



Heimdall Power

# Quicker connection of wind with grid monitoring and DLR

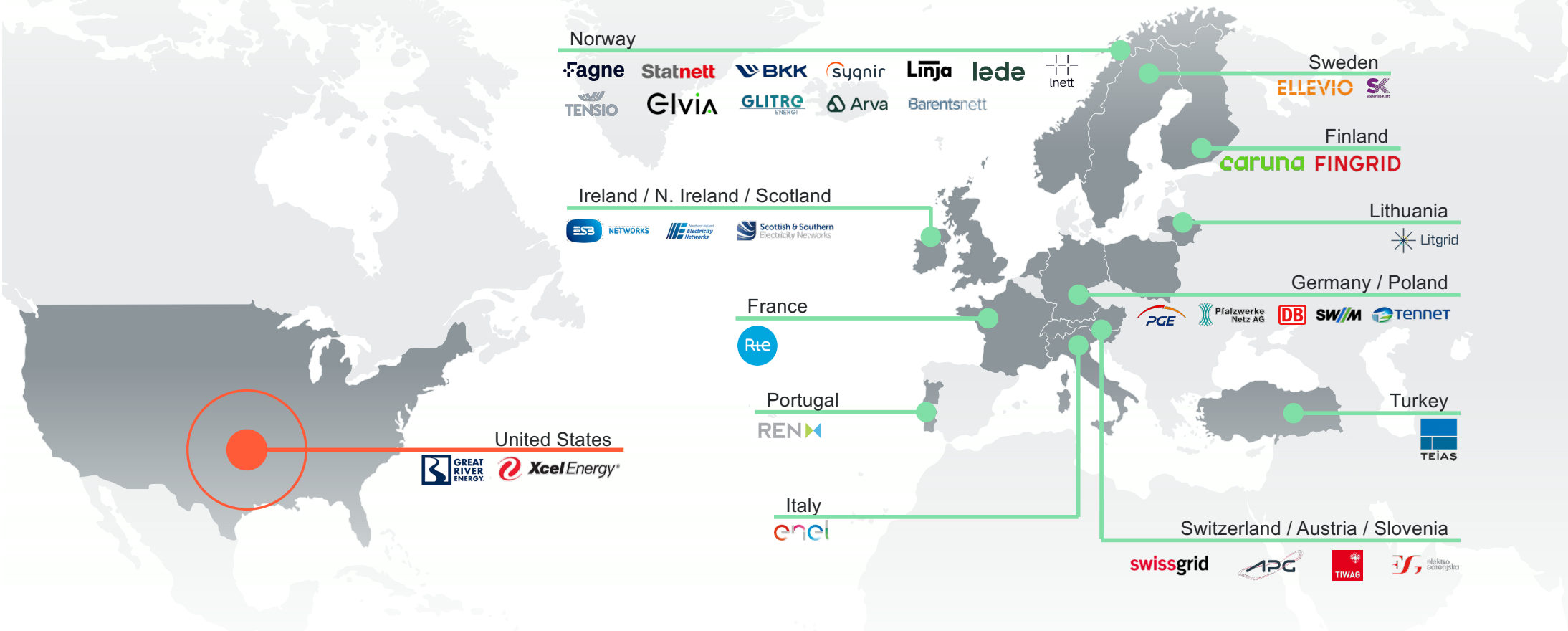
Vivi Mathiesen, VP Regulatory Affairs, Heimdall Power



