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

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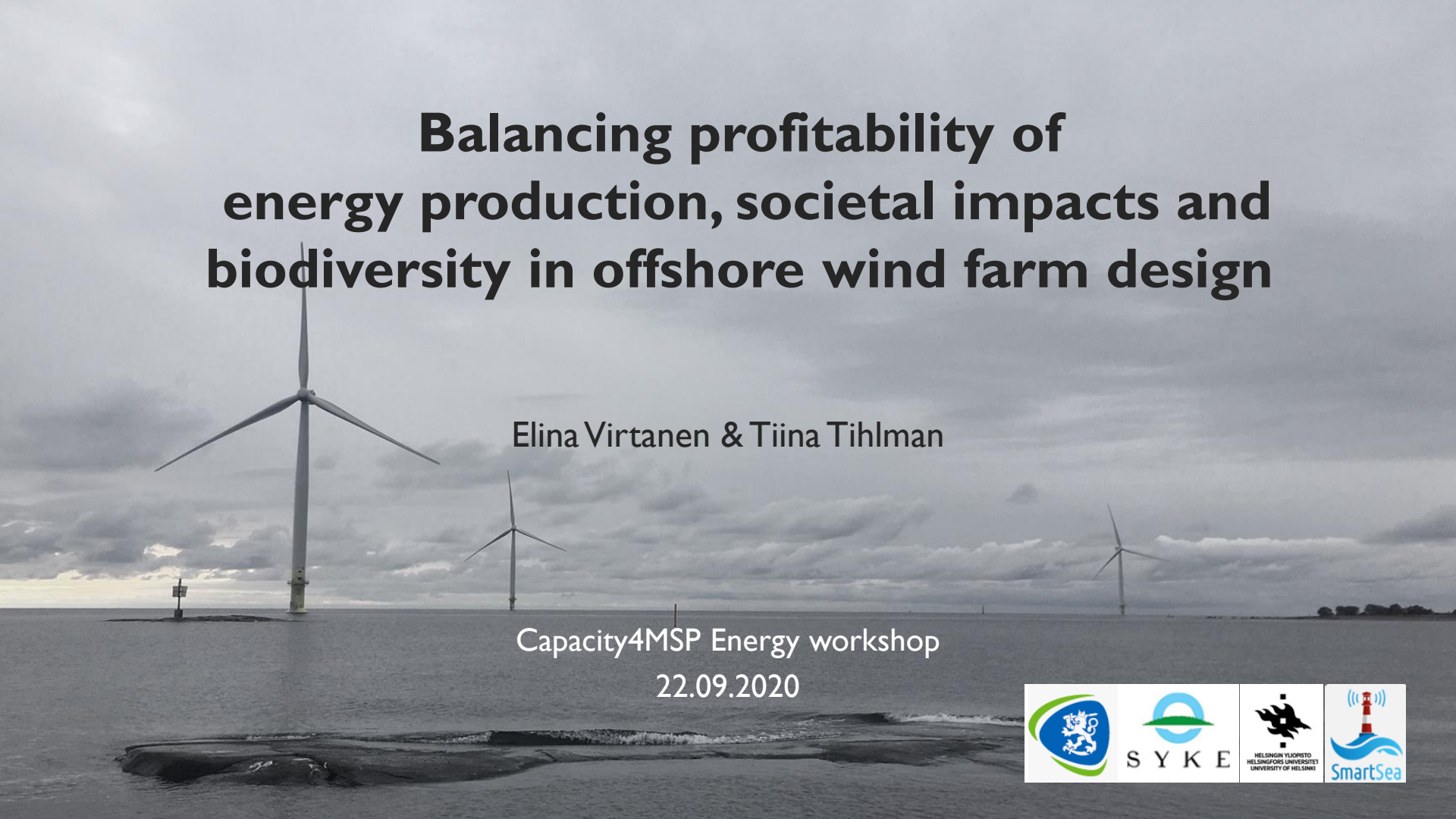
Capacity4MSP Energy workshop

