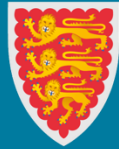


Environmental *Change* Institute



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SUSTAINABILITY LEADERSHIP

# Winter Peaks and Summer Valleys: Managing Grid Loads with Heat Pumps

KNVVK Young&Cool Congress 2025

**Dr Jan Rosenow**

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Jackson Senior Research Fellow, Oriel College, Oxford  
Senior Associate, CISL - Cambridge University

Utrecht, 19 June 2025



# EU power grid needs trillion-dollar upgrade to avert Spain-style blackouts

By Nina Chestney

May 6, 2025 9:02 AM GMT+1 · Updated 15 days ago

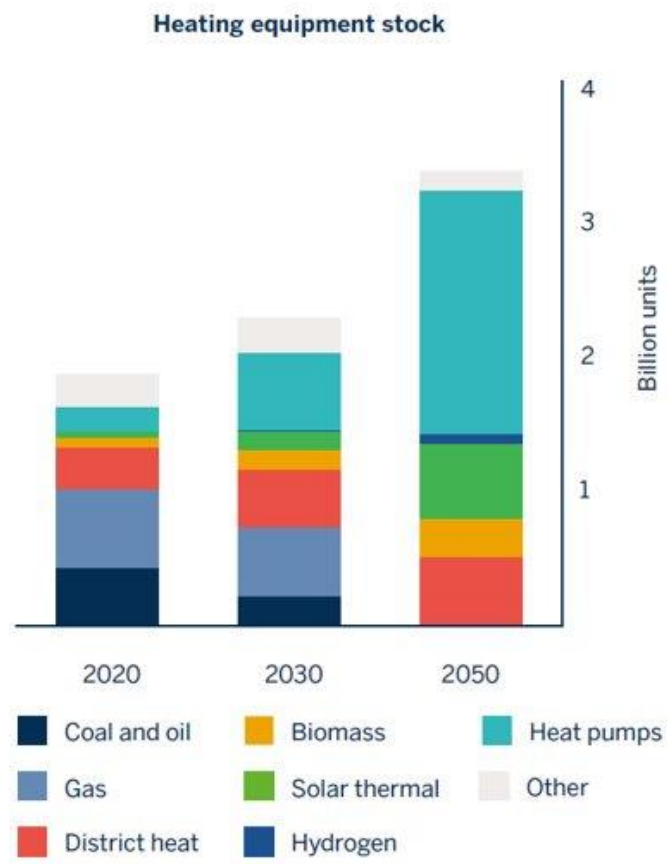


Power lines connecting pylons of high-tension electricity are seen during sunset at an electricity substation on the outskirts of Ronda, during a blackout in the city, Spain April 28, 2025. REUTERS/Jon Nazca/File Photo [Purchase Licensing Rights](#) 

