Equinor New Energy Solutions

Build a profitable renewables business

Develop new lower-carbon business opportunities for Statoil’s core products
Rapid expansion within offshore wind

Current projects in progress of providing renewable energy to over 1M European households

<table>
<thead>
<tr>
<th>Hywind demo</th>
<th>Sheringham Shoal</th>
<th>Dudgeon</th>
<th>Hywind pilot</th>
<th>Arkena</th>
</tr>
</thead>
<tbody>
<tr>
<td>In operation</td>
<td>In operation</td>
<td>In operation</td>
<td>In operation</td>
<td>In development</td>
</tr>
<tr>
<td>2.3 MW</td>
<td>317 MW</td>
<td>402 MW</td>
<td>30 MW</td>
<td>385 MW</td>
</tr>
</tbody>
</table>

North West Europe
United States East Coast
Japan
US West Coast

- Dagger Bank
- New York
- Hywind large scale

- Consented
- Auction won
- 3 x 1.2 GW
- 1-2 GW
- 2009
- 2012
- 2017
- 2017
- 2019
- 2020 +
- 2024 +
Major cost reductions for offshore wind

**Dudgeon cost reductions**
- Cost reductions from estimated £1.5 billion to £1.25 billion

**UK CfD auctions**
- Auction prices reduced with 52% from 2015 to 2017

**Danish auctions**
- Auction prices reduced with 52% from 2015 to 2016

**Hollandse Kust**
- ZERO SUBSIDY
Vast potential for floating offshore wind

<table>
<thead>
<tr>
<th>Size of the prize</th>
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<tr>
<td>12 GW in 2030</td>
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<table>
<thead>
<tr>
<th>Expected LCOE</th>
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<tbody>
<tr>
<td>40 – 60 €/MWh by 2030</td>
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<table>
<thead>
<tr>
<th>The big four</th>
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</thead>
<tbody>
<tr>
<td>US West Coast</td>
</tr>
<tr>
<td>Japan</td>
</tr>
<tr>
<td>France</td>
</tr>
<tr>
<td>Scotland/Ireland</td>
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</table>

- UTILITY SCALE
- BIG CITIES
- ISLANDS
- OIL AND GAS
### Operation of Equinor wind farms

#### Maximising value from the producing wind assets

<table>
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</thead>
<tbody>
<tr>
<td>• Scheduling and follow-up marine logistics</td>
<td>• 24/7 Control Centre monitor and control</td>
<td>• Technical integrity</td>
<td>• Supply Chain Mgmt.</td>
<td>• PPA handling</td>
</tr>
<tr>
<td>• Tracking of personnel movements</td>
<td>• Safe Work/High Voltage Switching</td>
<td>• Maintenance Planning &amp; Execution</td>
<td>• PL</td>
<td>• Certificates handling</td>
</tr>
<tr>
<td>• Tracking of vessel movements</td>
<td>• Transmission system interaction</td>
<td>• Condition Monitoring</td>
<td>• Finance</td>
<td>• Production Settlement</td>
</tr>
<tr>
<td>• Communication</td>
<td>• Communication</td>
<td>• Inspection</td>
<td></td>
<td>• Metering</td>
</tr>
</tbody>
</table>

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OM cost reduction | Risk reduction | HSE improvement | Digital solutions
Hywind Scotland on YouTube

https://www.youtube.com/watch?v=PUIfvXaISvc
Experiences from Hywind Demo inspections

Large work ROV (IMR)
- Capable but «overkill»
- High cost

Mini-ROV
- Great potential but limitations;
  - cleaning
  - currents
  - wave height
New innovative CTVs – fast and stable platforms for ROV work
Equinor New Energy Operations
Anders Wikborg, Marine Operations Manager
NES NEO OEX
New Energy Solutions – driving energy transition

Norwegian continental shelf
- Build on unique position
  - Highly cost competitive
  - Attractive project pipeline
  - Exploration potential

International oil & gas
- Deepen core areas
  - Enhance Brazil portfolio
  - Flexible US position
  - New growth options

Midstream and marketing
- Access premium markets
  - Flow assurance
  - Asset backed trading
  - Capital light

New energy solutions
Industrial approach
- Offshore wind
- Low-carbon solutions
- Ventures, R&D
Underwater Intervention Drones (UID™) - ?

