

Maritime spatial planning for offshore wind energy: Ecological impact avoidance using a spatial prioritization approach

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VASAB Webinar

Offshore Wind Energy: Challenges and opportunities
emerging from new European expansion targets

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Photo: Juho Lappalainen

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Balancing profitability of energy production, societal impacts and
biodiversity in offshore wind farm design

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The main analytical tool:

Zonation

Decision support and spatial prioritization tool developed for ecologically based land-use planning

Applications: conservation planning, impact avoidance, siting of activities, etc.

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I. Profitability

Spatial Life Cycle Cost analysis

Includes all costs during the project lifetime:

- Development and consenting
- Production and acquisition
- Installation and commissioning
- Operation and maintenance
- Decommissioning and disposal

Levelised Cost of Energy (LCOE):

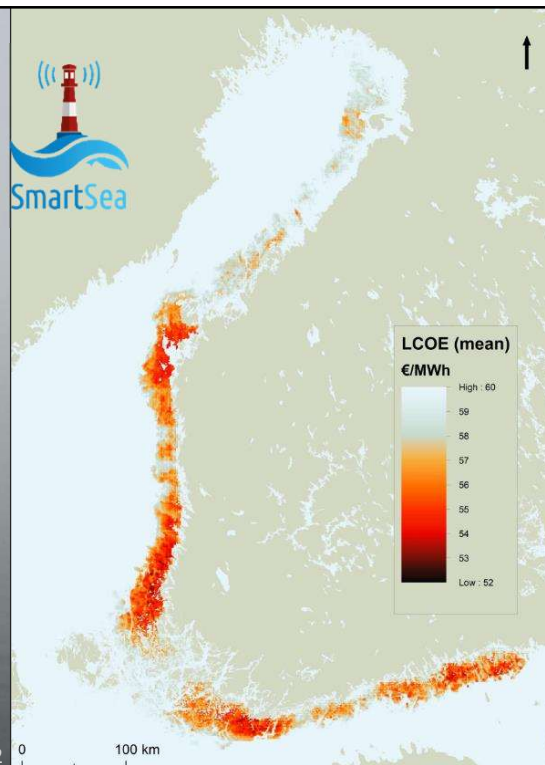
$$\text{LCOE} = \frac{\sum_{t=0}^{T_{\text{project}}} \frac{\text{LCC}_t}{(1+\text{WACC}_{\text{real}})^t}}{\sum_{t=0}^{T_{\text{project}}} \frac{E_{\text{annual}}}{(1+\text{WACC}_{\text{real}})^t}}$$

Where is it most profitable to produce OWE?



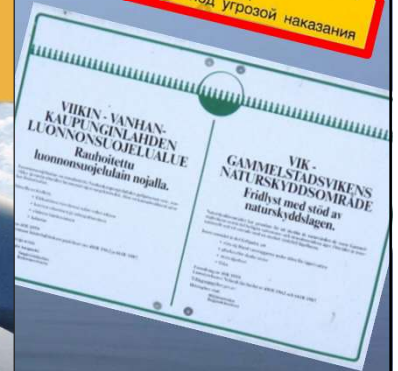
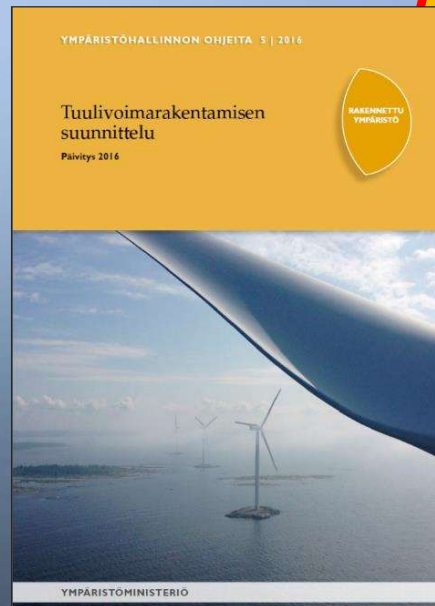
Lappalainen, Juho (2019):
Economic potential of offshore
wind energy in the Gulf of Bothnia

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2. Restrictions

- Military areas
- Conservation areas
- Shipping lanes
- Anchoring areas
- Weather radars, etc.



