Mitigating impacts of wind energy facilities on birdlife

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Wind energy in Norway

- Installed capacity of 2582 MW
- Annual electricity production of 8.2 TWh
- 42 Operational wind-power plants
- 20 wind-power plants under construction
- 26 with consession

Smøla wind-power plant

- Wind-power plant with 68 2-2.3 MW wind turbines (2002-2005)
- 150 MW installed capacity, 356 GWh annual production
- Smøla is an archipelago with one main island (274 km^2) and over 5000 islets and skerries (~2000 inhabitants)
- Circa 60 white-tailed eagle territories

A decade of research on Smøla

- BirdWind (2006-2011)
  - «Improve the information base and develop tools for the energy sector and authorities for optimal siting and conflict reduction of wind-power plants»
- INTACT (2013-2017)
  - «Test the efficacy of mitigation measures and develop tools to reduce the collision risk of birds with wind turbines»

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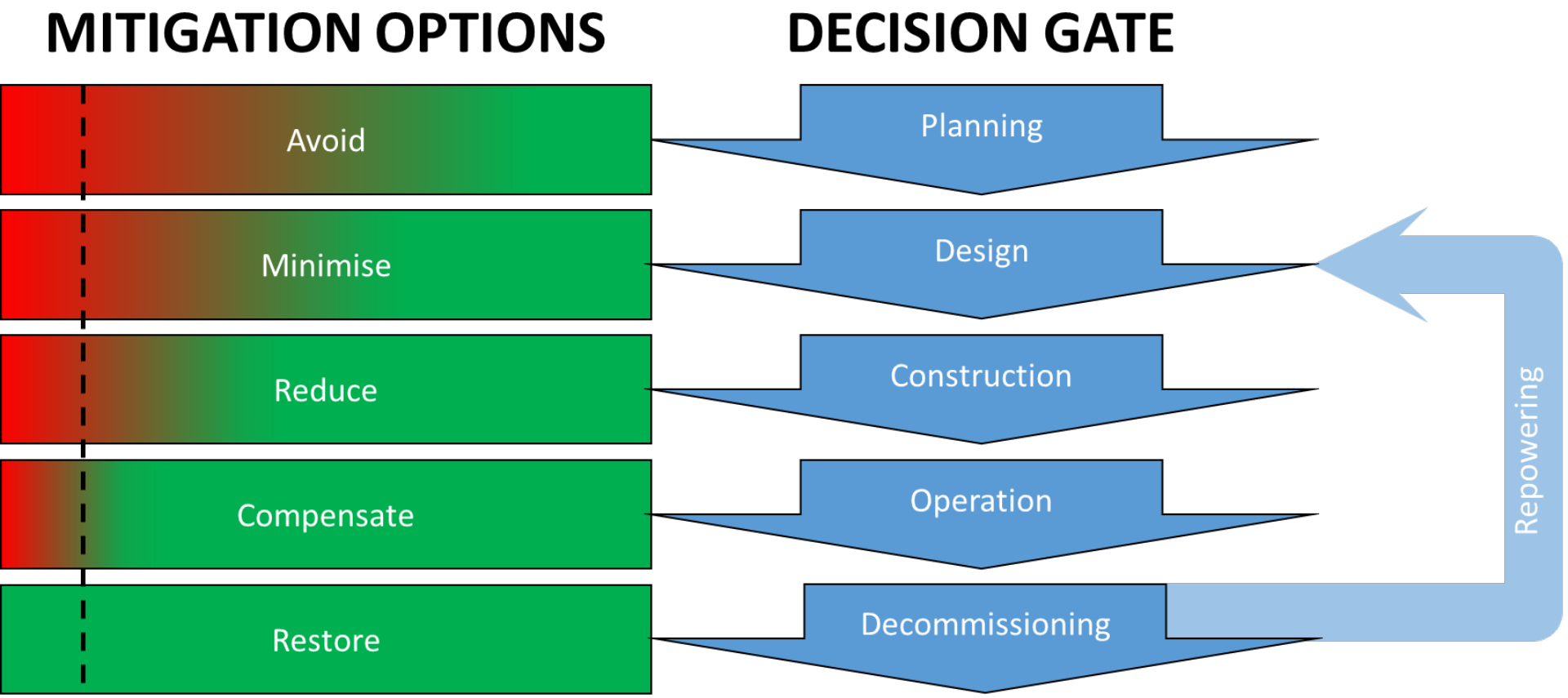
Conference on Wind energy and Wildlife impacts

