

BLICK ÜBER DEN TELLERRAND

Neue Wege im Bereich
Systemstabilität in Dänemark

Alexander Neufeld, Energinet



VISION

GREEN ENERGY FOR A
BETTER WORLD

ENERGINET



ENERGINET

THE ENERGY BACKBONE

We operate and develop the electricity transmission grids, gas pipelines and gas storage in Denmark and are also appointed to build the future hydrogen infrastructure

ENSURE BALANCE

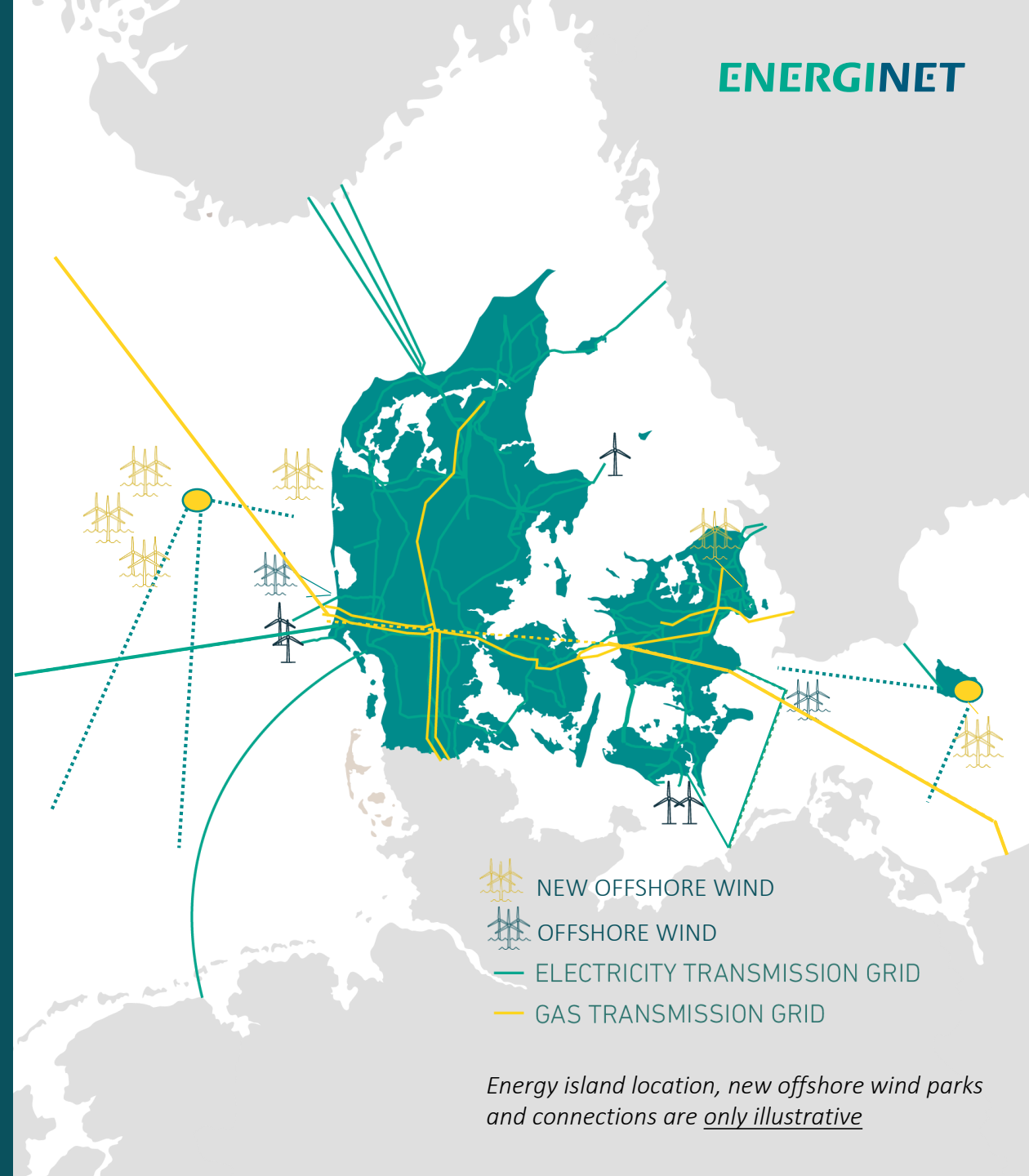
We have the day-to-day and long-term responsibility for the overall electricity and gas system in Denmark.

