

Sustaining our common future: pathways for a zero-emission transition

Insights from the Nordic flagship Flex4RES project

Sam Cross

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Aalto University
Energy Platform



Nordic Flagship project Flex4RES

Overall aim of project:

Demonstrate how the challenge of integrating high shares of variable renewable energy in the energy system can be handled efficiently through a stronger coupling of energy markets across the Nordic region, thereby facilitating a zero-carbon energy transition.

What is considered here:

*What can be concluded **least-cost strategy to develop a zero-emission pathway to 2050** for the Nordic and Baltic region and what is its global relevance*

Nordic Flagship project Flex4RES

Project background:

Financed by:



Nordics : Denmark, Finland, Norway, Sweden, (Iceland)

Baltics : Estonia, Latvia, Lithuania

Partners:

Technical University of Denmark (DTU)

Norwegian University of Life Sciences

Nordic Institute for Studies in Innovation, Research and Education (NIFU)

Tallinn University of Technology (Taltech)

Royal Institute of Technology (KTH)

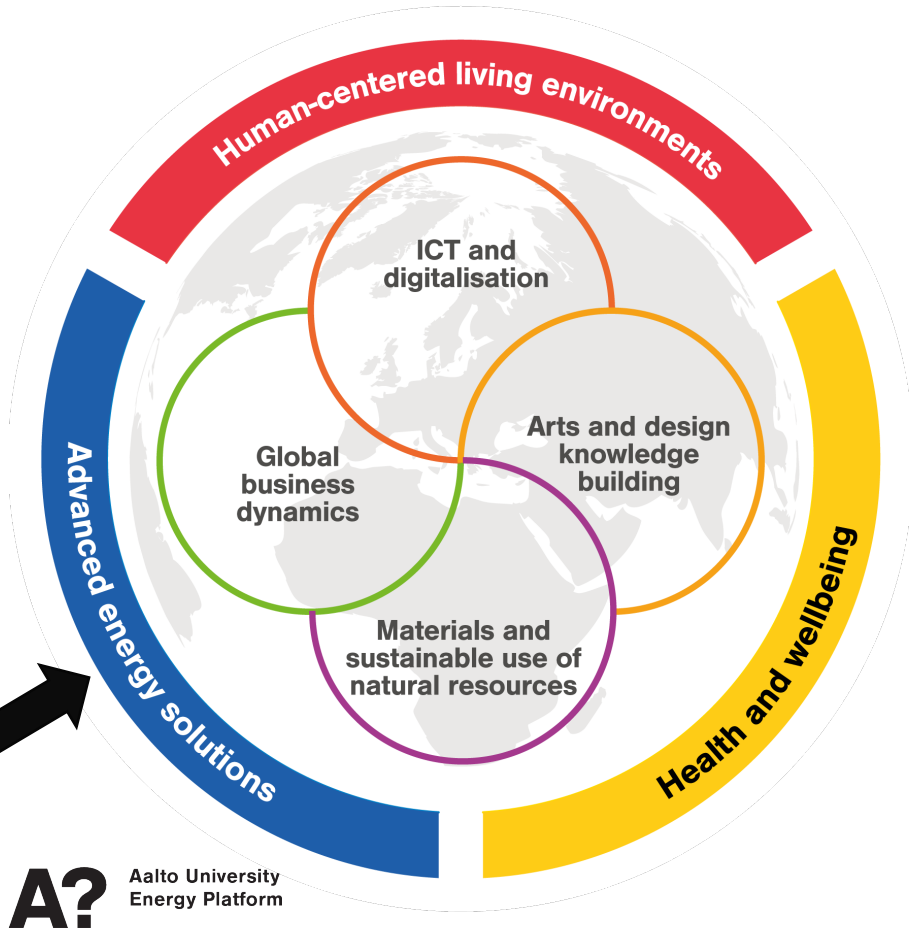
Riga Technical University (RTU)

Aalto University

Project led at Aalto by
Prof Peter Lund

Information: <https://www.nordicenergy.org/flagship/flex4res/>

Multidisciplinary platforms at Aalto



- Foster multidisciplinary research & education
- Single access point to Aalto & collaboration for external stakeholders for the field of the platform
- Joint vision and co-creation
- Joint study packages

Least-cost strategy for a zero-emission pathway to 2050?