Applying the Mitigation Hierarchy



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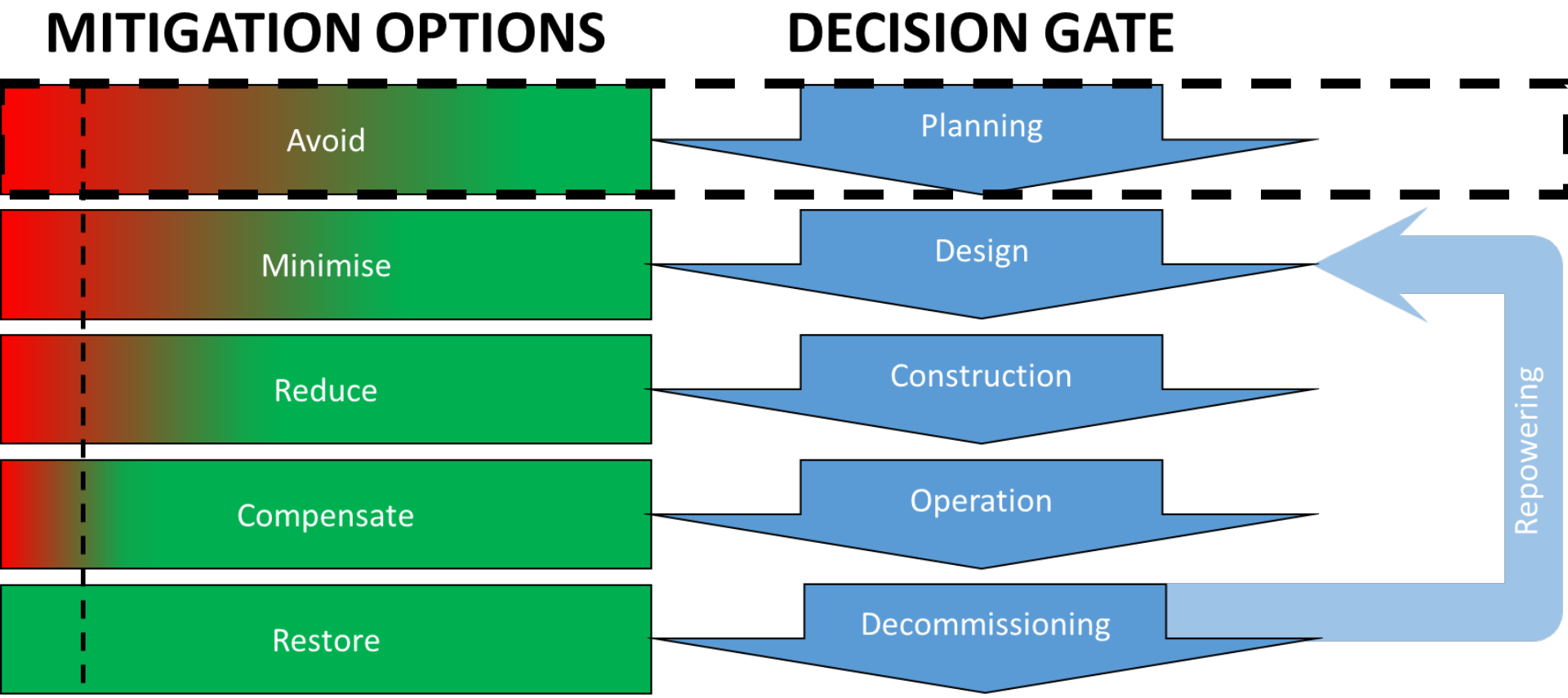
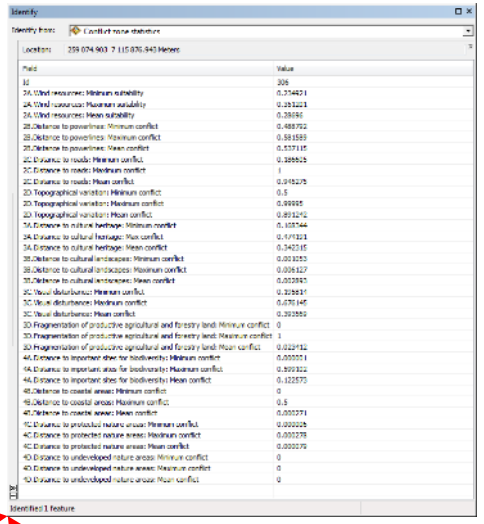
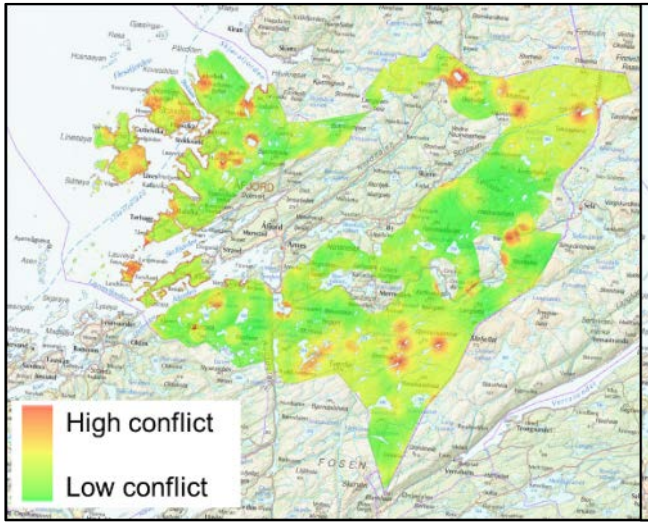
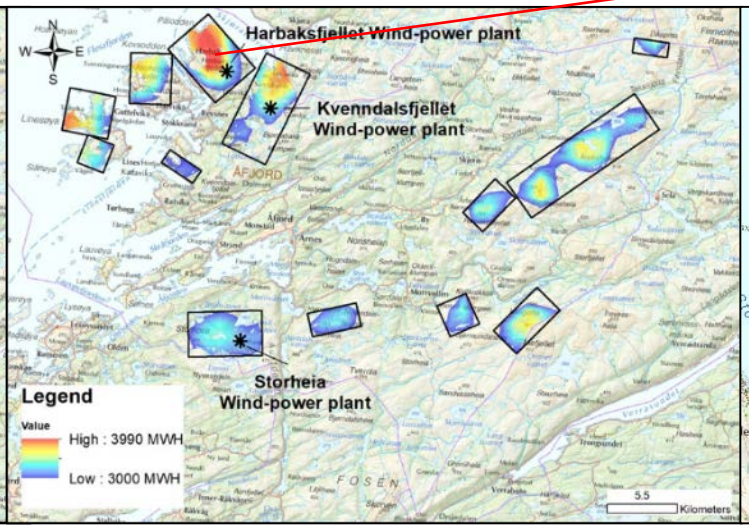


