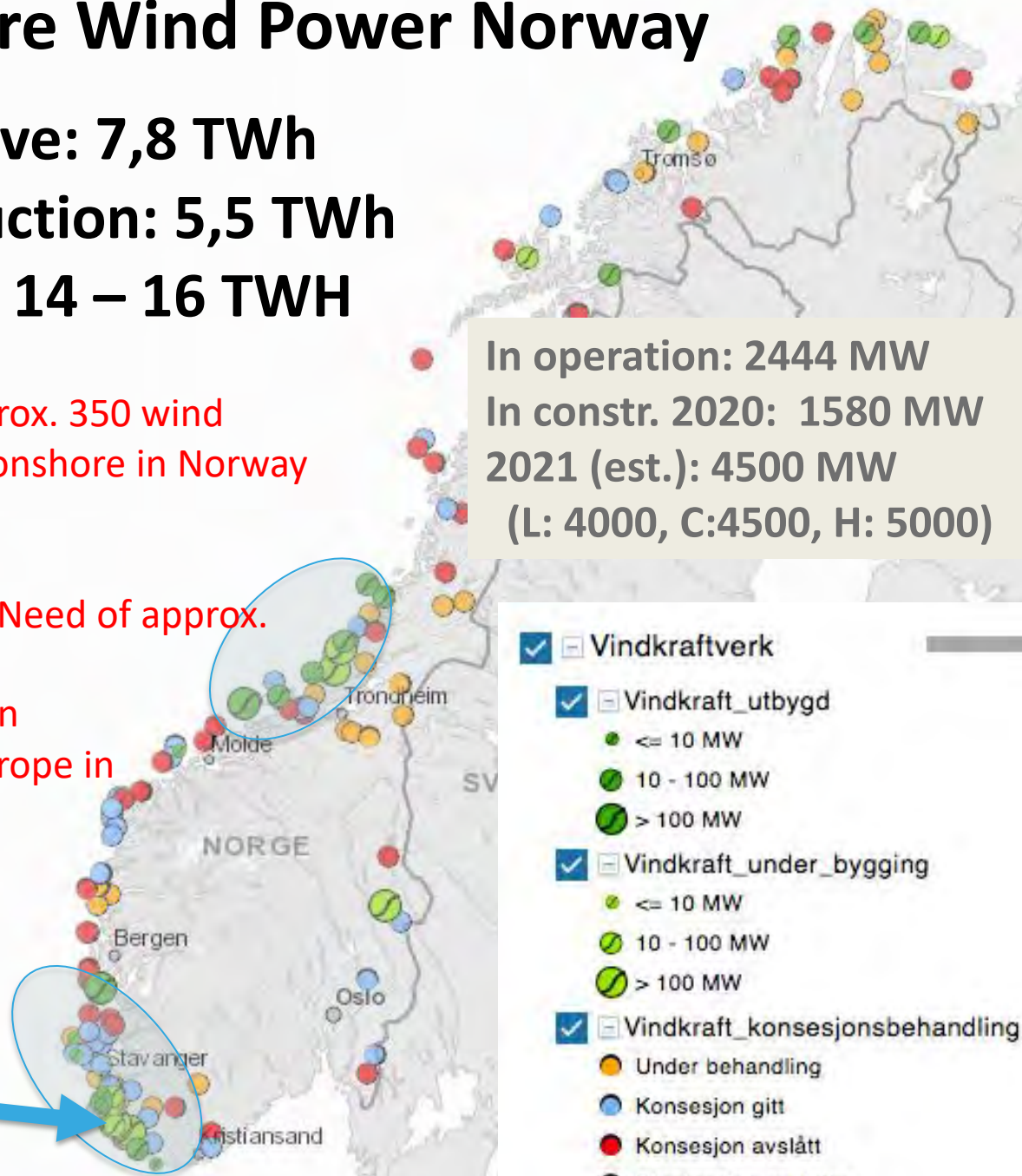
0 75 150 300 450 km

Årsmiddelvind i 80m [m/s]



