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Trender inom Energisektorn

"Utmaningar & Möjligheter"

Erik Mårtensson
Siemens Smart Infrastructure

Creating environments that care

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Trends and challenges

General picture of how the world changes and how that influences our energy systems.

Future Energy system

Wiich parts has largest impact and what challenges and opportunities that comes along

Examples and summary

How has customers already benefitted from Siemens solutions and key message going forward

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Trends and challenges

Transformation in all industries – Powered by megatrends

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10 billion
people by 2050


70% in cities

How to deal with transformations ?
Focus on digitalization !

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1.4 million
major assets
connected

5.6 billion
R&D expenditures

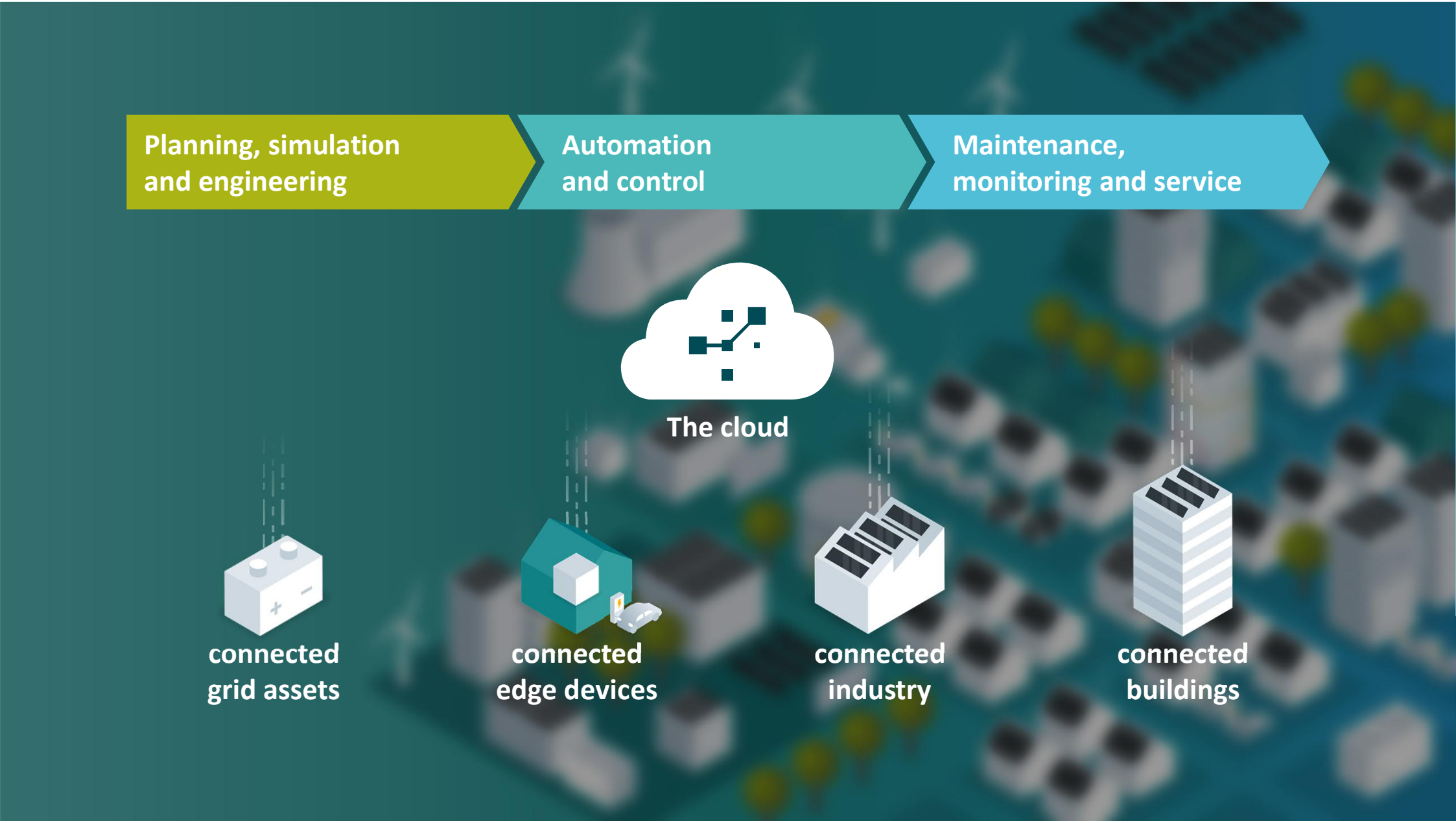
29,000
software engineers

75 million
smart meter
software licenses

#1
in automation

10 billion
investments in
digitalization portfolio

0110
011011
10110110


Planning, simulation and engineering
Automation and control
Maintenance, monitoring and service
The cloud
connected grid assets
connected edge devices
connected industry
connected buildings

Transformation of energy by the numbers

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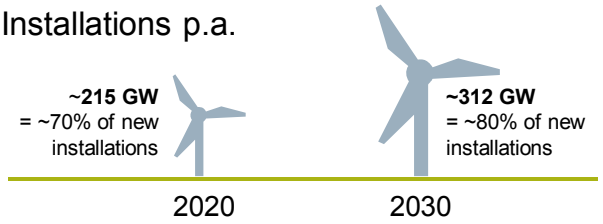
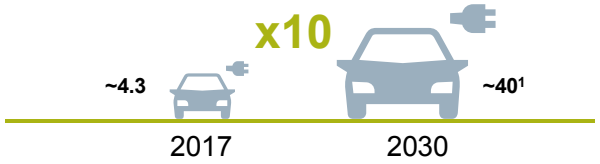
Decarbonization

Increase in renewables
Installations p.a.



Electrification of transport
Global e-charger market
(M units, installed base)



Decentralization

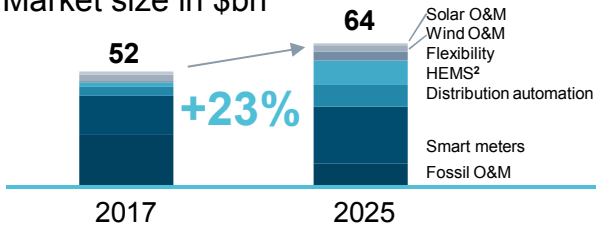
Grid-connected energy storage capacity[2]