22.09.2020



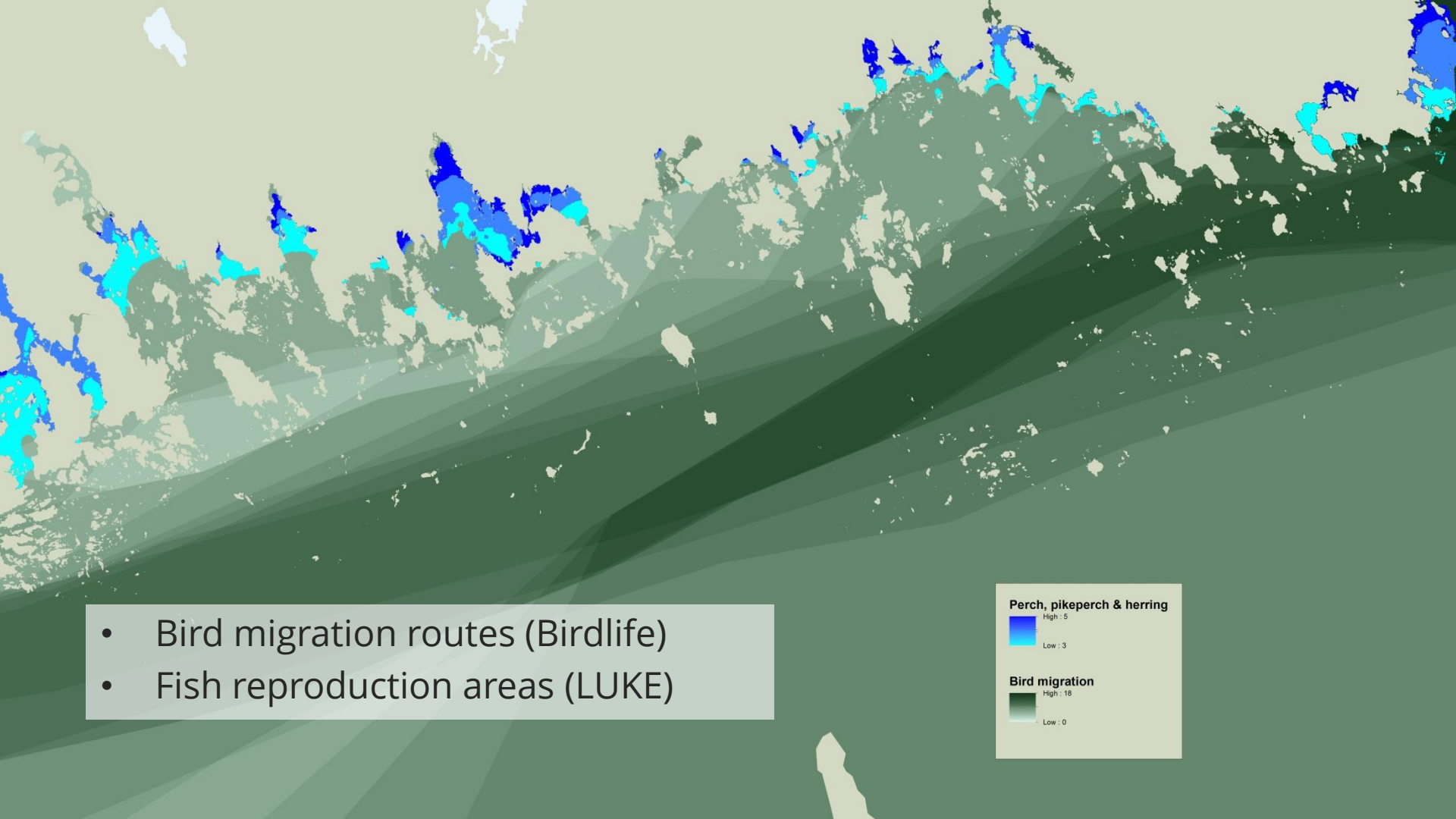
Where to locate offshore wind farms?