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3. "Enablers"

- Proximity of industrial areas ("spoilt" landscapes)
- Anoxic and hypoxic areas ("dead zones")



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4. Societal impacts

- Visual and noise impacts for summer cottages and other coastal housing, boating intensity, etc.
- Livelihoods
 - Commercial fishing
 - Aquaculture

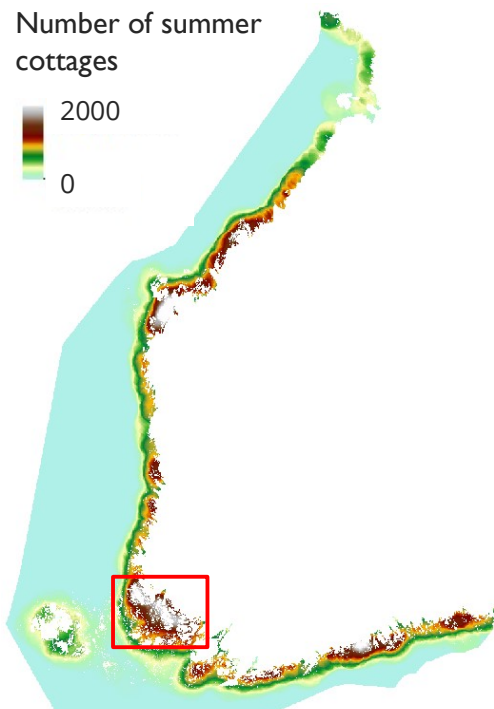
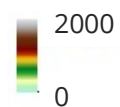


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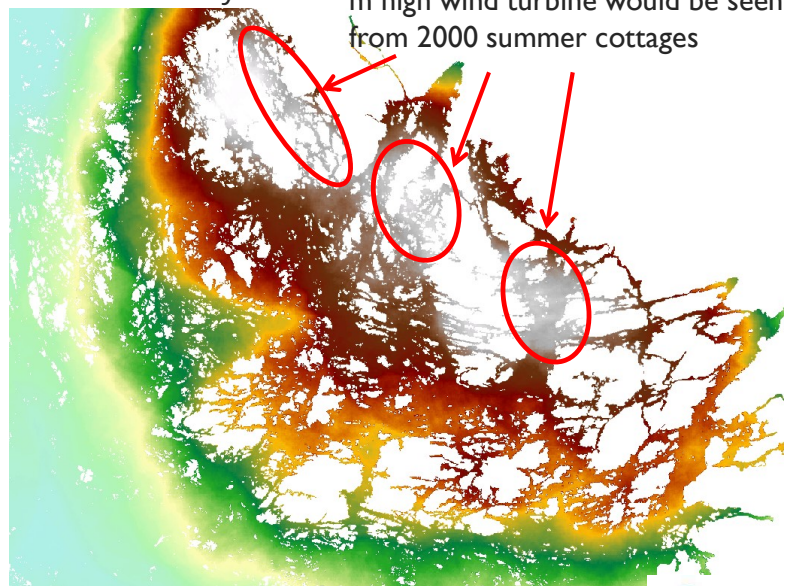
Number of summer cottages



From where OWE installations would be seen?