WORKING FOR THE SOCIETY


We are owned by the Danish Ministry of Climate, Energy and Utilities we safeguard society's interests as we move to a 100% green energy system.

Appr. 2200 Employees

ENERGINET



VISION



We want to establish a green power system where the most suitable technologies ensure cost-effective system stability

FOUR STABILITY PRINCIPLES

1

The aim is to predict and mitigate all stability phenomena that would lead to critical system events, over-conservative operation of the electricity system or delay the grid connection of operator facilities.

2

The aim is to deal with the stability problem using the right construction, operational and market solutions.

3

The aim is to have access to use the most suitable technologies to solve future stability challenges.

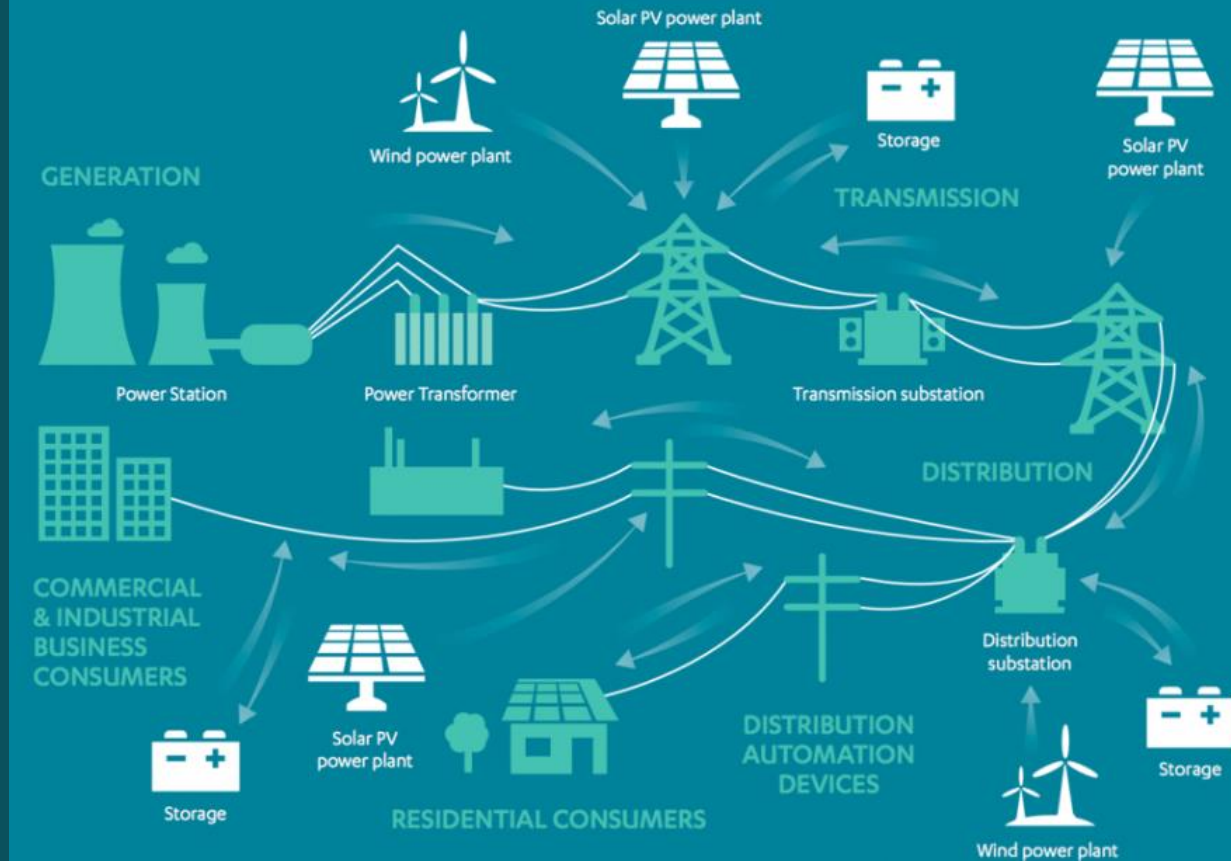
4

The stability challenges can be communicated, so that everyone who has a need to understand the problem, the solution space and the strategic choices, does this at a level so that they can participate in the debate in an informed manner and contribute to solving the task.