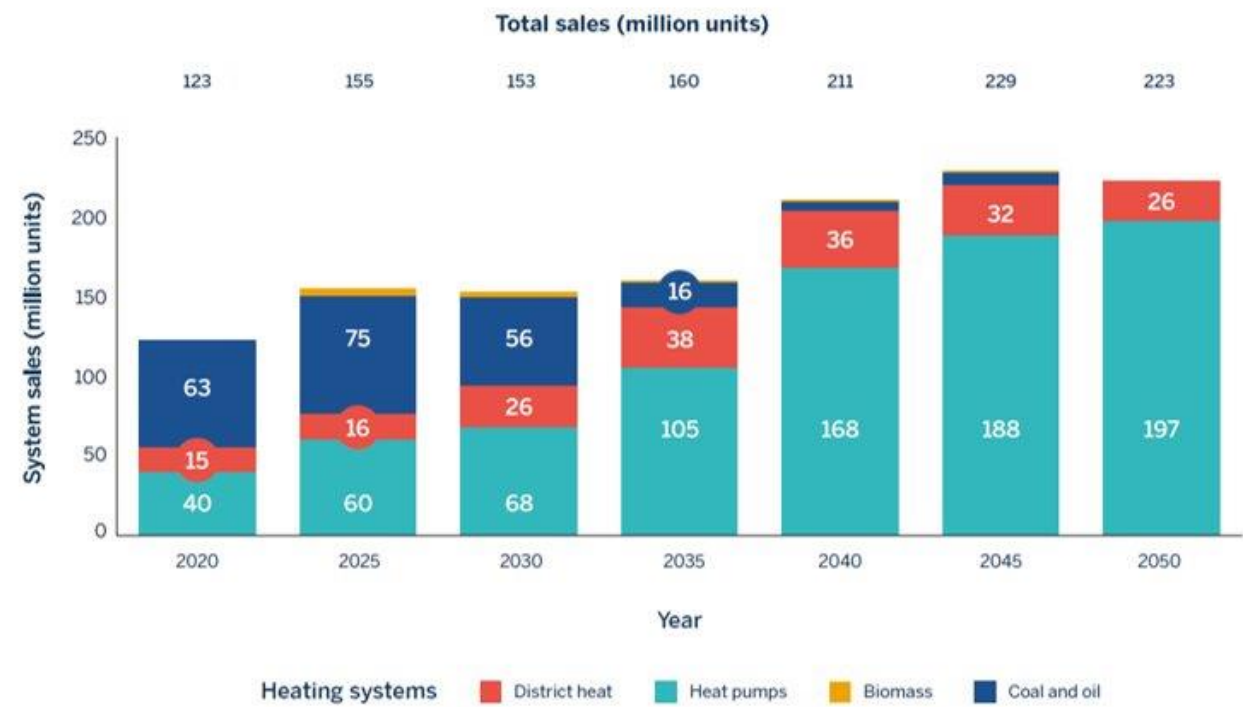


# Heat pump markets and trends

# Heat pumps are a critical technology for global heat decarbonisation

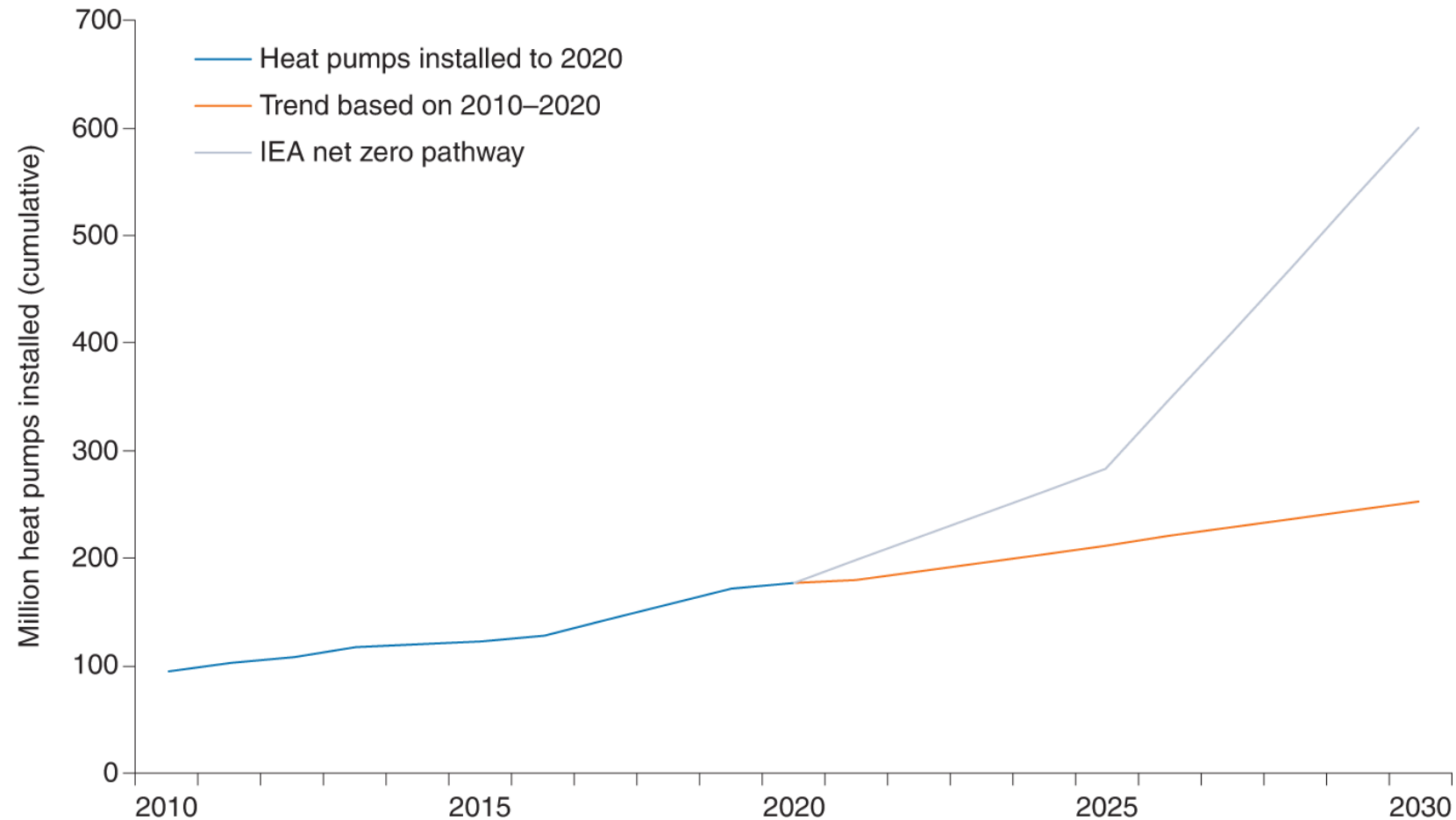


Source: IEA. (2021, May). Net Zero by 2050: A Roadmap for the Global Energy Sector.



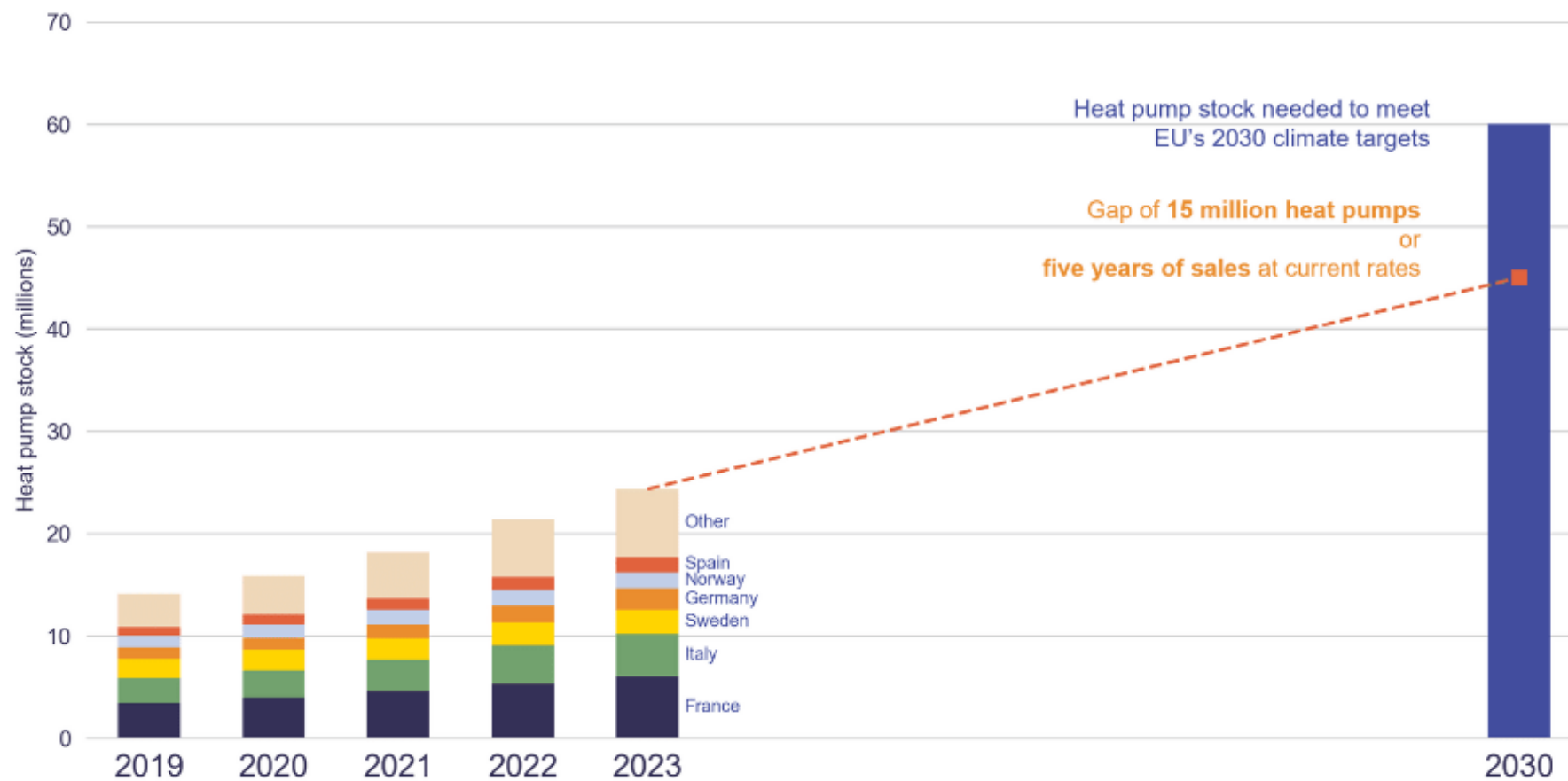
Source: McKinsey Global Institute. (2022, January). The net-zero transition: What it would cost, what it could bring.  
Note: Copyright (c) 2022 McKinsey & Company. All rights reserved. Reprinted with permission.