# Heimdall Power is a trusted vendor globally



35 grid companies across 16 countries<sup>1</sup>

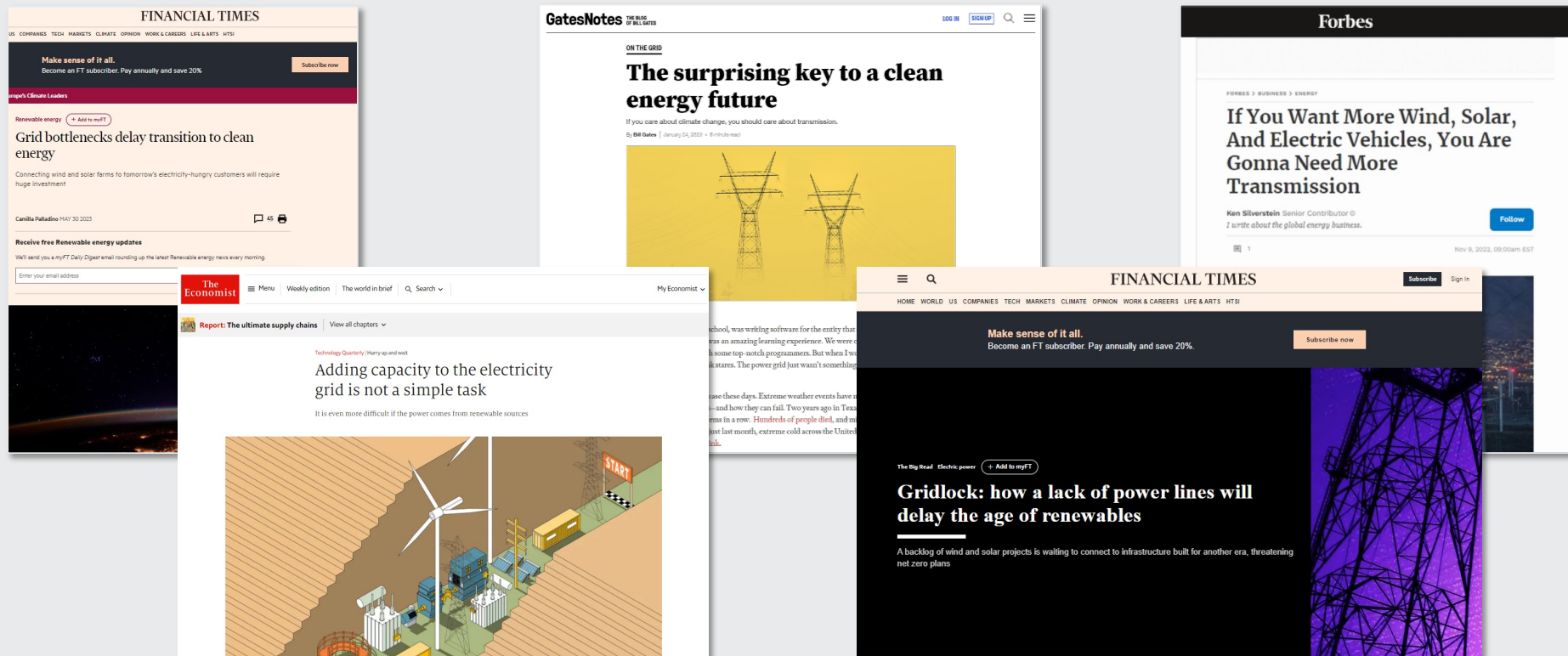


Notes: 1) selected clients



# Power grids have become a mainstream topic

Key to reaching net zero and other policy targets



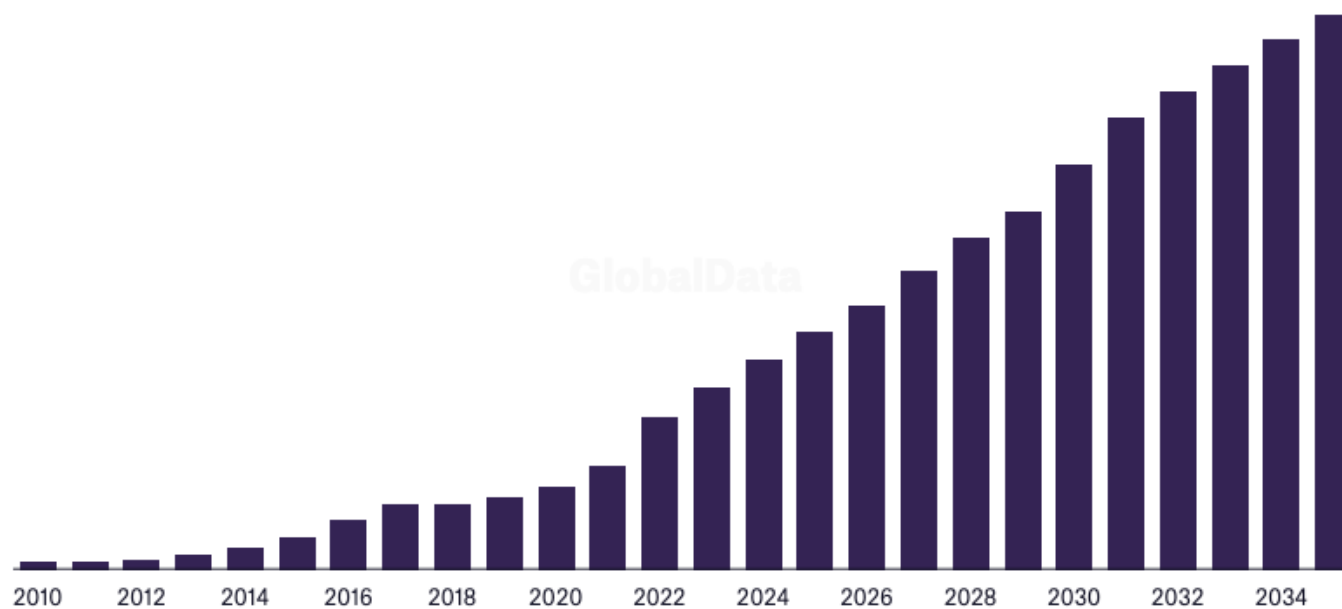
# Large planned volumes of wind in Finland

Can the grid keep up?



## Historic and forecast wind power generation capacity, 2010-2035

Installed Capacity (MW)