"Viewshed" analysis →

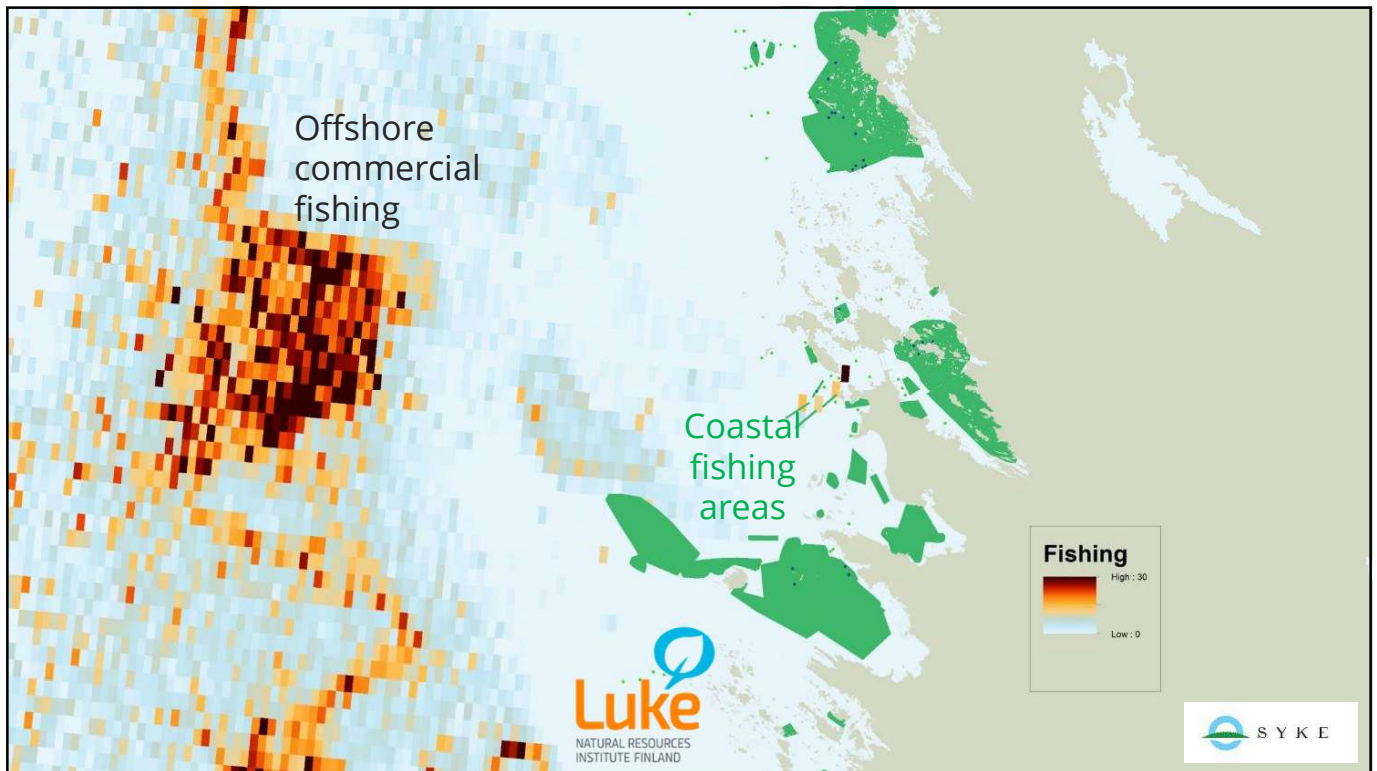
If OWE was developed here, 200 m high wind turbine would be seen from 2000 summer cottages



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5. Biodiversity

Finnish Inventory Programme for underwater Diversity (VELMU), from 2004

- 160 000 sites visited!
- Information on underwater geo- and biodiversity
- Algae, aquatic plants, invertebrates, fish

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5. Biodiversity

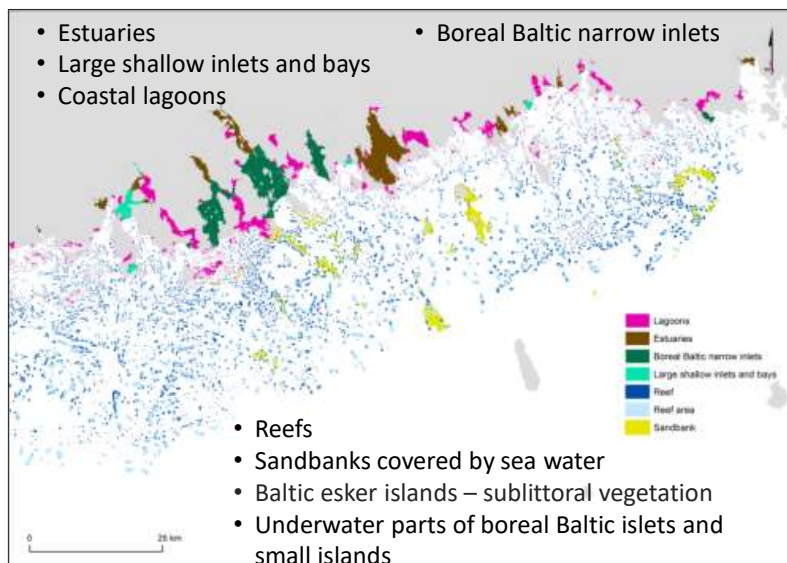
Key habitats, threatened species, other valuable areas

- EU Habitats Directive habitat types
- Threatened habitat types
- Geologically important areas
- Fish reproduction areas
- Bird migration routes
- Important areas for eagles and seals