# More than 200m heat pumps installed globally



Source: Rosenow et al. 2022

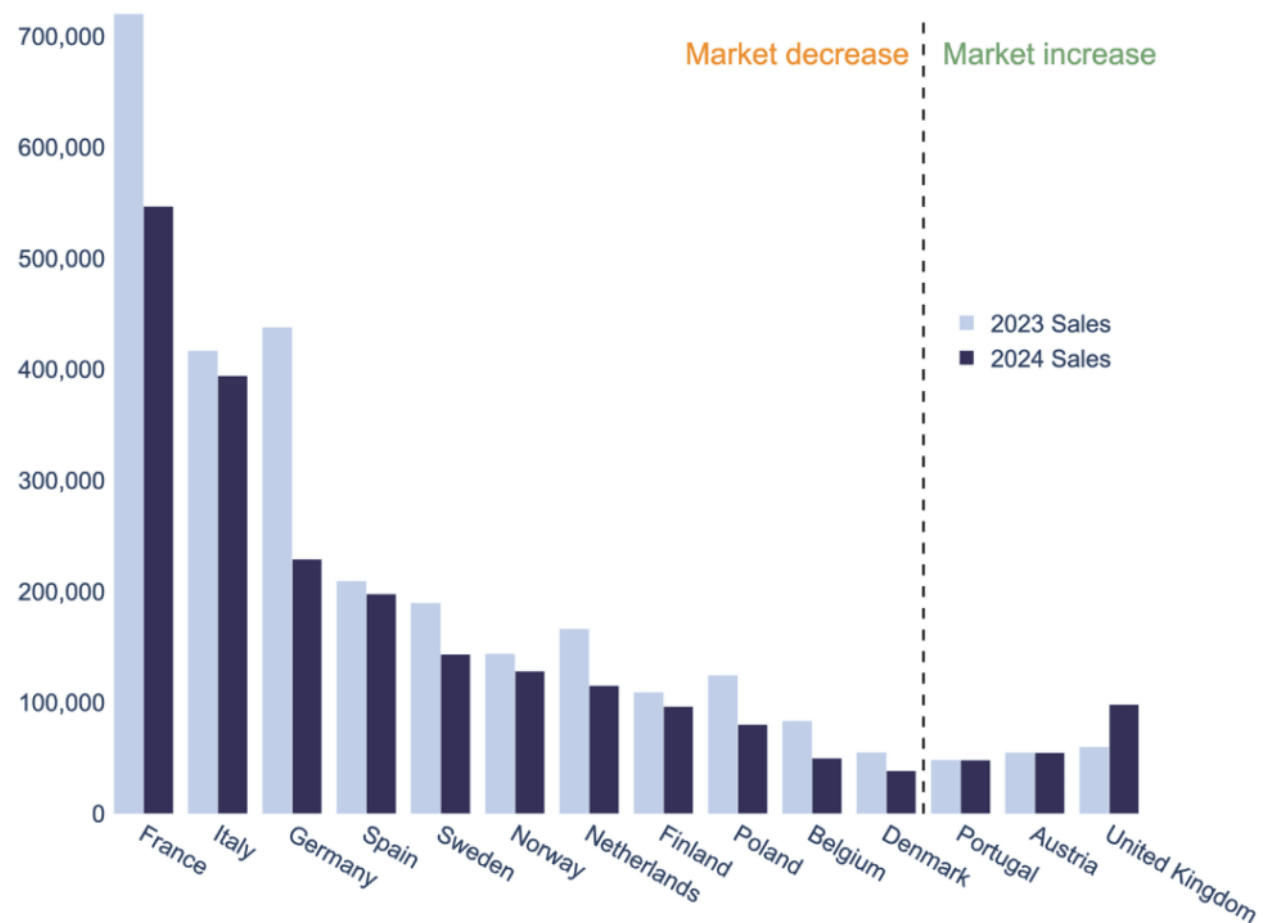
# EU heat pump deployment lagging behind targets