ROBUSTNESS OF FUTURE POWER SYSTEMS

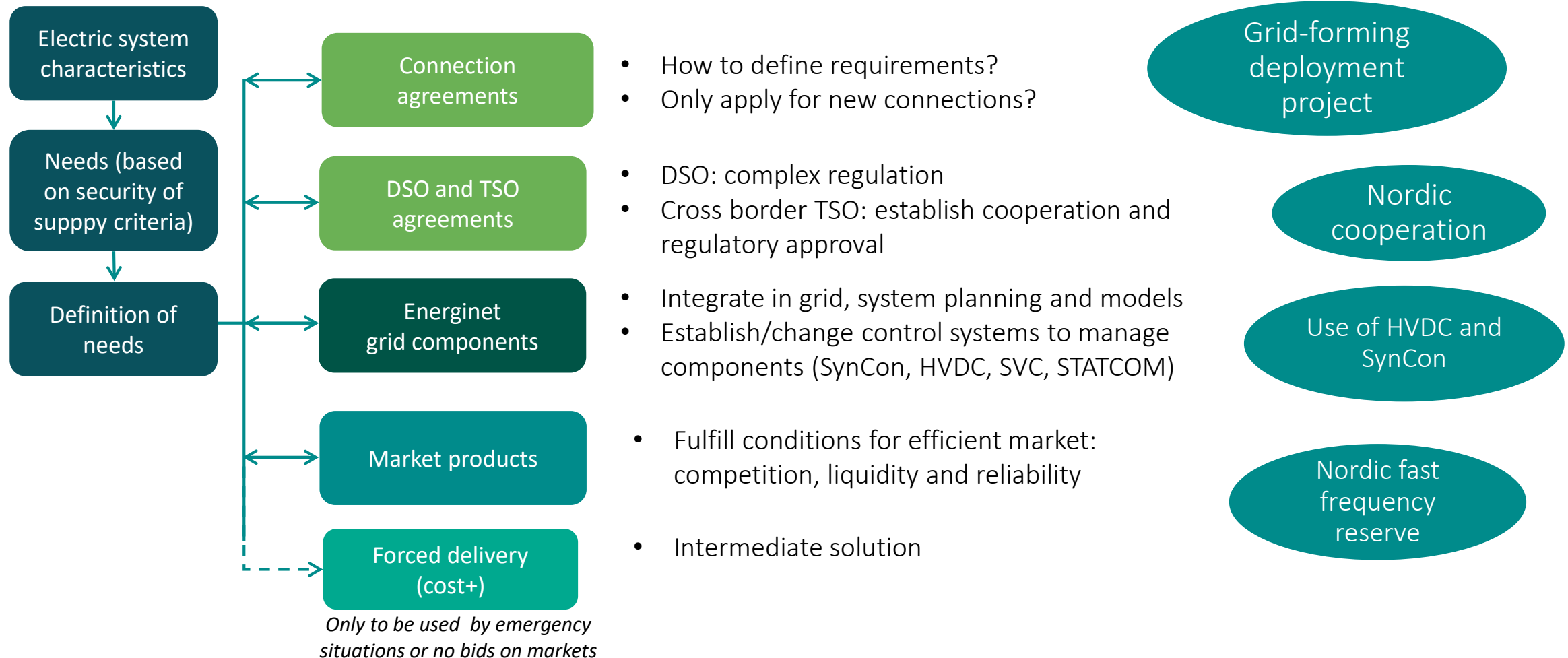
A **green, converter-based, and cable-dominated** power system

1. Large fluctuating power and energy storage
2. Reduction of rotating masses
3. Increased system complexity
4. Power electronic interfaced devices
 - a. Lower short circuit level
 - b. Voltage instability after contingencies
 - c. Control interactions leading to sub- and supersynchronous oscillations
 - d. Increased sensitivity to unbalance and voltage distortion