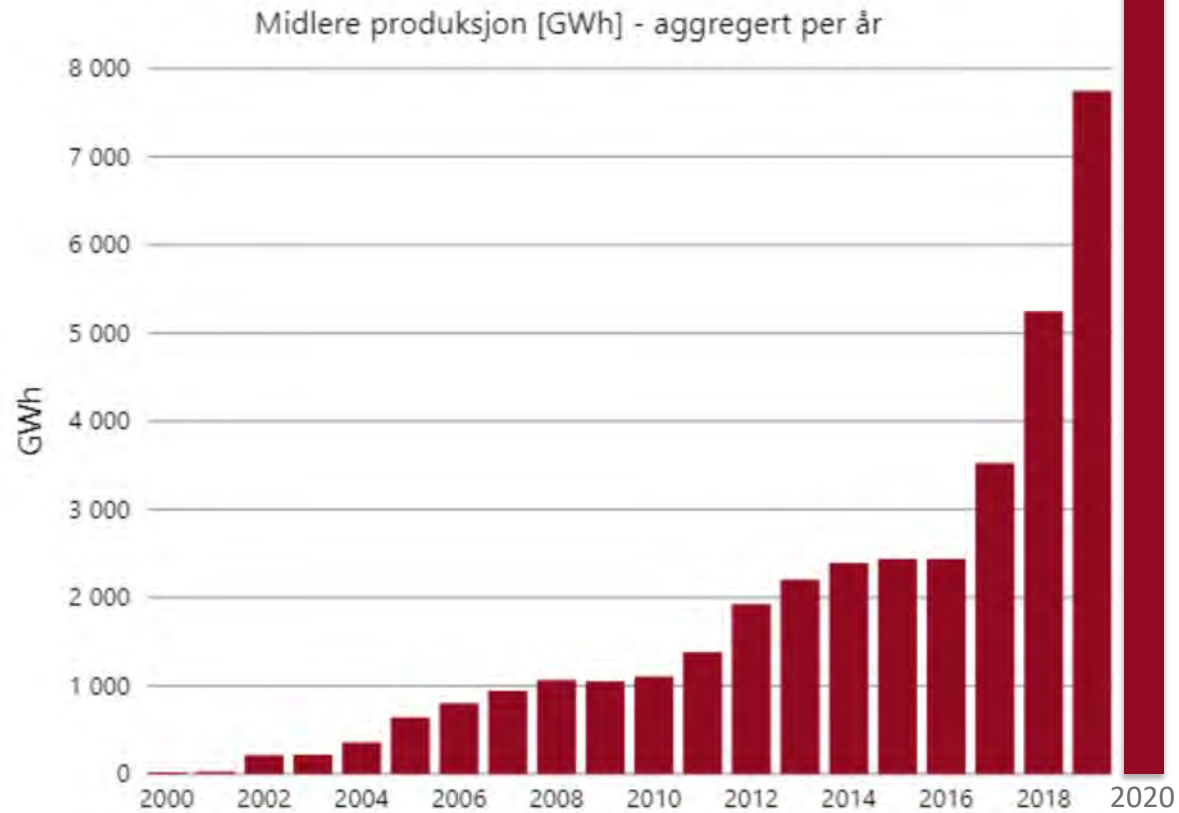
KJELLER

EGERSUND

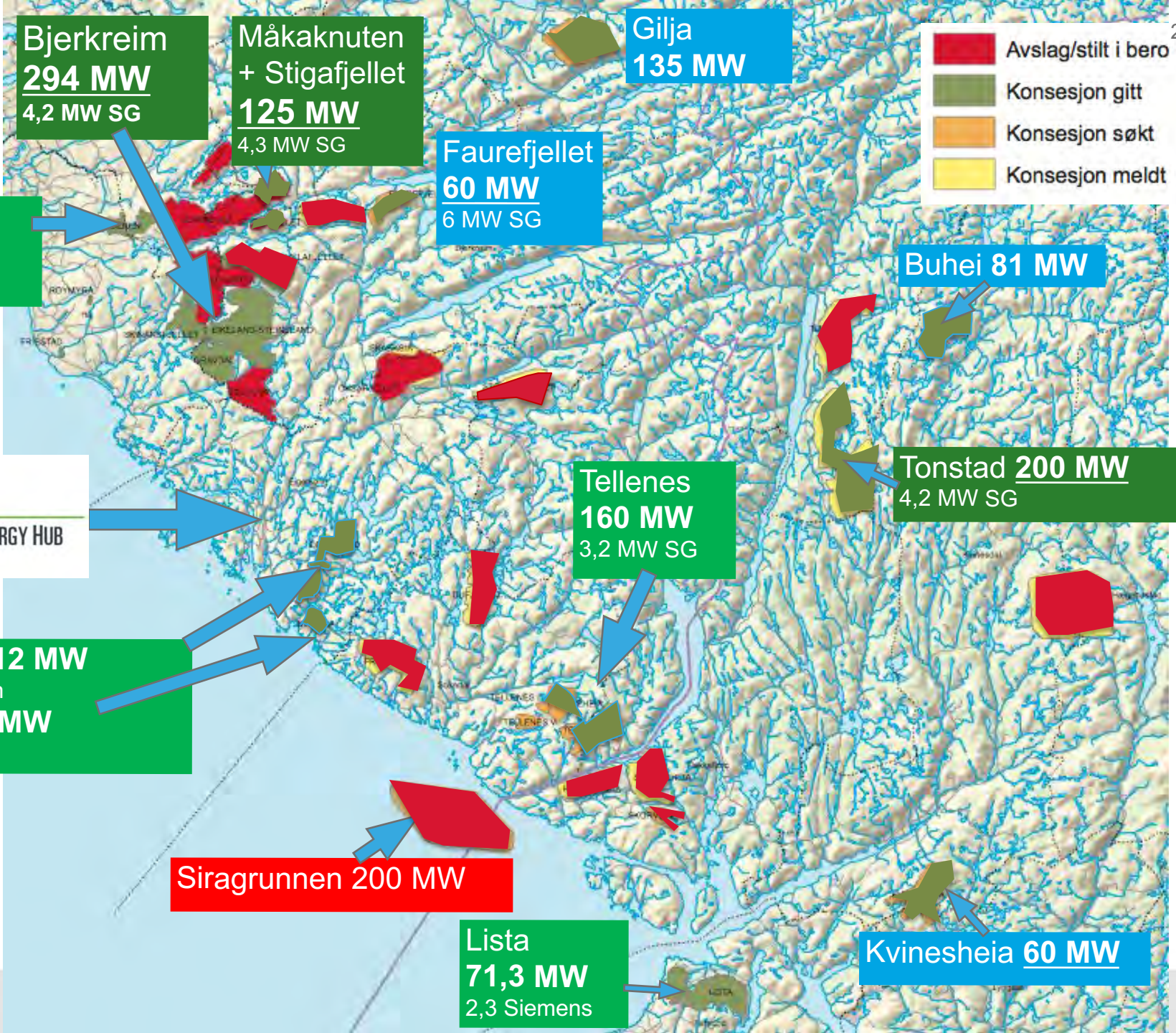


ONSHORE WIND NORWAY

13,3 TWh




In operation: 442 MW
In construction: 955 MW
Total: 1397 MW




22

- Avslag/stilt i bero
- Konsesjon gitt
- Konsesjon søkt
- Konsesjon meldt






Egersund Wind farm
Capacity factor 38%
33 Senvion 3,6 MW



Tellenes Wind Farm