Source: EHPA 2024

# Declining sales in 2024

Heat pump sales 2023 to 2024 per country



Source: EHPA 2025



## Grid impacts

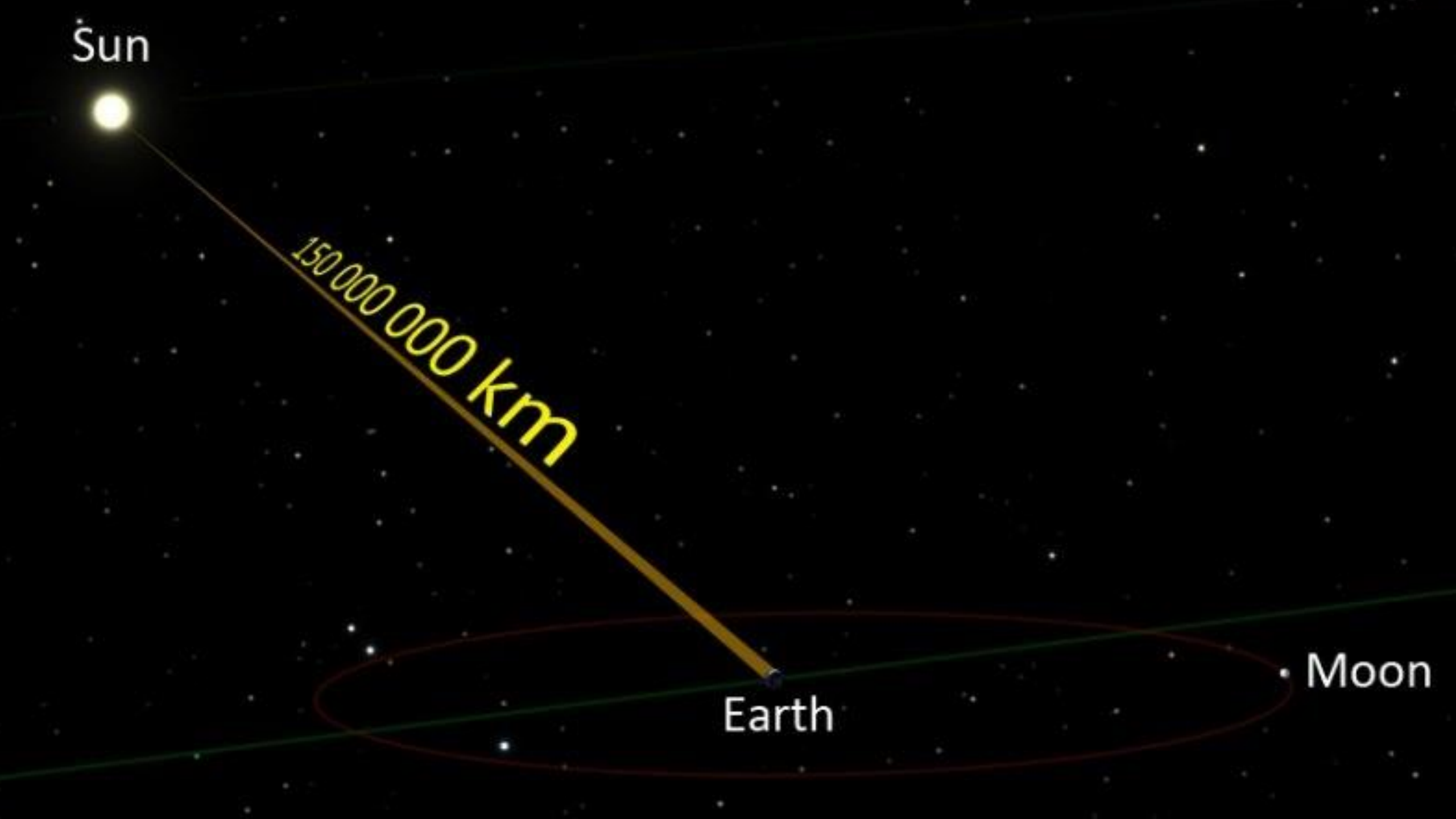
Sun



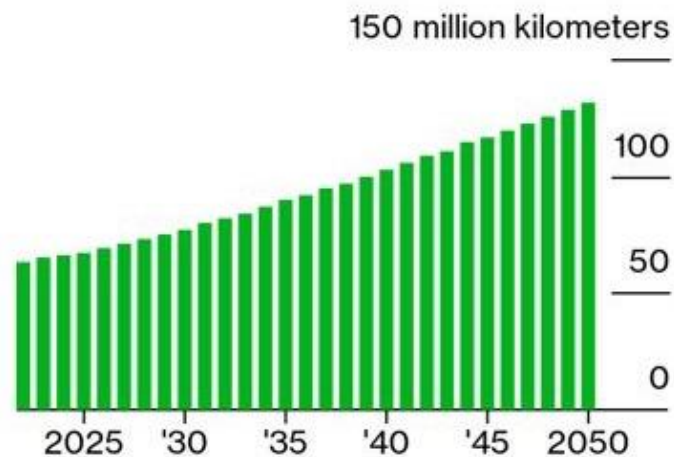
150 000 000 km

Earth

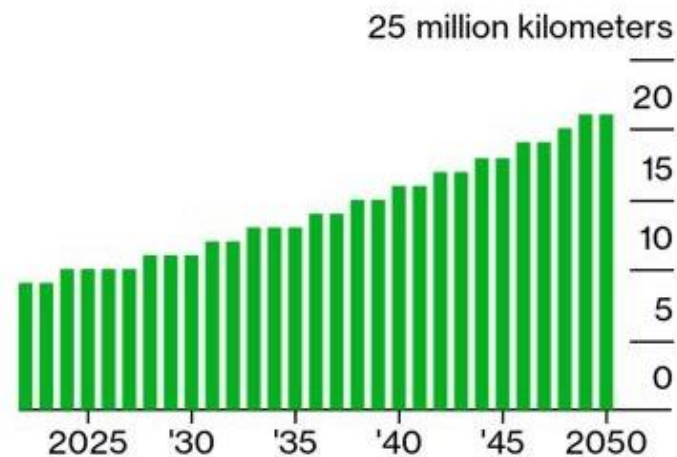
Moon



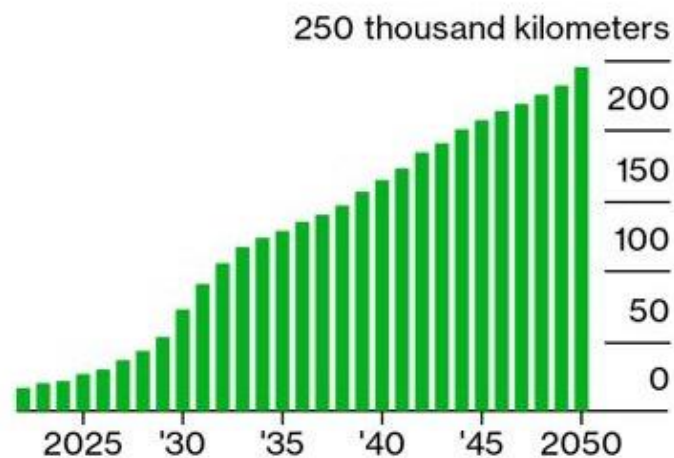
**Overhead cables**



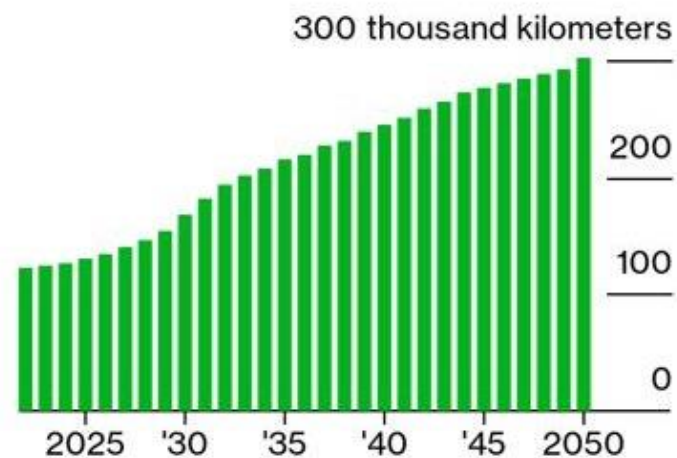
**Underground cables**



**Submarine cables**



**High-voltage direct current transmission**

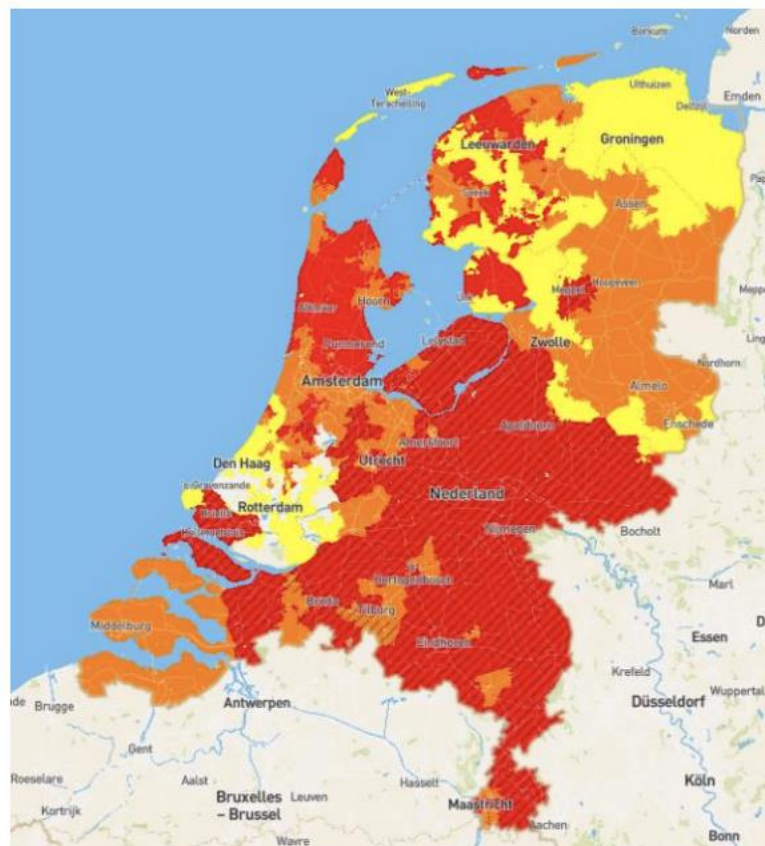


Source: BloombergNEF

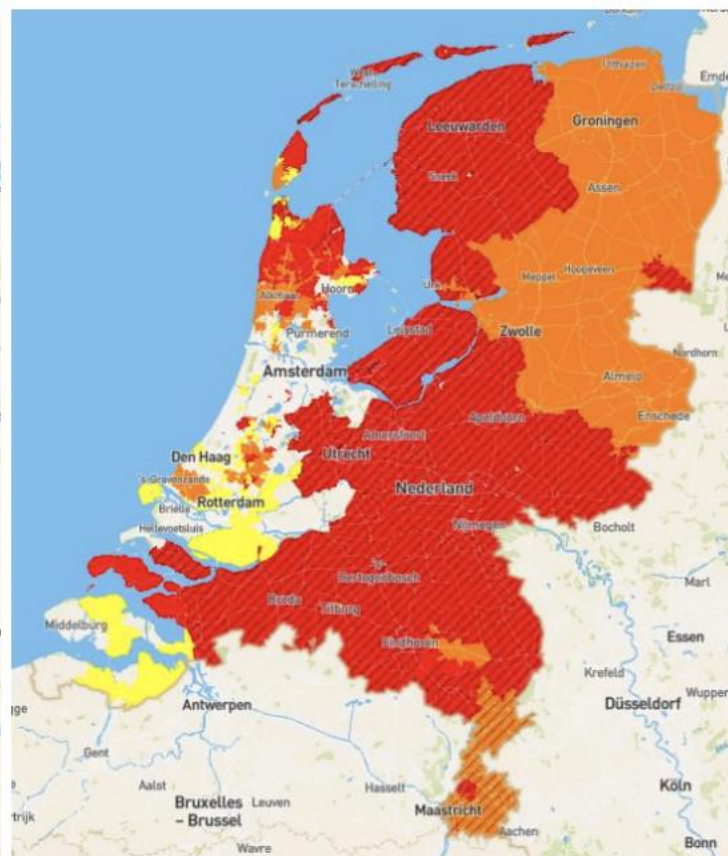
Note: Depicts the Net Zero Scenario in BNEF's New Energy Outlook, which maps a pathway to achieve net-zero emissions by 2050.

# Grids: the new frontier of the energy transition

New load



Feed in



## Meaning of the color codes

- Transparent: Transport capacity available
- Yellow: Limited transport capacity available
- Orange: No transport capacity available for the time being pending the outcome of the congestion management study
- Red: No transport capacity available: congestion management cannot be applied

## With congestion management:

- ▨ Transparent hatched: Transport capacity available based on application of congestion management
- ▨ Shaded yellow: Limited transport capacity available based on application of congestion management
- ▨ Shaded orange: No transport capacity available for the time being pending distribution of the released capacity over the queue based on congestion management. (it is still unclear whether and how much power will become available for new requests that are not yet in the queue)
- Shaded in red: No transport capacity available: the limits for the application of congestion management have been reached.

