



# Balancing socio-ecological & economy trade-offs in spatial planning of wind-power projects

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*Frank Hanssen, Roel May and Jiska van Dijk  
EERA Deepwind Conference, Trondheim, January 18-20th 2023*



# Balancing socio-ecological and economy trade-offs in spatial planning of onshore wind projects



Photo: Espen Lie Dahl

## ConSite Wind: What it is and how it helps

### A multiple criteria decision analysis web-app that helps to

- Compile layman and expert knowledge in wind power development projects
- Balance ecology-economy trade-offs, reduce conflicts and optimize production
- Test different decision scenarios and evaluate their spatial consequences
- Improve spatial planning and decision support
- Ensure more transparent, efficient and sustainable decision making processes

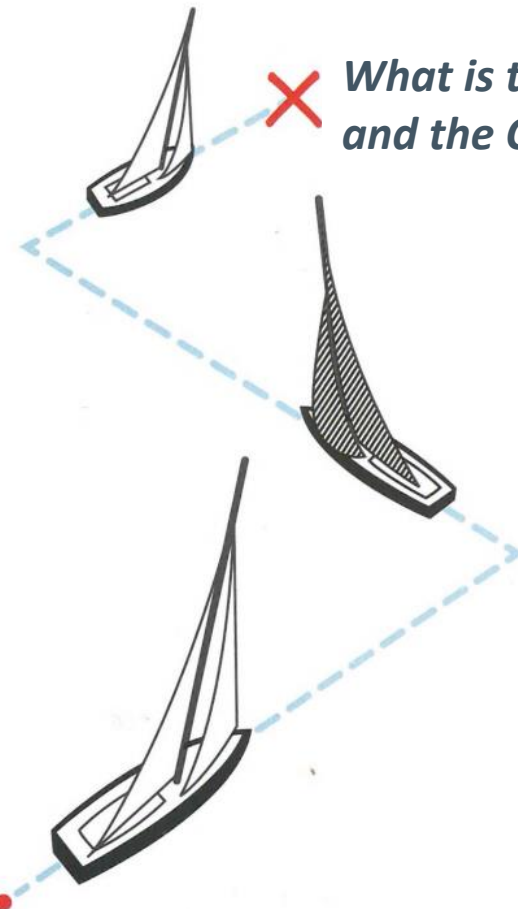
*The tool is developed by the [Norwegian institute of nature research \(NINA\)](#), as a part of the [FME NorthWind research centre](#)*



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# Agenda



***What is the added value of this approach and the ConSite Wind spatial planning tool?***

***How are Socio-ecological and economy trade-offs implemented in ConSite Wind?***

***What are Socio-ecological and economy trade-offs in the context of spatial planning?***



# Introduction



- Wind power is an important contribution to achieve the climate goals
- Yet, biodiversity trade-offs in terms of land-use change, habitat loss, wildlife impacts and ecological deterioration are emerging
- Planning where to develop wind-power, while at the same time ensuring sustainable land-use and robust ecosystems is challenging