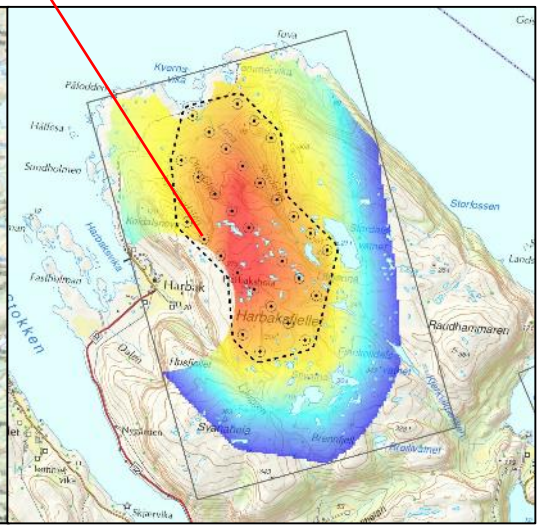
ConSite Wind Toolbox

Spatial multi-criteria decision support tool for optimal siting of wind-power plants based on ecological, societal and technological criteria

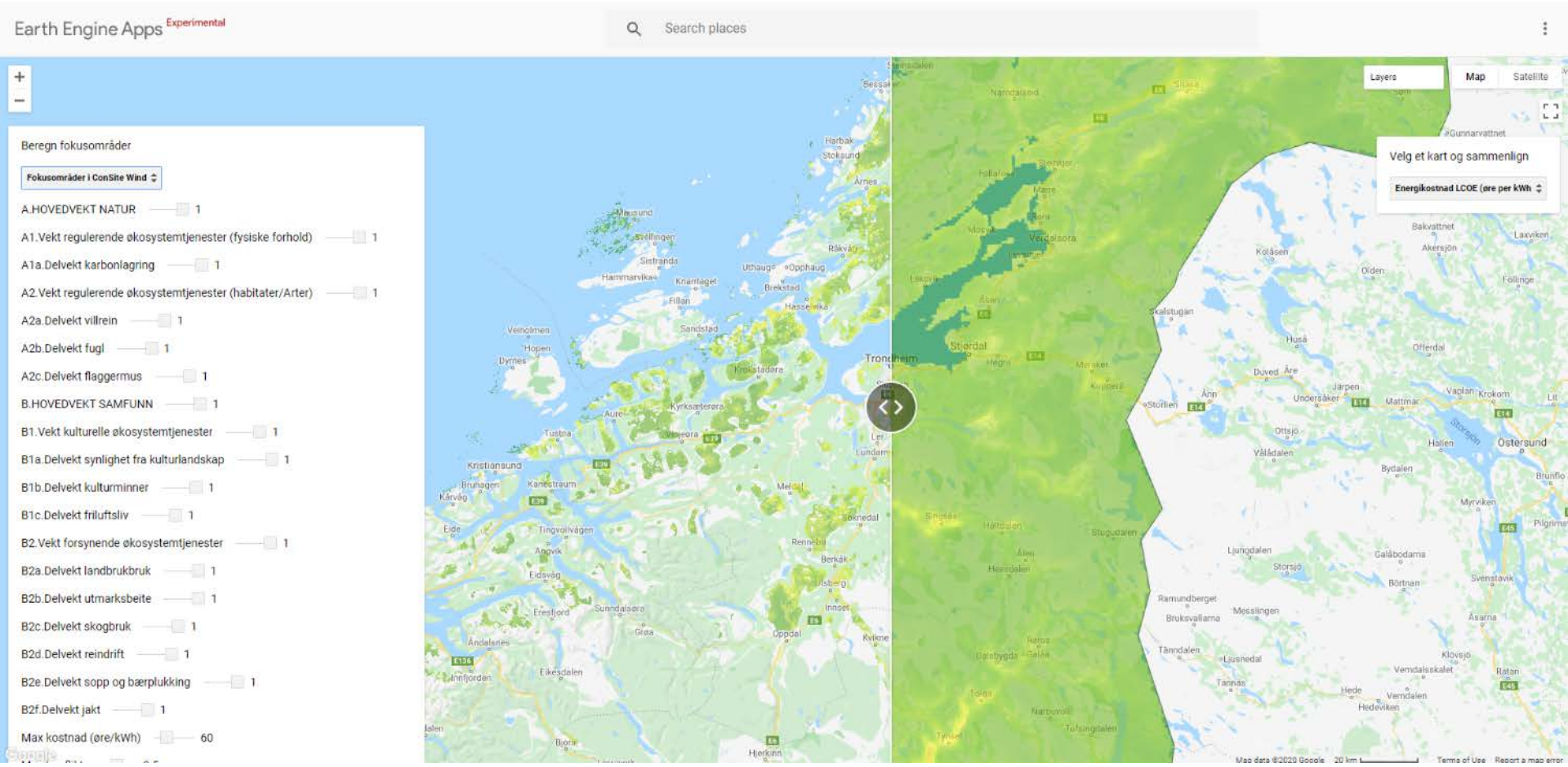