Capacity factor 39%
50 Siemens 3,2 MW

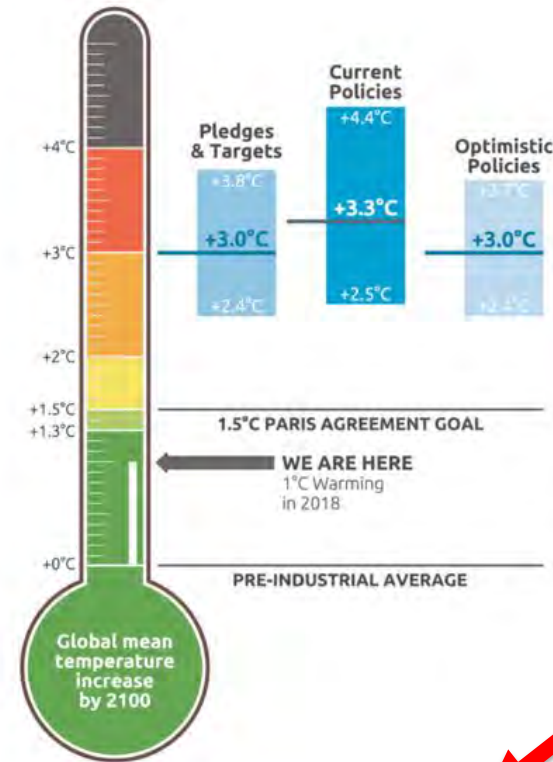
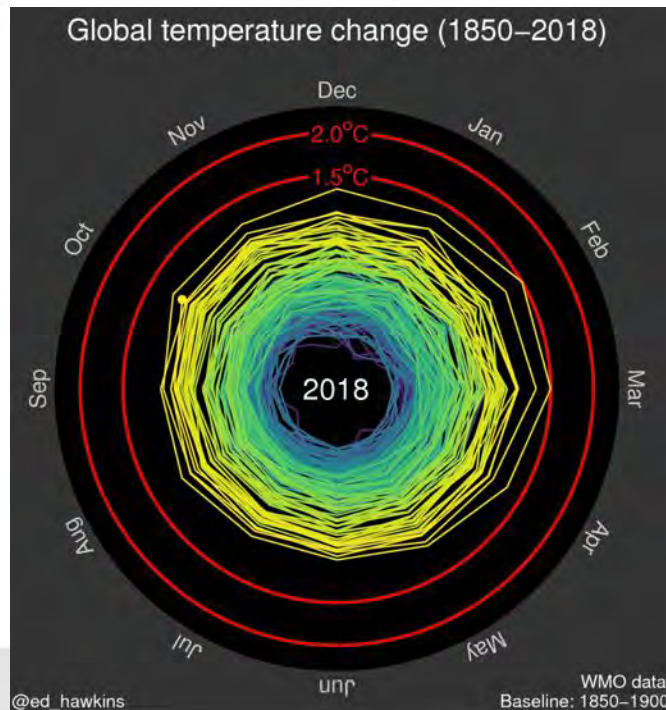


Svåheia Wind Farm
Capacity factor 44%
7 Vestas 3,6 MW

In EU - Capacity factors 2018
Averages:
Onshore 22%
Offshore 37%



SKOLESTREIK: Her sitter Greta, den gang 15 år, streikende foran Riksdagen i Sverige. Foto: Jessica Gow/TT NYHETSBYRÅN / NTB scanpix