Global distributed power generation
New installations by 2020

Digitalization

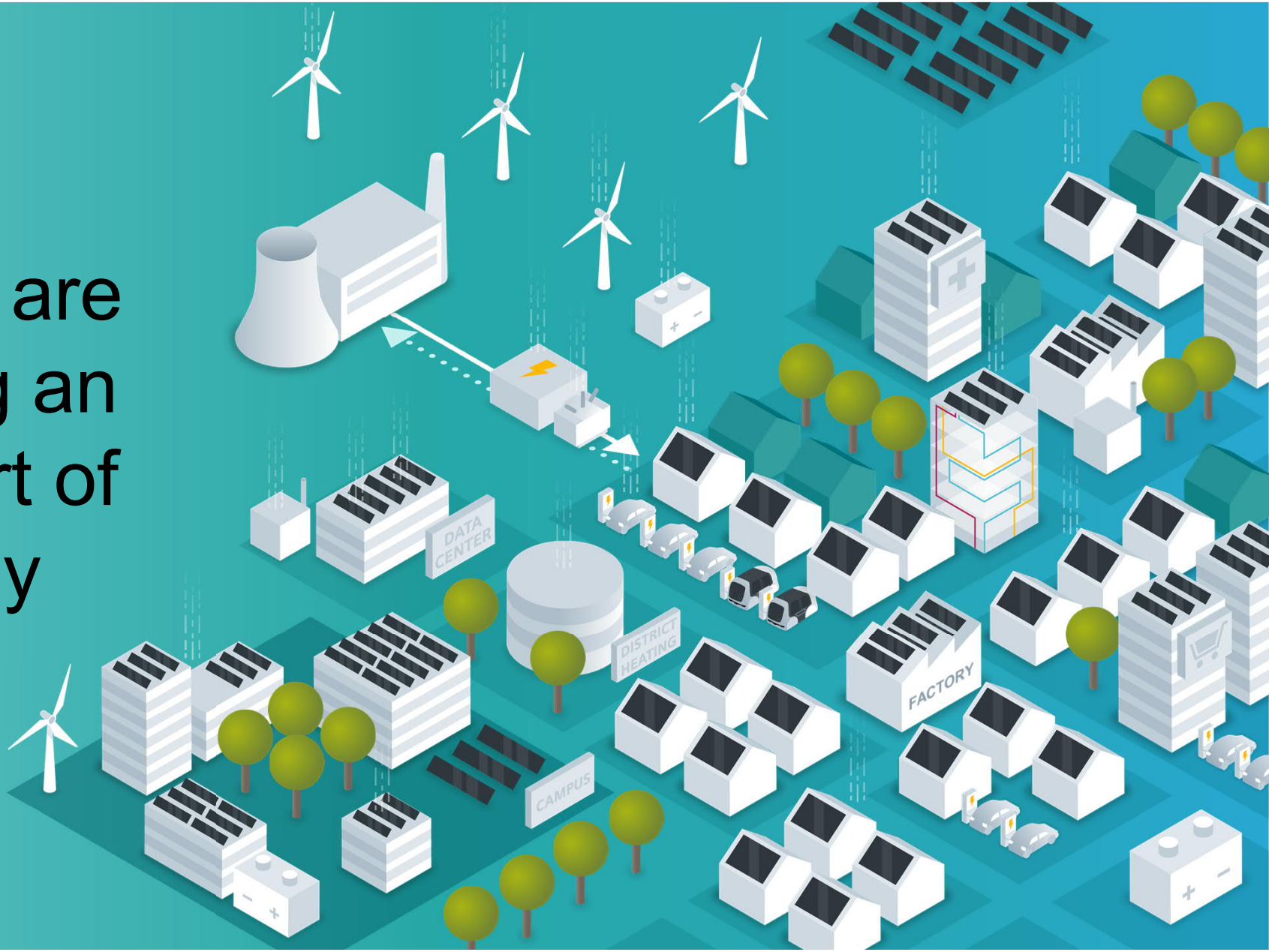
Intelligent connectivity

Digital technologies in energy
Market size in $bn



1 Source: bloomberg.com | **2** Source: IHS, global installed capacity, rounded figures

Buildings are becoming an active part of the energy system



Something drives us every day to make buildings better.

People spend about
90% of their lives indoors.

We believe that the places we spend time in have a **great influence** on our lives.

They affect how we grow, how we develop, what we achieve, **who we become.**

With our digitalization competence, we can drive additional customer value for our customers

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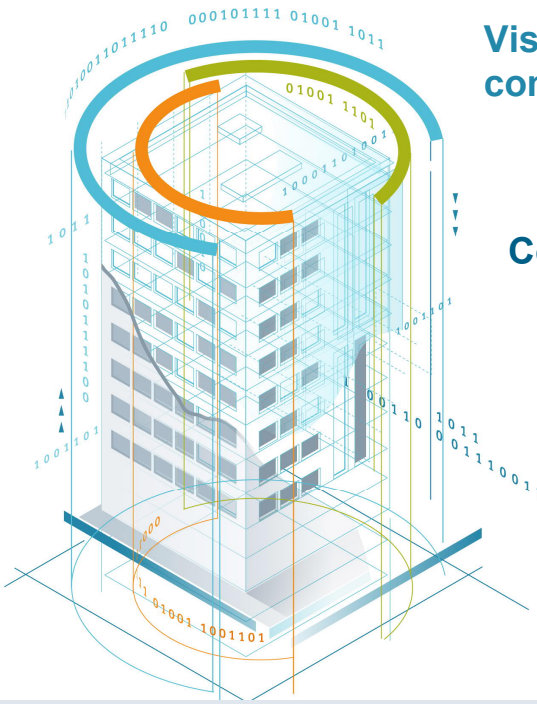
From building data…