ConSite Wind Google Earth Engine



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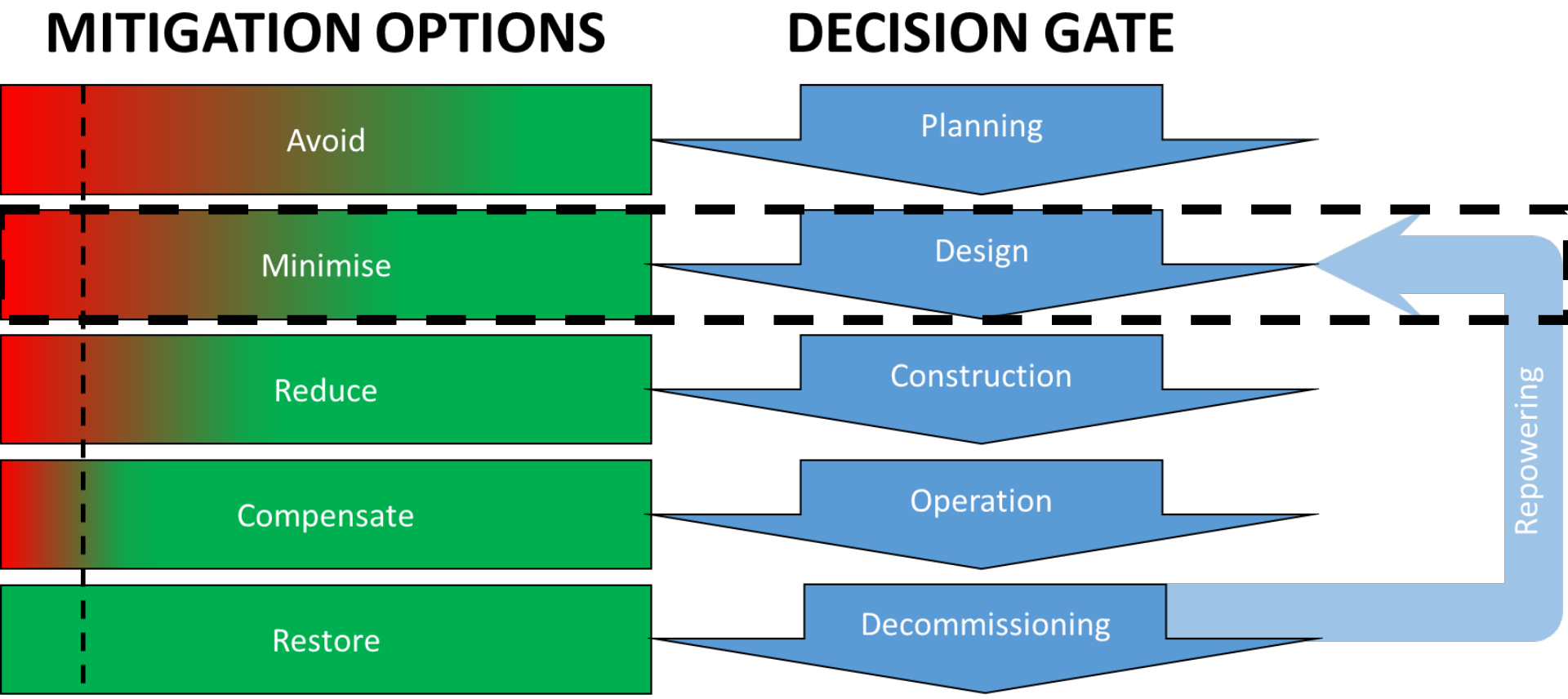
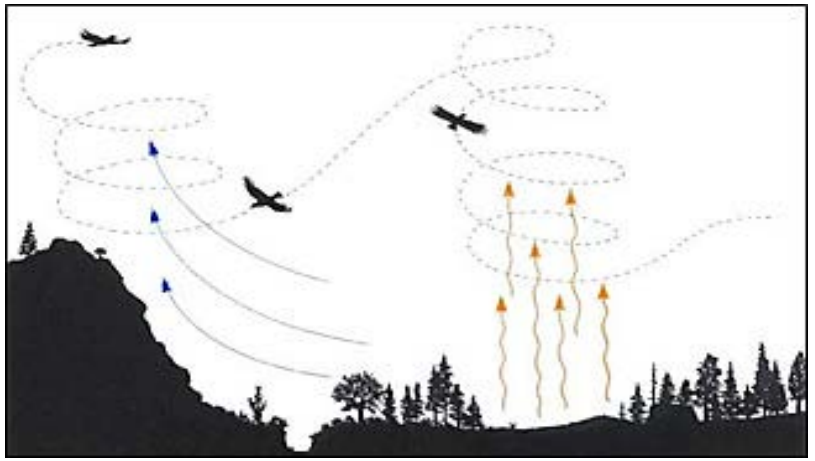
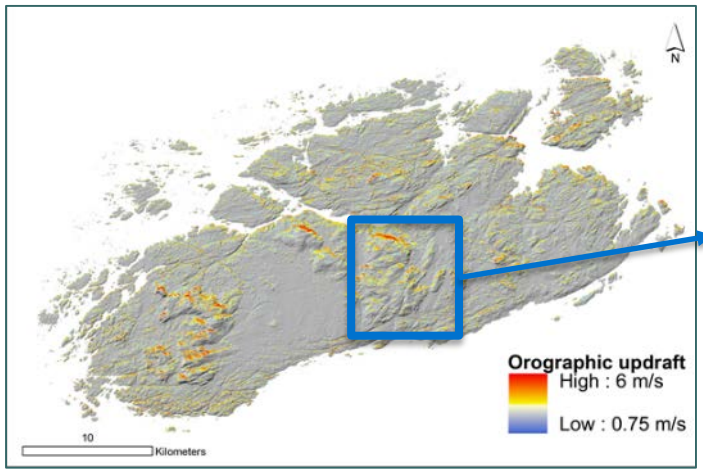
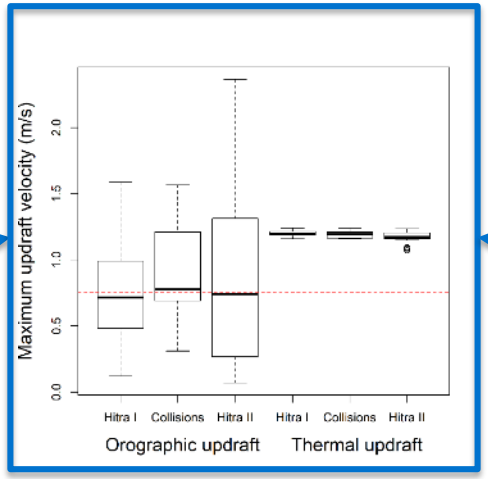