CAT warming projections
Global temperature increase by 2100

December 2018 Update

NORWAY AND EU

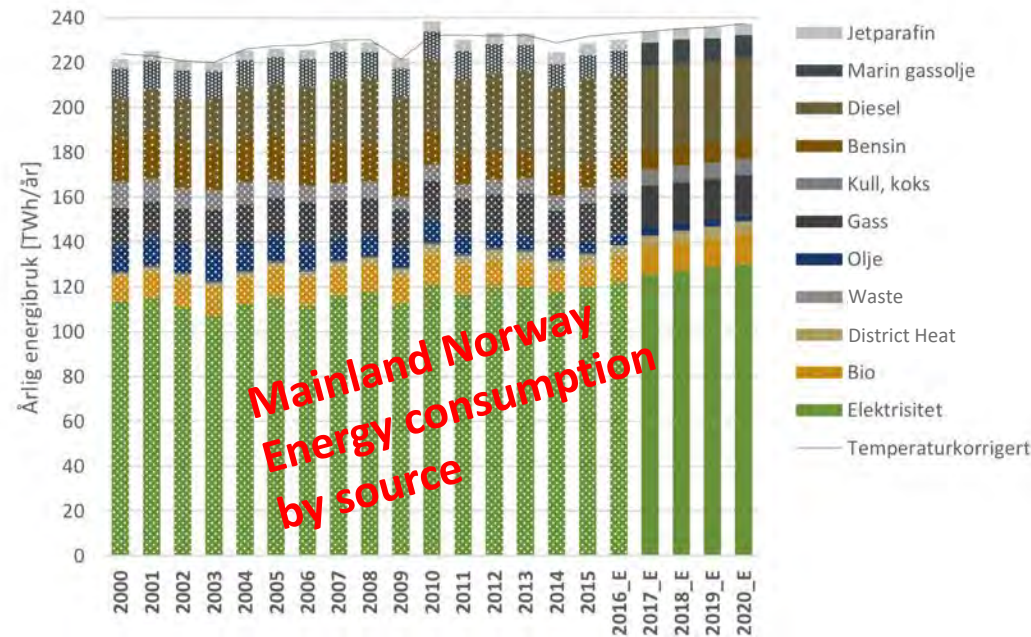
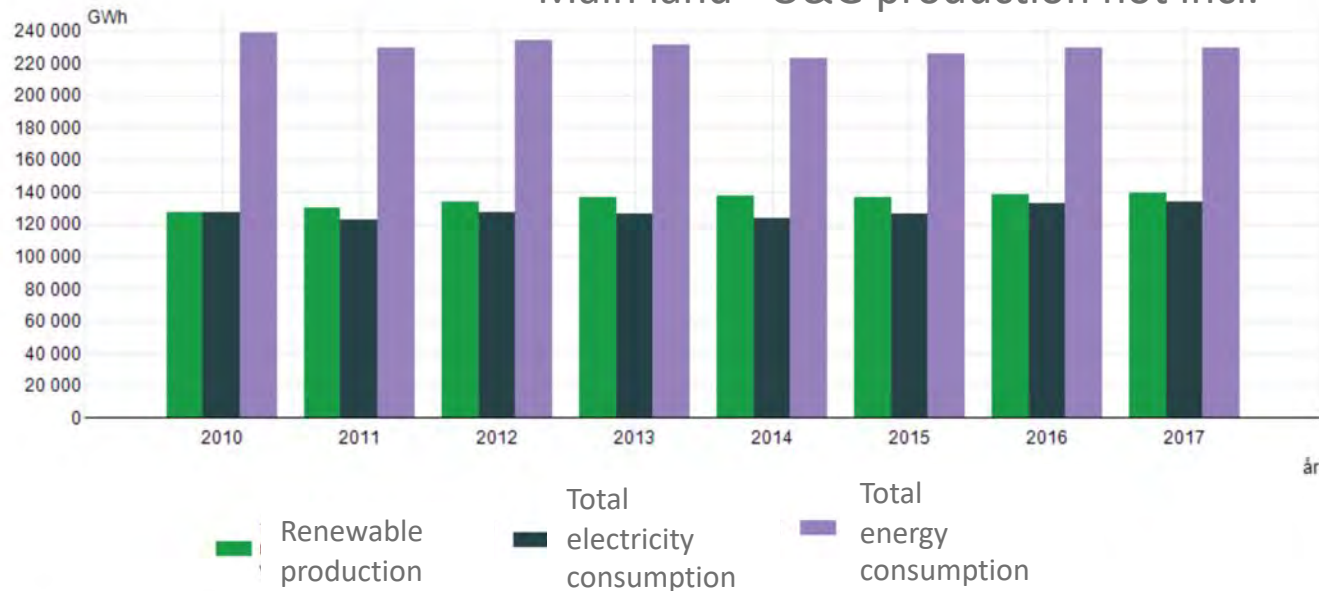
4°C+ World	< 4°C World	< 3°C World	< 2°C World	< 1.5°C World	< 1.5°C World
CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL
RUSSIA	ARGENTINA	AUSTRALIA	BHUTAN	MOROCCO	0 Countries
SAUDI ARABIA	CANADA	BRAZIL	COSTA RICA	THE GAMBIA	
TURKEY	CHILE	EU	ETHIOPIA	2 Countries	
UKRAINE	CHINA	KAZAKHSTAN	INDIA		
USA	INDONESIA	MEXICO	PHILIPPINES		
5 Countries	JAPAN	NEW ZEALAND	5 Countries		
	SINGAPORE	NORWAY			
	SOUTH AFRICA	PERU			
	SOUTH KOREA	SWITZERLAND			
	UAE	9 Countries			
	10 Countries				



CAT country ratings of Pledges & Targets

December 2018 update

Main land - O&G production not incl.



**Mainland Norway
Energy consumption
by source**

Figur 1-5 Energibruk i Fastlands-Norge etter energivare. Historisk utvikling og anslag på utvikling til 2020. Kilde SSB og NVE. E i figuren står for estimert energibruk.

2018: TOTAL ENERGY CONSUMPTION INCLUSIVE OIL&GAS PRODUCTION

230 TWh energy consumption mainland

+65 TWh fossil fuel consumption for production of energy

+11 TWh electricity consumption for production of energy

SUM 306 TWh:

RENEWABLES: 140 TWh = 45,7% of total energy consumption

FOSSILE FUELS: 166 TWh = 54,3% of total energy consumption

**CONCLUSION: ALSO IN
NORWAY WE NEED MORE
ELECTRICITY!**

A fully electric Norway is possible

Norway can become a fully electrified society, where all consumption of fossil energy is replaced by energy from renewable sources. A report launched by Statnett outlines how this can be achieved with an **increase in electricity consumption by 30-50 TWh**.