# Nature versus Climate

*Nature*



Land for species and robust ecosystems



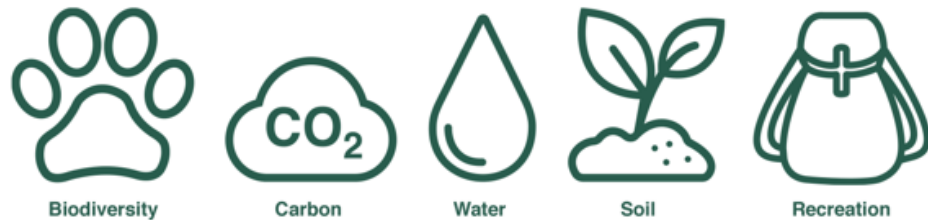
*Climate*



Land for development of wind power



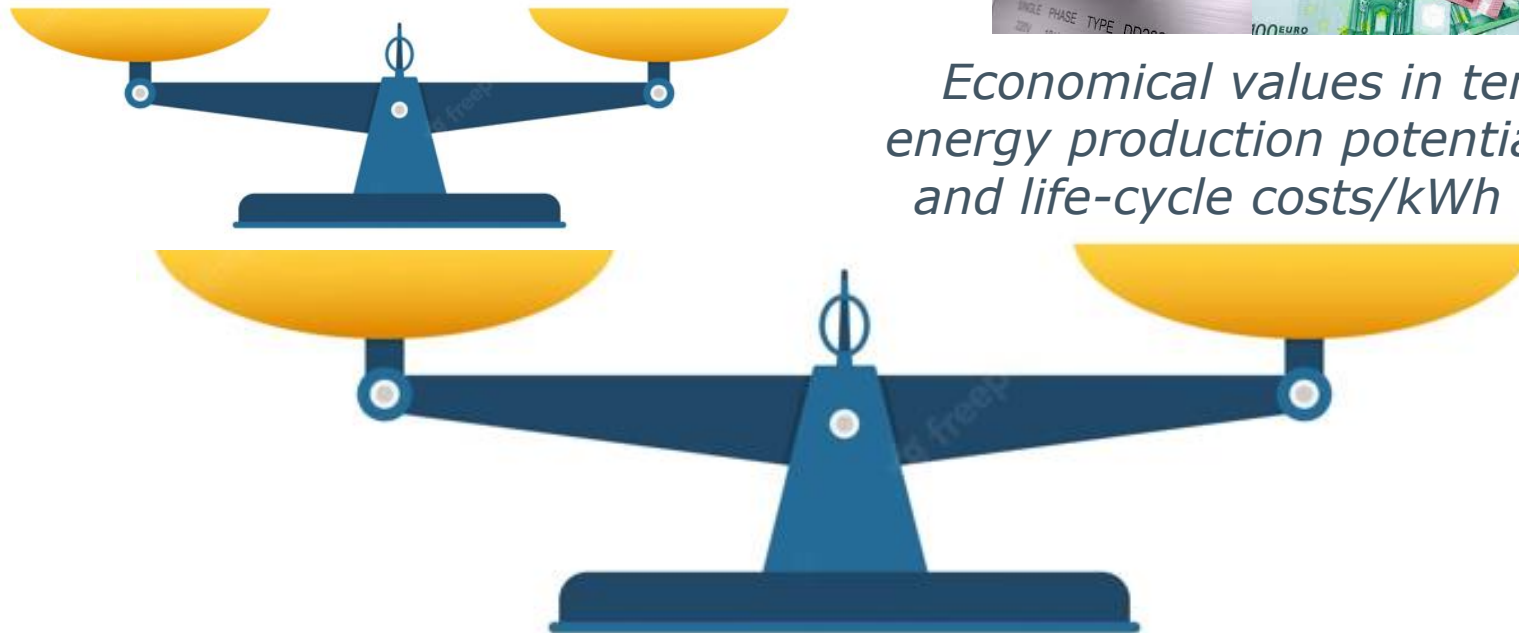
# Socio-ecological & economy trade-offs



*Socio-ecological values in terms of benefits (ecosystem services)*



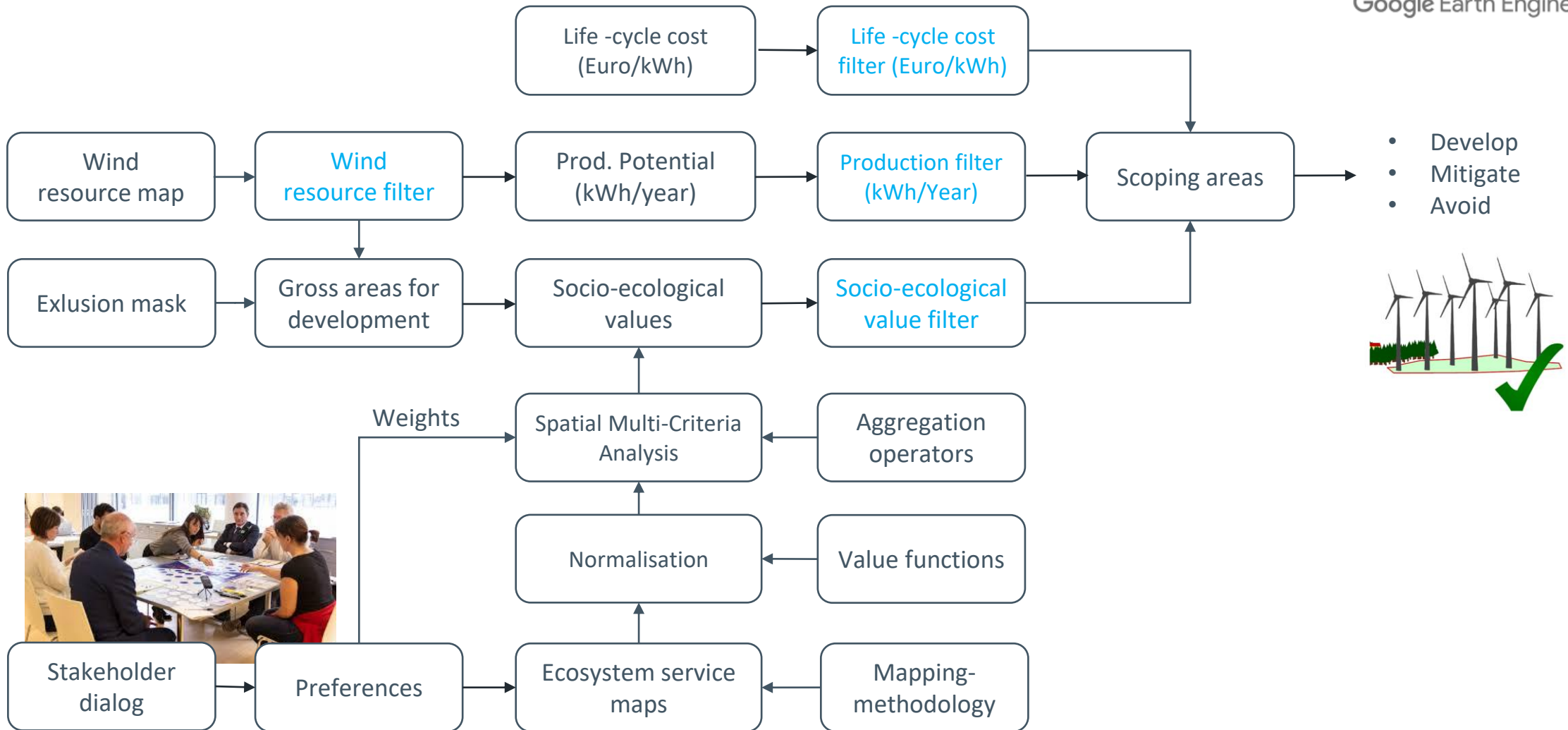
*Economical values in terms of energy production potential (kWh) and life-cycle costs/kWh (LCOE)*



# The ConSite Wind framework



Google Earth Engine



Hanssen, F., May, R., van Dijk, J. and Rød, J. Spatial multi-criteria decision analysis tool suite for consensus-based siting of renewable energy structures. *Journal of Environmental Assessment Policy and Management* 2018 ; Vol 20.(3) s. 1-28



**What it is and how it works**

This web-app allows you to balance socio-ecological values and wind-energy production potential to find suitable areas for development of onshore wind-energy projects. Weight the ecosystem service maps (scale 0-1) and filter the production requirements in the Trade-off schema below. Click the "Update map" button, select and compare the results (areas suitable for development, areas where mitigation is required and areas to avoid).

Read more: [www.nina.no/english/Sustainable-society/Consensus-based-Siting](http://www.nina.no/english/Sustainable-society/Consensus-based-Siting)

**Trade-off schema**

- 0.58 A.REGULATING ES
- 0.56 A1.Carbon storage
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- 0.72 B.ECOLOGICAL ES
- 0.56 B1.Wild reindeer
- 0.53 B2.Birds
- 0.48 B3.Bats
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- 0.68 B6.Wilderness areas
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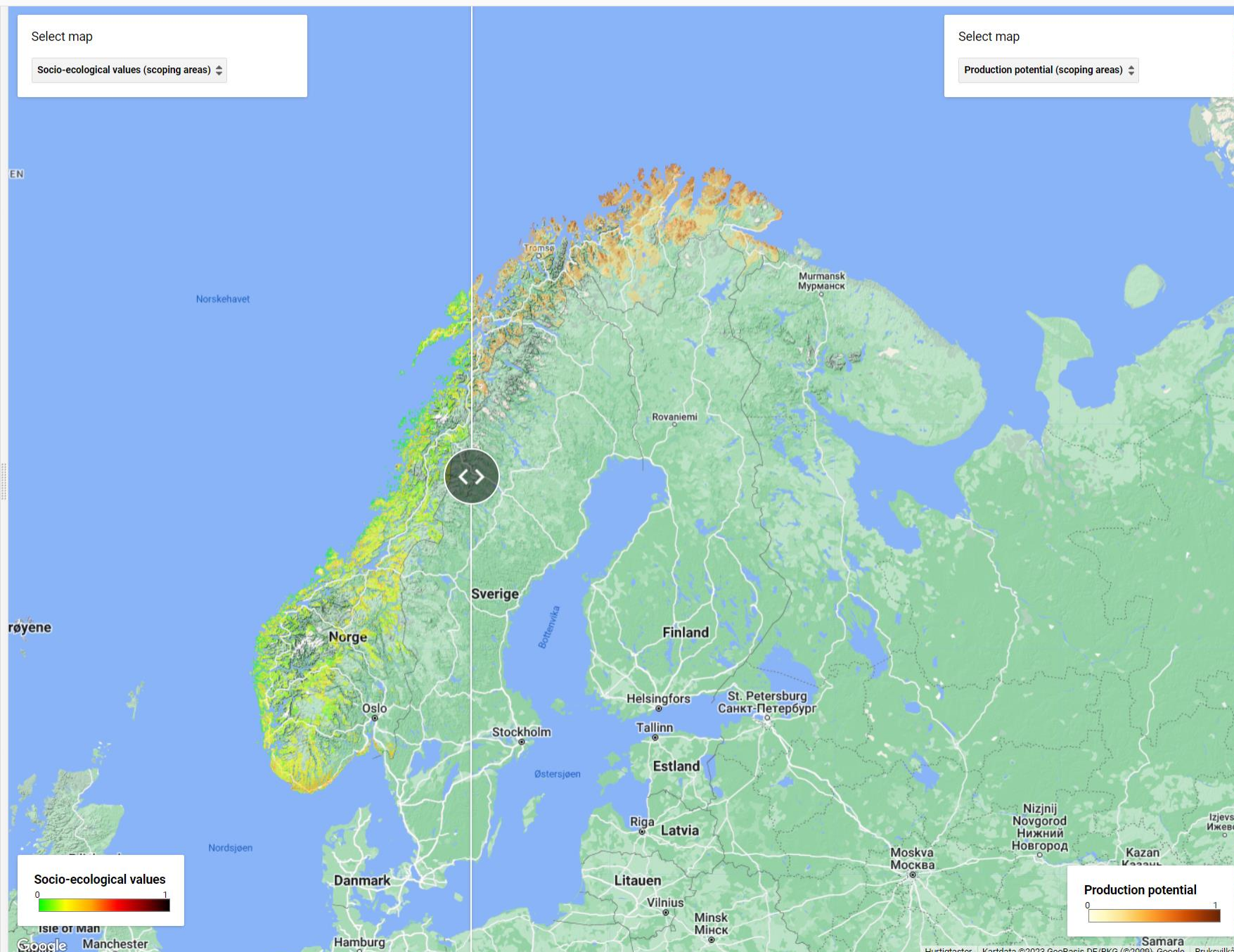
Update map