Source: RAP 2024



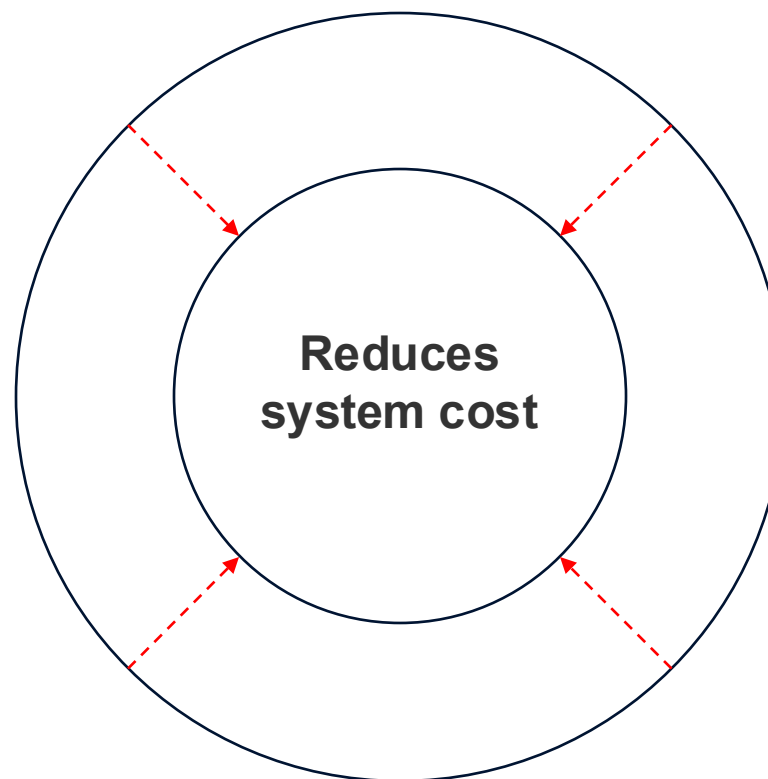
# HOW THE FAR RIGHT TURNED HEAT PUMPS INTO ELECTORAL ROCKET FUEL



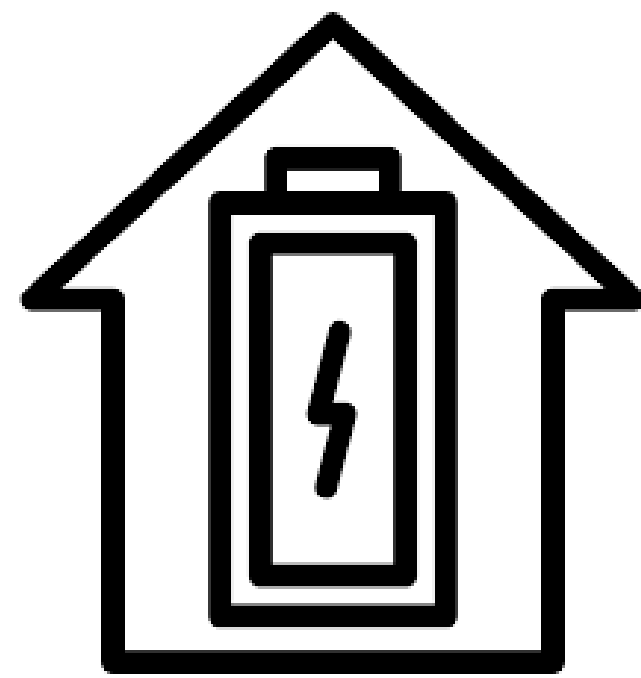
## Solution 1: Efficiency



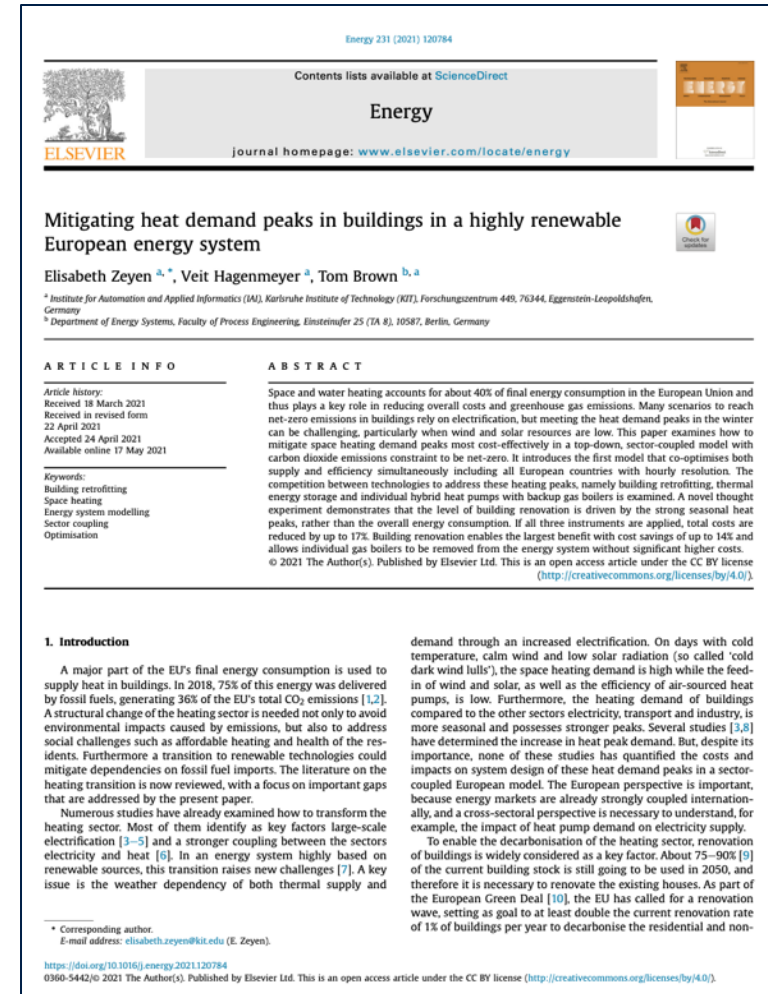
# Benefits of fabric efficiency



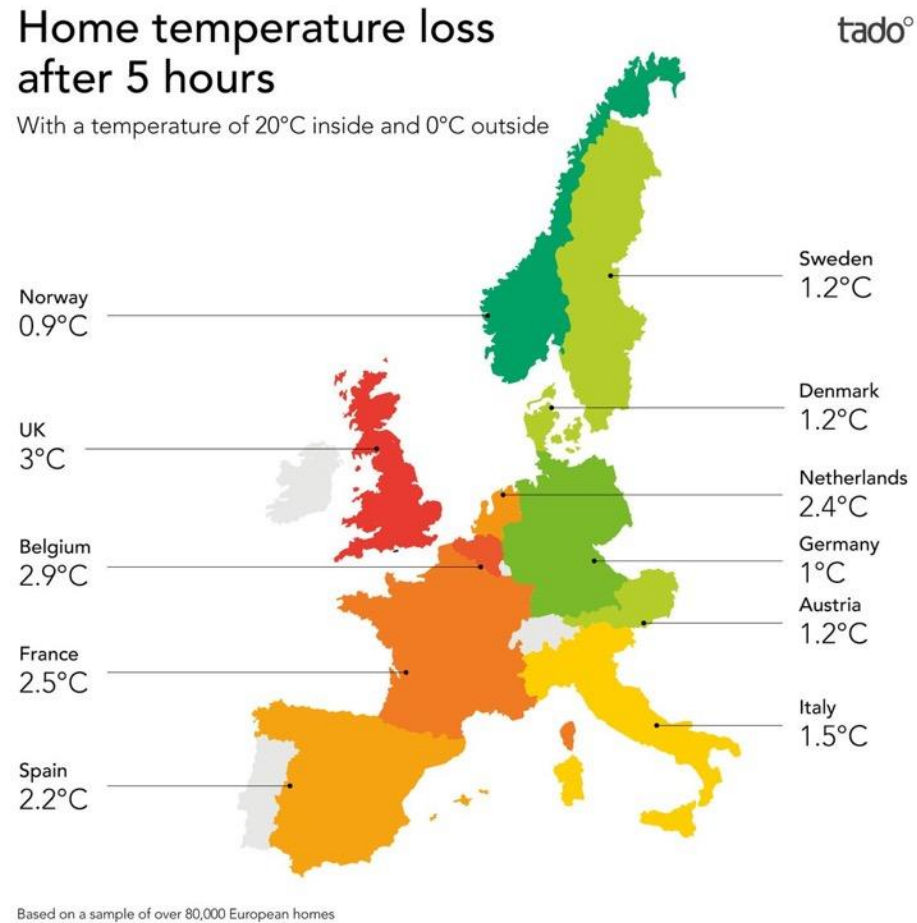
Reduces  
system cost



Provides thermal  
storage



# Thermal storage potential across Europe





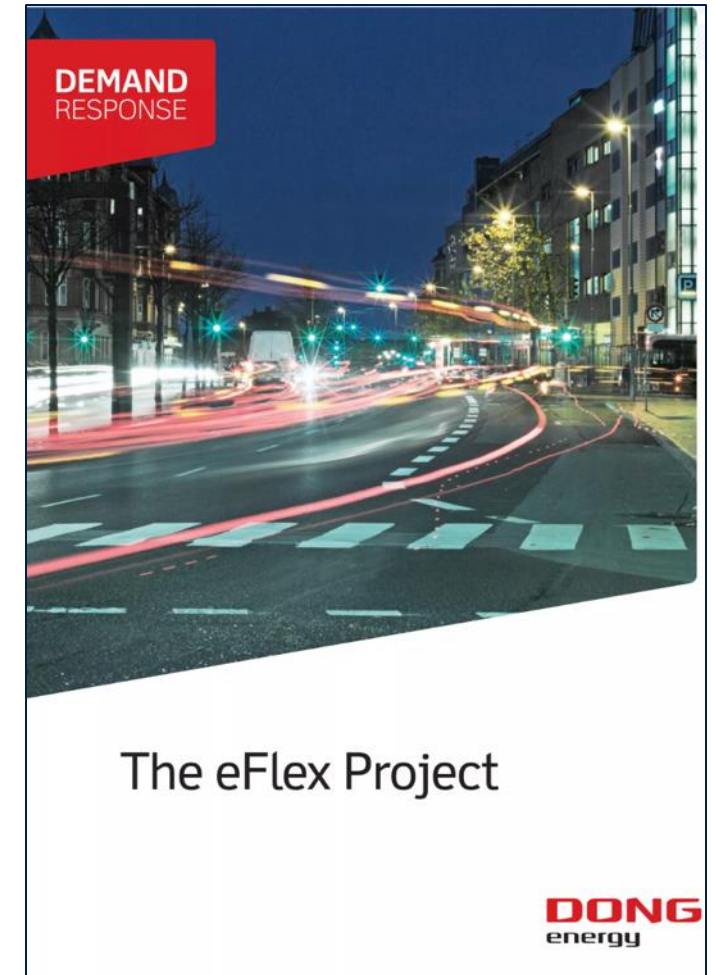


## Solution 2: Flexibility

# Early pilot project in Denmark

“Heat pump portfolio optimisation can reduce the peak by 30% of the heat pumps’ own contribution in the peak.”

“In 2/3 of the planned two hour optimisations the heat pumps did not consume energy in the full two hour period.”