Source: GlobalData's Finland Wind Power Analysis: Market Outlook to 2035 report

<https://www.power-technology.com/data-insights/wind-power-in-finland/>



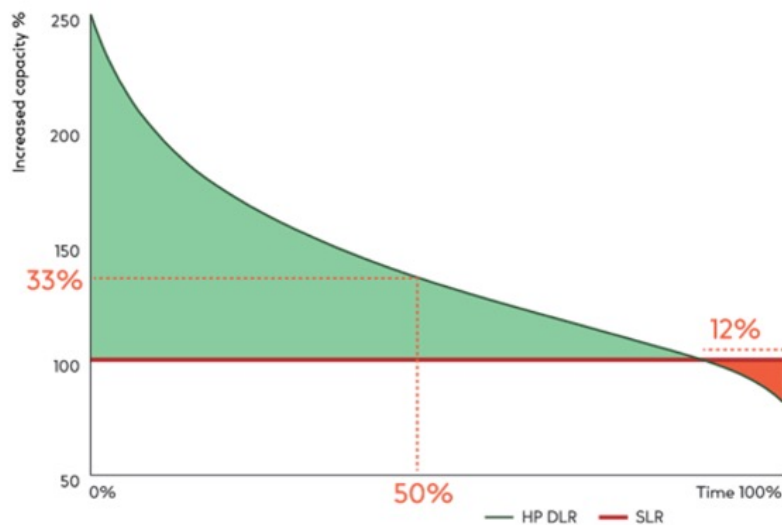
# Monitoring can reveal significant additional capacity



DLR utilizes the fact that capacity varies with temperature

In operations:

- Temperature measurements
- Sag and clearance to ground
- Actual Ampacity - DLR
- Emergency rating



