New role of the energy system

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Director Operations & Energy System

Energy Networks in Sweden

Our Purpose

We take an **active role** to drive change in the energy market and **contribute to society**. We **actively listen to our customers' and partners' input** to become better every day.

Together We Make New Energy Work

We **originate and develop** solutions as ***One E.ON*** with **customers, partners and society**.

We **make it easy** for our customers to be a part of the **new energy landscape.** We develop innovative solutions based on **customer's needs, for a sustainable future**.

Our group

Everyone is talking about new energy: we make it work!

We are one of Europe's largest energy companies with the business areas of energy distribution networks, energy infrastructure solutions and energy sales.

With our 1.6 million kilometer-long energy distribution grid and around 47 million customers, we are playing a leading role in shaping a green, digital and decentralized energy world.

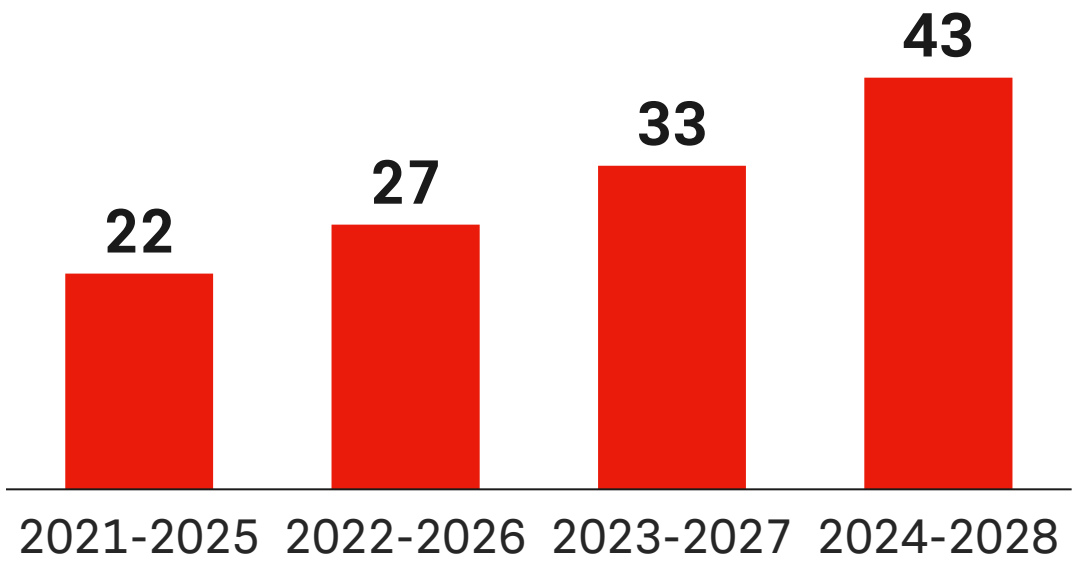
It's on us to make new energy work.

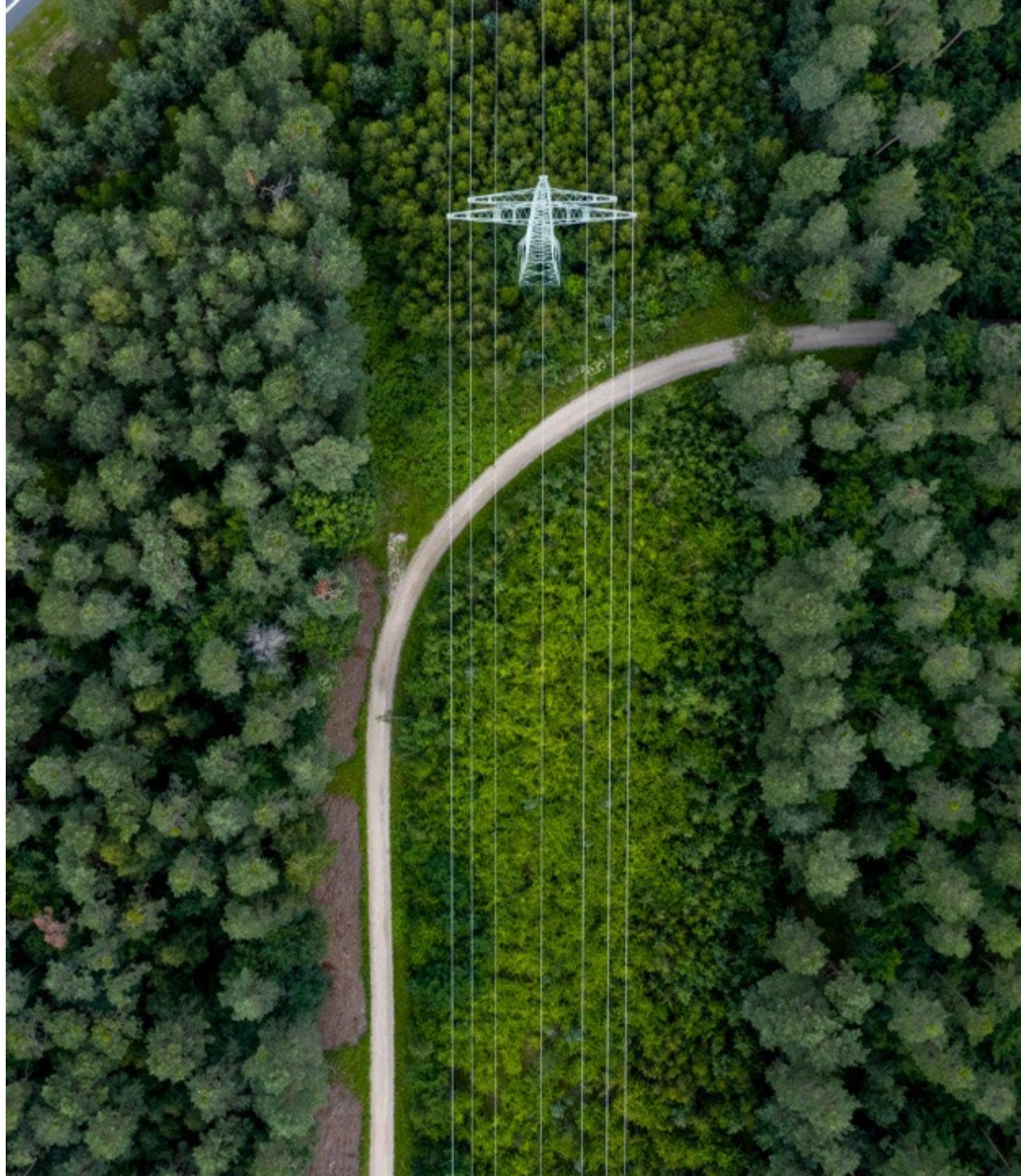
At a glance (financial year 2024)

Employees **77** thousand	Customers **47** million
Energy grids **1.6** million kilometers	Investments **7.5** billion euro
New connections to E.ON grid in Europe **~500** thousand	Adjusted EBITDA **9.0** billion euro

Our investments enable a secure, sustainable and affordable energy system

Updated planned investments (Billion €)





Our strategic priorities

Growth

The energy transition offers great growth potential for our business model. We are underpinning this with a further expansion of our planned investments: Between 2024 and 2028, we will increase our planned investments to a total of 43 billion euros.