UID™ – Underwater Intervention Drone, is a hybrid of
   ROV – Remotely Operated Vehicle
   AUV – Autonomous Underwater Vehicle

UID™ is trade marked by Equinor to secure freedom to use in the industry

UID™ - important part of the sharpened Equinor technology strategy
(released Q1 2017)
Underwater Intervention Drones (UID™) - Operator Business Case

Benefits and possibilities

Always safe
- Reduce human exposure
- Simplify procedures
- “Online” emergency response

High value
- Reduce need for specialized vessels
- Reduce operating cost: onshore remote operations
- Increase Production Efficiency (PE): short response time, large operating window
- Increase usage of installed infrastructure
- Profitable field development in remote areas

Low carbon / environmental
- Reduce CO₂ emission
- Improve environmental and condition surveillance
Underwater Intervention Drones (UID™) - Current projects in execution

- Remote operations from onshore control room, 2017
- Resident W-ROV, Snorre B, 2018
- Variable Buoyancy System (VBS), 2018
- E-ROV, 2017/2018
- Eelume, late 2018/early 2019
- UID™ Test site in Trondheimsfjorden Collaboration project NTNU – Equinor, 2018
- First generation UID™ subsea docking station - Docking panel with inductive connectors, 2019 (similar to Trondheimsfjorden), 2019
- Wireless subsea communication standard- aim to establishment industry standards through Subsea Wireless interest Group (SWiG), 2018
Roadmap UID™ intervention ~ next 10 year ++

UID™ – Underwater Intervention Drone

- Reliable UID™ systems on the NCS (multi use)
- Network of subsea docking stations
- Semi-autonomous resident light WROV
- Subsea docking station
- E-ROV, Eelume, RROV pilot, others
- Resident ROV
- Onshore Pilot centre

Increase PE, reduce OPEX, POB, CO₂ footprint, reduced HSE risk
UID™ and Offshore Wind

- Similar use as for subsea production system (IMR needs)
- Resident and onshore controlled UID™ @ offshore wind farms
- Co-operations with Topside drones
- Sharing UID™s with other offshore wind parks or nearby oil & gas fields
Underwater Intervention Drones (UID™) - Equinor’s vision for the market

- Standardisation of interfaces:
  - UID™ subsea docking station
  - Sensor interfaces
  - Subsea communication

- Establishment of onshore control rooms

- Development of autonomous technology
  - UID™ intervention friendly solutions for subsea hydrocarbon production systems and offshore windfarms
    - Infrastructure for power and communication
    - Accessibility
    - Wireless subsea communication

https://www.youtube.com/watch?v=q-4vhiH1u6E&feature=youtu.be
Kostefektive løsninger

Subsea IMR
Subsea IMR

Inspection
Maintenance
Repair

IMR kontrakt: Normand Ocean
IMR kontrakt: Seven Viking
IMR forvalter Asgard-kontrakt: North Sea Giant
Tilleggskapasitet
E-ROV
miniROV
Ny teknologi:

E-ROV – fjernstyrt operasjon

miniROV – for inspeksjon av plattformstruktur
E-ROV pilot
E-ROV

• Komplett arbeids-rov
• Robust og rimelig
• Opereres fra land
• Kommunikasjon via subsea fiber eller 4G-bøye
• Har sitt eget batterisystem, men kan også suppleres med strøm subsea
• Bøye, E-ROV og batterisystem er legoklosser som har mange bruksområder
Stor intresse for E-ROV systemet:

2017: World Oil Award

2018: OTC- New Technology Award

E-ROV System Selected for OTC Spotlight on New Technology® Award
Veien fremover:

- ITT-prosess for 3 årig E-ROV kontrakt pågår. Oppstart av E-ROV operasjoner i Q4
- Infrastruktur inkluderes i nye prosjekt for å nyttiggjøre ny teknologi
- IMR vil velge optimalt verktøy fra en stor verktøykasse
- For havvind-prosjektene er det viktig at infrastruktur muliggjør et effektivt vedlikehold
- Fokus de første par årene er å operasjonalisere bruk av E-ROV og planlegge operasjonene for å maksimere bruken av teknologien
- Kosteffektivt E-ROV system muliggjør ROV-operasjoner som tidligere ikke var lønnsomme -> økt volum
Hva ser vi på i IMR?

Trådløs subsea bredbåndskommunikasjon.

Muliggjør eksempelvis fritflygende kameradroner som tilleggsverktøy for E-ROV.
There’s never been a better time for **good ideas**

Kaj-Ove Skartun
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