Select map

Socio-ecological values (scoping areas)

Select map

Production potential (scoping areas)





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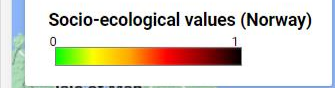
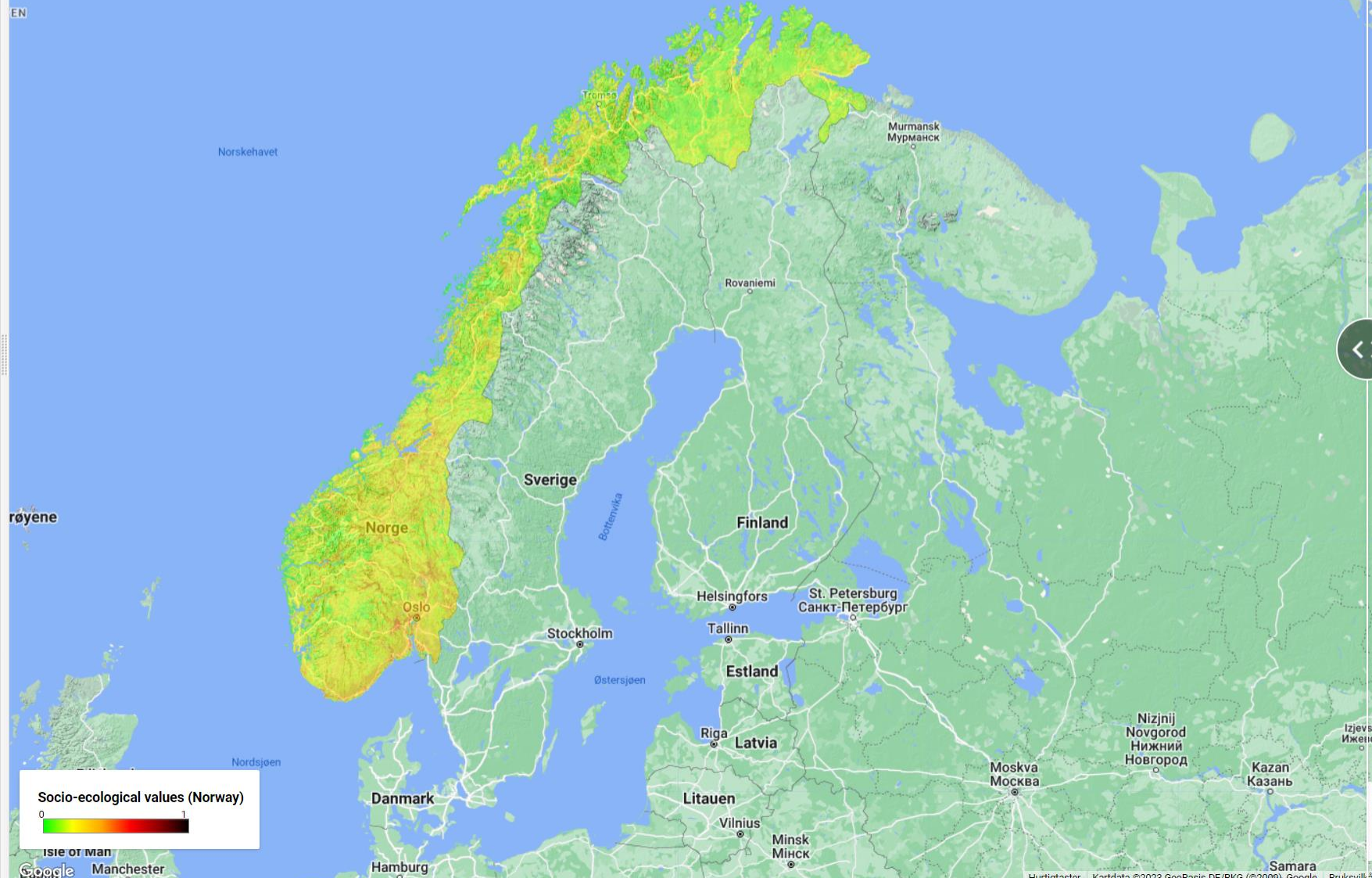
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Update map

Select map  
Socio-ecological values (Norway)





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Update map

Select map

Production potential (Norway)





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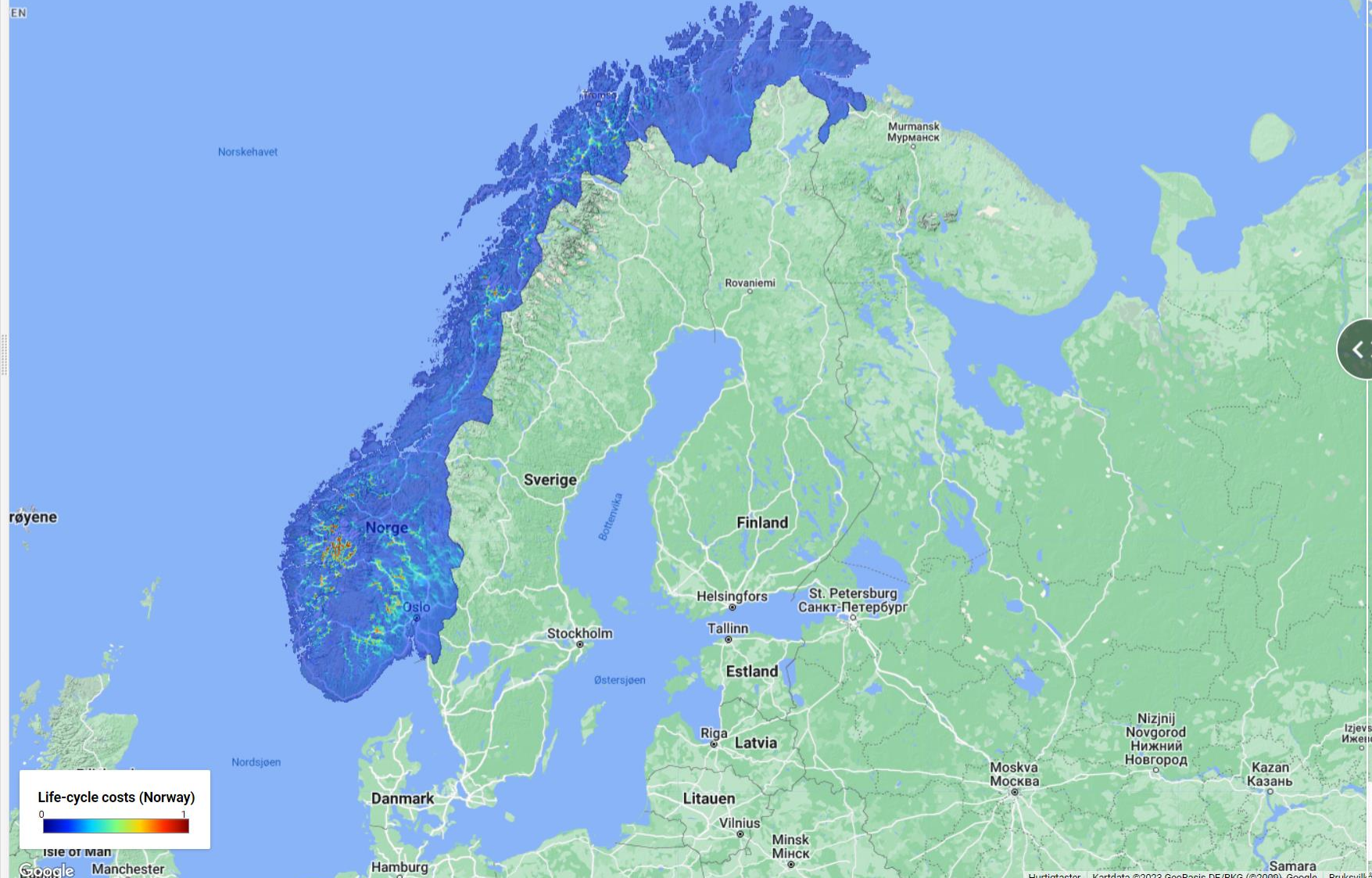
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Update map