**+30%** capacity increase on average and up to 200% in many cases

**1-5%** of the cost of a new power line to deploy Heimdall's solution

**Days** and weeks rather than years of installation time – no shut down

**Plan** more efficient and save cost by postponing or avoiding investments

TRL 9 – System ready for full scale deployment

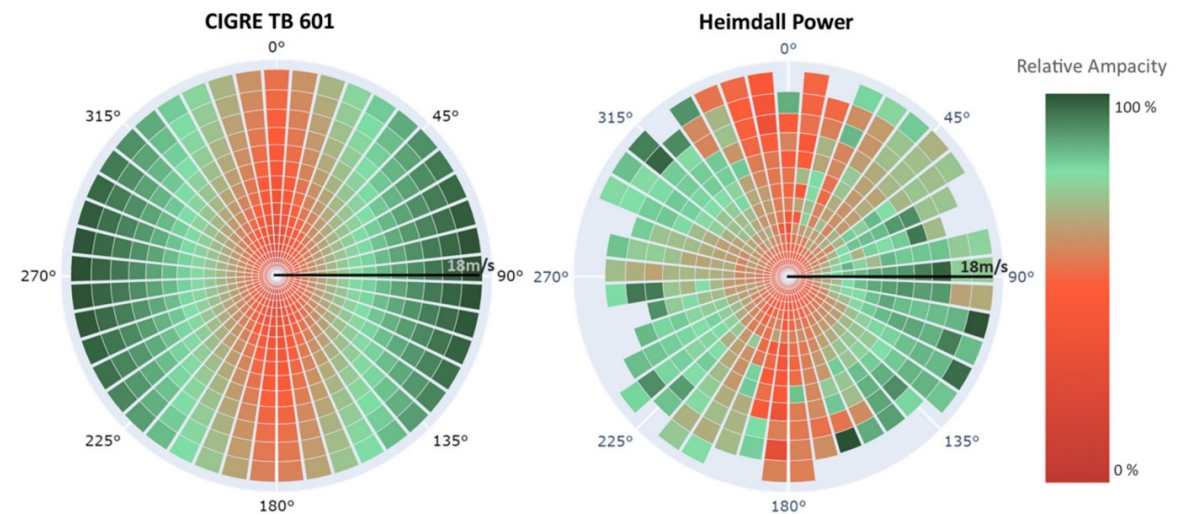
Source: <https://www.entsoe.eu/Technopedia/>