Where do we want to be in 2050: Nordic leadership

Country	Share of RES	CO ₂ target
Denmark	100% by 2050 ¹	Carbon neutrality by 2050
Finland	>50% by 2030 ¹	Carbon neutrality by 2035
Norway	67.5% by 2020 ¹	Carbon neutrality by 2050
Sweden	100% by 2040 ²	Carbon neutrality by 2045
Estonia	42% by 2030 ¹	-80% by 2050
Latvia	45% by 2030 ¹	-80% by 2050
Lithuania	45% by 2030 ¹	-80% by 2050
EU	~32% by 2030 ¹	Carbon neutrality by 2050 (2020 Climate Law proposal)

¹ Of final energy; ² Of electricity

Flex4RES – “Framing matters!”

Starting-point

- Present policy base
- Market-based - Functioning power market & increasing CO₂-price

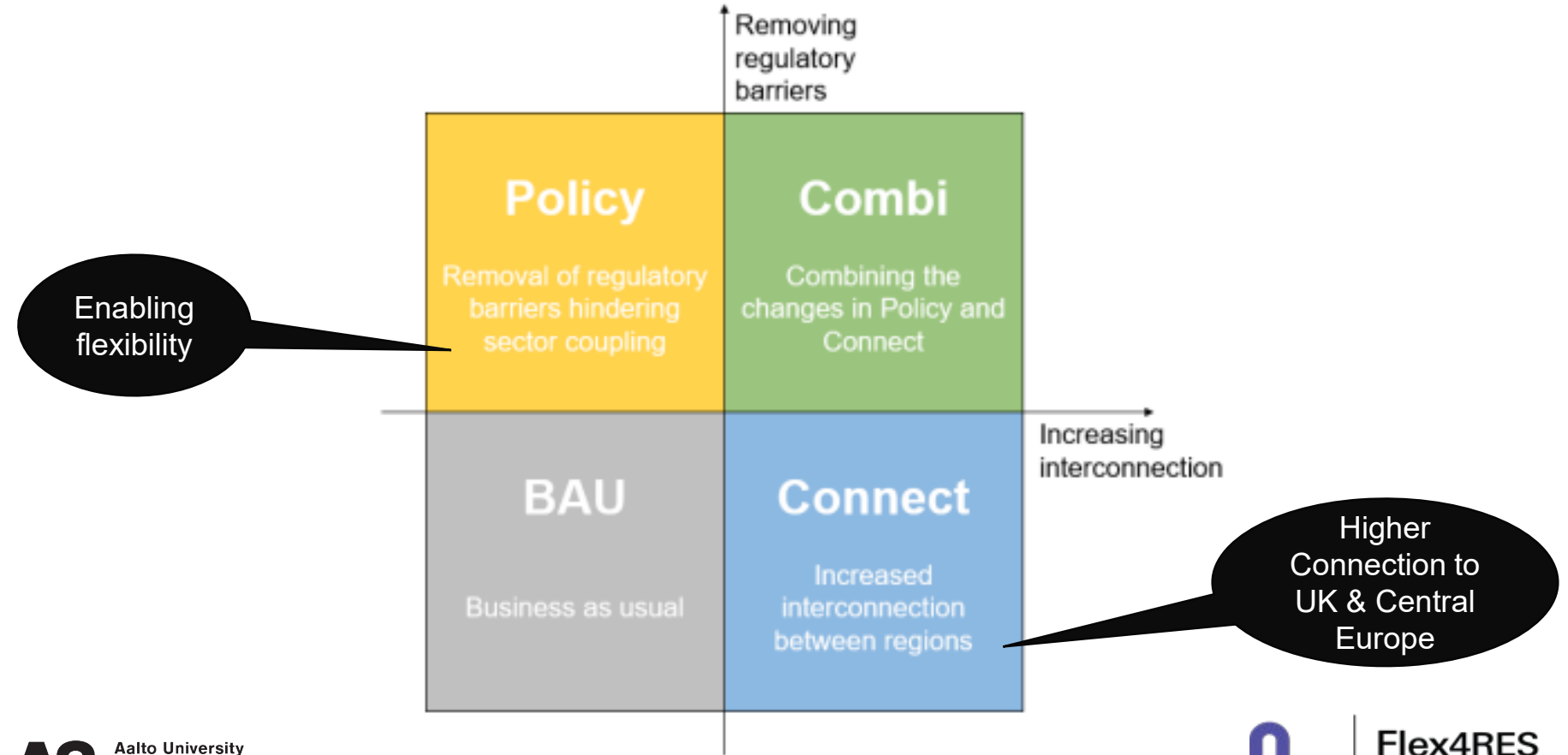
Energy change = co-evolution

- Techno-economic layers
- Socio-technical layers
- Policy layers

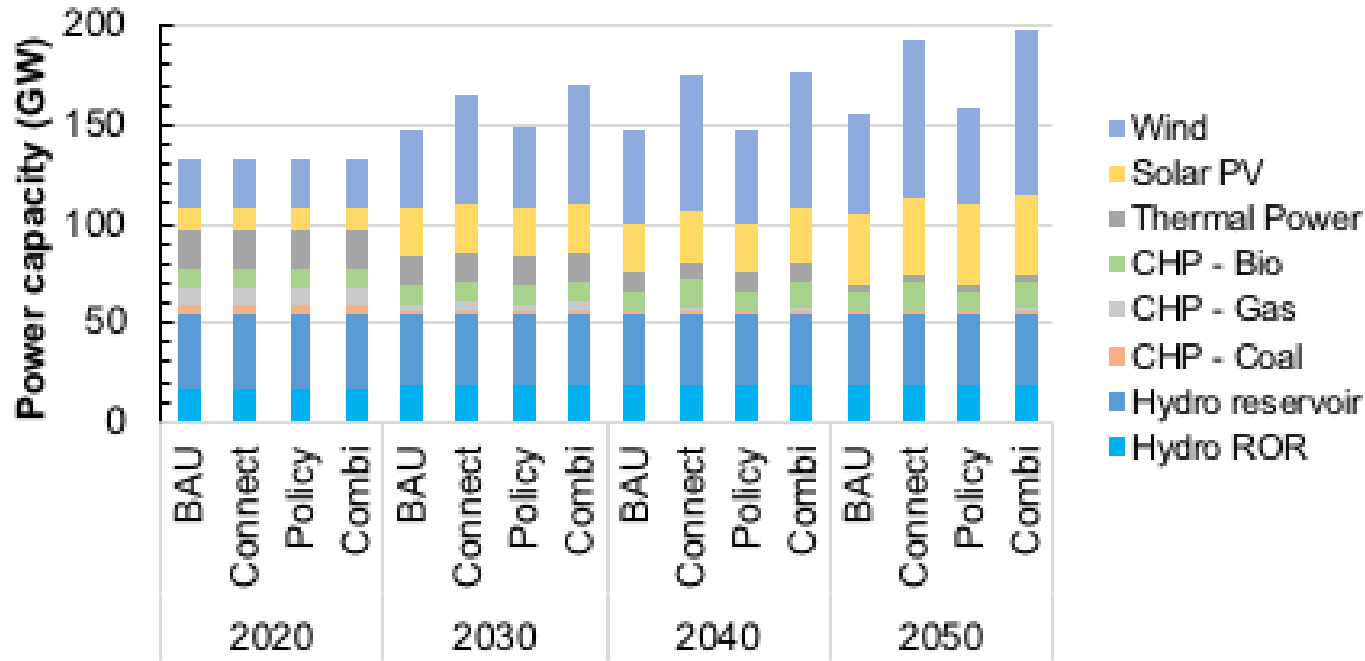
“Whole-picture view”

- Stronger coupling of markets across sub-regions and sectors
- Technical, economic, regulatory, policy analyses combined with energy scenario modelling