Sustainability

Sustainability is the core of our strategy and the benchmark for our actions. Our energy distribution grids are the backbone of the energy transition. Our solutions enable us to save more than 100 million tons of CO_2 every year. We ourselves intend to reduce the emissions that we can directly influence to net-zero by 2040.

Digitalization

We are reshaping the energy world through the power of digital innovation. We develop and are responsible for technologies for the energy transition, implement innovative and reliable software solutions, operate our IT platforms and are committed to digitalizing the entire system in all of E.ON's business areas.

Our business in Sweden

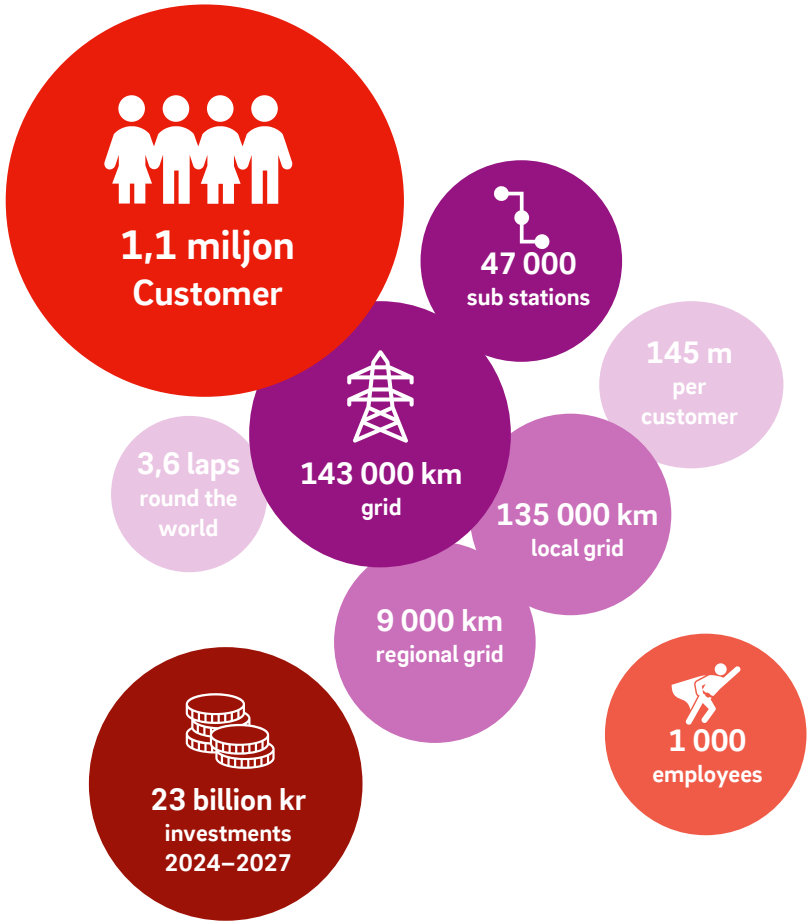
With our unique position, we have the power and the will to respond to the market changes and drive the energy transition forward

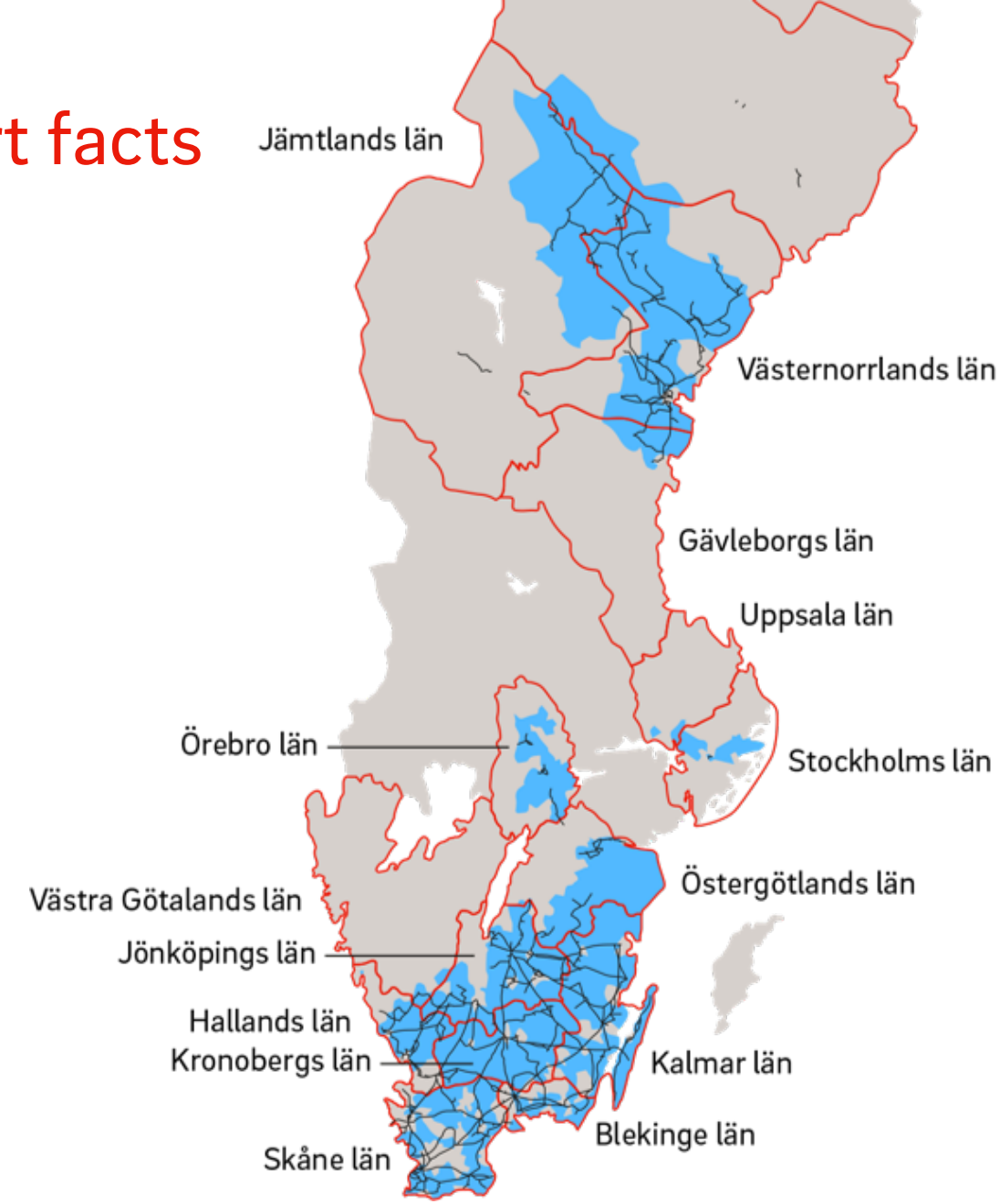
We have over
1 100 000 grid customers,
780 000 energy retail customers
and
300 000 district heating customers