# In general – two ways to acquire DLR

## Weather based vs. sensor based

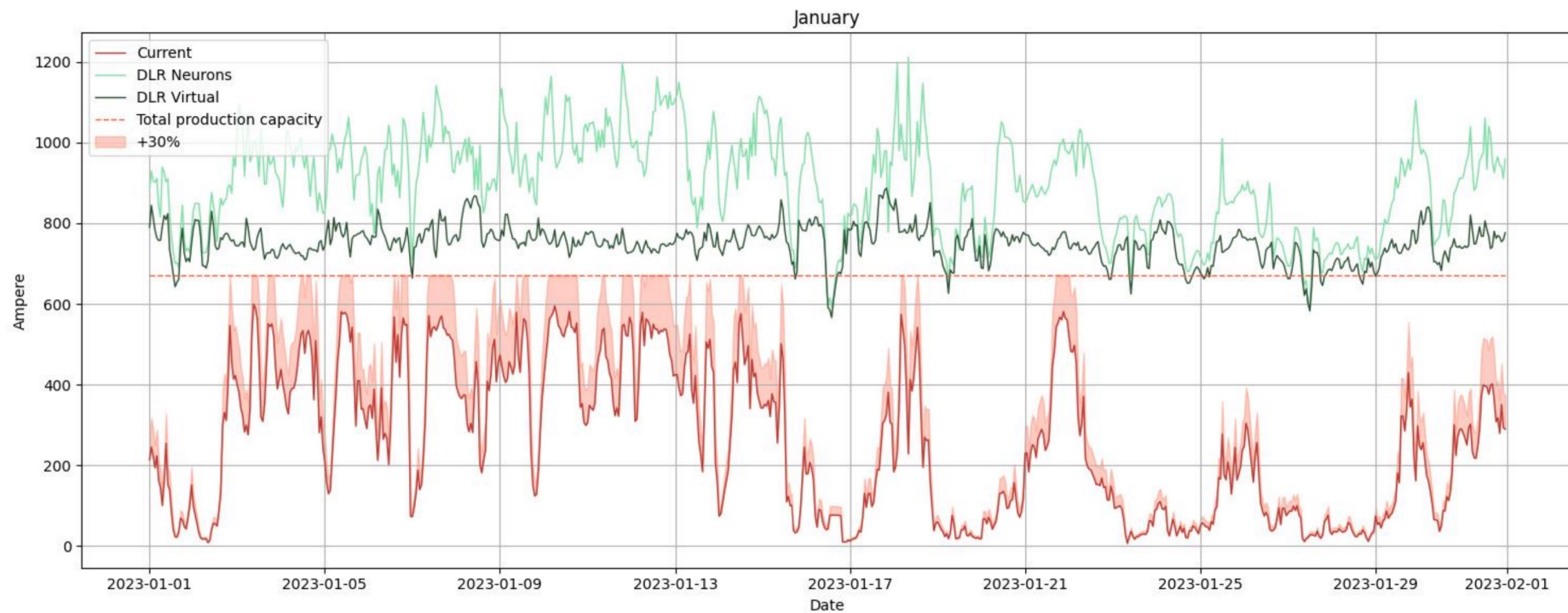
- Weather- (software-) based
  - Data from meteorological services & local weather stations
  - Calculates temperature on the conductor
- Sensor-based
  - Measures temperature directly on the conductor
  - Calculation of sag based on the angle of the line at the span point