1) Biodiversity

Balanced solution

Biodiversity

- Conservation areas
- Bird migration routes
- Fish reproduction areas
- Geodiversity
- Marine and terrestrial nature values



- Bird migration routes (Birdlife)
- Fish reproduction areas (LUKE)

1) Biodiversity

2) Profitability

Balanced solution

Profitability

Spatial Life Cycle Cost analysis

→ Includes all costs during the project lifetime

- Costs divided into 5 categories:
  - Development & Consenting
  - Production & Acquisition
  - Installation & Commissioning
  - Operation & Maintenance
  - Decommissioning & Disposal

Levelised Cost of Energy (LCOE):

$$\mathrm{LCOE} = \frac{\sum_{t=0}^{T_{project}} \frac{LCC_t}{(1+WACC_{real})^t}}{\sum_{t=0}^{T_{project}} \frac{E_{annual}}{(1+WACC_{real})^t}}$$

Lappalainen, J. (2019)
Economic potential of
offshore wind energy in
the Gulf of Bothnia

1) Biodiversity

2) Profitability

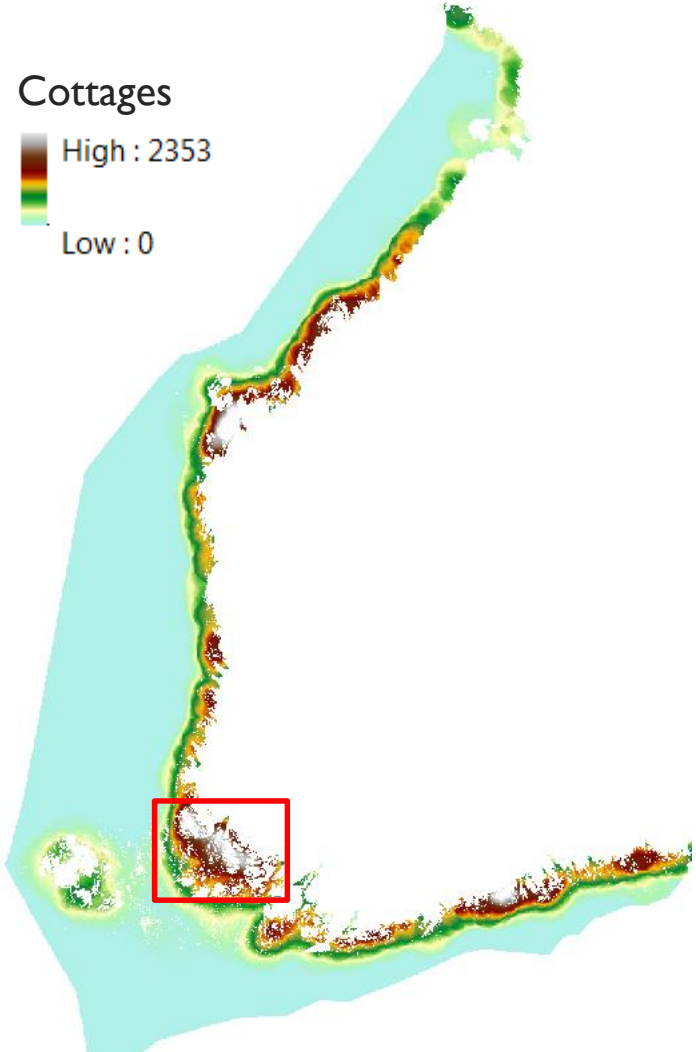
3) Societal impacts

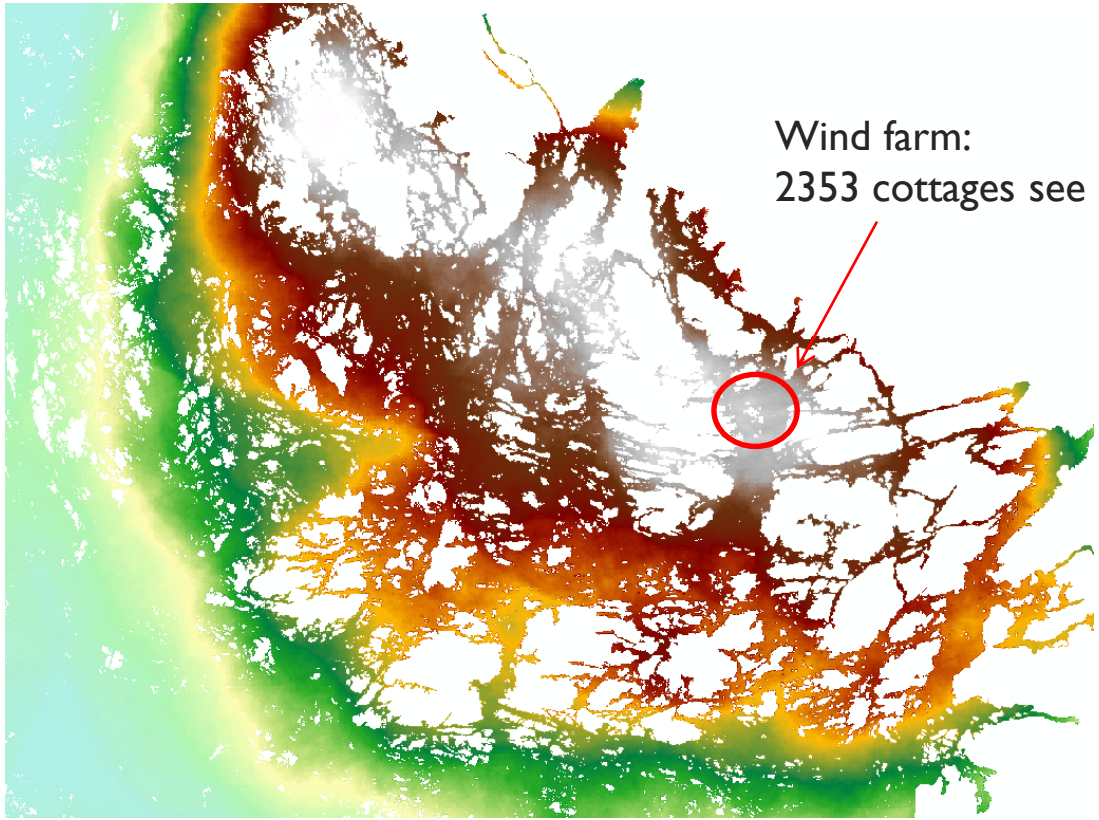
Balanced solution

Societal impacts

- Visual and noise impacts, boating intensity, etc.
- Livelihoods, e.g. :
  - → fishing effort
  - → Aquaculture
  - → Coastal fishing areas

