OCEAN ENERGY
A European Perspective
Lisbon 2010-May-14
Dr. Karl Strømsem, Director
EU-OEA

www.eu-oea.com
Topics covered

• Short about EU-OEA, European Ocean Energy Association

• Ocean Energy, what and how

• Ocean Energy Roadmap, published 5 may 2010 to the EU commission

• Offshore floating wind and potential synergies with Ocean Energy
European Ocean Energy Association (EU-OEA)

- **Started in 2006 - 60+ members strong and growing**
  - 5 Lead Sponsors (Alstom, DCNS, EDF, EVE, Statkraft)
  - 2 Associations (WavEC, RenewableUK)

- **Goals & Objectives:**
  - To strengthen development of OE sector in EU
  - Act as the single OE sector voice to the EC
  - Act as the representative for our members towards the EC

- **2010 Ocean Energy events**
  - Mar 22, Brussels – Marine Renewables: “Turning The Tide”
  - May 6-7, Brussels – “Ocean Energy”, 1st Annual Event
  - May 19-20 - EU Maritime Days, “OE Open House”
  - Oct 6-8, Bilbao – ICOE 2010, Exhibit coordinator

- **2010 EU-OEA has started to gain momentum**
  - Delivered “European Ocean Energy Roadmap, May 2010
  - Continuous dialogue with the EU – commission and various member states
  - Focal point for developers, and industry entering into the ocean energy area
What is Ocean Energy?

Ocean Energy with its potential is defined as:

- Wave Energy – 45,000 TWh/year
- Ocean Currents – 400 TWh/year
- Tidal – 1,800 TWh/year
- Ocean Thermal – 33,000 TWh/year
- Osmotic – 20,000 TWh/year

Source: Ocean Energy: Prospects & Potential, Isaacs & Schmitt, with 15% utilization factor & 50% capacity factor

Pr definition, Offshore Floating wind is not ocean energy although it resides in the same environment and share many of the technological challenges.
Ocean Energy, How to get there?

- Typical for the OE sector is
  - A range of different technologies
  - A number of small developers poorly financed
  - Limited cooperation between the various companies
  - A huge number of patents

- What is needed?
  - **Consolidation (a massacre!)**
    - A focus on a few successful devices
    - Proper funding and backing of these. (Compare this with the wind industry)
  - **Cooperation,**
    - sharing of information.
    - Acknowledge that if it is not demonstrated successful development the sector will not get the growth potential.
  - **Interest and focus from the supply chain industry**

**A Roadmap and a Coordinated industrial initiative (EII)**
European Ocean Energy Roadmap 2010 – 2050

- Published to the EC may 2010
- Set key targets
- Describes
  - Energy potential
  - Opportunities for industrialization
  - Potential for green jobs
  - Requirements for R&D
- Identifies
  - Necessary actions
  - Required funding for risk reduction
  - European Industrial Initiative

Can be downloaded from EU-OEA website
http://www.eu-oea.com
European Ocean Energy Roadmap

Key Targets

- GENERATE > 15% of the EU energy demand
- CREATE > 470,000 new jobs
- AVOID > 136 MT/MWh OF CO₂
European Ocean Energy Roadmap
EU Ocean Energy Targets

- Generation Targets:
  - 2020 - 1% of EU electricity generation
  - 2050 – 15% of EU electricity generation

- What:
  - 5-6 operational offshore test site; 1 offshore platform for testing; grid integration techniques; spatial planning tools

- How:
  - demo funding to reach 240 MW of installed capacity; new manufacturing;

- Cost: 850 M€ for the 2020 time frame
European Ocean Energy Roadmap
EU Ocean Energy Potential

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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</thead>
<tbody>
<tr>
<td>GW</td>
<td>3.6</td>
<td>20</td>
<td>54</td>
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<td>188</td>
</tr>
<tr>
<td>TWh/yr</td>
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<td>150</td>
<td>317</td>
<td>546</td>
<td>645</td>
</tr>
</tbody>
</table>
Total projected installed capacity based on national targets is 4.9 GW installed capacity.

1.3 GW higher than projected in the roadmap.

National targets updated since numbers for roadmap was collected.
European Ocean Energy Roadmap
OE Sector Growth Rate Projection

Figure 3
ONSHORE, OFFSHORE WIND & OCEAN ENERGY
PROJECTED GROWTH

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
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European Ocean Energy Roadmap
Potential for Jobs

Total direct & indirect jobs
- 2010: 40,000
- 2050: 470,000
Comparison with Offshore Wind Growth

FIGURE 2: Offshore wind energy annual and cumulative installations 2011-2020 (MW)

FIGURE 4: Annual and cumulative investments in offshore wind power 2011-2020 (€billion 2005)
European Ocean Energy Roadmap
Policies Support Growth

- March 2001: Decision by the European Court of Justice: the German feed-in tariff model complies with European State Aid and Competition Law.
- April 2000: Adoption of the Renewable Energy Sources Act ("Act on Granting Priority to Renewables Energy Sources").