Flex4RES – Scenarios

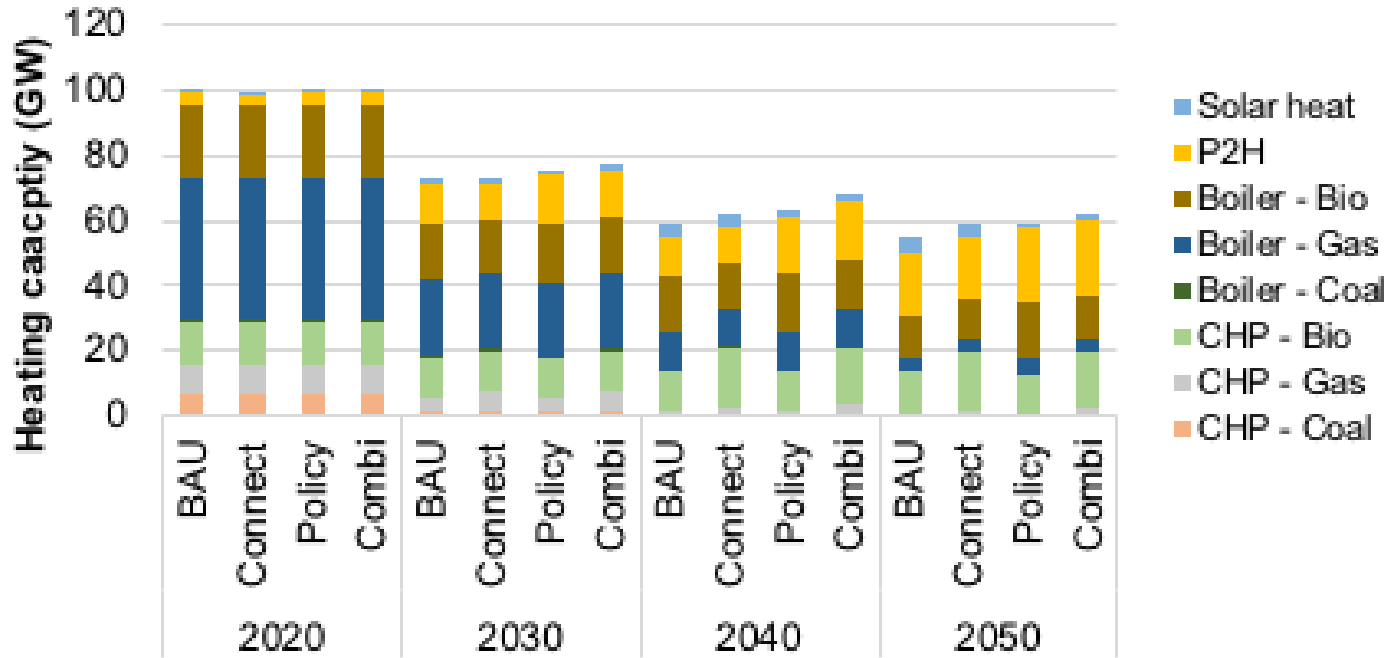


Nordic Energy Transition - Power



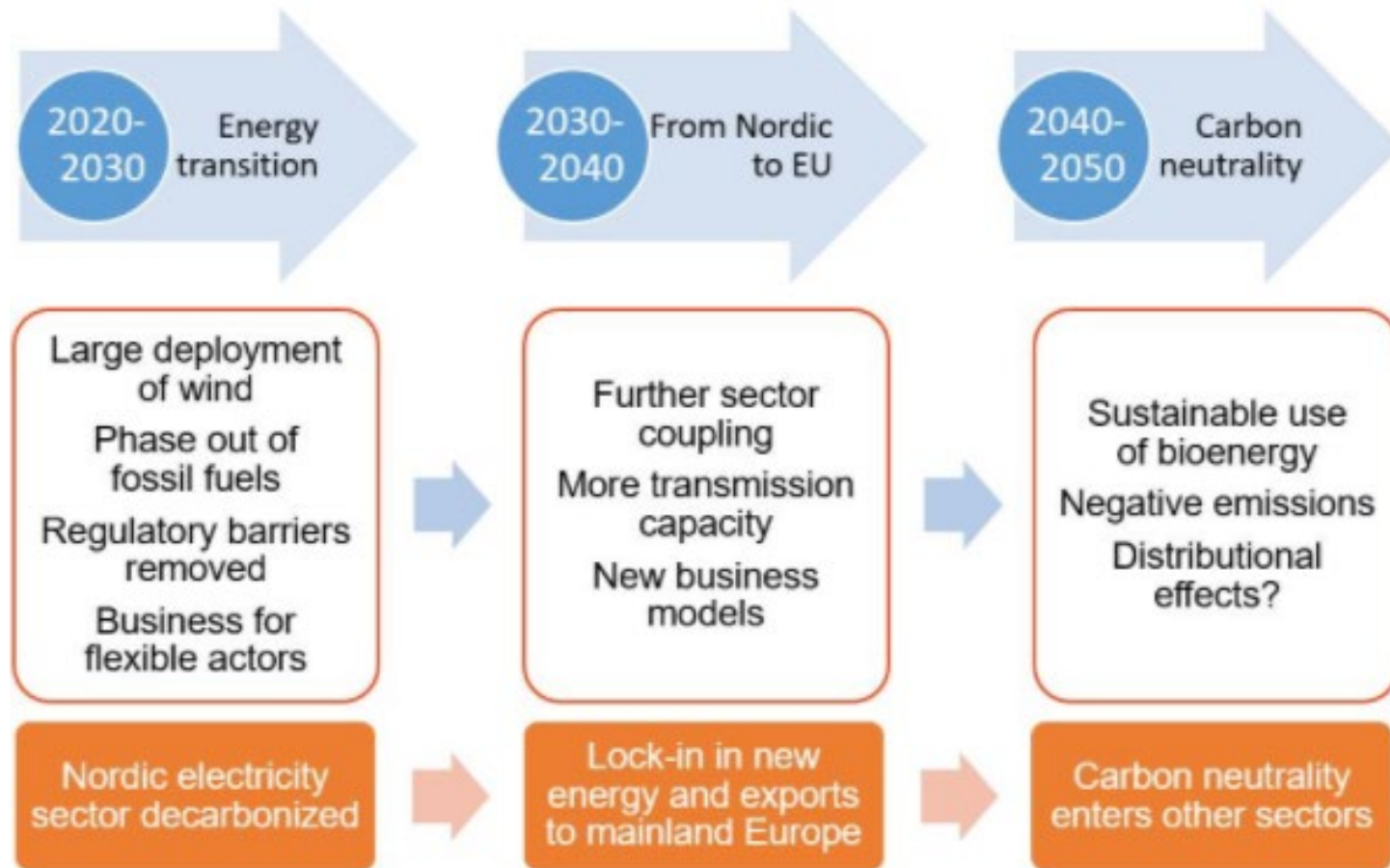
- Dominance of wind, solar & hydro
- Strong electrification > more electricity for transport & heating
- Fossil fuels → 0% by 2050
- Largest energy system change 2020-2030

Nordic Energy Transition - Heat



- Power to Heat (P2H) is a key source of system flexibility > how to deal with variable renewable electricity
- Heat capacity & consumption are reduced overall by energy efficiency

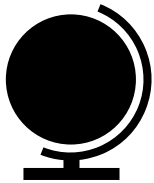
The Nordic Pathway to Zero-Emissions



**What is needed to efficiently
achieve this transition, and
which measures are globally
relevant?** 

1. Act fast to achieve decarbonization:

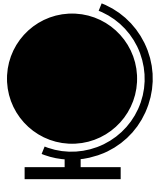
- Postponing investments in clean energy NOW would require even steeper and costlier emissions cuts LATER
- Main energy transition to be achieved in 2020s
- The technologies are there already!