Select map

Life-cycle costs (Norway) ▾





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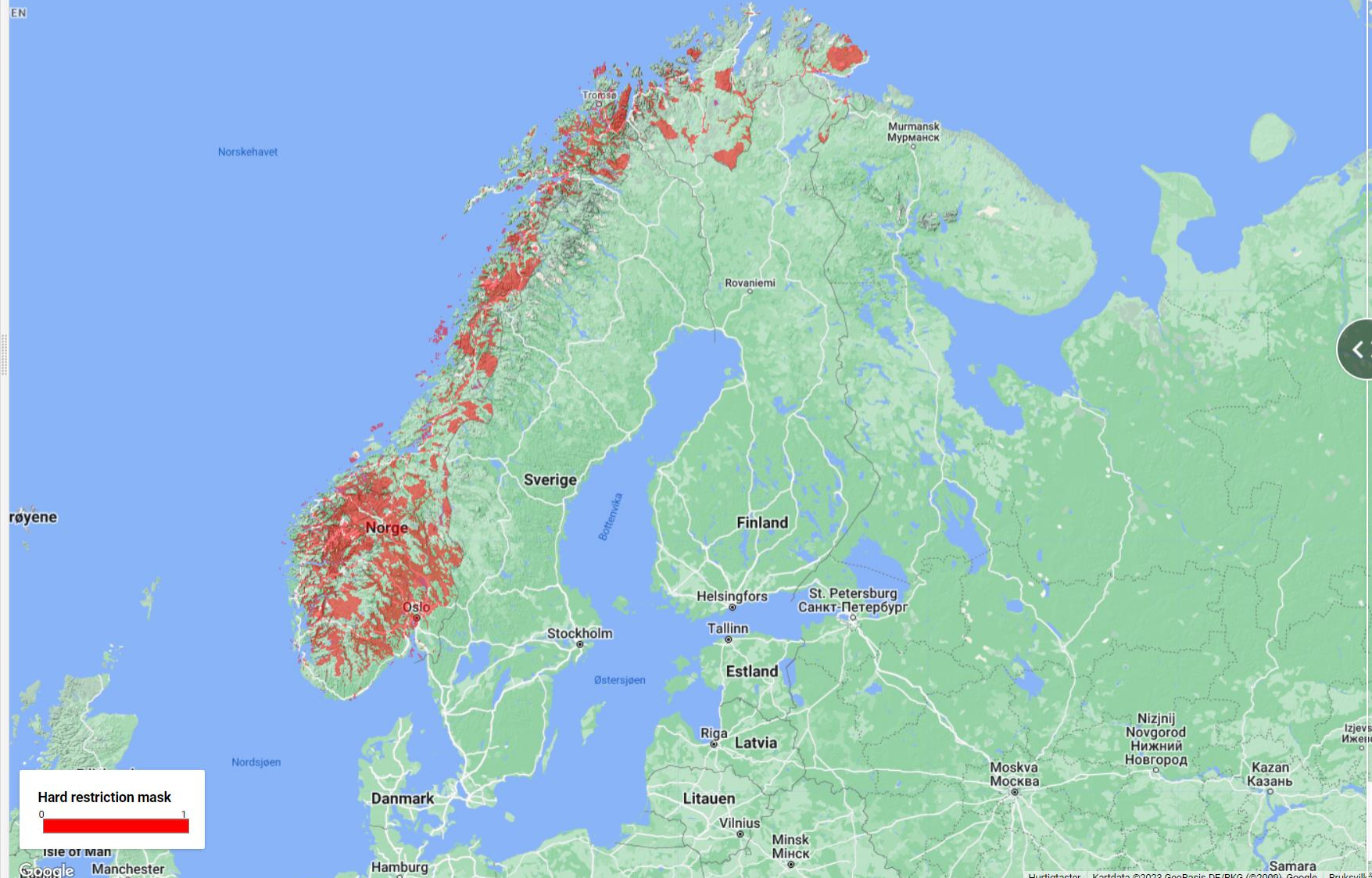
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Update map

Select map

Hard restriction mask





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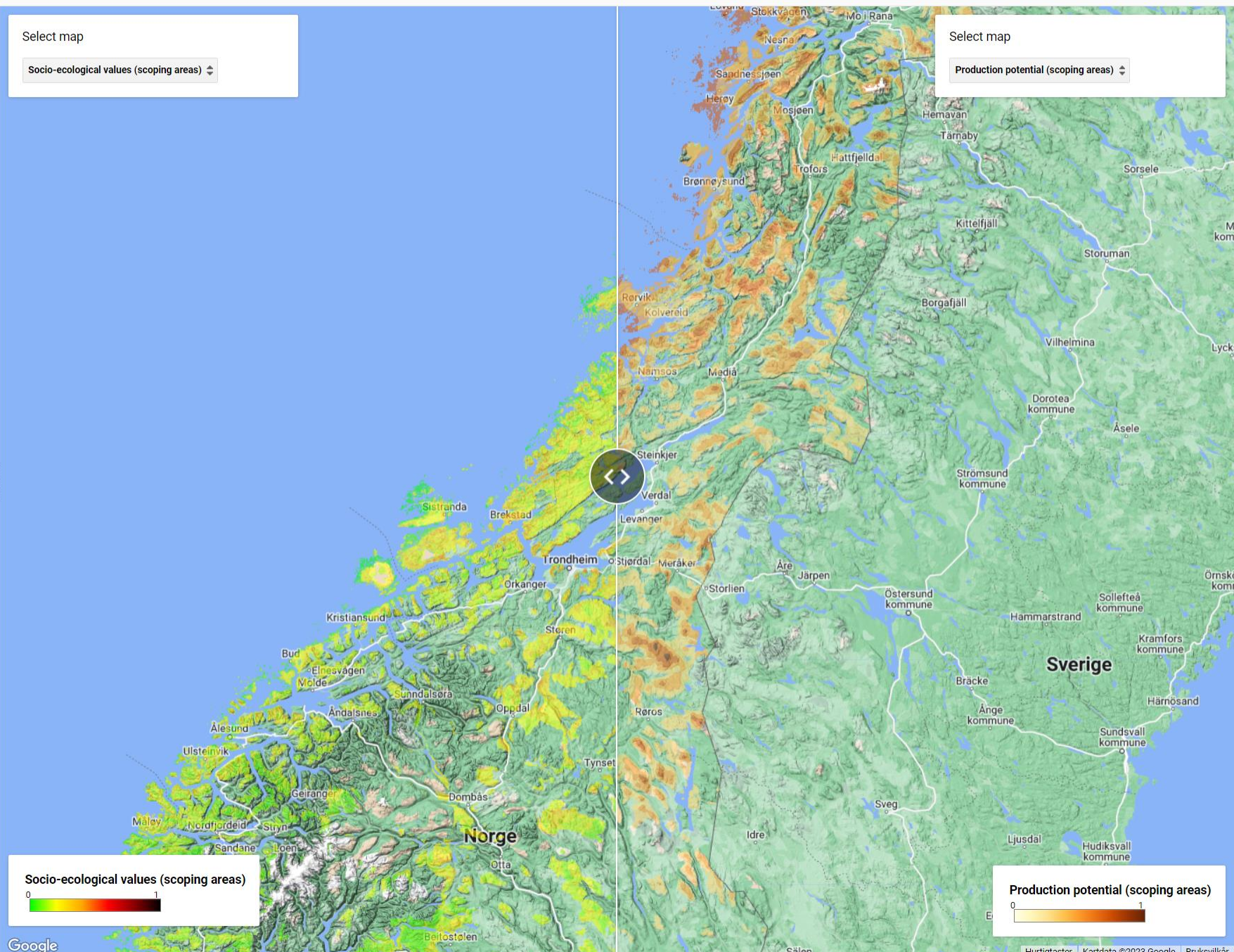
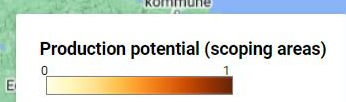
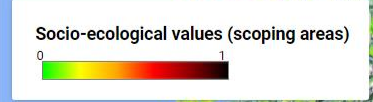
Update map