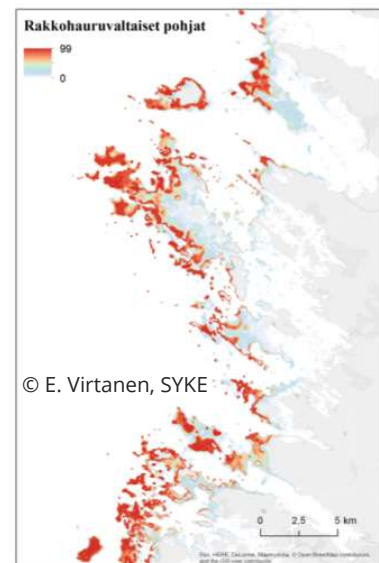


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Habitats of the EU Habitats Directive (Annex I)

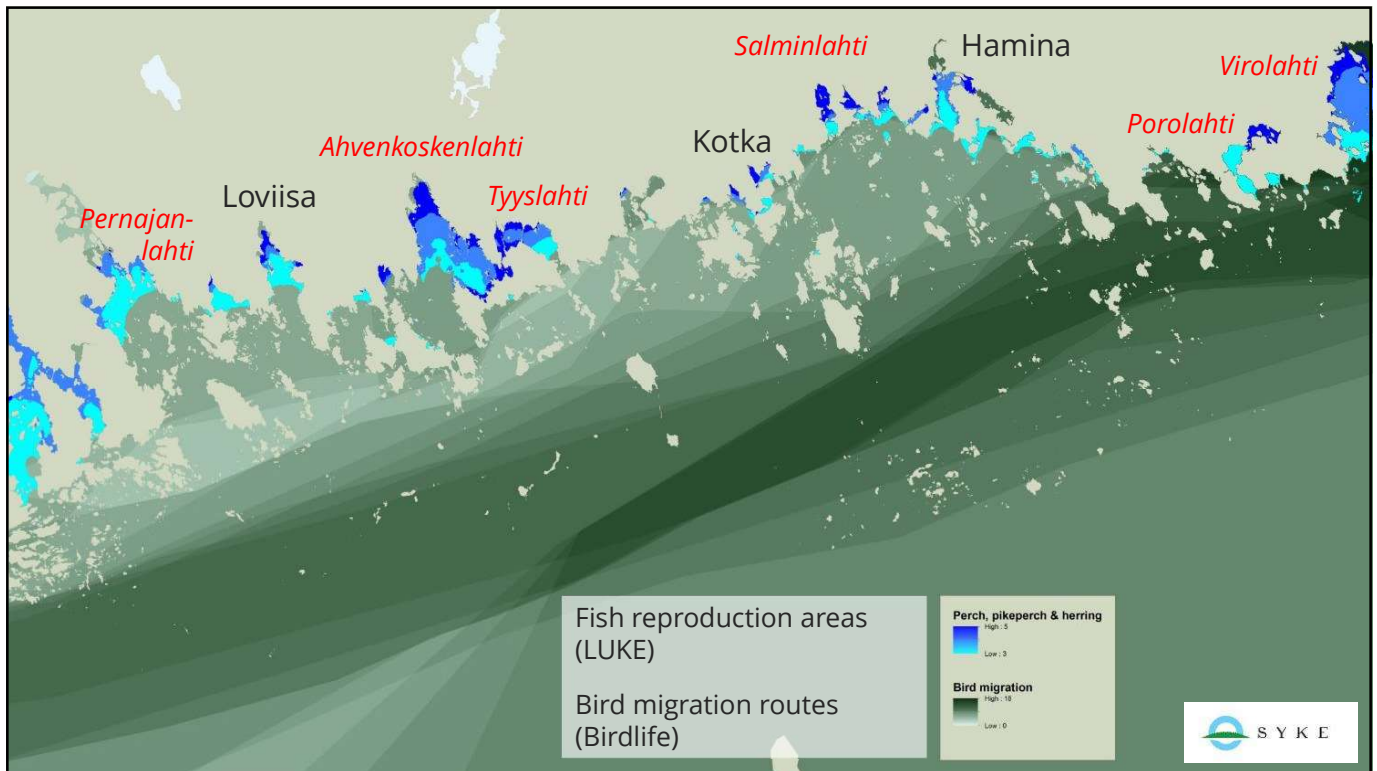


Threatened habitat types (from FI Red Lists)



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In total 171 spatial layers

- Profitability: 5
- Restrictions: 16
- Enablers: 3
- Societal: 25
- Biodiversity: 122