NO SINGLE SOLUTION

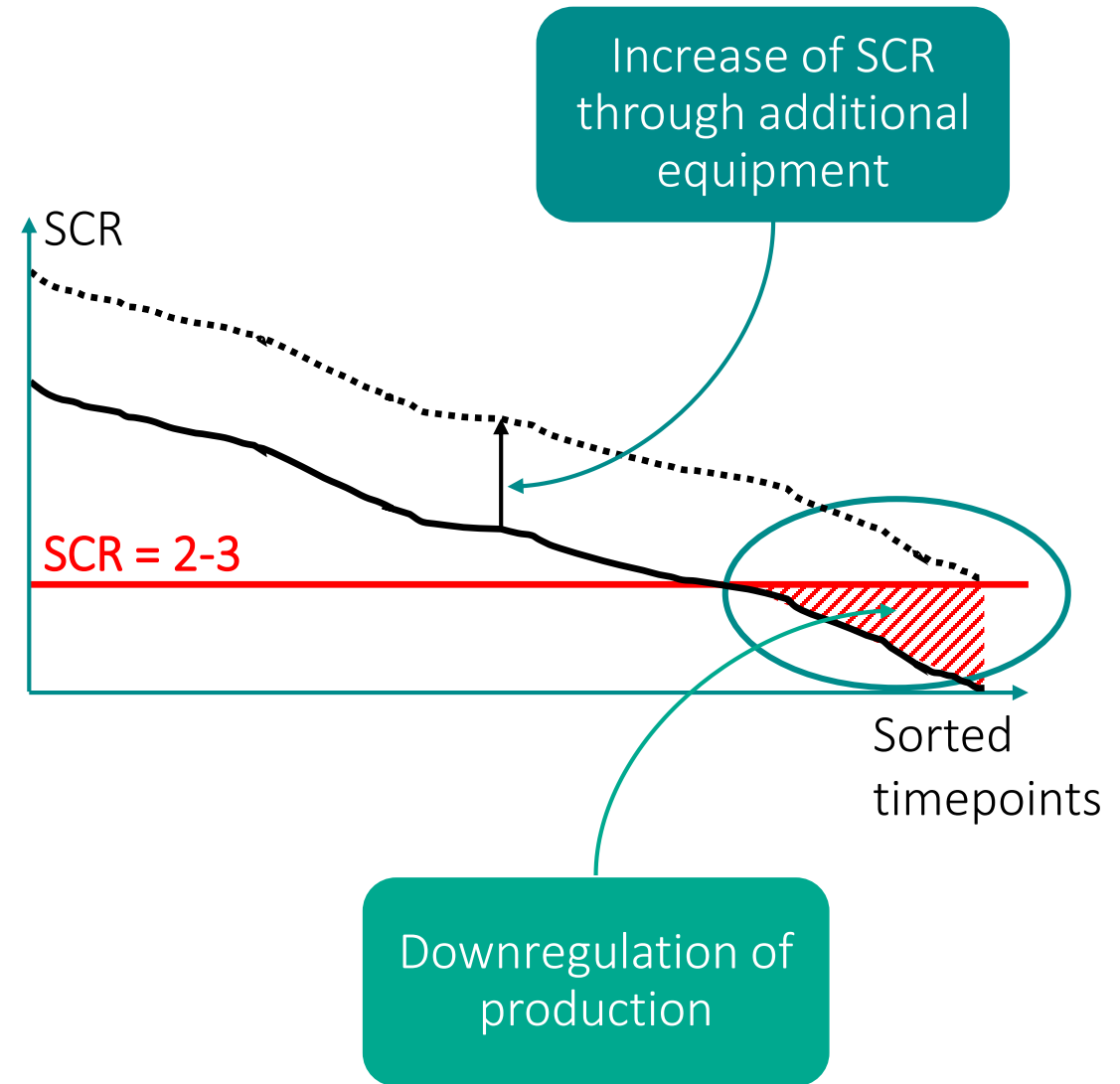
Separation of system needs and solutions for technology neutral and socio-economic efficient solutions