Select map

Socio-ecological values (scoping areas)

Select map

Production potential (scoping areas)





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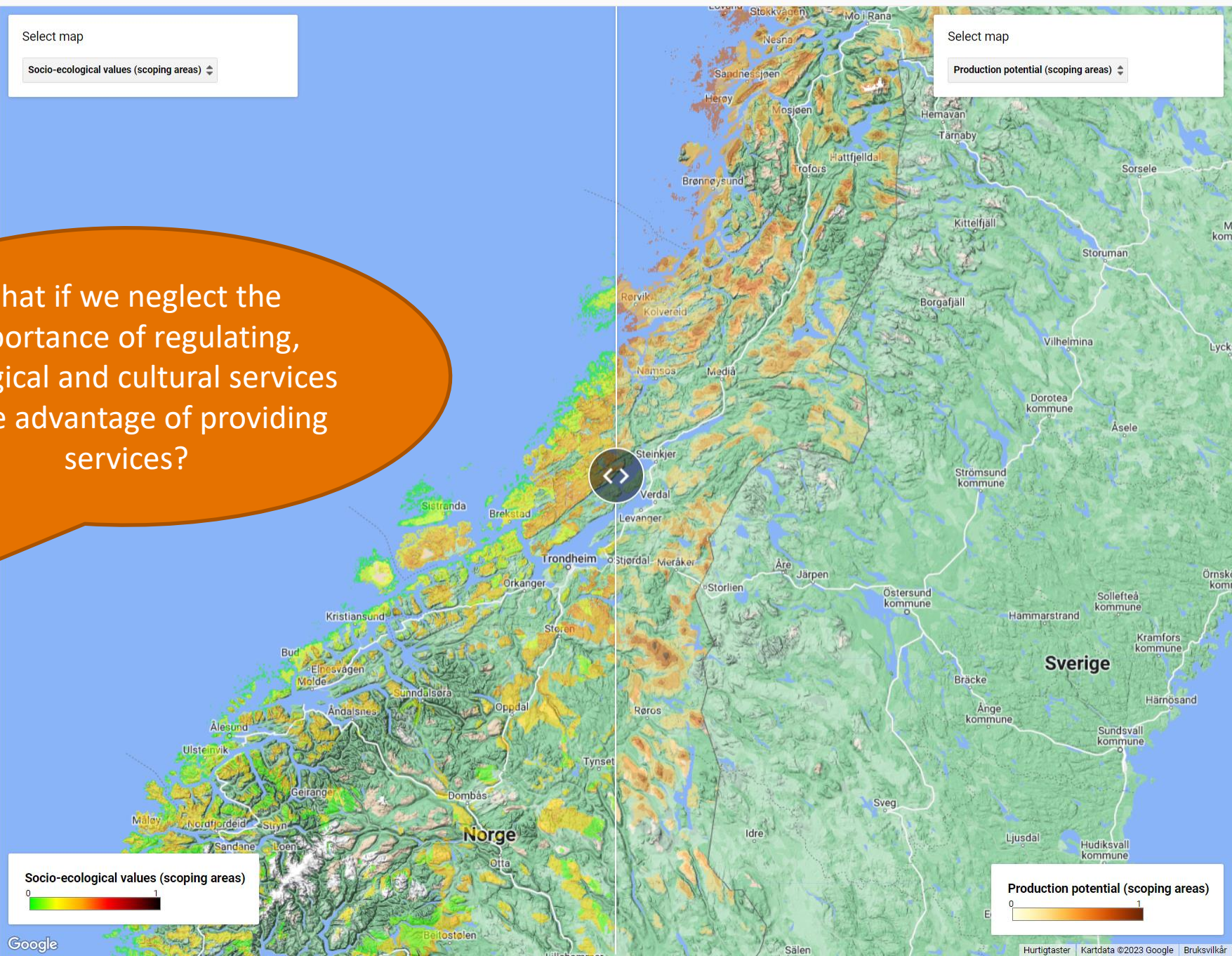
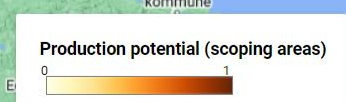
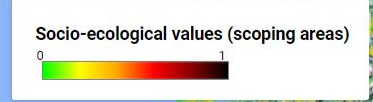
What if we neglect the importance of regulating, ecological and cultural services to the advantage of providing services?

Select map

Socio-ecological values (scoping areas)

Select map

Production potential (scoping areas)