Same conclusions apply globally even if RES starting from a lower level (thus transition may take longer to achieve)

2. Market-based framework for sector coupling & flexibility

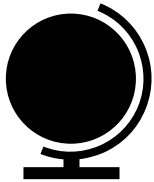
- Sector coupling is critical to integration of variable renewable power generation AND decarbonizing heat & transport
 - Power to heat (P2H)
 - Power to electric vehicles (P2V)
 - Power to gas (P2G)
- Remove barriers between power, heat, gas & transport markets
- Price signals must reach end users to facilitate flexibility



Market-based framework ALWAYS critical, allow for the right balance of solutions in each location

3. Cross-border connections reduce costs and facilitates integration

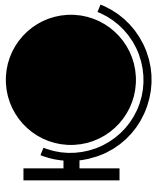
- Delivers RES from least cost locations
- Allows variable renewable electricity to be managed over a wider area, allows integration of higher shares



Interconnectivity should be increased where geopolitics allow

4. Social-technical issues are critical to the transition

- A “just” transition. Consider & ameliorate:
 - Lost employment in sunset industries
 - Public acceptance of power & transmission infrastructure
 - Distributional effects > e.g. connecting power markets may increase prices for consumers



Transition cannot be achieved without public acceptance & support > think about this from the start

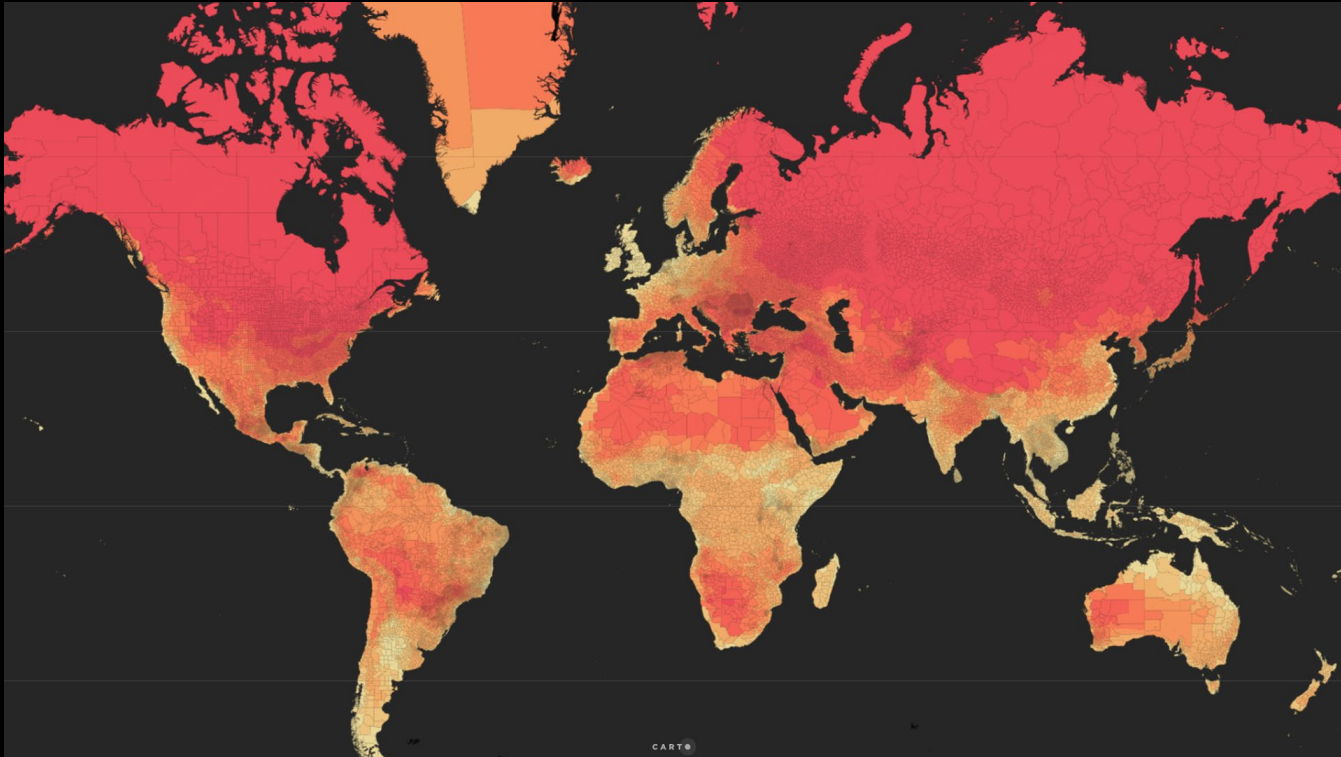
SUNRISE for this



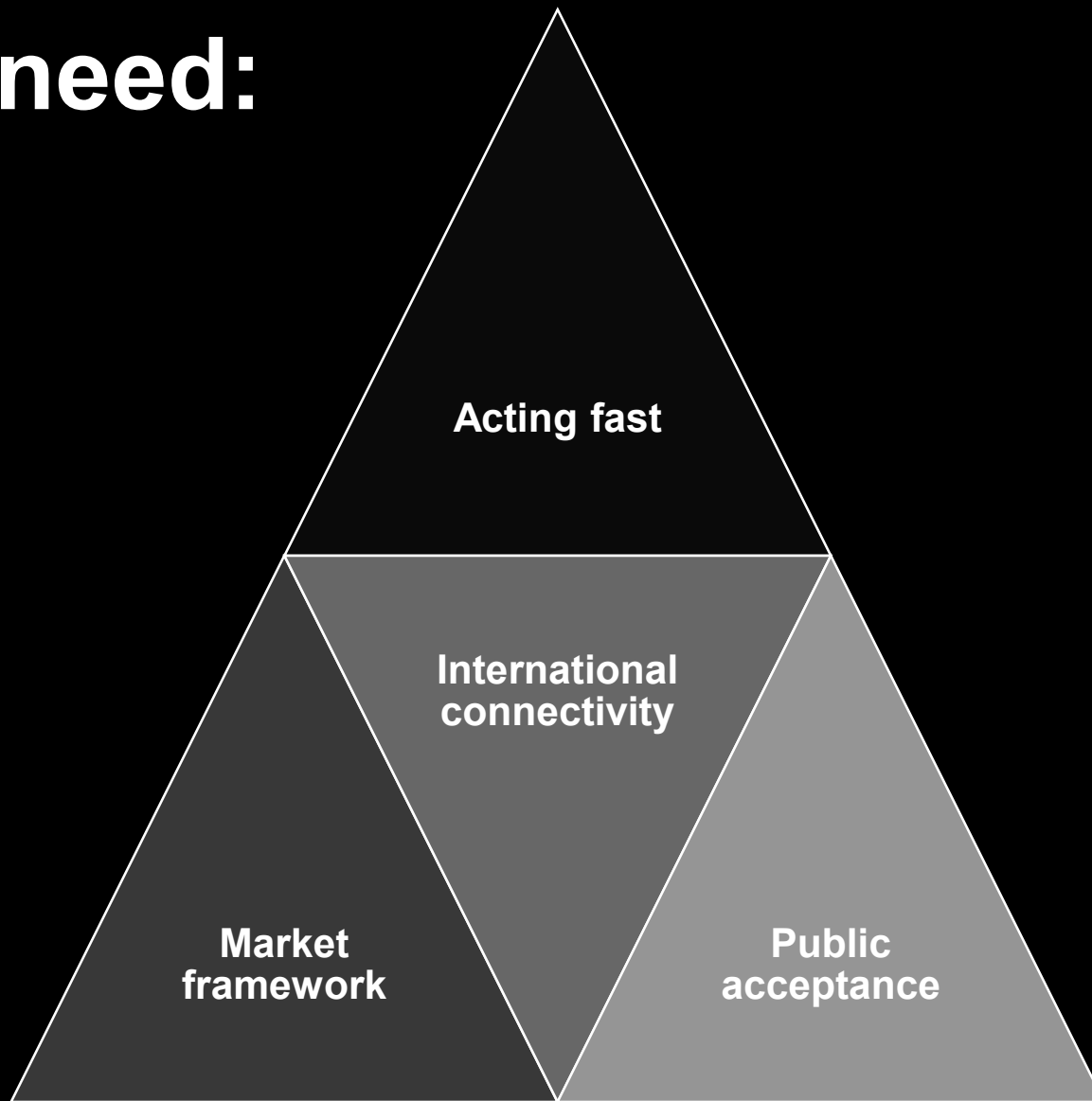
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...to avoid this...



....will need:



Aalto University
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Thanks for your attention!

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Sam Cross

samuel.cross@aalto.fi

+358 50 4096615

energy.aalto.fi



Flex4RES

Flexible Nordic Energy Systems