Visual impact for summer cottages





1) Biodiversity

2) Profitability

3) Societal impacts

Balanced solution

4) Restrictions

BirdLife IBA IMPORTANT BIRD AREA

Restrictions

- Army areas
- Weather radars
- Anchoring areas
- Nature reserves

1) Biodiversity

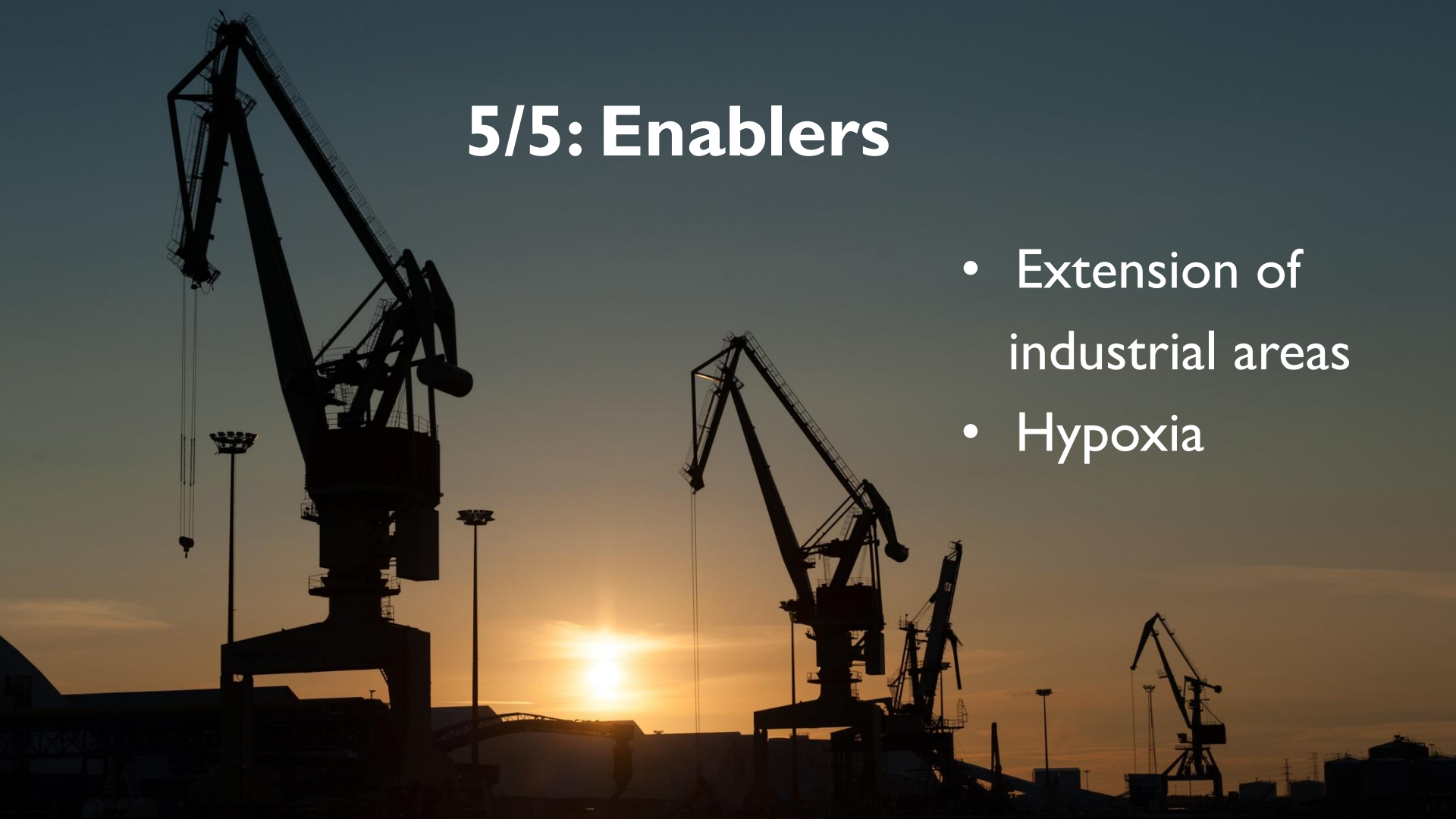
2) Profitability

3) Societal impacts

Balanced solution

5) Enablers

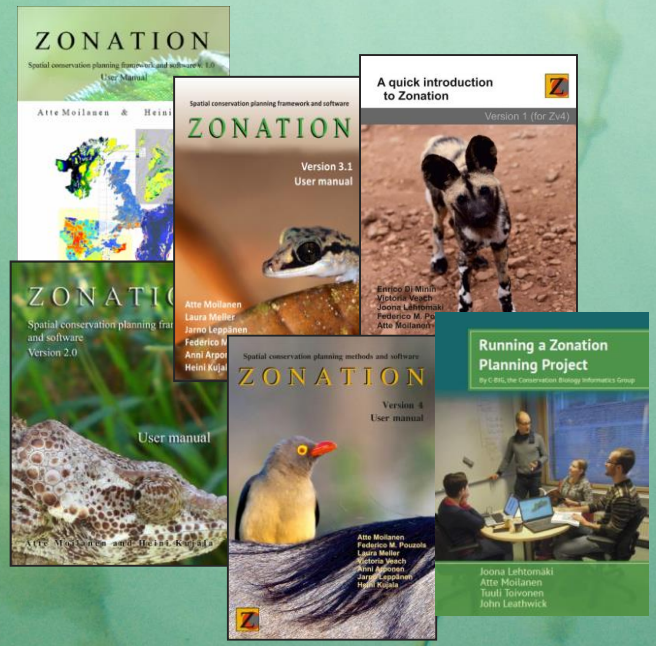
4) Restrictions



5/5: Enablers

- Extension of industrial areas
- Hypoxia

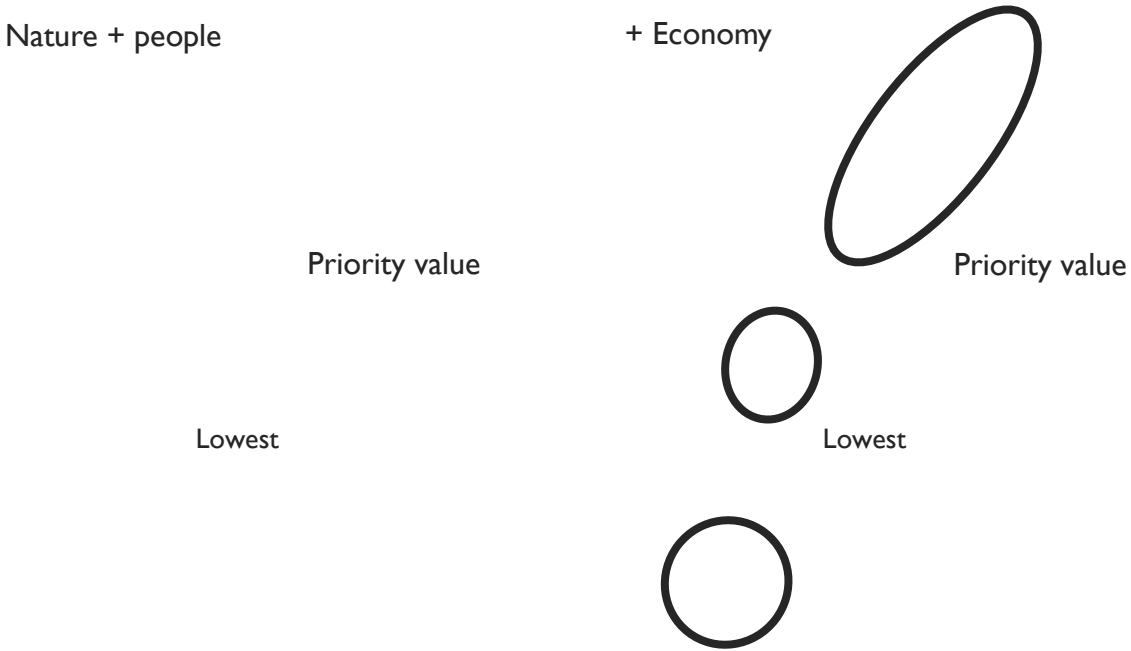
Zonation



Decision support-tool for ecologically based land use planning

Zonation: Atte Moilanen

Optimal areas for offshore wind farms



Most potential areas located in the Bothnian Sea and Bothnian Bay

Virtanen et al. *in prep*

Analyses solutions used in the national MSP process

Impacts on marine biodiversity and society minimized

Suitable wind energy areas identified in the analysis were reconciled in the planning process with the needs of other uses
→ Best compatible areas with other activities were selected

Finnish MSP is a strategic plan, not an area reservation plan
→ more areas indicated for wind farms than needed

Implementation of wind energy farms requires still more detailed plans and impacts assessments