## Energy & Grid Management

# TenneT to pilot household flexibility in managing grid congestion

Jonathan Spencer Jones • Jun 04, 2021

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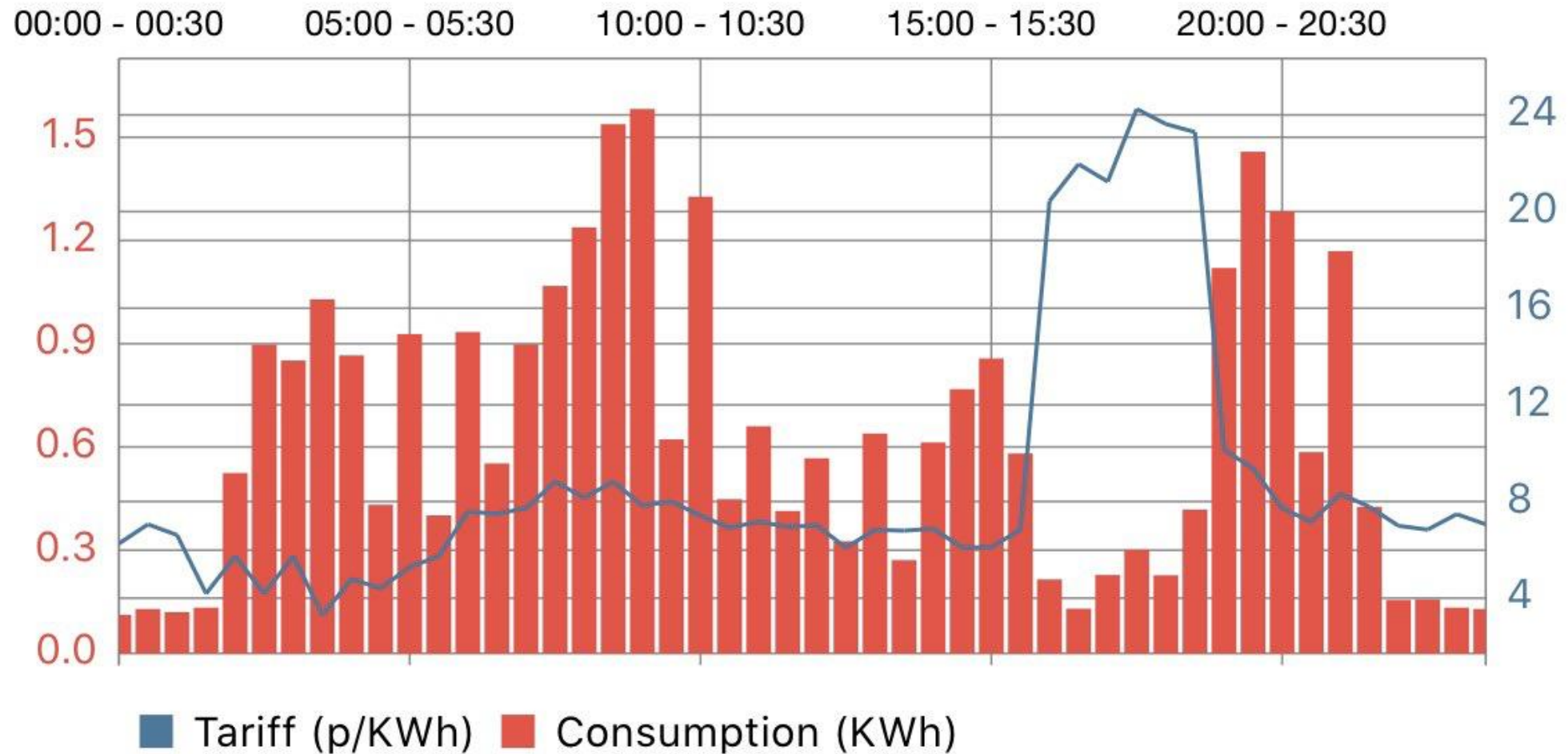


TenneT is partnering with software provider GreenCom Networks to pilot securing flexibility on the blockchain-based Equigy platform.

The trial is aimed to test ways in which decentralised energy producers, consumers and storage can be integrated to prevent bottlenecks in the transmission system and to balance out fluctuations in power generation and consumption.

To this end, GreenCom will aggregate the control of smart devices such as heat pumps and electric vehicles of the test customers on the company's own platform and then offer these capacities on the Equigy Crowd Balancing Platform. From there, TenneT, the transmission system operator (TSO) with operations in Germany and the Netherlands, can call them up if necessary.

# Tariffs to reward flexibility



# Time-of-use tariffs make heat pumps flexible

## Impact of heat pump adoption and heat pump time-of-use tariff on consumption throughout the day



“Based on Octopus Energy’s Cosy Octopus tariff designed for heat pump owners, we see an approximate doubling of consumption during off-peak periods and a halving of consumption during the evening peak.”

Source: Bernard et al. 2024

# Pilots from US confirm possibility of load shifting



## BTO Peer Review: Load Flexibility with Heat Pumps

Field study of heat pump load shifting  
in rural cold climate regions

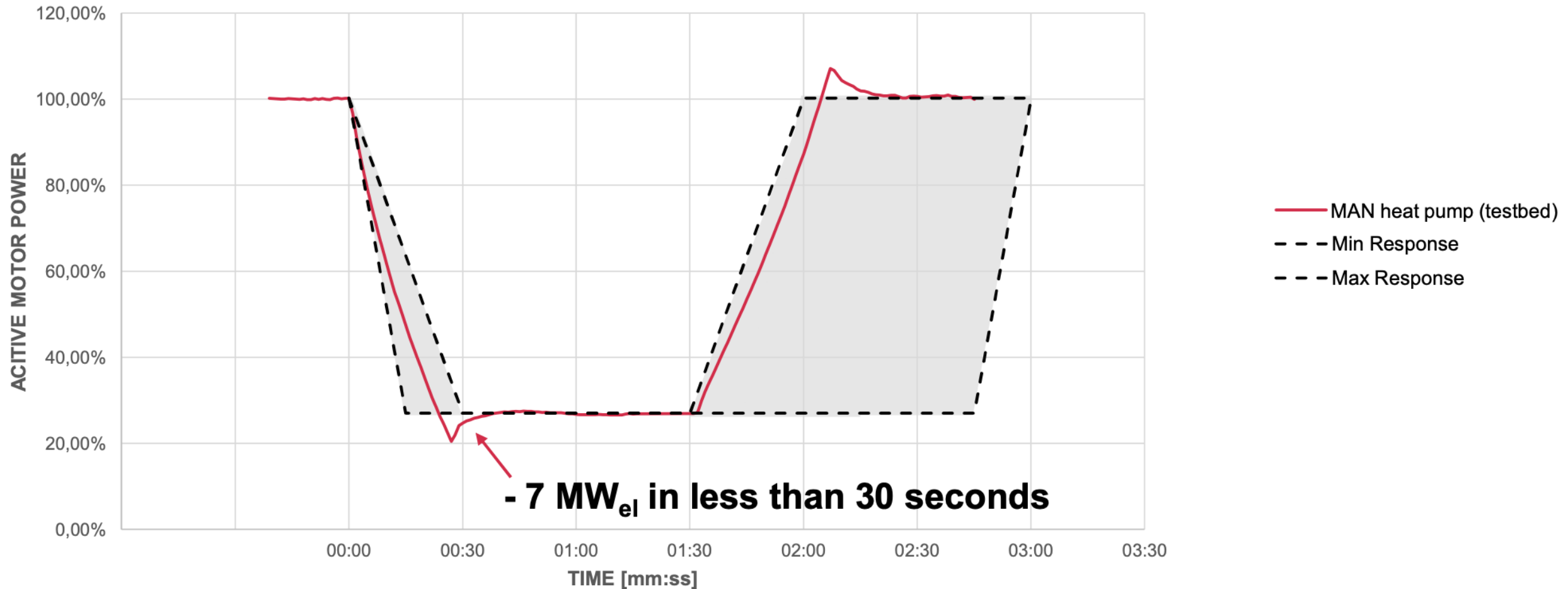
Presented by Chitra Nambiar

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Org: Pacific Northwest National Laboratory  
PI: Sam Rosenberg, Building Scientist  
509-375-2685, [samuel.rosenberg@pnnl.gov](mailto:samuel.rosenberg@pnnl.gov)  
Project No.: 1.4.1.19 Task 2