# Weather based vs. sensor based DLR

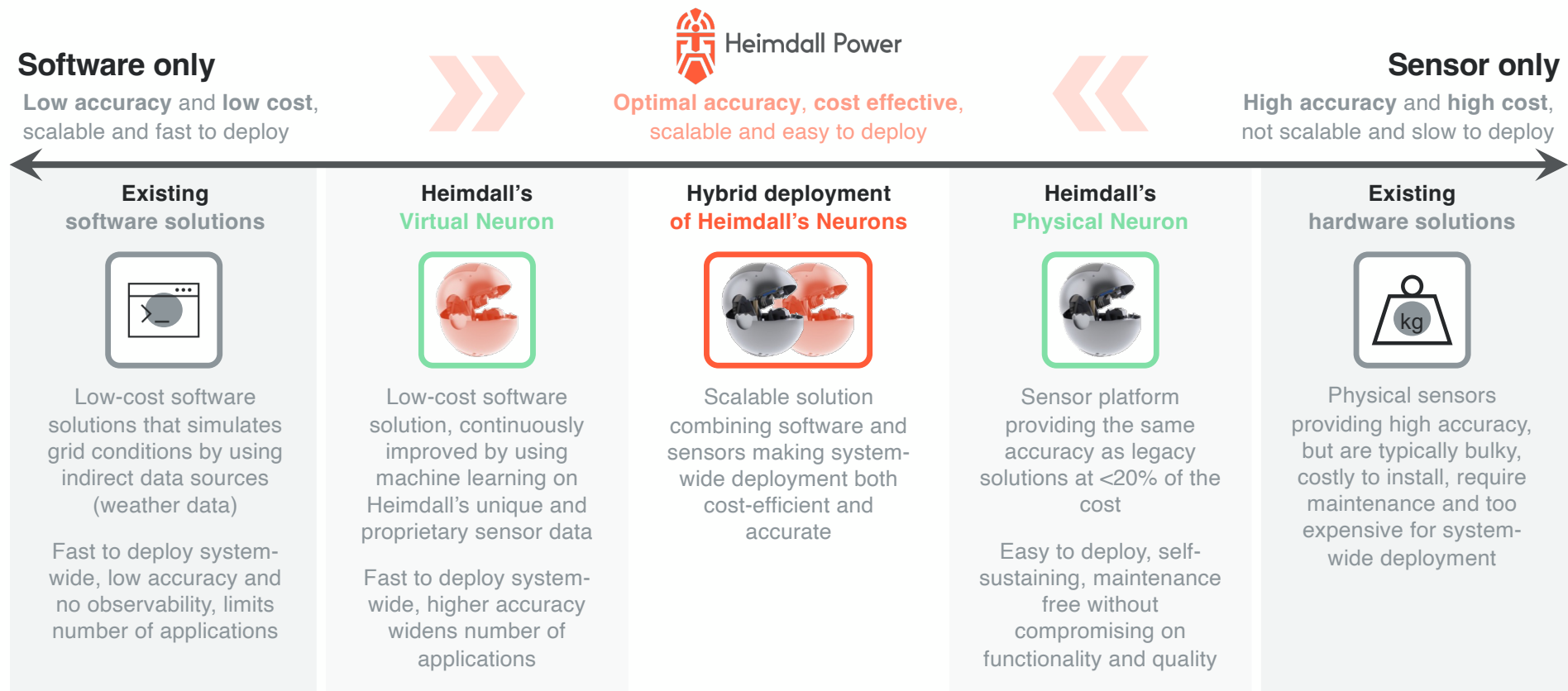
Adding more capacity and understand the dynamic load limits