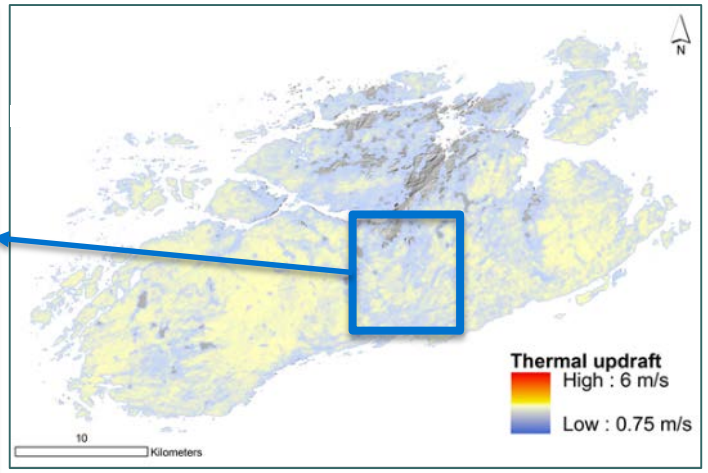
Bird-friendly micro-siting of turbines

- GIS tool for identifying wind turbine locations with increased collision risk for soaring birds which are attracted to updrafts

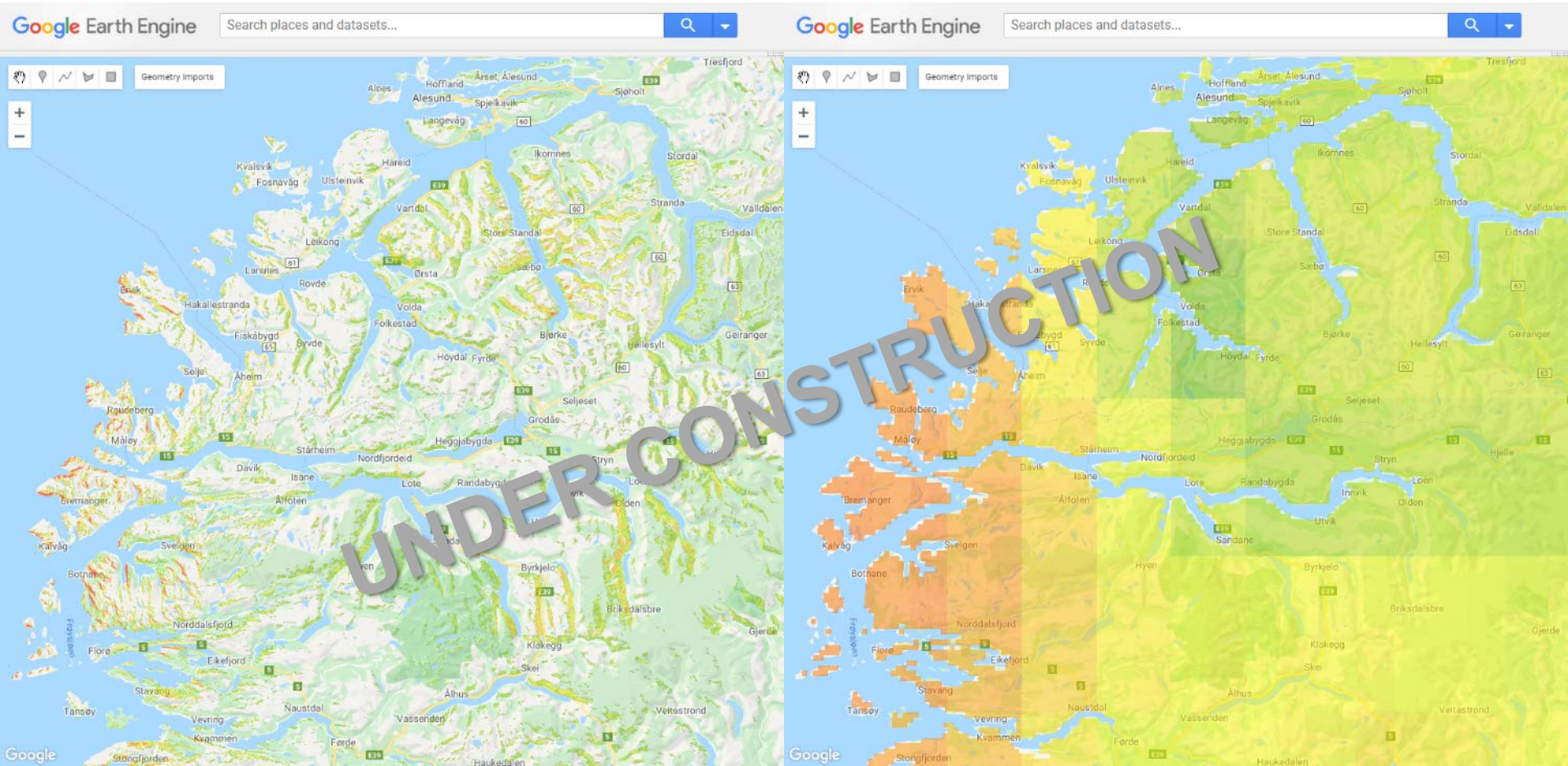








Updraft tool Google Earth Engine



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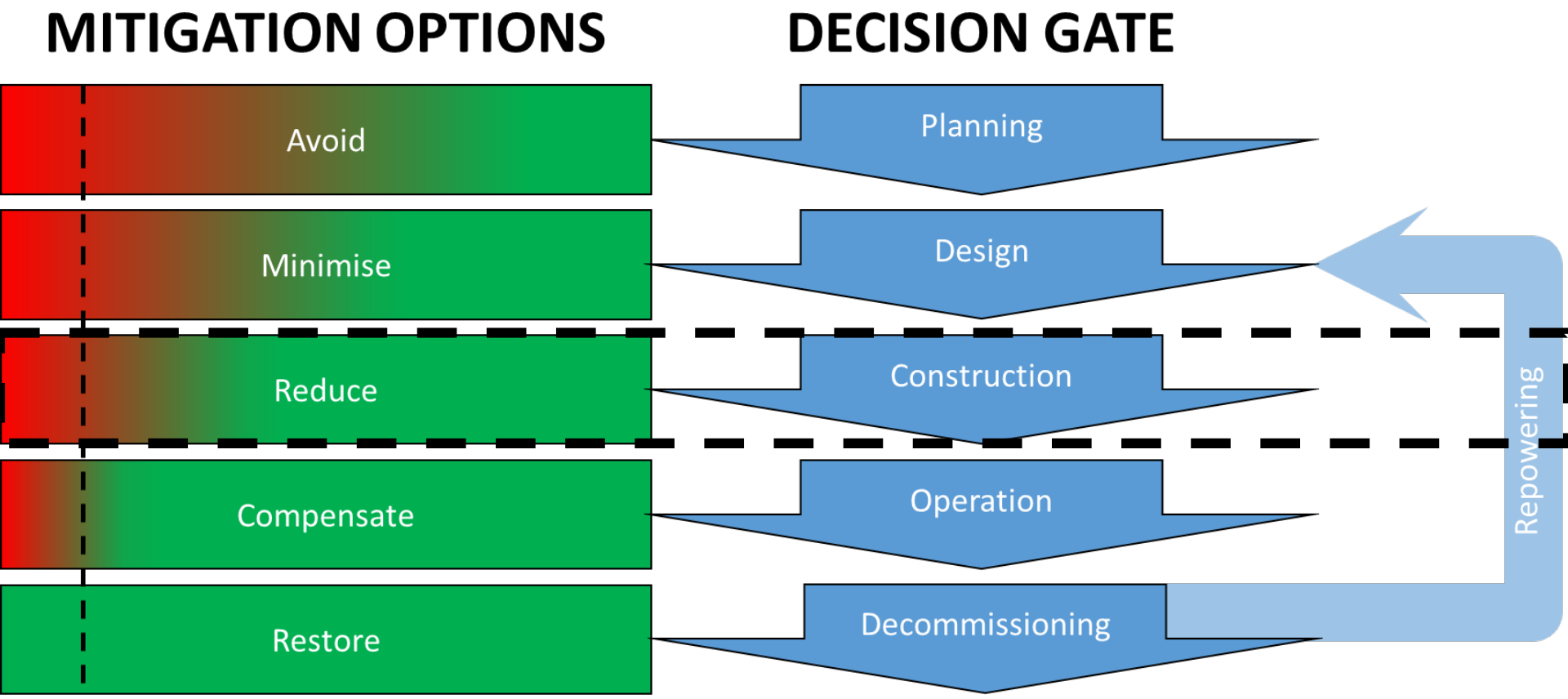


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Painting of wind turbines

- Rotor blade – one of three was painted black to reduce ‘motion smear’
  - Only minor changes in bird behaviour…
  - …but collision rates decreased by 71%
- Turbine tower – lower 10m was painted black to visually increase the horizon