Electricity is also a highly efficient energy carrier, and the estimates from Statnett indicate that a transition to electrical energy consumption where possible will mean that **40TWh of renewable energy will replace 95TWh of fossil energy**.

-Transition of energy consumption to electricity is not only a transition from fossil to renewable energy, it is also a **substantially improved energy efficiency**

Hydrogen can lead to zero emissions

In addition to the 30–50 TWh, there are parts of industry and heavy-duty or long-haul transport where direct electrification will be difficult to implement. If Norwegian energy use is to move to zero emissions, this has to be solved.

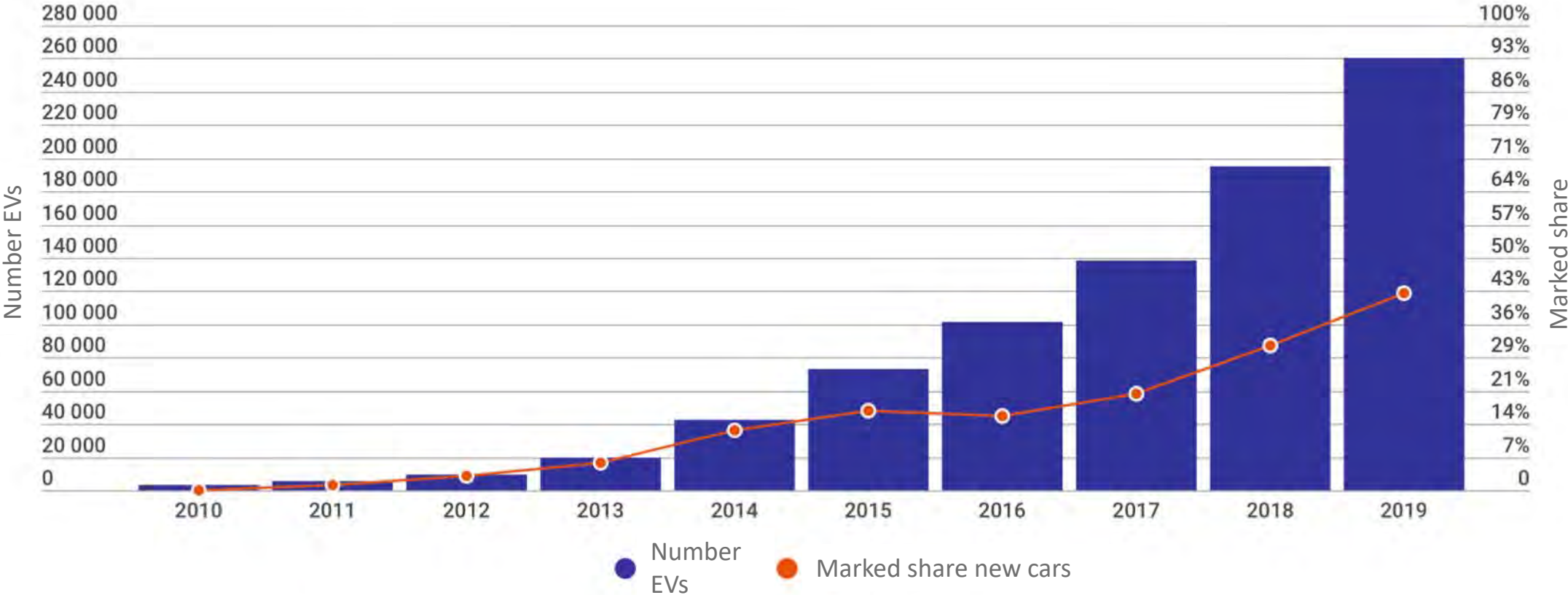
-There are several possible solutions to this, including zero emissions technologies like **hydrogen**, **CCS** and **biofuels**. Should future zero emissions solutions include **hydrogen from electrolysis**, this will impact the need for power production the most. Our calculations indicate that this will **lead to a demand for a further 40 TWh of power generation**

REPORT MAY 2019:

[An electrical Norway – from fossil to electricity](#) (1 MB)

FULL Electrical vehicles for personal traffic

Numbers and marked shares



Totalt antall registrerte elektriske personbiler og ladbare hybrider, og tilhørende markedsandel av nybilsalget.

Kilde: Motorvognregisteret og Opplysningsrådet for veitrafikken.
Sist oppdatert: 7. februar 2020.

In September 2019 54,4 % of all new cars sold was full electric!
Tesla Model 3 had a marked share of 21%!





Electrifying Norway – A Plan for Heavyweight Vehicles

The “Green Shift” of Norway is in full action. The country has achieved significant progress in electrifying public and private passenger transport. What’s more, heavyweight sectors such as freight transport, shipping, fjord traffic and even aviation are to be transformed as well. Politics, industry and NGOs are pushing the envelope to enable the “Silent Revolution”.

National Transportation Plan:

- 31% of Norway's GHG emissions is from transportation
- 50% reduction in 2030
- All new ferries and speed boats on biofuels or low- / zero-emission vessels- several already in operation
- Yara Birkeland – the world first fully electric, autonomous container ship launches in 2020

Potential for offshore wind offshore

Norway: 14.000 TWh/yr

= 100 x norwegian hydropower

= 6 x norwegian Oil&Gas production/year



HYWIND I:

**FIRST FLOATING WIND TURBINE IN THE
WORLD – 2009**

KARMØY – ROGALAND – NORWAY

STATOIL – EQUINOR

2,3 MW Siemens turbine

Floating offshore wind – A golden opportunity

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OFFSHOREWIND
Norwegian Offshore Wind Cluster 
www.offshore-wind.no

Cluster ambition

The cluster shall establish a leading global supply chain for floating offshore wind farms.