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Update map

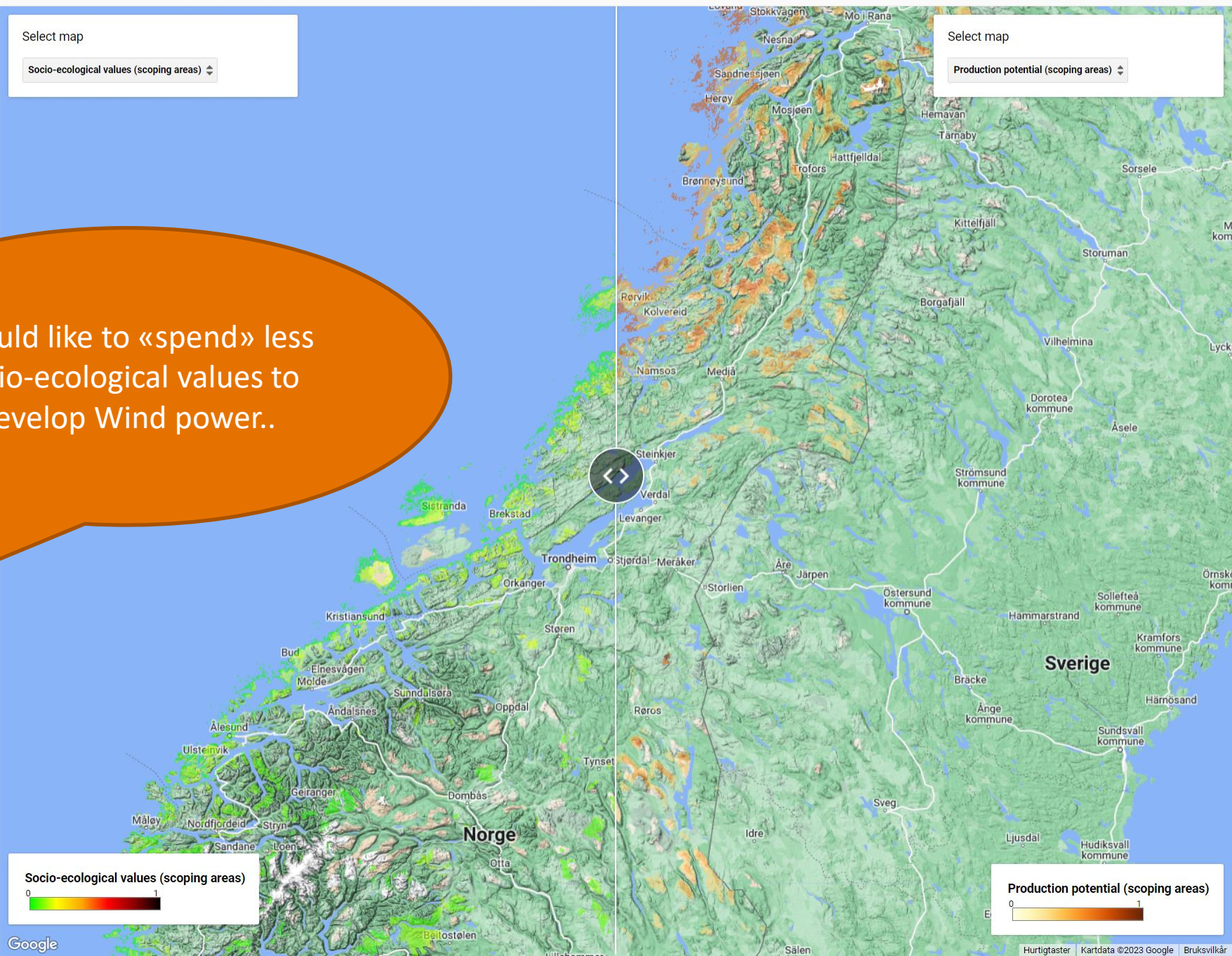
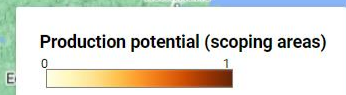
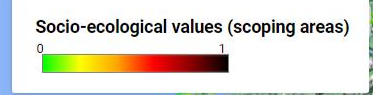
I would like to «spend» less socio-ecological values to develop Wind power..

Select map

Socio-ecological values (scoping areas)

Select map

Production potential (scoping areas)





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- 3000 Production filter (kWh/year)

Update map

Frank Hanssen (frankhanssen@nina.no) is signed in

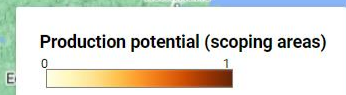
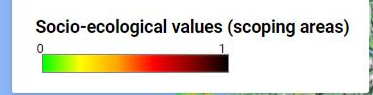
Select map

Socio-ecological values (scoping areas)

Select map

Production potential (scoping areas)

I would like to reduce the level of life-cycle costs..





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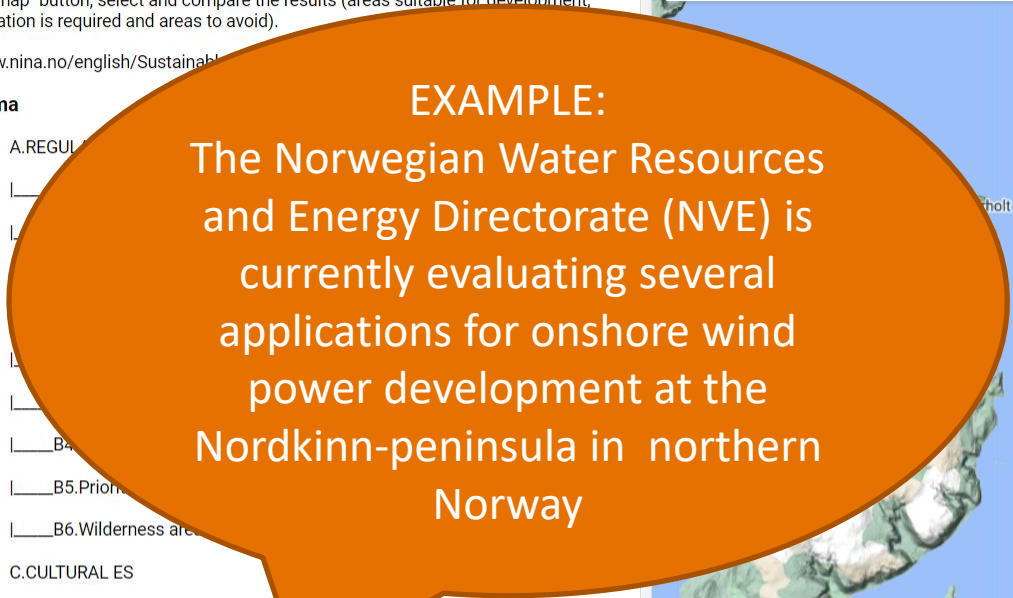
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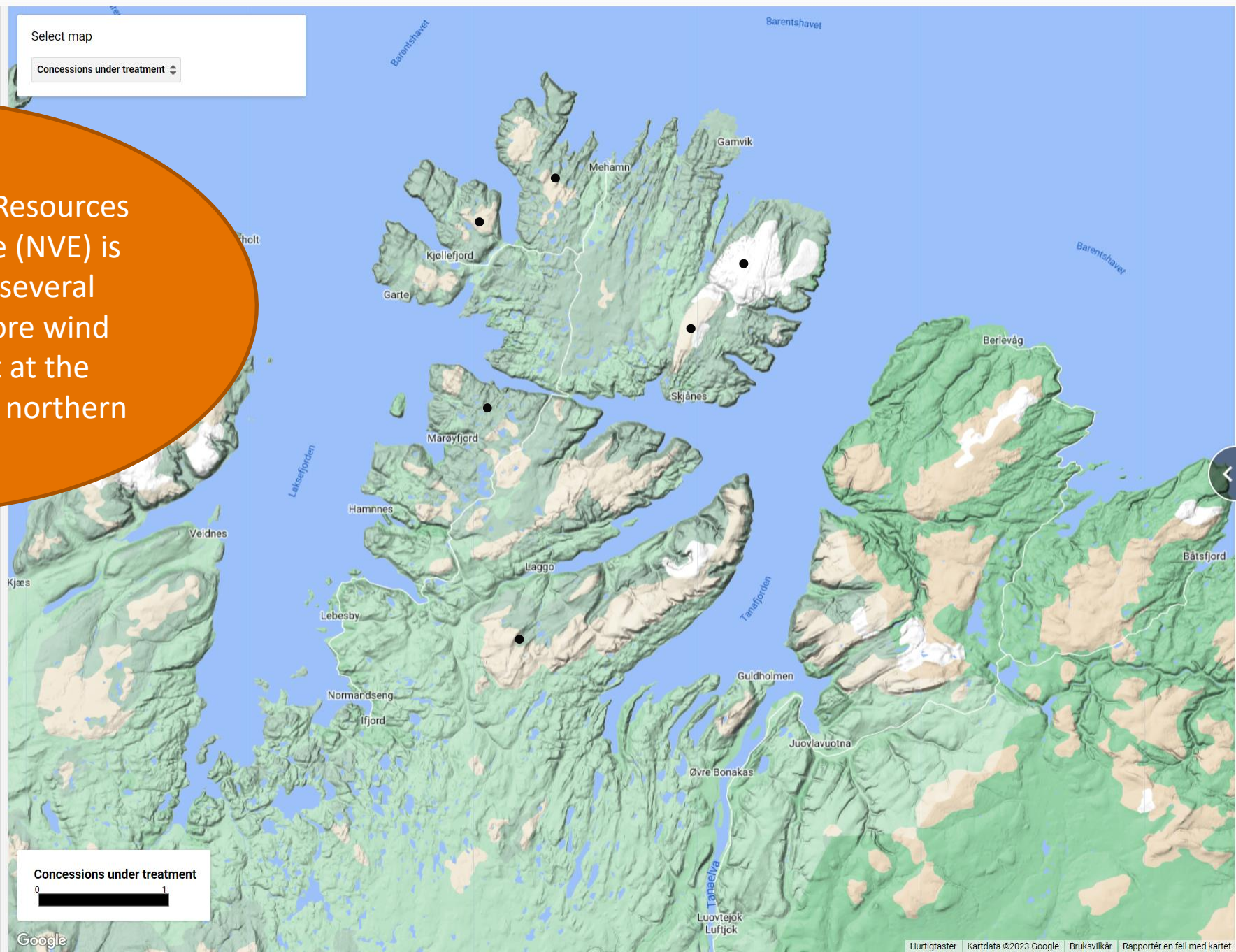
Update map