  - Ptarmigan collision rates decreased by 53%...
  - …with highest effect during spring and autumn

Reminders for painting

- Visual effects in the landscape
- On-the-ground painting
- Exemption from regulatory color schemes
  - Civil Aviation Authorities
  - Licensing authority
  - …

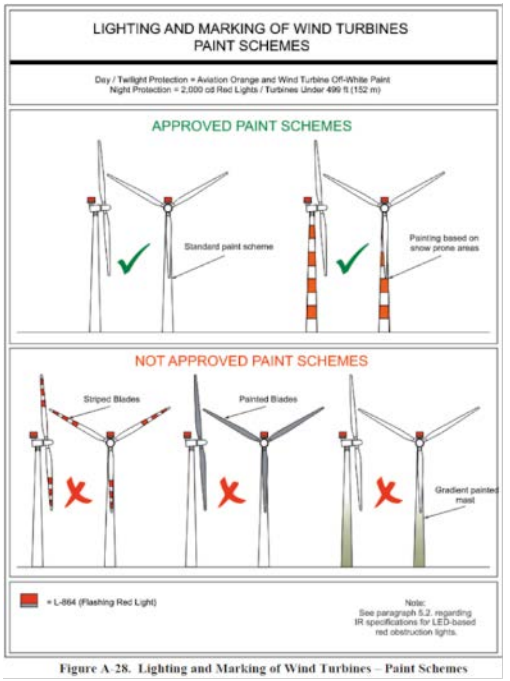


Figure A–28. Lighting and Marking of Wind Turbines – Paint Schemes



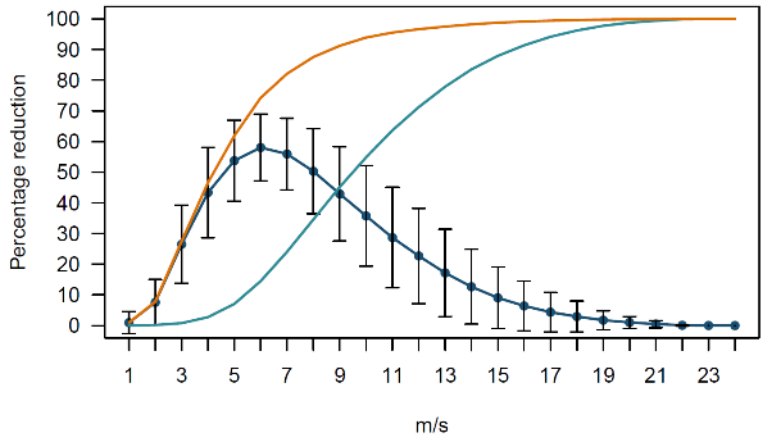
Pilot ultra-violet ‘light fence’

- Test the use of UV-light to deter birds from wind turbines in periods of reduced visual conditions (dusk/dawn, night, fog)
  - 12-27% lower bird activity compared to nights without lighting
  - Birds flew 7 m higher versus 40-50 m long rotor blades