- Trends are leading to deeper water and floating foundations suits Norwegian industry with many years of experience from oil/gas and maritime sector.
- Golden opportunity.

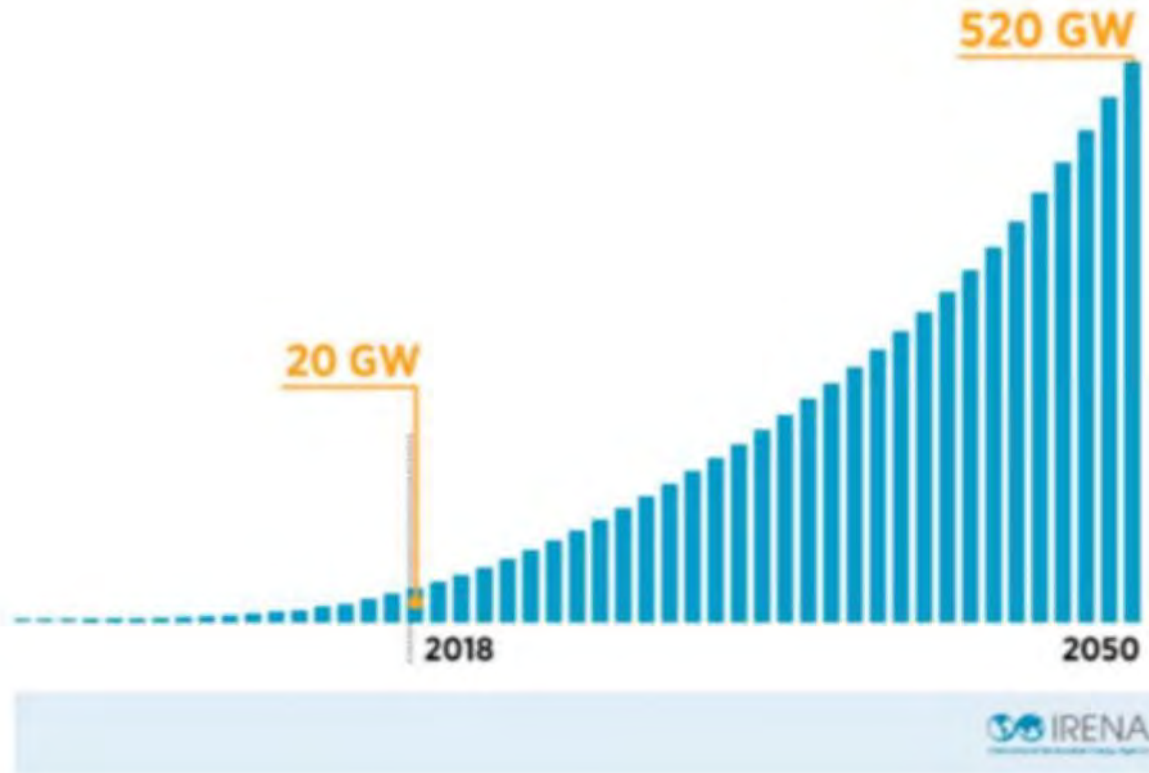


Our goal is to **develop a strong Norwegian supply chain** for the global floating wind market, focusing on collaboration, execution and innovation.

www.offshore-wind.no



Way forward – WFO’s mission: “500 GW by 50”



- Large-scale floating wind needed
- Accelerated growth path required
- Global effort is essential

OFFSHOREWIND

Norwegian Offshore Wind Cluster

- Established 2016
- > 100 members

SUPPLY CHAIN OFFSHORE WIND = GREAT OPPORTUNITIES!



Focus areas

1. Develop a Norwegian supply chain
2. Innovation – new concepts. Test and demo.
3. International markets.
4. Electricity supply for oil and gas installations.
5. Develop Utsira Nord and other Norwegian areas.

FIRST FLOATING WIND FARM IN NORWAY DECIDED!

Equinor to build \$550 million wind farm to power offshore Oil & Gas platforms

engineeringpro



by Matt Donnelly

15/10/2019

F Like 6Likes

in Follow

Equinor have made a final investment decision on the Hywind Tampen offshore windfarm, which will deliver power to Oil & Gas platforms in the North Sea.



(Image via Equinor)

The company have submitted updated plans for development and operation of the 88MW wind farm to the Norwegian authorities.

The proposed wind farm will be located 140km from the Norwegian coastline, in 260-300 metres of water, between the Snorre and Gullfaks platforms - for which it will provide the power. According to Equinor, these platforms will become the first to ever be powered by a floating offshore wind farm.

"The pioneering Hywind Tampen project will help cut emissions from Gullfaks and Snorre. We are driving a transition aimed to sustain and add value on the Norwegian continental shelf, while reducing the carbon footprint from our operations," said Arne Sigve Nylund, Equinor's Executive Vice President for Development & Production Norway.