# Heimdall Power combines both methods

The sweet-spot between accurate sensors and advanced software



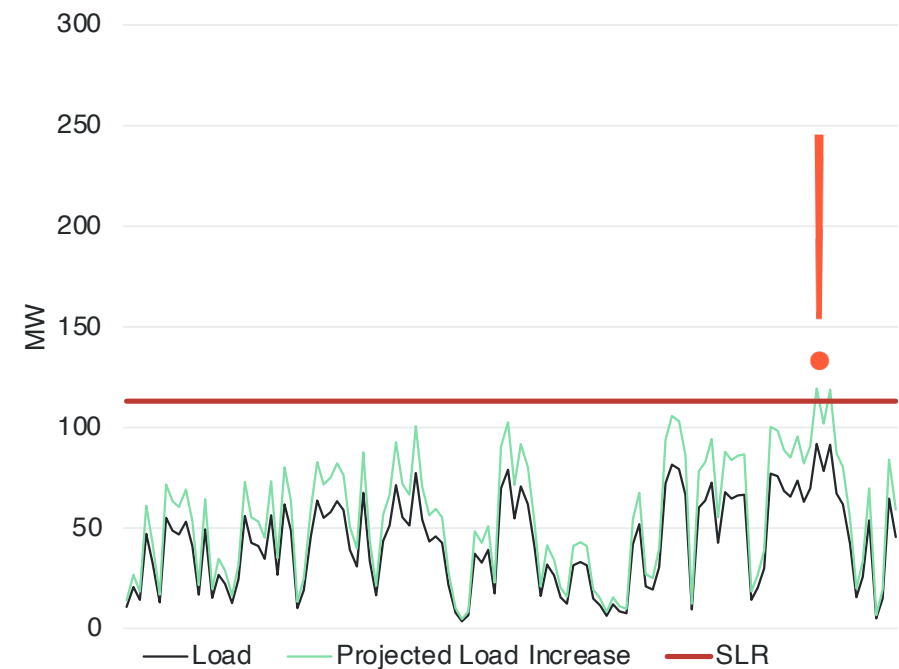


# Case example: increased capacity of wind farm

Heimdall technology unlocked hidden capacity through new load limits



Grid capacity over time  
MW load

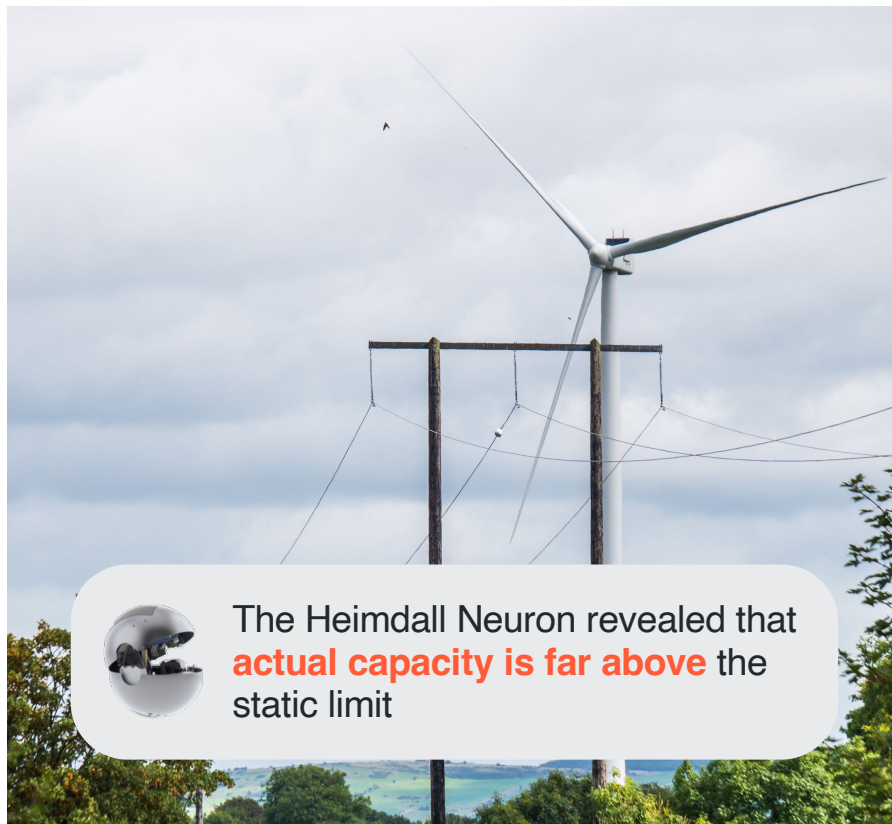






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Grid capacity over time  
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# Our journey towards a system-wide offering

From R&D-pilots to single-line monitoring, and now system-wide applications

## Non-commercial 2016-2019

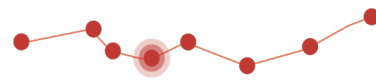
Technology verification of sensors and software through PoCs with pilot customers



Exploratory phase

## Single-line monitoring 2019 →

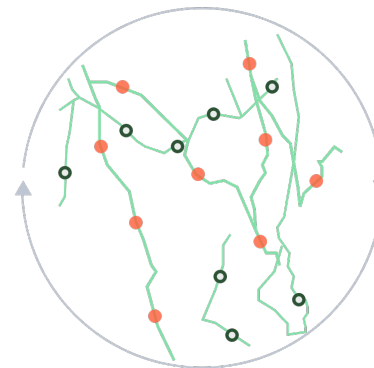
Deployment of a limited number of sensors to solve specific problems on a few lines (Capacity / Ice / Vibration)



Pilot phase

## System-wide grid monitoring 2023 →

Combination of Virtual and Physical Neurons to provide an unrivaled combination of accuracy and cost at scale