We provide an **extensive range** of offerings, from **fundamental energy deliveries** to **highly innovative solutions**, addressing different needs of **consumers, businesses** & **municipalities**

With over **3 000** employees across the Nordic region, we maintain a strong **local presence,** active in around **100** Swedish **municipalities**

E.ON Energy Networks Sweden – short facts



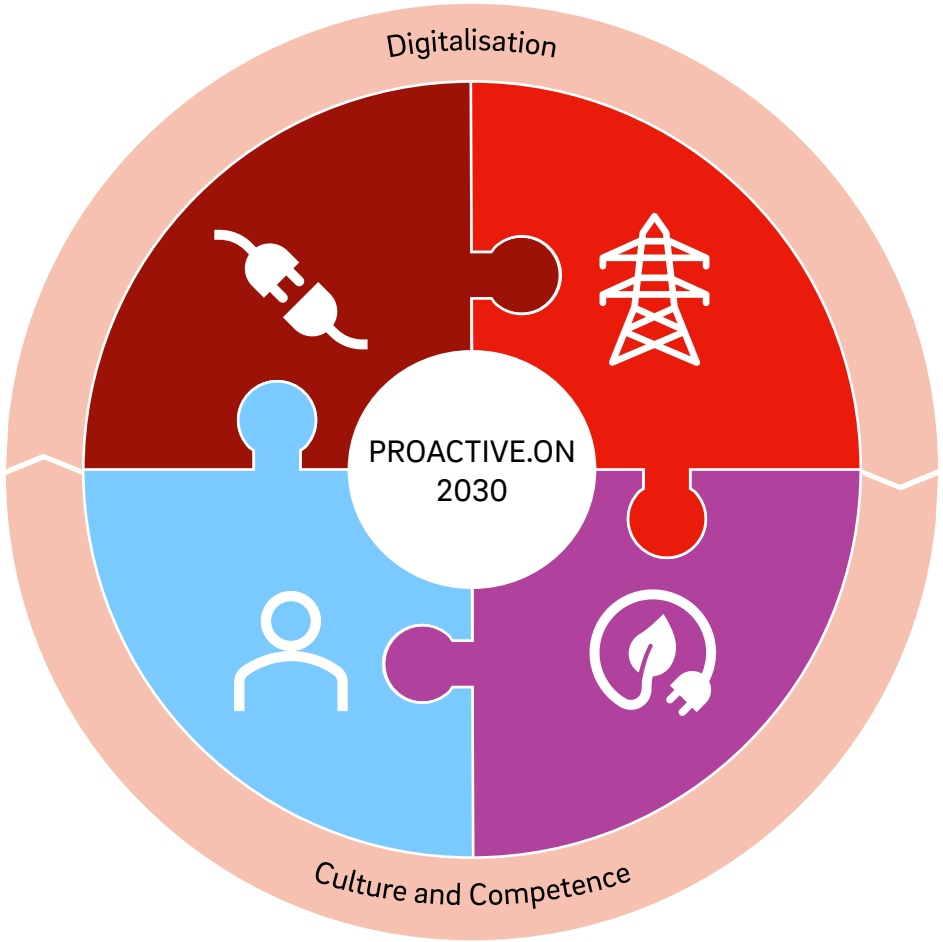



PROACTIVE.ON – we drive a sustainable energy transition with outstanding accessibility for our customers