Huge marked For Floating Wind



This map shows the vast potential of offshore wind worldwide

Demo projects - Metcentre



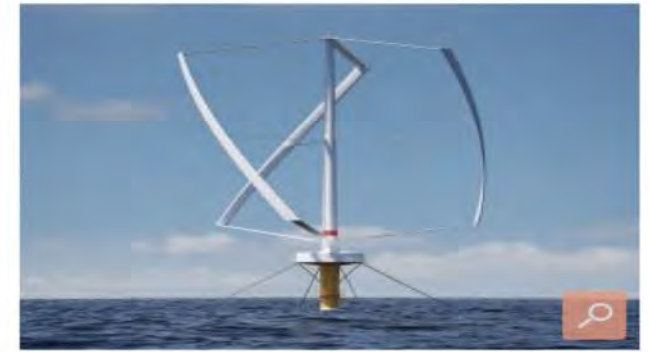
- Hywind changes owner from 2019 and will be named Unitech Zephyros
- Open for external R&D projects



- Makani tested offshore from July 2019
- Kite technology
- Innovative project from Google X



- Stiesdal Offshore Technologies from 2020
- Shell and Innogy are investors.



- SeaTwirl from 2021
- Vertical axis wind turbine.
- Developed at University of Gothenburg

Makani First Offshore Test Summer 2019



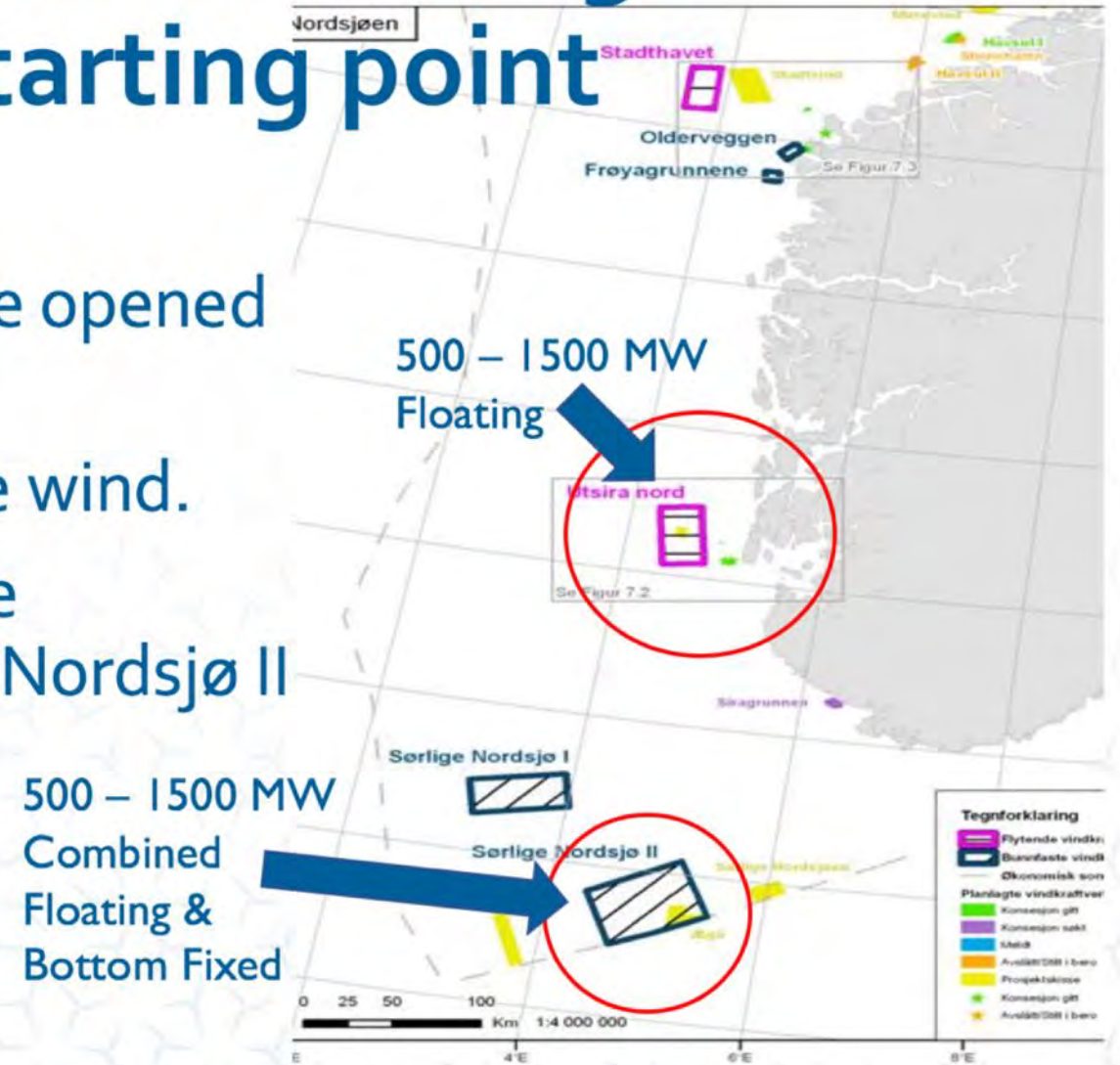


The test centre will be extended the coming years to host more floating technologies