Implementation phase

### Sand-box solution

+ PGO

+ New assets



# Announcing the world's... 1st system-wide contract!

**Elvia** +  **Heimdall Power**



Grid to be monitored with Virtual Neurons  
**+3000 km**



Physical Neurons  
**>100**

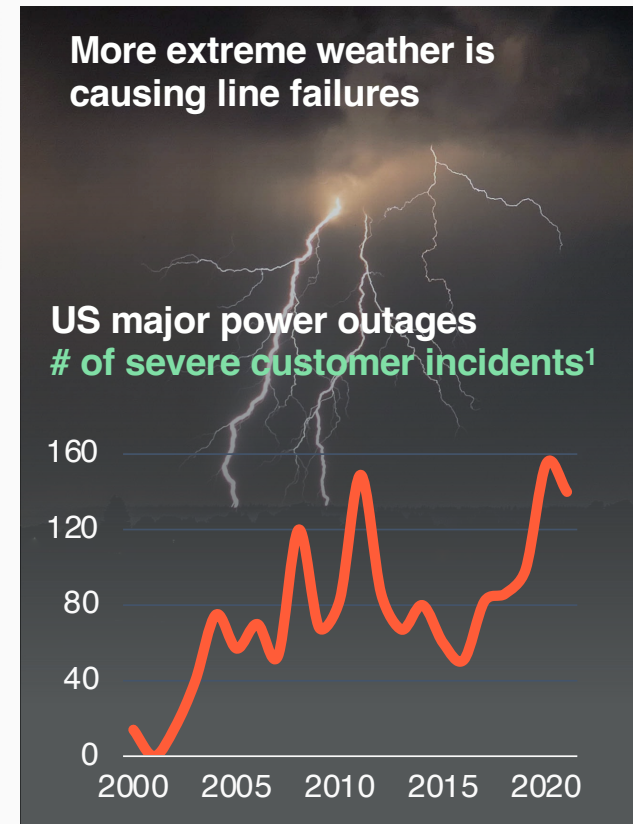
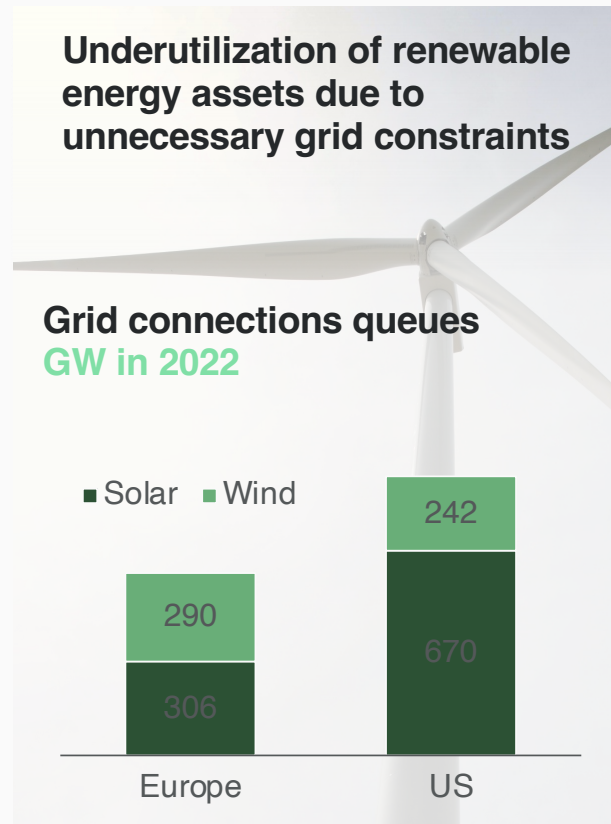
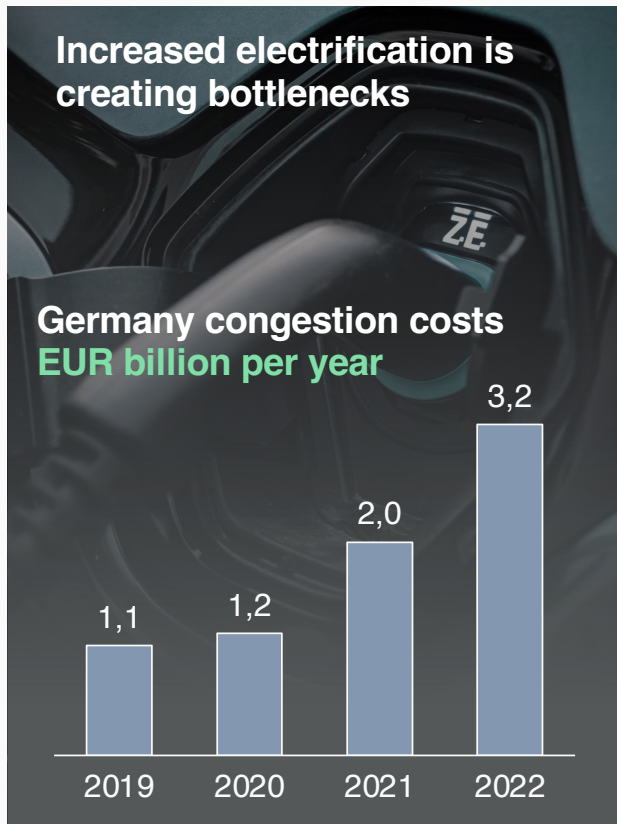


Neurons to be installed by drone  
**minimum 50%**

# The grid is facing new challenges – status quo is not an option



Grid operators need digital tools to accommodate renewables and electrification



Source: Climate Central; Bloomberg New Energy Finance; Heimedat Power  
Notes: 1) Affecting 50k customers or more





# Thank you!

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