# Large heat pumps can also offer demand response



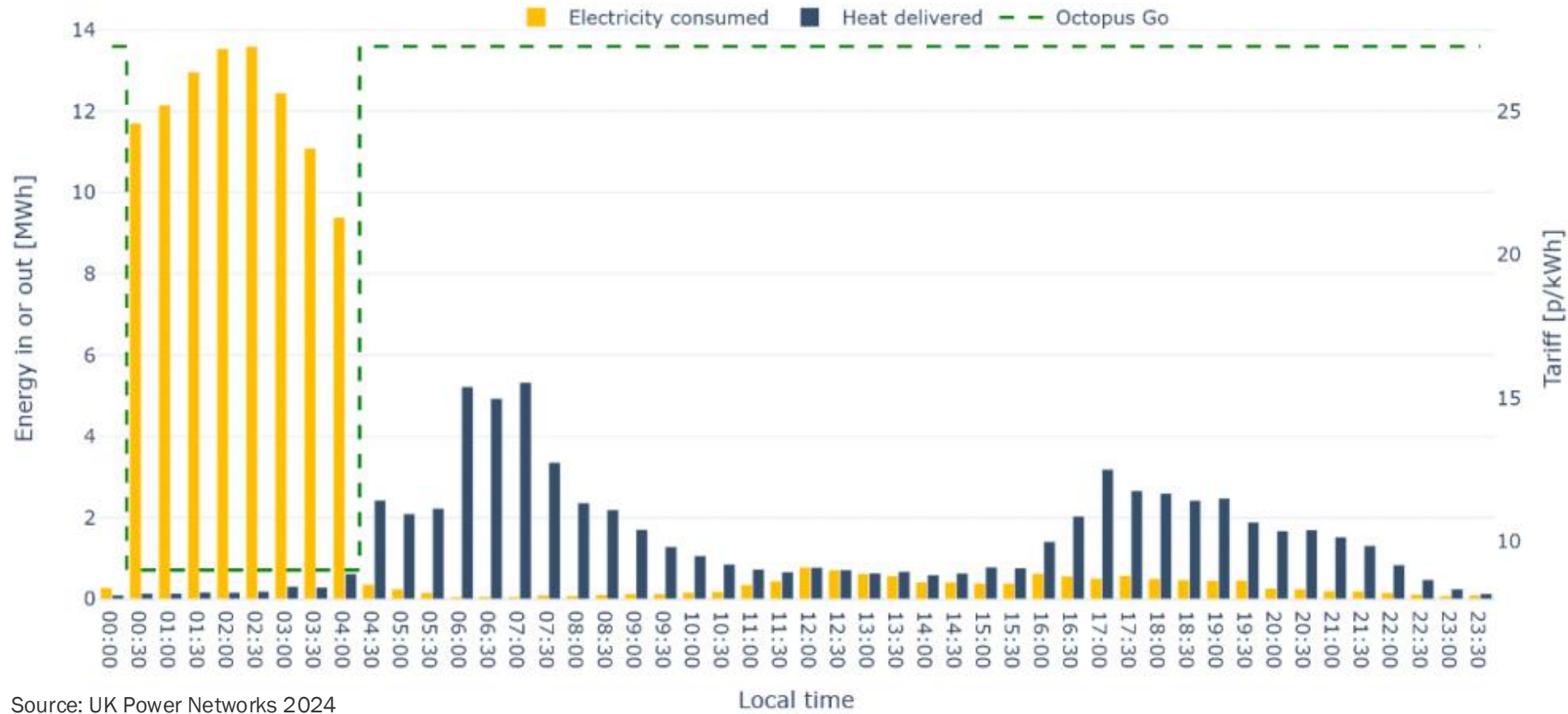
Source: Wolscht 2023



## Solution 3: Storage

# Heat batteries can help to shift load off-peak

Energy Consumed and Delivered by Time of Day: 40 ZEBs on Octopus Go.  
2023-06-01 to 2024-05-31. **88.3%** of energy consumed off-peak



Source: UK Power Networks 2024

“Even in winter conditions, where 67% of the heating demand fell during the most expensive system price periods (morning & evening), the ZEBs drew <10% of their total power requirement at peak times.”

# Thermal storage combined with district heating



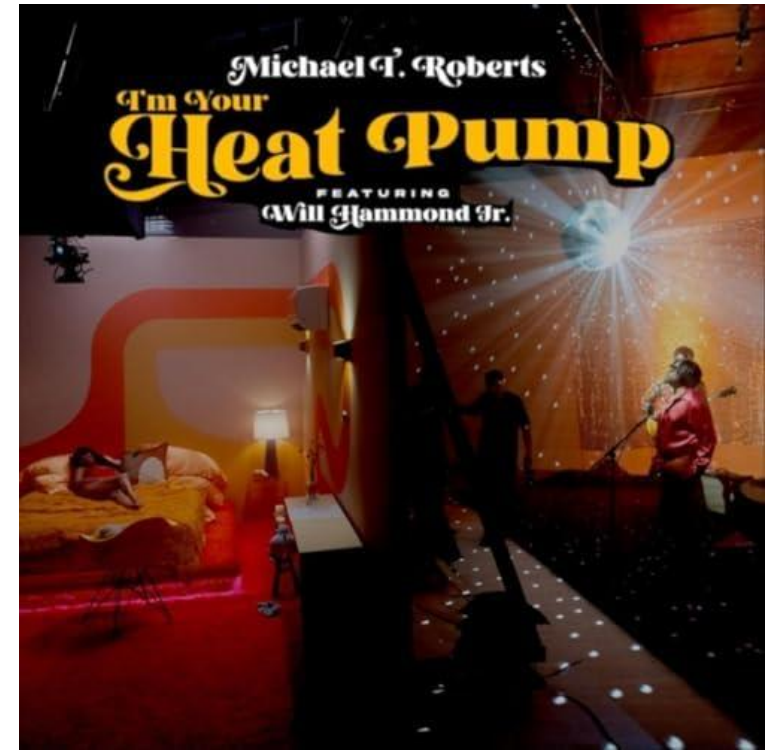


**Wrap up**

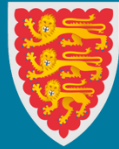
Lyrics: I'm Your Heat Pump by Michael T Roberts and Will Hammond Jr

I'm your heat pump  
When you want it hot, I'm hot for you (I'm your heat pump)  
When you want it cool, I'm cool witchu, babe  
'Cause I can do it all for you, baby  
All you got to do is turn me on  
And I'll go on and on for you (check me out) Part of me goes inside (inside)

Part of me goes out (all of me pumpin' for you)  
I'm precisely calibrated  
To make you scream and shout ('cause I'm electric in yo' hizzy)  
'Cause I can move heat in or out (in or out)  
'Til you feel what you wanna be feelin' You and me + electricity (come on) =  
Climatic healing (Math y'all!)



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# Thank you

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