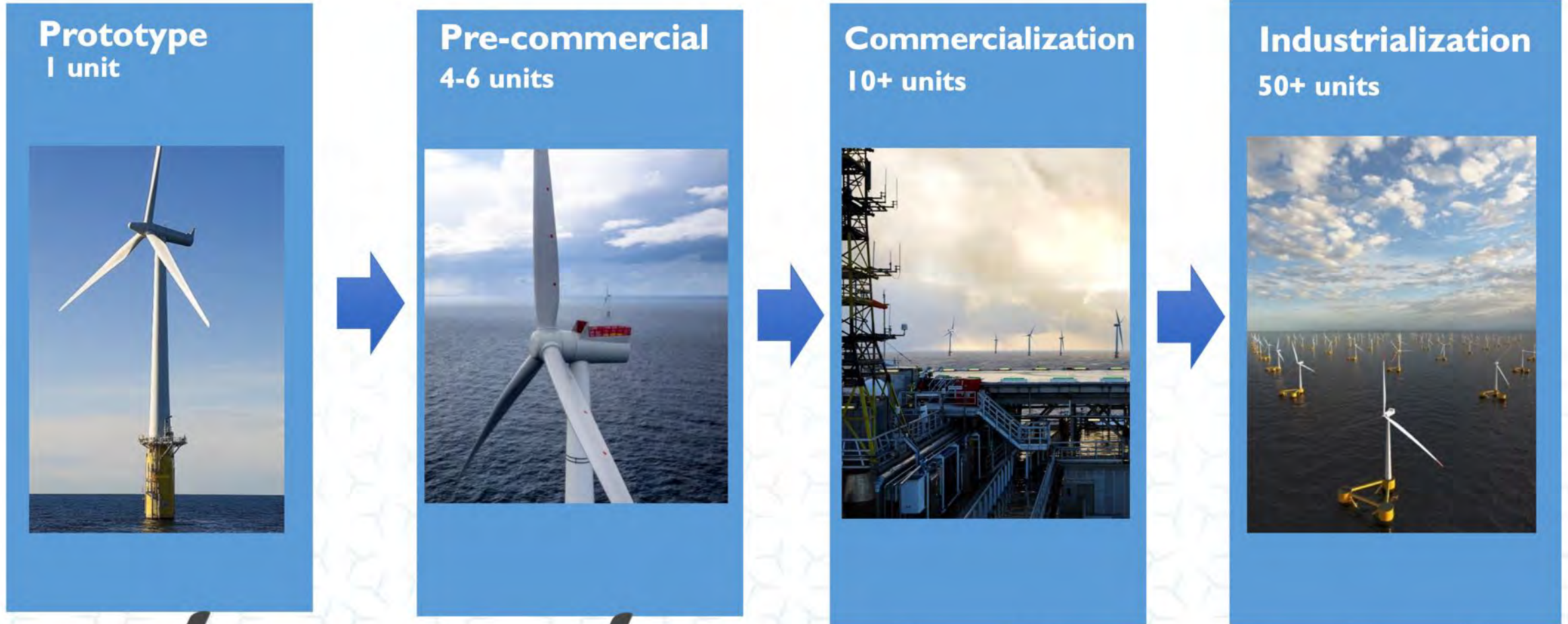


Utsira Nord, Sandskallen and Sørlige Nordsjø II can be the starting point

- Areas for floating technologies to be opened
- Norway to be at the forefront of industrialization of floating offshore wind.
- Possible power export without cable connection to Norway from Sørlige Nordsjø II




Can Norway keep the leading position?



Events 2020

- **January 27:** [Offshore Wind France](#) **STAVANGER**
- **January 28:** [HAVROMMET - Havvind & Havbruk til havs](#) - **EGERSUND**
- **February 3-7:** [Delegation travel & Meetings in Tokyo](#) - **TOKYO**
- **February 13:** [Kapitalseminar](#) - **STAVANGER**
- **February 17:** [Merkevarebygging for havnæringene](#) - **HAUGESUND**
- **March 13:** [Contract seminar](#) - **STAVANGER**
- **March 18-19:** [High Wind 2020](#) - **STAVANGER** (Greater Stavanger)
- **March 24:** [FoU-seminar Havvind & påvirkning marint liv](#) - **BERGEN**
- **April 15:** [Workshop Marine Operasjoner](#) - **HAUGESUND**
- **April 16:** [Capital seminar](#) - **OSLO**
- **April 22-24:** [FOWT 2020](#) – (NOWC/NORWEP) **MARSEILLE**
- **May 27:** [Delegation Travel and meetings DUBLIN](#) (NOWC/NORWEP)
- **June 3-4:** [Floating Wind 2020](#) - **HAUGESUND**, NOWC
- **Aug 31 - Sept 3:** [ONS Offshore Wind Plaza & conference](#) **STAVANGER**
- **September 17:** [Seminar Simulation](#) - **ÅLESUND**
- **September 22-25:** [WindEnergy](#) - **HAMBURG**
- **October 20:** [Havvindkonferansen 2020](#) - Nasjonal konferanse - **OSLO**
- **November 3-4:** [Cluster meeting 2020](#) - **SOLA**



In Stavanger 18th – 19th of March
www.highwind.no

HIGH WIND
2020

Register today for the High Wind 2020
conference

[Register now!](#)



INTERNATIONAL
CONFERENCE

FLOATING WIND 2020

3-4 JUNE 2020

HAUGESUND – SOUTH WEST NORWAY


www.floating-wind.no



SEMINAR - KON- TRAKTER I OFF- SHORE VIND

March
13
2020

[DETAILS](#)

 **Greater Stavanger**

Professor Olav Hanssens vei 7a
Stavanger, Norway

 10:00 — 15:30