Some layers represent multiple features or synthesis of features



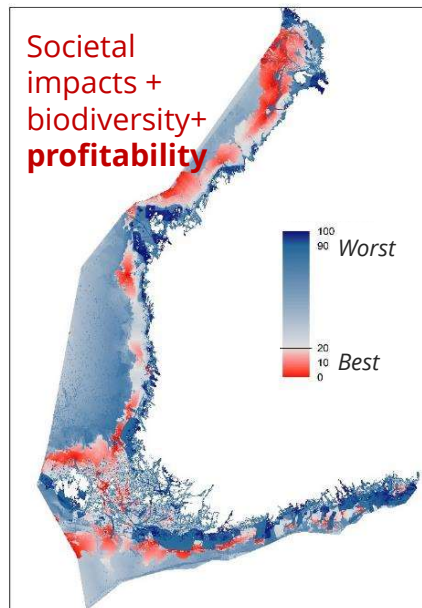



All included in spatial prioritization analysis (Zonation)



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Suitable areas for offshore wind energy (in red)

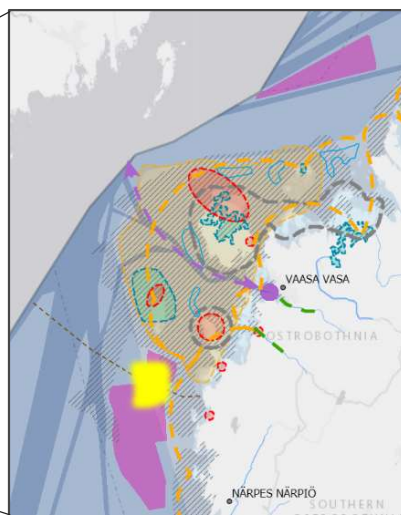
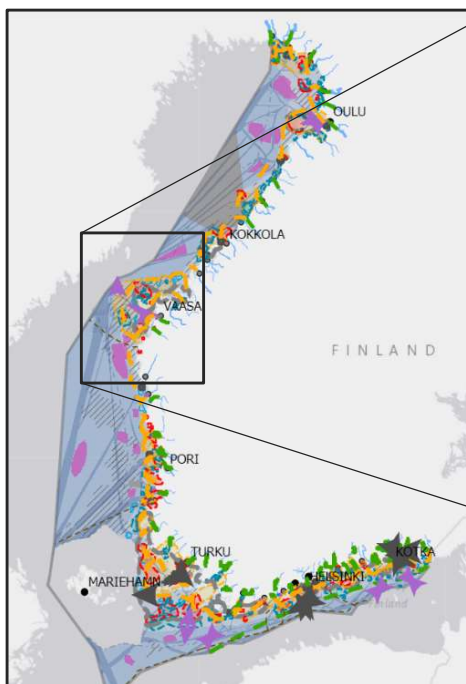


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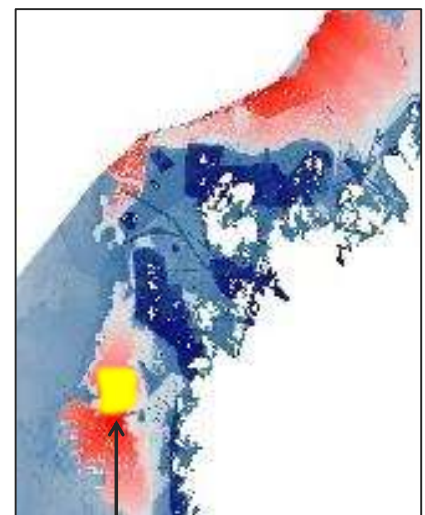
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MSP of FIN



- TEN-T-port
- Port
- Special area
- Seafaring areas
- Energy production
- Maritime industry
- Aquaculture
- Fishing
- Cultural values
- Significant underwater natural values
- Tourism and recreation
- Archipelago
- Specific coordination area

Original analysis



Planned wind park, 70-100 mills, each max 350 m high; 1300 MW



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Conclusions

- In designing offshore wind energy, it is possible to take into account both biodiversity, societal impacts as well as profitability
- Suitable areas in all marine areas: largest areas in the Bothnian Sea, some areas also in the Bothnian Bay and Gulf of Finland
- Suitable wind energy areas identified in the analysis were reconciled in the MSP process with the needs of other uses → Best compatible areas with other activities were selected
- Implementation of wind energy farms requires still more detailed plans and impacts assessments



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