Select map  
Concessions under treatment

Concessions under treatment  
0 1



EXAMPLE:  
The Norwegian Water Resources and Energy Directorate (NVE) is currently evaluating several applications for onshore wind power development at the Nordkinn-peninsula in northern Norway





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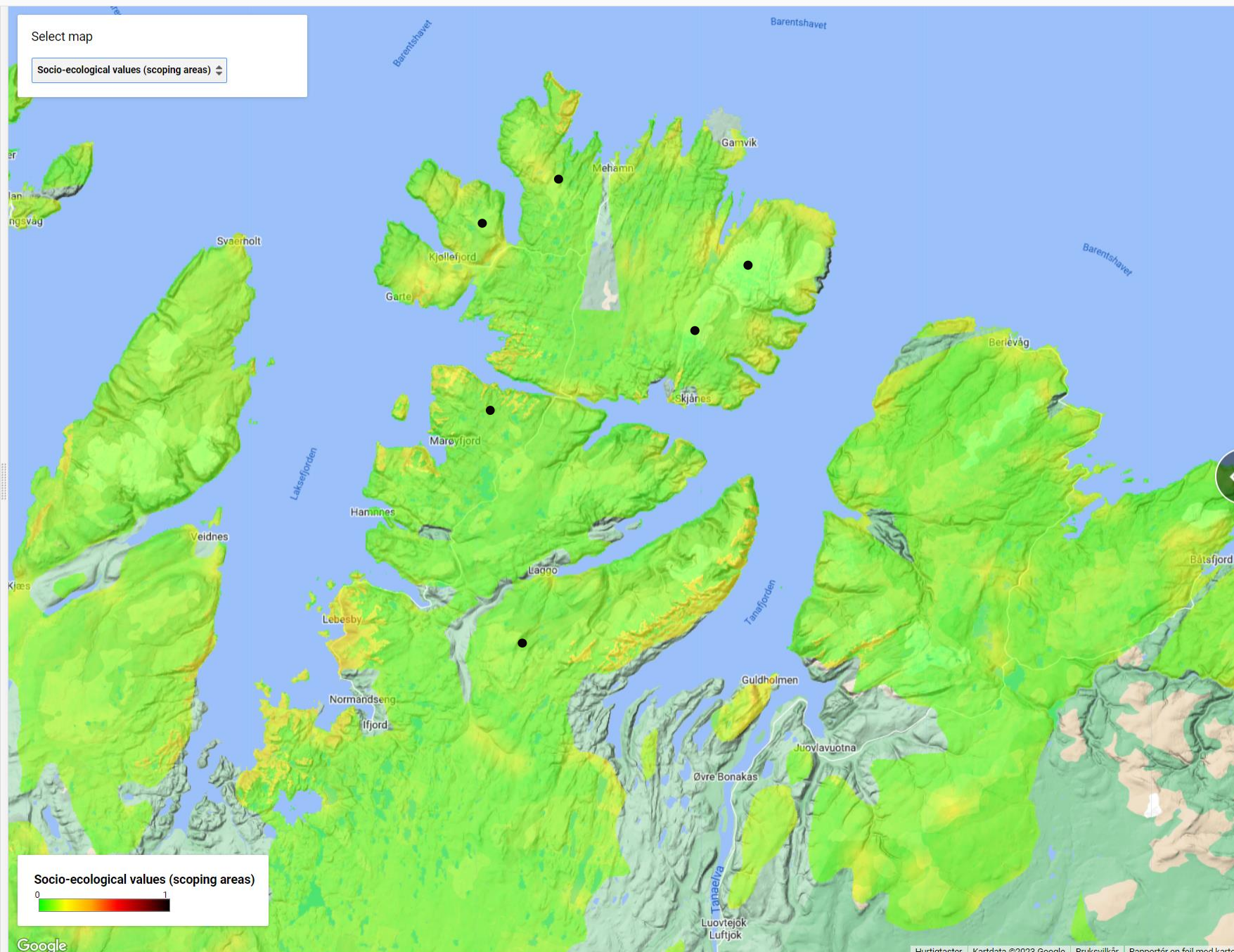
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Update map

Select map

Socio-ecological values (scoping areas)





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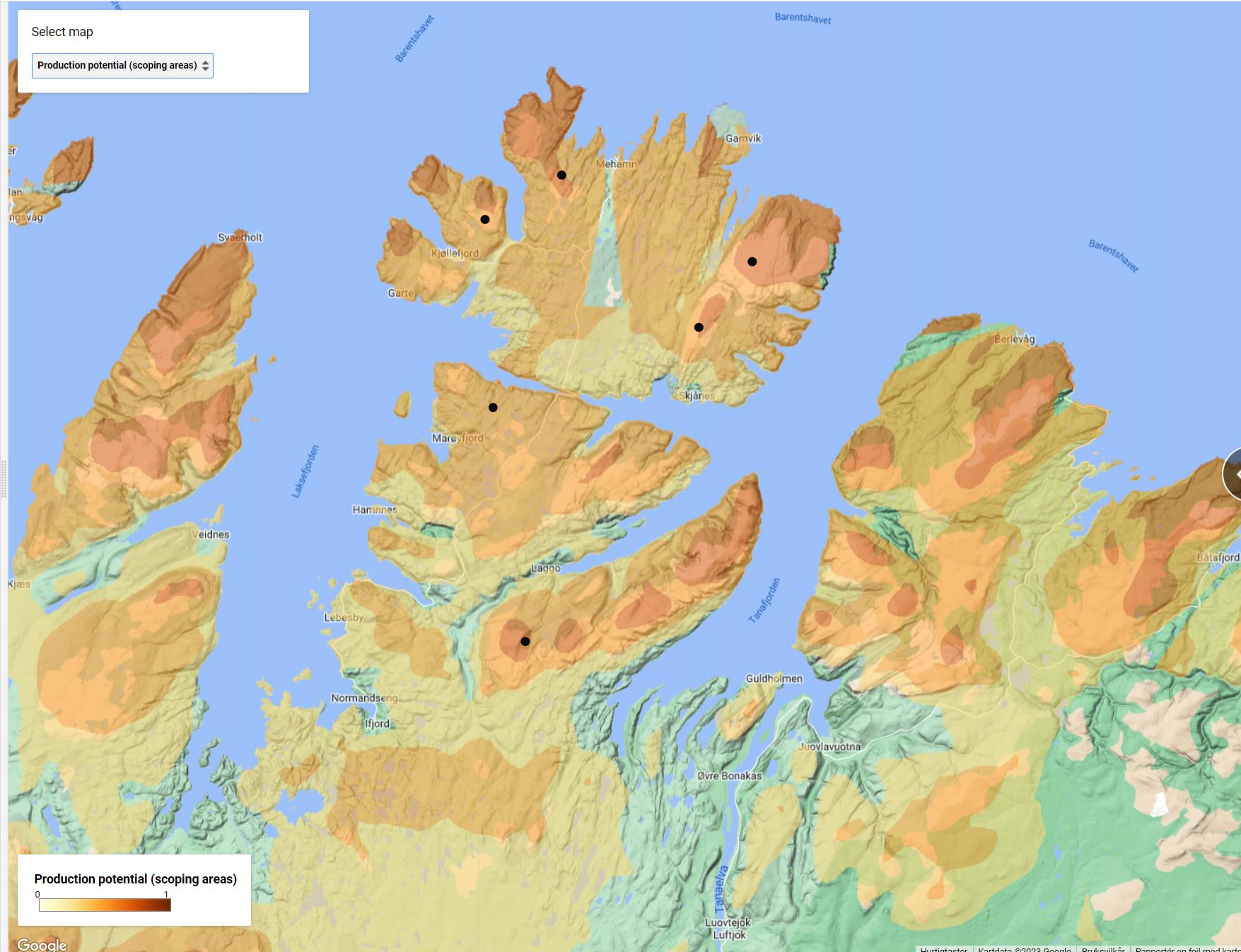
This web-app allows you to balance socio-ecological values and wind-energy production potential to find suitable areas for development of onshore wind-energy projects. Weight the ecosystem service maps (scale 0-1) and filter the production requirements in the Trade-off schema below. Click the "Update map" button, select and compare the results (areas suitable for development, areas where mitigation is required and areas to avoid).