Our strategy has four focus areas and two enablers

CAPACITY
Meet capacity needs

AVAILABILITY
<30,000 customers with >3 outages

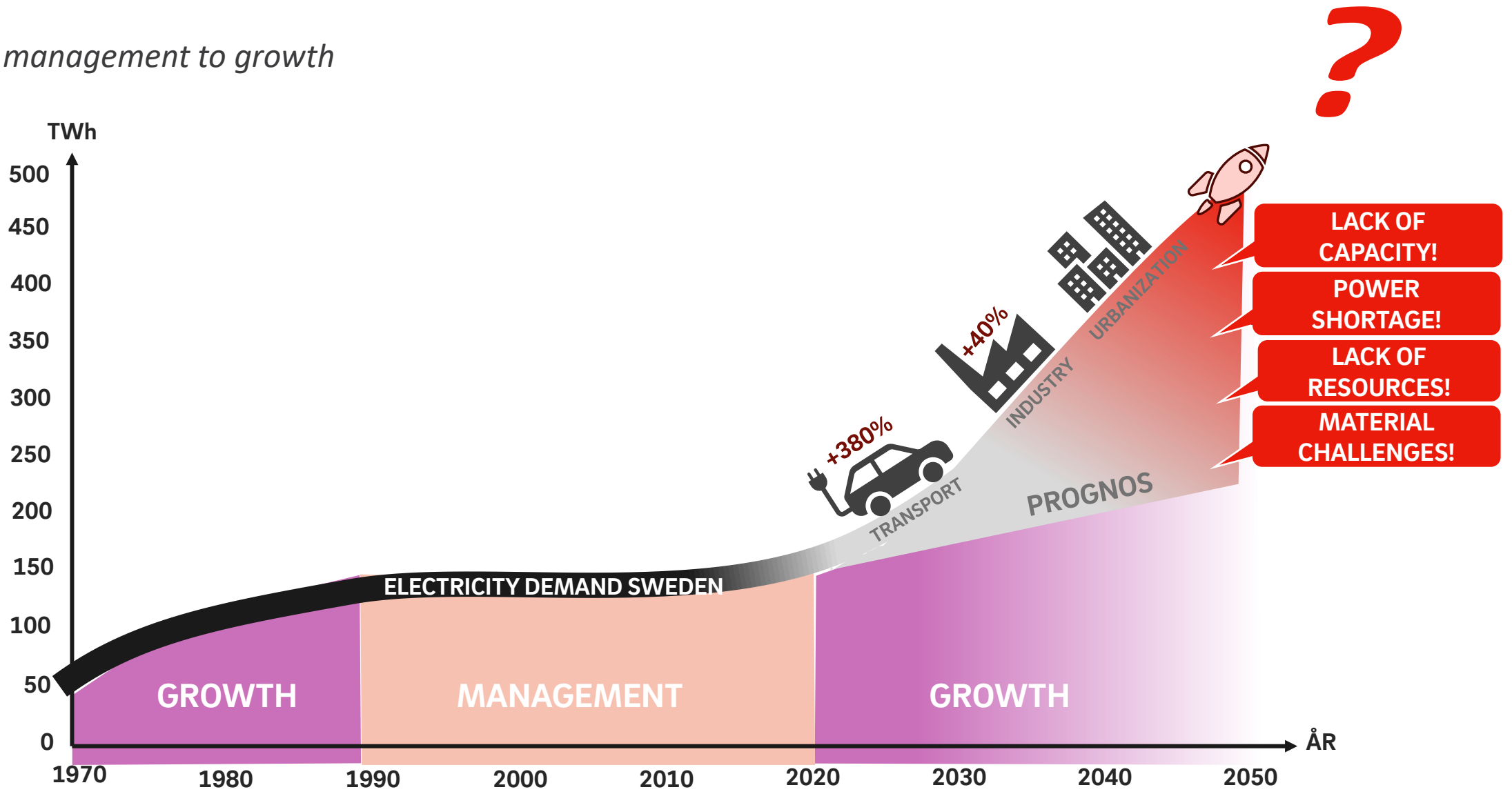


CUSTOMER RELATIONS
CSAT level of 75% for our
Private and business customers

SUSTAINABILITY
Halved carbon dioxide emissions scope
1–3 (net zero by 2035)

Development and future of the electricity grid

From management to growth



The energy transition places demands on the electricity grids, that require new solutions

The energy transition

Electrification of society is progressing rapidly, but building the electricity grid takes time.

Climate impact

A significant portion of the electricity system's climate impact comes from the expansion of the electricity grids.

Socioeconomics

The cost of expanding the electricity grid is paid by the grid customers.

Growth

When more companies want to establish, the electricity grid risks not being sufficient.

The energy transition happens now – in total there are 56 GW of requests. Only if a fraction will be realized it's a major increase!

e·on Public statistics

Nät | Län | Kommun | Avtalsområde

On-going connection errands E.ON Energy Networks SWE

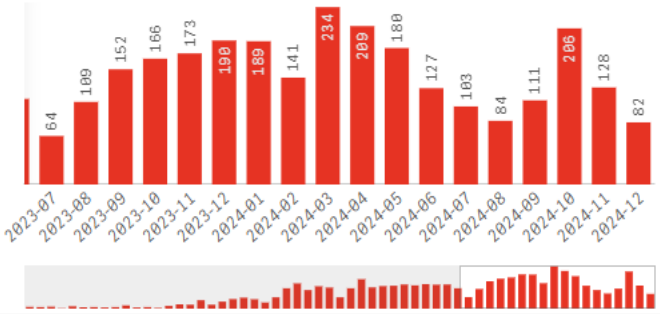
2159 On-going errands thereof 472 new since last 3 months

uppdaterad 2025-01-30

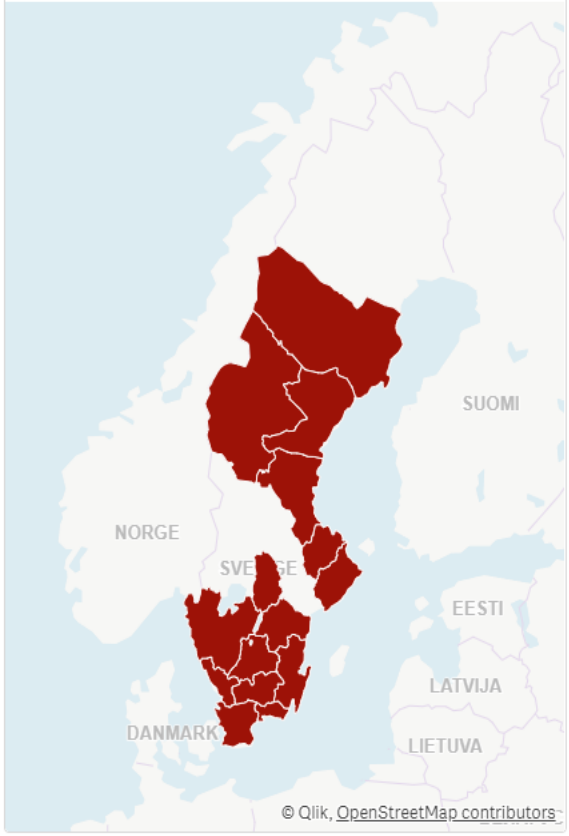
* Över 200 kW

Förfrågningar	Under investigation	Under construction
1297 st	691 st	168 st

Requests eon.se in total



Områden med pågående ärenden

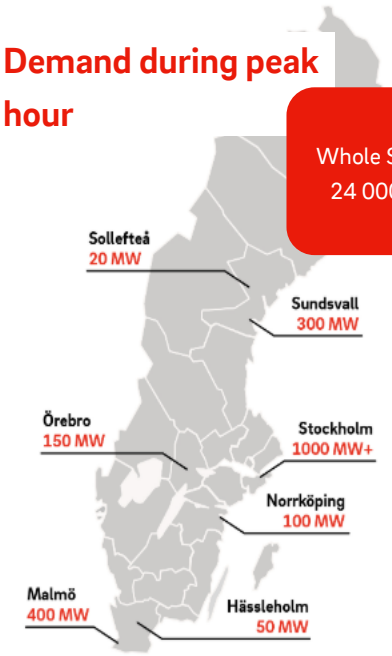


Requested capacity per connection category

29 705 MW Photovoltaic	~1000 st
12 546 MW Wind power	~100 st
10 316 MW Energy storage	~700 st
213 MW Charging	~200 st
4 217 MW Ohters	~1000 st