Operational adjustments

- Adjustments of turbine cut-in speed to minimize collision risk per kWh
  - Minor seasonal effects
  - Wind speed large effect



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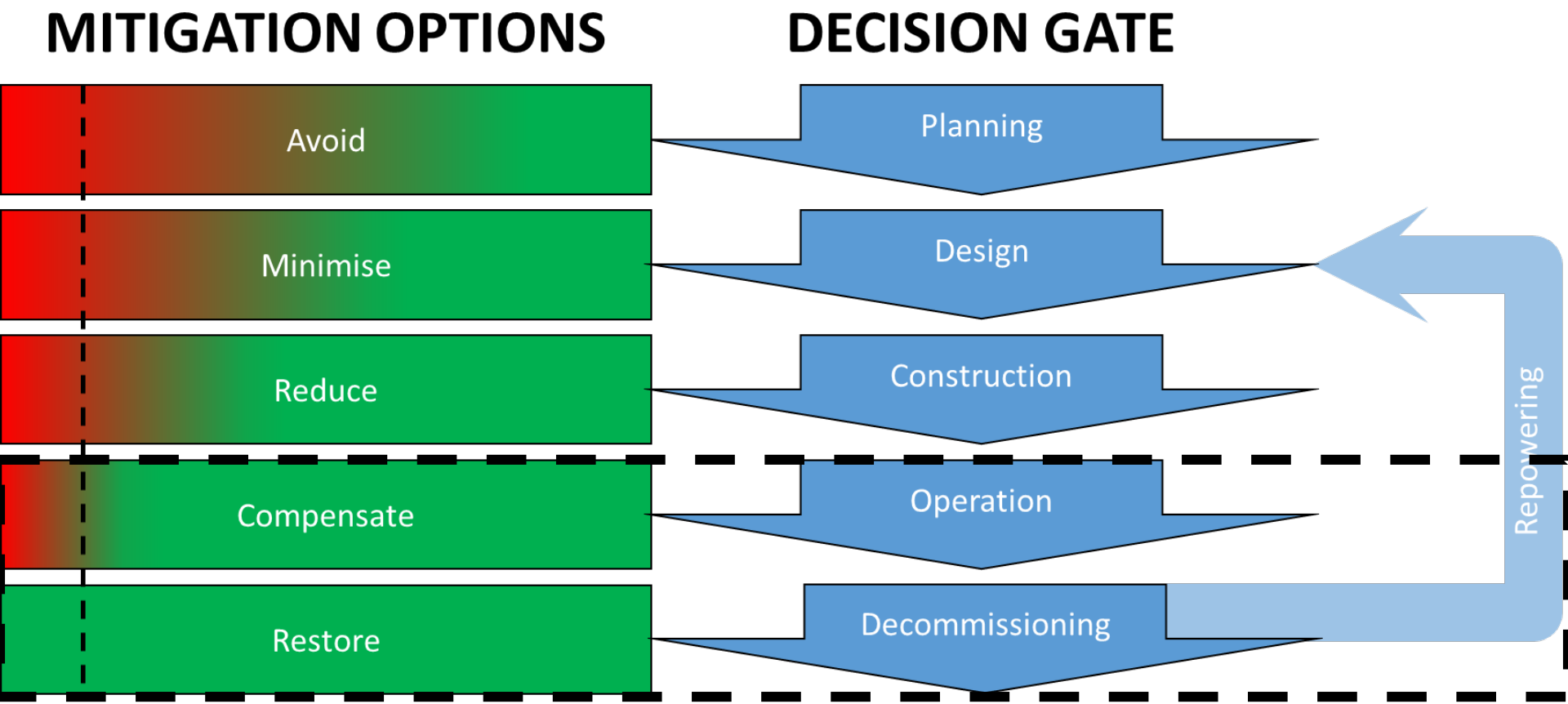
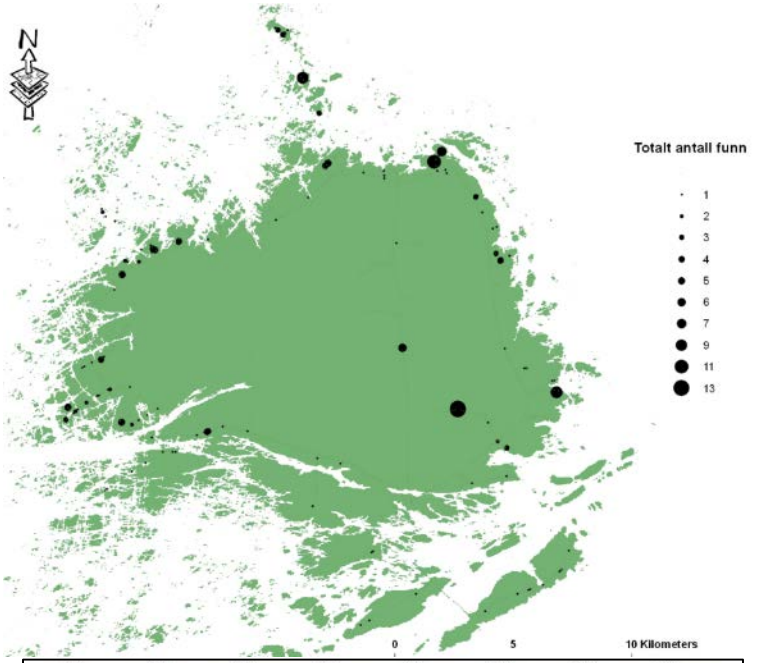
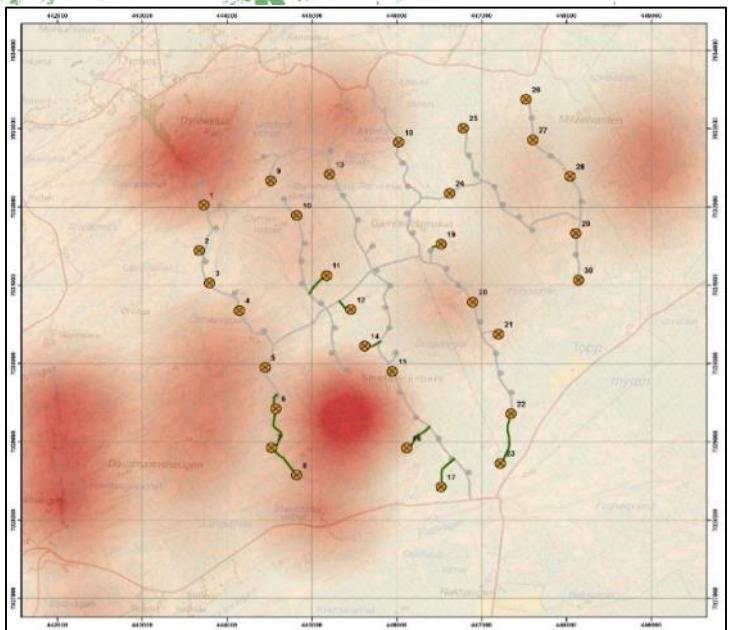