Read more: [www.nina.no/english/Sustainable-society/Consensus-based-Siting](http://www.nina.no/english/Sustainable-society/Consensus-based-Siting)

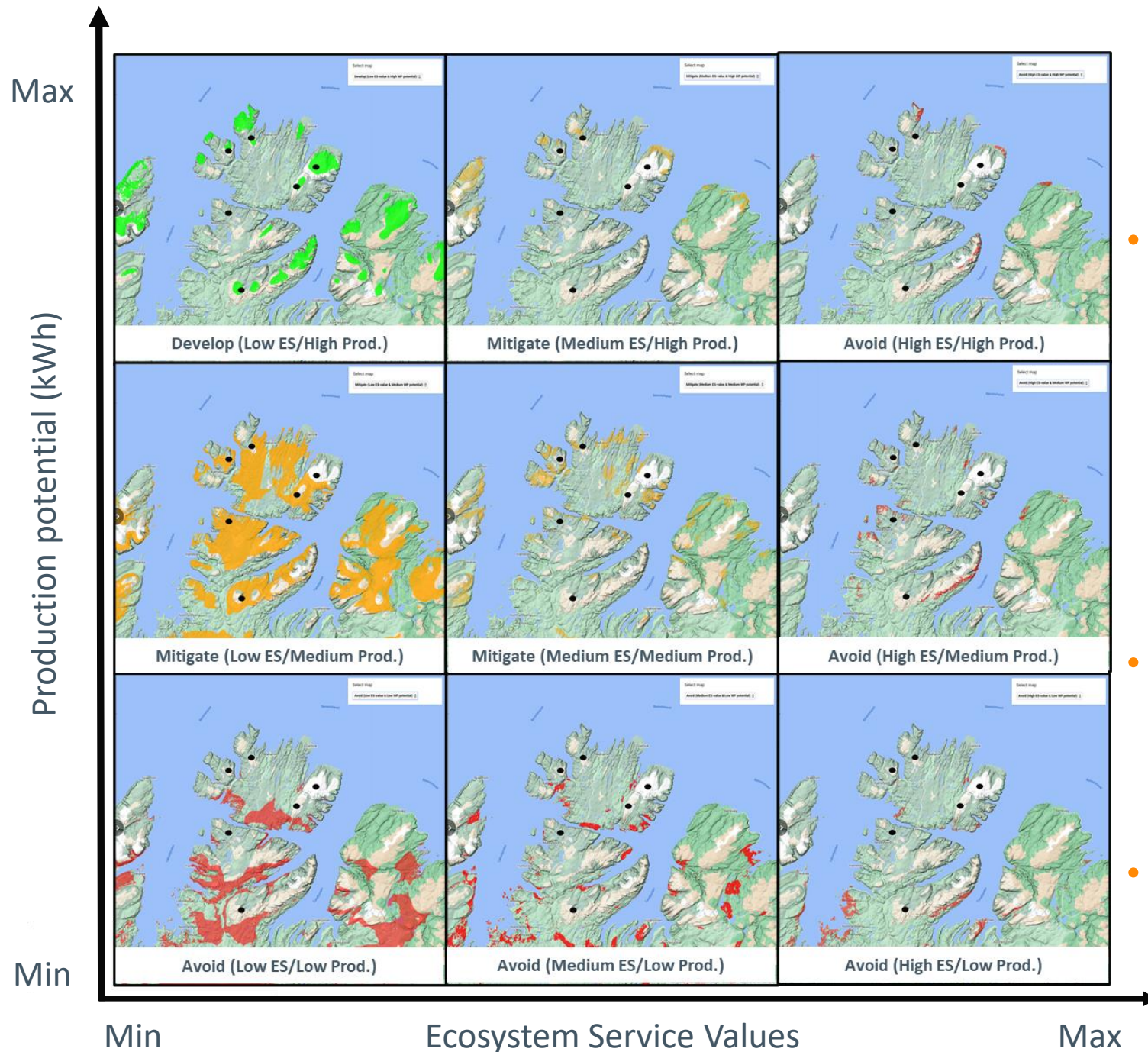
**Trade-off schema**

- 0.58 A.REGULATING ES
- 0.56 A1. Carbon storage
- 0.53 A2. Water retention
- 0.72 B.ECOLOGICAL ES
- 0.56 B1. Wild reindeer
- 0.53 B2. Birds
- 0.48 B3. Bats
- 0.67 B4. Prioritized species
- 0.77 B5. Prioritized Nature types
- 0.68 B6. Wilderness areas
- 0.53 C.CULTURAL ES
- 0.59 C1. Cultural landscapes (visibility)
- 0.46 C2. Cultural heritage (distance)
- 0.66 D.PROVIDING ES
- 0.68 D1. Agriculture
- 0.77 D2. Outfield grazing
- 0.67 D3. Forestry
- 0.61 D4. Reindeer herding
- 0.51 D5. Mushroom/berry harvesting
- 0.46 D6. Hunting
- 0.5 Socio-ecological value filter
- 60 Life-cycle cost filter (Øre/kWh)
- 6 Wind resource filter (m/s)
- 3000 Production filter (kWh/year)

Update map







# A Traffic light-approach to spatial planning

- Within the scoping areas ConSite Wind helps to identify areas that are:
  - ▶ Suitable for development (**green**)
  - ▶ Suitable for development areas given required mitigation (**orange**)
  - ▶ Not suitable for development (**red**)
- Useful for the evaluation and treatment of applied WP-concessions
- Useful for scoping of new areas for WP-development





# Balancing socio-ecological and economy trade-offs in spatial planning of onshore wind projects



Photo: Espen Lie Dahl

## ConSite Wind: What it is and how it helps

### A multiple criteria decision analysis web-app that helps to

- Compile layman and expert knowledge in wind power development projects
- Balance ecology-economy trade-offs, reduce conflicts and optimize production
- Test different decision scenarios and evaluate their spatial consequences
- Improve spatial planning and decision support
- Ensure more transparent, efficient and sustainable decision making processes

*The tool is developed by the [Norwegian institute of nature research \(NINA\)](#), as a part of the [FME NorthWind research centre](#)*



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**Thanks for your attention!**

**Questions?**



Foto: Espen Lie Dahl (CC BY-NC-ND 4.0)

Read more at

[www.nina.no/consite](http://www.nina.no/consite)

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