Demand during peak hour

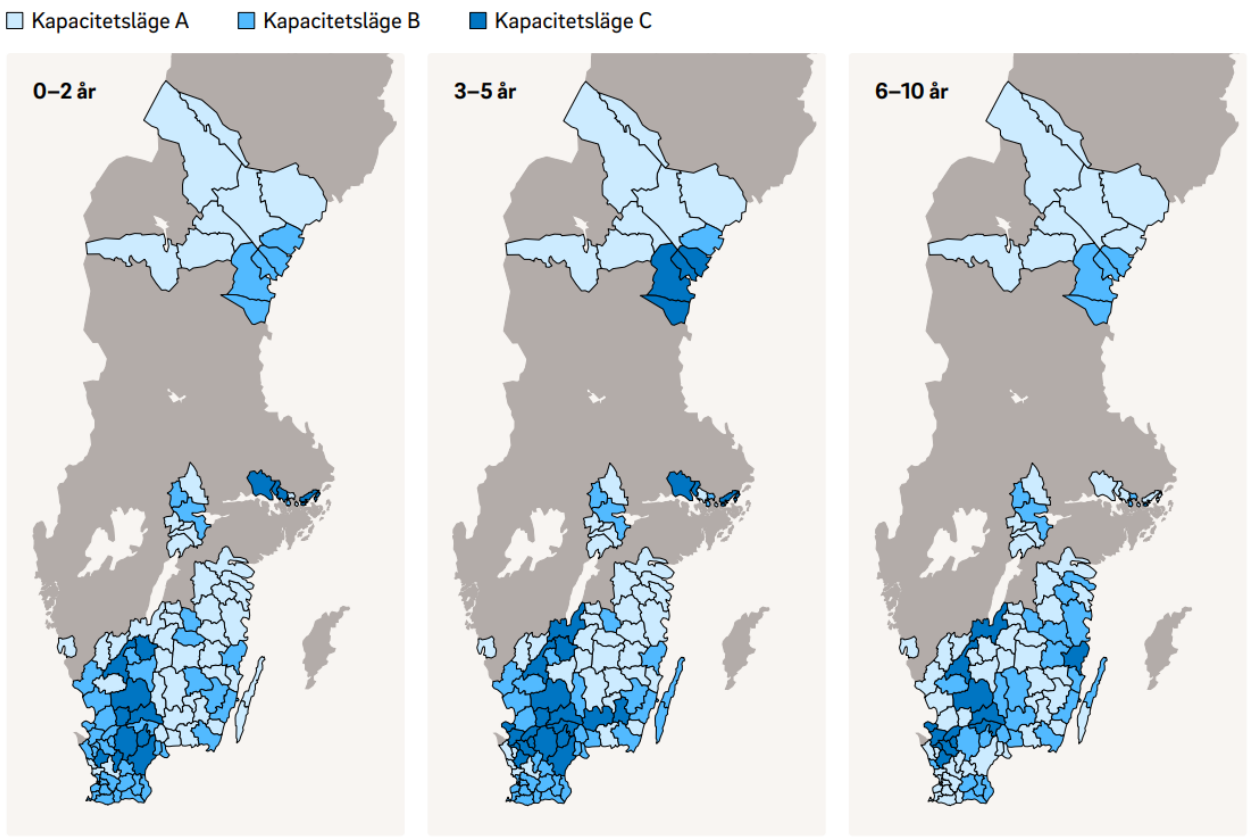
Whole Sweden 24 000 MW



1 MW corresponds to 700 apartments or 200 houses

Capacity needs for next 10 years will be partly met by grid investments but it's not enough therefore flex & grid utilization are

Capacity situation based on consumption



- The Network Development Plan combines forecast with planned investments and has provided interesting insights.
- The illustration demonstrates to what extent capacity demand will be met the next decade, where dark blue indicates capacity constraint.
- The capacity assessment is made for peak load scenarios and is based on:
  - Baseline
  - Forecast
  - Current grid capacity
  - Planned investments

Note: The capacity constrained areas, the blue and dark blue, are possible to solve with grid investments, flexibility and higher grid utilization. However, the measures/solutions are not yet defined or decided for all areas.

E.ON's ambition with full utilization of grids goes beyond current regulatory definition – for full utilization regulation must adopt

Ei Definition	Grid utilization is the relation between the hourly, average load and top load, on specific grid components
E.ON ambition	**Use the grid to its technical full limit by integrating customers and using grid management: Grid utilization, is the relation between the hourly, average load and top load, on all major grid components**

Values derived from increased grid utilization

Increased value of existing assets

Shortened time to connect customers

Avoided carbon emissions

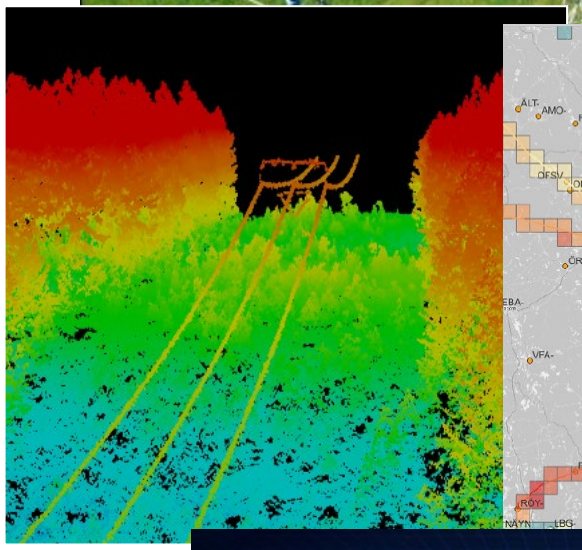
Lower increase of tariffs for customers

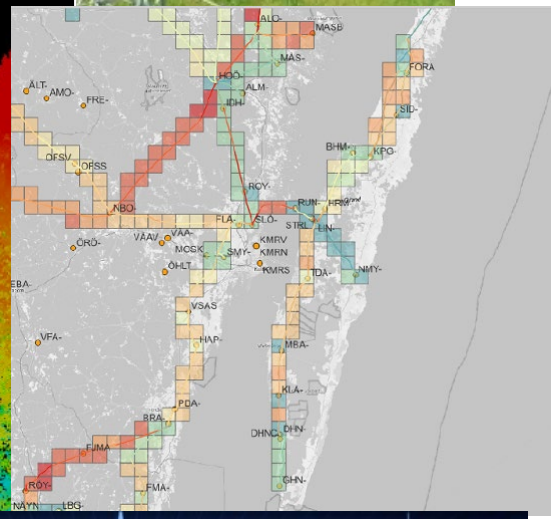
Several solutions drive the increase in grid utilization

1. Asset rate optimization & grid monitoring
2. Active grid power flow management
3. Voltage & reactive power management
4. Higher risk in grid design and system operations
5. Flexibility solutions such as local flexibility markets, flexible connection agreements and power tariffs
6. **Digital and automated processes to operate the grid and for grid planning**

1 Asset rate optimization & grid monitoring solutions

Solutions/products	Status EN
• **Increasing the static line rating** by analyzing the possible maximum rating as a design measure	Partly in use
• **Identify weak grid sections**, i.e. under dimensioned, and replace assets with higher rating	Partly in use
• **Use laser scanning to measure real hight above ground** and adjust asset ratings accordingly to maximum limit	Partly in use
• **Use Dynamic Line Rating/On-line capacity control** for optimal line utilization	In use – roll-out





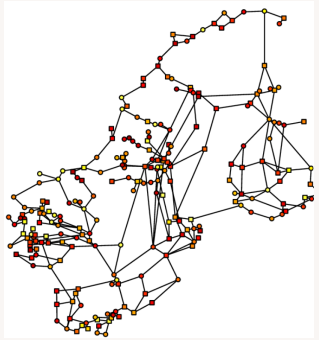
2 Active grid power flow management solutions and technologies

I

Dispatching: Change grid topology

Dispatching from grid control centre

Changing grid topology to change power flow in constrained grid sections.