- Jan. 1997: Change in the Federal Building Code: Wind turbines are now considered privileged building projects.
- Installed capacity in megawatts

5/17/2010 Ocean Energy 2010
EC funding for Ocean Energy

- **Period** - 1990-2009
- **Amount** - 60.85M€
- **DG RTD & TREN**
  - FP 7  27,50 M€
  - FP 6  17,30 M€
  - FP 5  4,54 M€
  - FP 4 (Joule III)  6,91 M€
  - FP 3 (Joule II)  3,05 M€
  - FP 2 (Joule I)  0,52 M€
  - IEE  1,00 M€
European Industrial Initiatives

Technology Roadmaps 2010-2020

Ocean Energy 2010
From potential to targeted actions

- Technology Maps:
  - Potential contributing to energy and climate goals
  - EU added value and additionally;
  - Willingness of actors to join forces
  - Potential market penetration – 2020 / 2050

- Methodology

Objectives → Activities → Resources → Structure → Technology roadmaps
## European Ocean Energy Roadmap

### Funding Needs

#### Table 1

**ESTIMATED BENEFITS OF DEVELOPING A WORLD LEADING EUROPEAN OCEAN ENERGY INDUSTRY**

<table>
<thead>
<tr>
<th>Installed Capacity / GW</th>
<th>Direct Jobs&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Total Jobs (Direct &amp; Indirect)&lt;sup&gt;2&lt;/sup&gt;</th>
<th>CO&lt;sub&gt;2&lt;/sub&gt; avoided Mt/year&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Investment €m.&lt;sup&gt;4&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6 (in 2020)</td>
<td>26,000</td>
<td>40,000</td>
<td>2.61</td>
<td>8,544</td>
</tr>
<tr>
<td>188 (in 2050)</td>
<td>314,213</td>
<td>471,320</td>
<td>136.3</td>
<td>451,104</td>
</tr>
</tbody>
</table>

1. Direct Jobs
2. Total Jobs (Direct & Indirect)
3. CO<sub>2</sub> avoided Mt/year
4. Investment €m.
Ocean Energy - Technology Roadmap 2010-2020

1. Ocean energy devices & generating facilities
   - R&D program focused on development of MW scale ocean energy conversion devices
   - Development and testing of 40 MW each ocean energy plants
   - Implementation of testing facilities for demo of MW scale ocean energy conversion devices
   - Testing and demo
   - Demonstration of cost-effective logistics techniques
   - Installed 6 ocean energy generating facilities, 40 MW each
   - Additional facilities for demo
   - Installation techniques for ocean energy facilities

2. Support infrastructure and test sites
   - Development of support infrastructure to test components, subsystems and systems
   - Support infrastructure operational
   - Establish financial mechanisms to support testing ocean energy devices

3. Grid Integration
   - Coordinate grid connection availability
   - Integration with large scale storage systems & HVDC/HVAC interconnections
   - 6 fully operational, grid connected installations

4. Enable ocean energy deployment
   - Conduct marine spatial planning analysis
   - Ocean energy resource/grid availability campaign
   - Results of public acceptance analysis
   - EU spatial planning implemented
   - Publication of EU 27 Ocean Energy Atlas (wave, tidal, osmotic)
   - Statistical forecast of ocean energy resources & energy production

5/17/2010 Ocean Energy 2010
European Industrial Initiative (EII)

• Led by industry
• GOALS:
  • Boost research and innovation
  • De-risk projects to allow industry to invest
  • Accelerate deployment of technology
  • Deliver progress beyond business-as-usual
  • Define & realize clear targets (quantified objective)
  • Contribute to political goals (energy & climate change)
## European Industrial Initiatives

<table>
<thead>
<tr>
<th>Initiative</th>
<th>2020 Objectives</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>20% of EU gen</td>
<td>6 bn €</td>
</tr>
<tr>
<td>Solar</td>
<td>15% of EU gen</td>
<td>16 bn €</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>14% of EU gen</td>
<td>9 bn €</td>
</tr>
<tr>
<td>Smart Grid</td>
<td>50% of networks</td>
<td>2 bn €</td>
</tr>
<tr>
<td>CCS</td>
<td>12 plants</td>
<td>13 bn €</td>
</tr>
<tr>
<td>Sustainable fission</td>
<td>1 prototype</td>
<td>7 bn €</td>
</tr>
<tr>
<td>Smart-Cities</td>
<td>40% reduction</td>
<td>11 bn €</td>
</tr>
<tr>
<td>Ocean Energy</td>
<td>1% of EU gen</td>
<td>0.85 bn €</td>
</tr>
</tbody>
</table>

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5/17/2010

Ocean Energy 2010
European Ocean Energy Roadmap

Conclusions

● Ocean Energy can be a contributor to EU energy needs:
  » 2020 – 1%
  » 2050 – 15%

● Can NOT happen at the present rate of growth

● EIT can pull the critical mass together
Ocean Energy and Offshore Floating Wind Potential for synergies
Cost of energy and areas for synergies

<table>
<thead>
<tr>
<th>Cost comparisons nearshor (shallow wind) and offshore wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearshore shallow wind</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>2.2 M€/MW</td>
</tr>
<tr>
<td>Installed</td>
</tr>
<tr>
<td>Offshore floating wind presently</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>160 M€/MW</td>
</tr>
<tr>
<td>Installed</td>
</tr>
<tr>
<td>Offshore floating wind projection</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>16 M€/MW</td>
</tr>
<tr>
<td>Installed</td>
</tr>
<tr>
<td>Learning rate for neashore wind</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>Each time the installed capacity doubled</td>
</tr>
</tbody>
</table>

- Grid access and cable to shore, infrastructure
- Installation spreads and heavy equipment costs
- Operation and maintenance ships and crews
- Share location but different resource potentials

Floating offshore wind and wave/tidal ocean energy devices share many technical challenges and both regarding CAPEX and OPEX it makes sense to treat these devices in conjunction with each other.
Thank you for your attention
Questions?