Unknown options?

- Potential to compensate for electrocution mortality instead of wind turbine collisions

- Potential for a ‘repowering’ of Smøla wind-power plant (30 5MW turbines)





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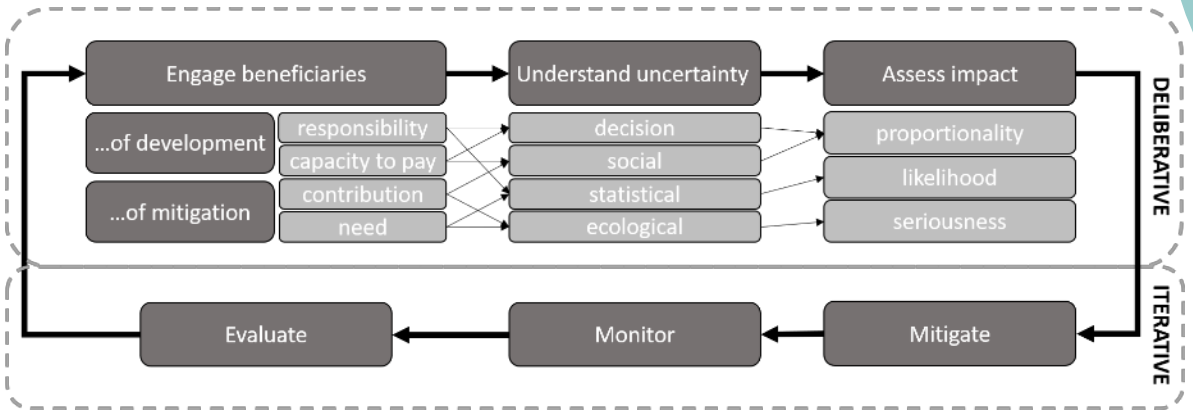
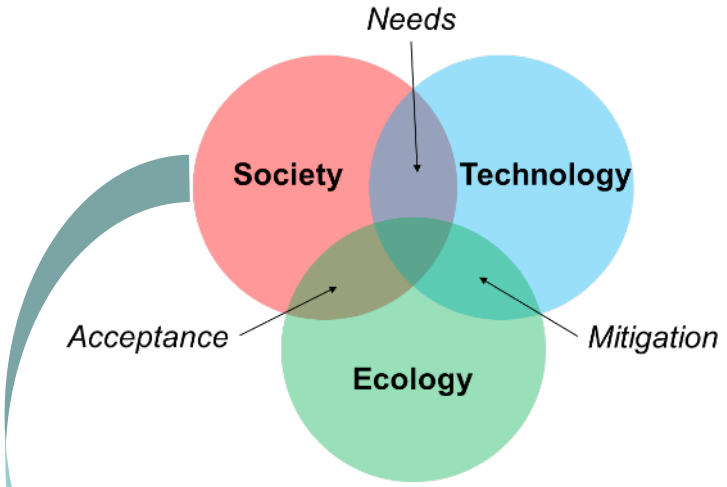
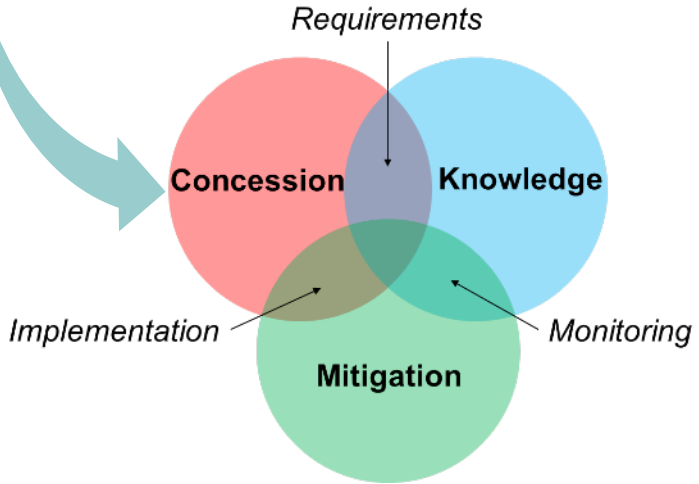
With birds in its wake
Painted wings, feathered blades
Art of reduction

When is implemention warranted?

- Wind energy with the least environmental impact per kWh requires balancing multiple interests, and acting upon this







Recommended reading

- May, R., Nygård, T., Falkdalen, U., Åström, J., Hamre, Ø., Stokke, B.G. 2020. Paint it black: Efficacy of increased wind-turbine rotor blade visibility to reduce avian fatalities. *Ecology & Evolution*. https://doi.org/10.1002/ece3.6592
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Thank you for your attention!