II

FACTS

Flexible AC Transmission systems

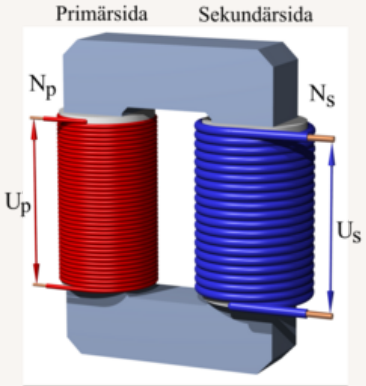
Different technologies for controlling the reactance on the line leading to changing power flow

III

PST

Phase Shifting Transformer

By changing the phase angel for the voltage between two grid points the power flow changes



IV

HVDC

High Voltage Direct Current

By using power power electronics on both ends of a line the power flow can be steered

Status EN	In use	Investigation (2025)	Investigation (2025)	Investigation (2025)

3 Voltage & reactive power management

I

Capacitor bank, reactor and tap changers

Classical voltage regulation assets

Assets that increases or decreases the voltage in the grid with voltage steps

II

FACTS

Flexible AC Transmission systems

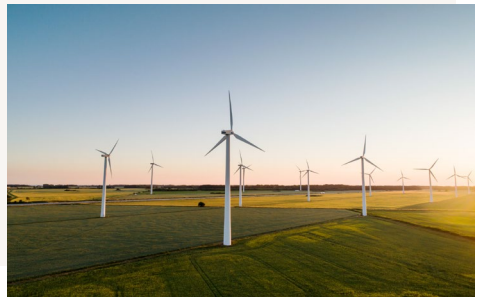
There are several power electronic technologies that can control the voltage

III

Generation sources

Windpower/PV

New windpower & PV have advanced power electronic converter solutions that can support voltage control



IV

BESS

Battery Electric Storage System

Battery solutions have advanced power electronic converter solutions that can support voltage control

Status EN	In use	Investigation (2025)	Partly in use	Investigation (2025)

4 Higher risk in grid design and system operations

Power circle study states

- replacing the N-1 criterion in the electricity grid with more probabilistic methods,
- changing the operation of the electricity grid,

can result **in 20-25% increased grid utilization**. The prerequisite for achieving this, is the ability to rely on high quality data.

2024-10-22

POWER CIRCLE
Electricity for sustainable energy

Elnät

Potentialer till 2030:

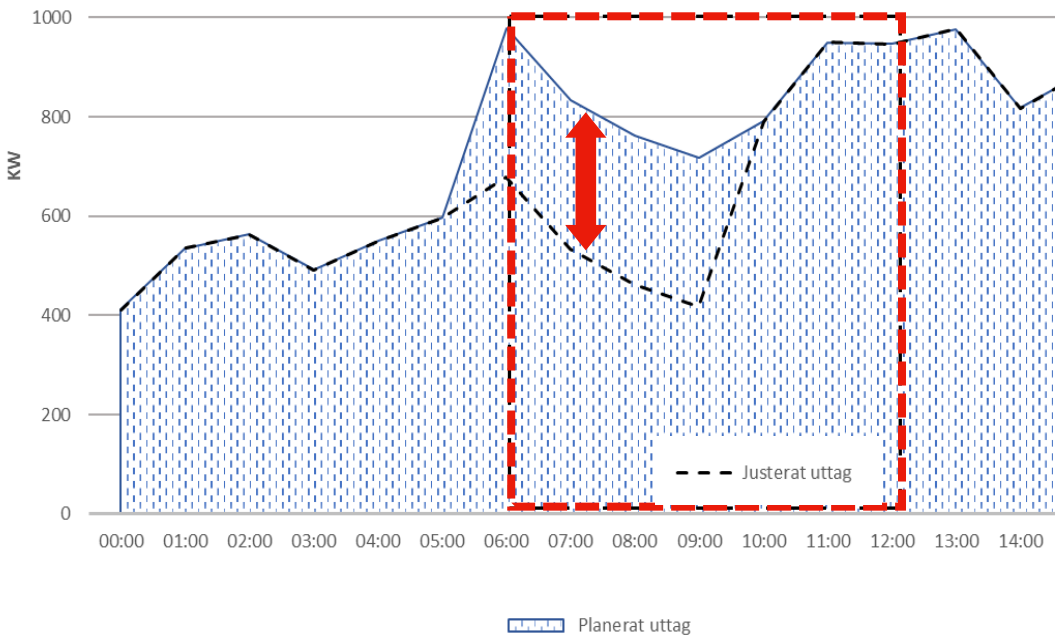
	Flex – sekund	Flex – minut	Flex – timme	Flex – dygn	Flex – vecka
Potential 2030	↓ 25 % ↑	↓ 25 % ↑	↓ 25 % ↑	↓ 20 % ↑	↓ 20 % ↑
Nuläge	0 %	0 %	0 %	0 %	0 %

...these figures are analyzed in context of grids in Sweden

5 Flexibility contributes to increased grid utilization

Flexibility is the ability of a resource, to change the normal pattern of consumption or production of electricity, at a given signal