SYSTEM STRENGTH

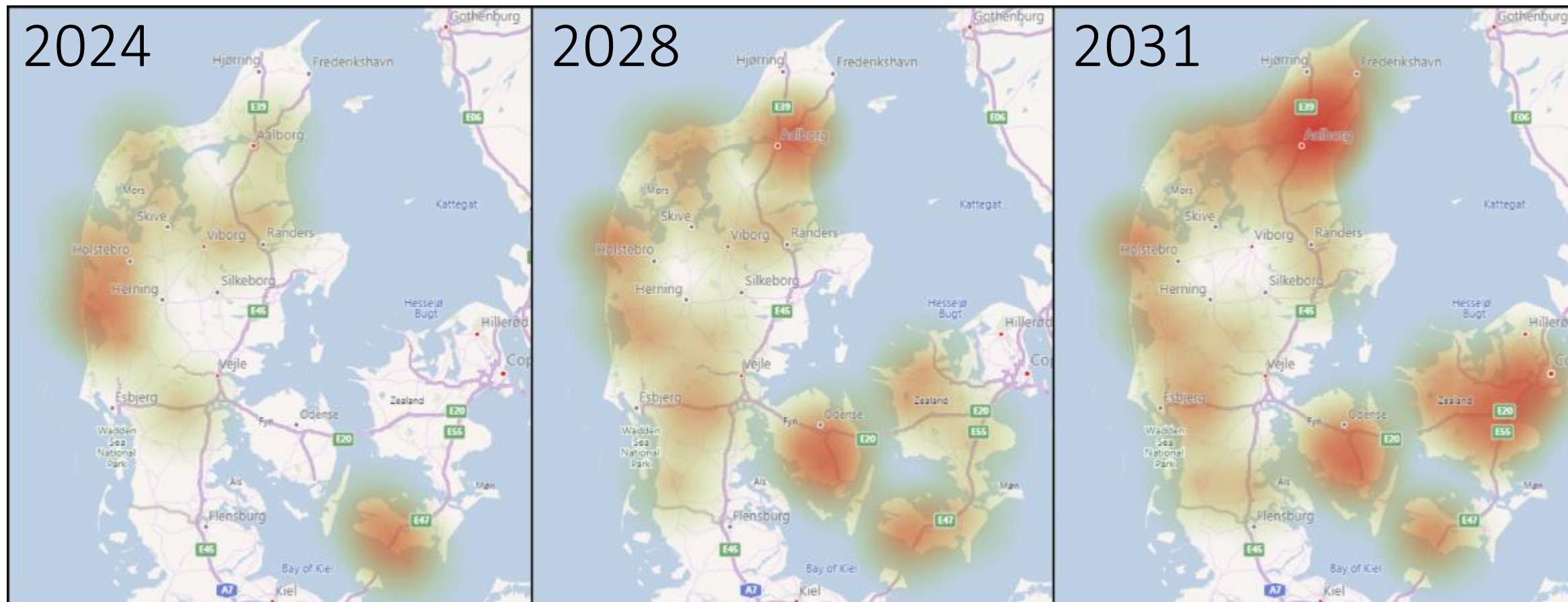
The ability of power system equipment to operate in a stable manner and for the system as a whole to recover intact from major disturbances.

- Is influenced by the electrical “strength” of the system at the point where equipment connects.
- Typically described by short circuit ratio (SCR) – ratio between short circuit and rated power
- Dependent on the location and grid components
 - Synchronous machines strengthen the system
 - Power electronics can weaken or strengthen the system dependent on the control



SHORT CIRCUIT EFFECT (SCR < 3)

High-level overview of the potential issues



NORDIC COOPERATION

Future objectives:

- System response during fault and recovery phase is managed
- Short term frequency stability / inertia response is managed
- Cross-border and system level converter-driven oscillations are managed
- Cross-border resonance stability is managed
- Nordic black start and islanding capabilities are maintained
- Cross-border effect of voltage control is coordinated
- Cross-border relay protection systems are coordinated and well-functioning
- Cross-border power quality is managed

Immediate actions:

- Systematic Nordic PEID related stability event and study knowledge sharing
- Harmonizing Nordic electromagnetic transient modelling requirements for connections
- Creating Nordic NDA legal framework for model exchange between plant owners and TSOs
- Nordic phasor measurement unit (PMU) deployment and data exchange to enhance the system awareness and controllability using PMU in the Nordic system for the long run
- Harmonizing understanding of PEID grid forming capability on functional level

GRID-FORMING DEPLOYMENT PROJECT

Energinet has started a project to accelerate the potential of using grid-forming technology in the Danish power system.

- Solving the chicken or the egg problem by direct communication and cooperation
- Alignment of system needs and technical capabilities
- Overall goal:
 - Ensure that the grid-forming technology becomes available to Energinet and stakeholders as quickly as necessary – this in close cooperation with the right stakeholders.



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