1. Power tariffs
2. Local flexibility markets
3. Flexible connection agreements
4. Technical solutions



5 We are forerunners in flexibility in Sweden, and we will increase the pace

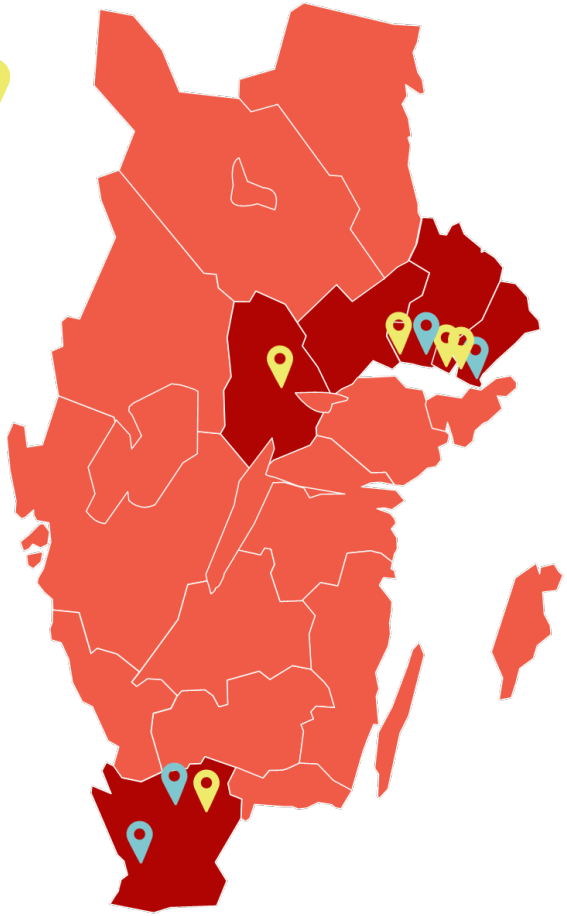
- E.ON has developed a way of working with flexibility since 2019, and are the playmaker of flexibility among Distribution System Operators in Sweden.
- SWITCH is considered one of the most mature flexibility platforms in Europe, being the digital enabler of the communication between grid owner and flexible resorces.
- As of January 2025, E.ON operates 9 local flexibility markets and have signed 15 flexible connection agreements.
- During 2025, we will launch the first local flexibility market, designed to adress congestion in electricity production, rather than consumtion.

New markets 2024-2025

- Norra Örebro
- Enköping
- Kungsängen
- Kallhäll
- Nordöstra Skåne

Continued markets

- Bålsta
- Vaxholm
- Hässleholm
- Södra Skåne



5 Flexible solutions in the portfolio set us in a good position to push the development with more customers becoming active

Power tariffs	Flexibility markets				Flexible connection agreements		Technical solutions	
Fixed conditions	Seasonally	Week ahead – D-2	Day ahead - Intraday	Operating hour	Operating hour	Operating hour	Operating hour	Operating hour
LONG-TERM FORECAST		SHORT-TERM FORECAST			REAL-TIME METERING			
Customers adapt their consumption according to E.ON's power tariffs.	*E.ON procure long-term availability from flexibility service providers according to long-term forecast.*	*E.ON procure short-term availability from additional flexibility service providers when the short-term forecast shows risk of overrun.*	*E.ON activates available flexibility from flexibility service providers if the short-term forecast continues to show risk of overrun during day-ahead or intraday.*	*The activated flexibility service providers delivers flexibility according to their offer when the forecasted overrun is expected to occur.*	*If real-time metering shows actual overrun, customers with flexible connection agreements will get an automatic signal to steer down their resource.*	*If customer with flexible connection agreement is not steering down according to signal, the customer is breeching the contract and will therefore be disconnected from grid.*	*If the overrun remains, any possible switches of loads in the grid are performed manually by the operating center.*	*Network protection solutions breaks automatically if the security limits of the grid is breeched.*

SWITCH

SWITCH is used as the technical platform for flexibility markets and flexible connection agreements.

Status

Developed

Roll-out 2026

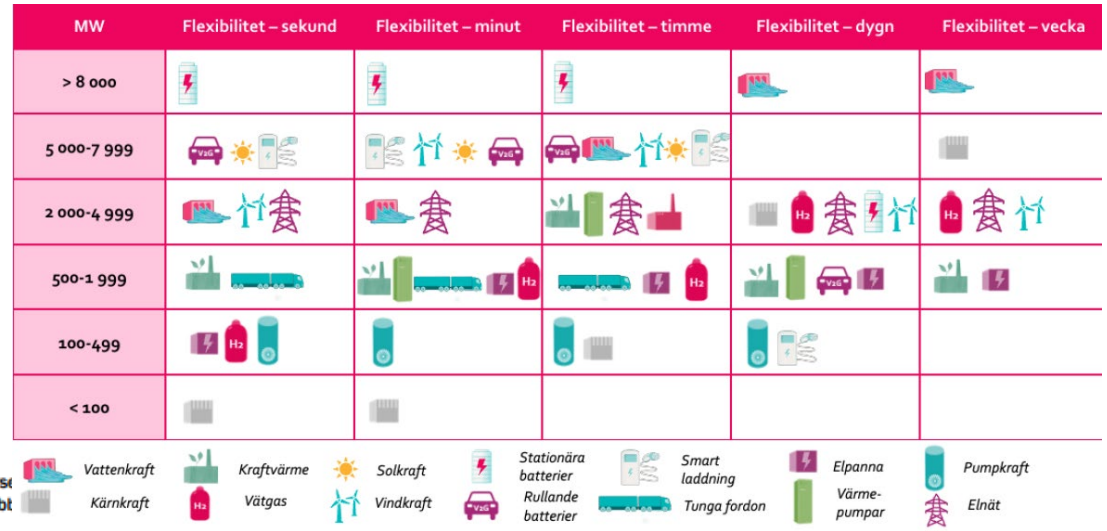
In use, ramp-up underway

Partly in use, ramp-up underway

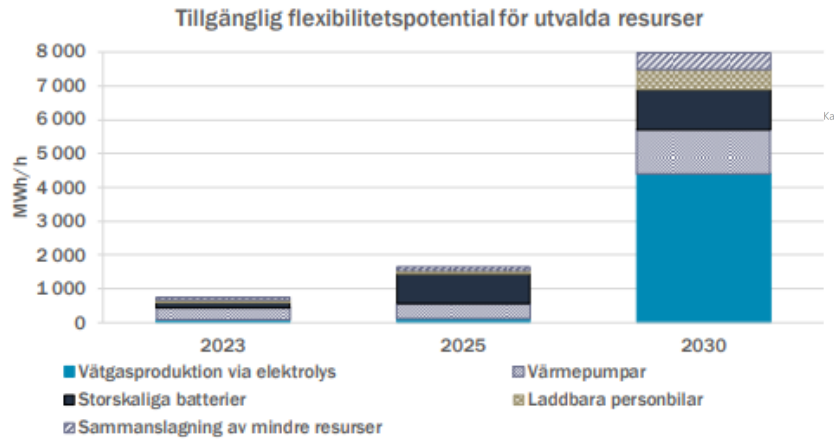
5 The potential for flexibility in Sweden is extensive

External studies identify large flexibility potential

- Power circle, Svenska kraftnät and Energimyndigheten have in different studies, analyzed the potential of flexibility in Sweden by 2030*
- Preliminary results show that the volumes are large, and sources of flexibility are more or less suited for different time frames



Figur 10 Tillgänglig flexibilitetspotential för de resurser som analys
mindre resurser ingår kyla & ventilation, småskaliga batterier, dubb
gatubelysning

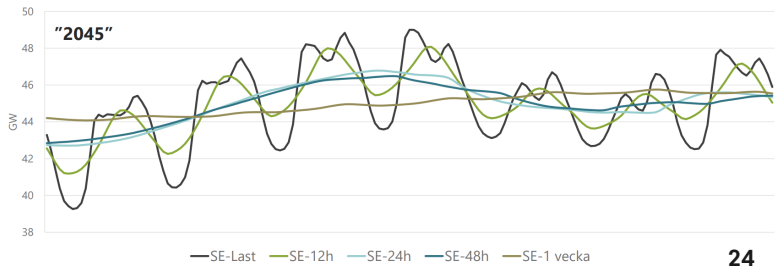


Kapitel 6. Effektbehov över flera tidskalor

Energiforsk profu

Lastutjämning under den mest ansträngda veckan

- Givet att produktionskostnaden för el enbart varierar med eleffektbehovet kan lastutjämning användas för att få en uppfattning om vilken reduktion av eleffekt som kan erhållas med olika tekniker.
- Lastutjämning: glidande medelvärden för olika tidsperioder. SE-12h innebär ett glidande medelvärde som tittar +/-6 timmar från aktuell timme.



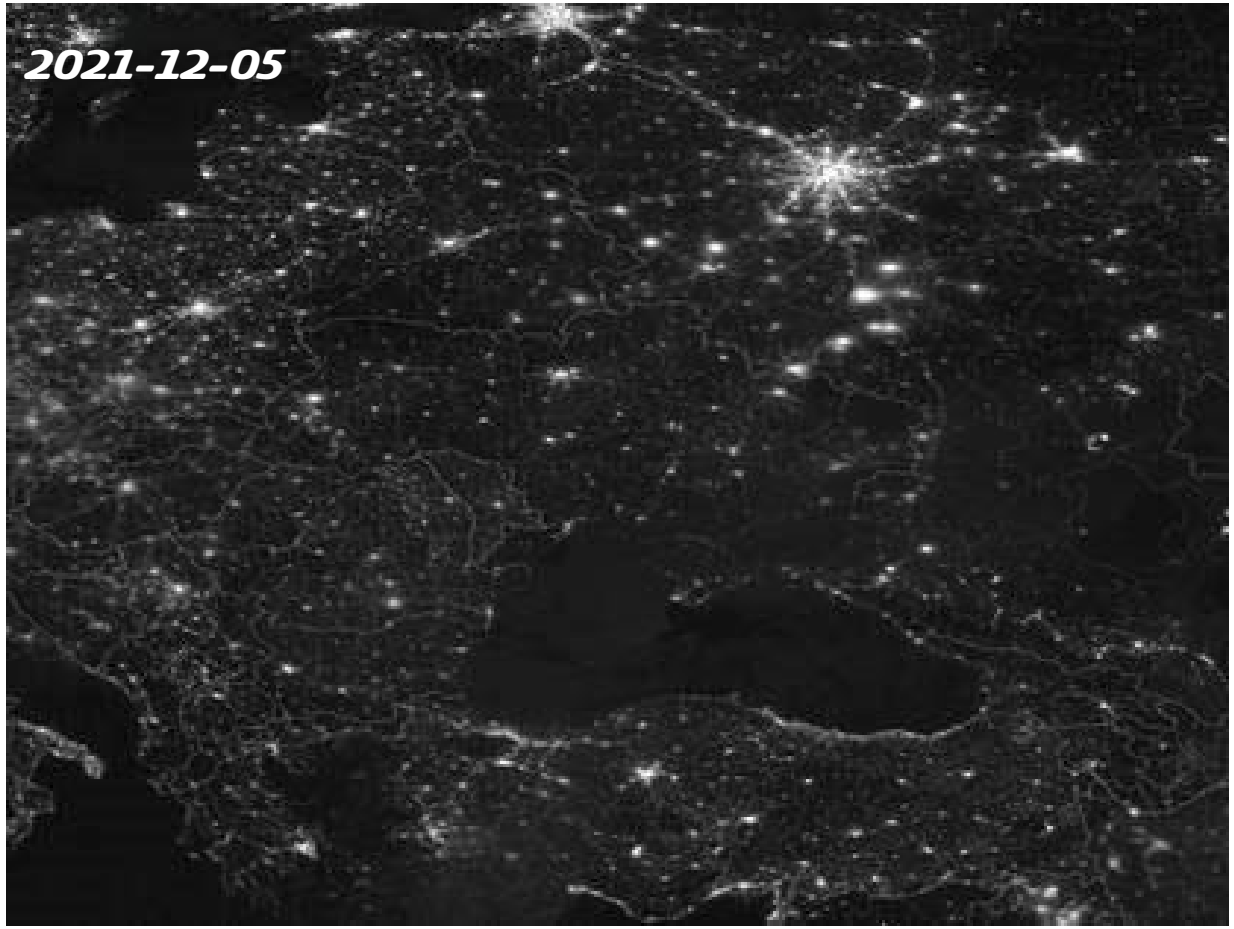
* Flexibilitetspotentialer till år 2030, by Power Circle, SvK and Energiforsk RAPPORT 2023:913

The DSO-role is defined in the Clean Energy Package and entails an expansion of the DSO responsibilities

In the past	*Today and forward*
Focus on the grid components	Focus on the development of the power system and its stability, both regarding generation and consumptions
Investments in the grid	Investments in the grid & utilization of flexibility
Measure energy consumption	Measure much more: generation, consumption, stability parameters, flows, temperatures and more
Individual solutions to handle data	Data driven operations, data exchange and standardized protocols
Low focus on resilience	Increased focus on resilience and handling of disturbed operations

Overall it's about how we utilize the energy system to it's maximum, which requires changes of roles!

Nordic countries are significantly stepping up the civil defence...



...What are key learnings to increase the resilience that you would like to pass on for Sweden?

Conclusions and summary

1

The status in the energy transition/growth is two folded: 1) **some industries** especially connected to PV and battery manufacturing **are slowing down**, 2) **connection pipe line grows** esp. with PV and battery connections. However, **overall we see a growth going forward**

2

The grid development plans for next 10 years require high investments. However**, to meet capacity needs flex and grid utilization measures are required**

3

Affordability of the energy system is on the top agenda. E.ON is developing resource efficient grids:
1) **technical solutions**
2) **risk based operations and design**
3) **flexibility solutions with tariffs, market based flexibility and condition based contracts are being rolled-out**

4

The DSO role is changing to be a clear system operating role with responsibility on local and regional level with much higher collaboration with TSO

A new world order and higher insecurity requires even higher emphasis on robust, affordable and highly efficient infrastructure!

Thank you

e·on