Visualize and communicate

Optimize

Connect

Analyze and simulate

Store

Collect

to customer value

- Increase energy efficiency
- Optimize energy supply
- Increase sustainability
- Be legal- and regulatory-compliant
- Ensure business continuity
- Reduce cost
- Increase building value

Better informed decisions, optimized investments and effective use of buildings

The Energy market is changing

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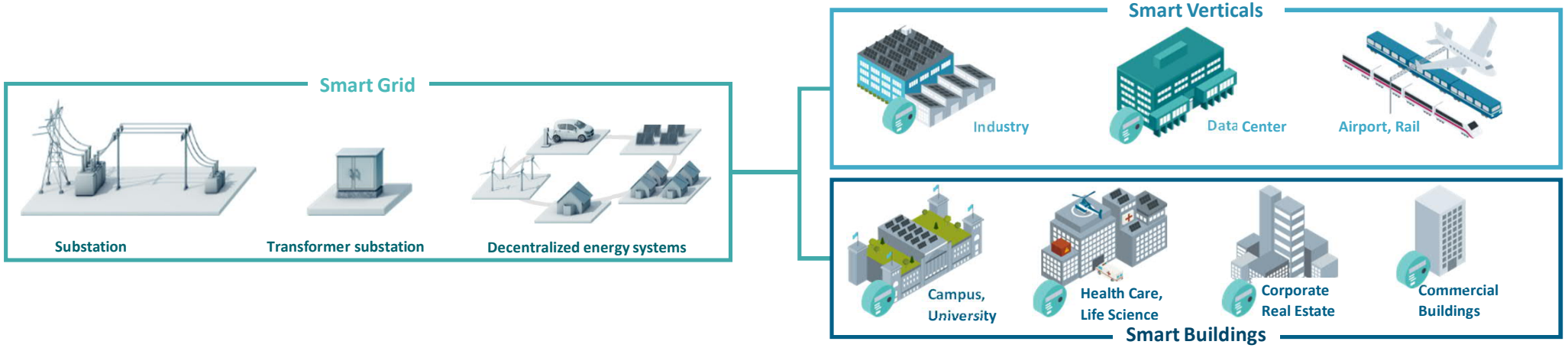
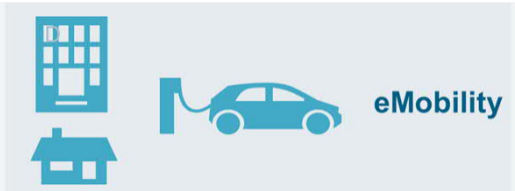
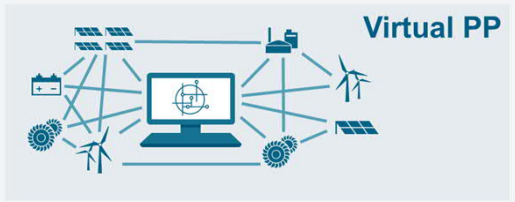


Enablers

- Domain consulting
- OT/IT & IoT integration
- IoT platform
- Digital Twins





Value adds

- Digital Services
- Analytic insights
- Partner programs
- Digital engagement portal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Future Energy system

Today's main challenges of the energy system

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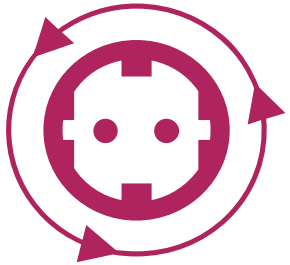
Economic efficiency

"Over the past century, affordable energy has been a significant component of global economic growth and development."

World Economic Forum



Reliable power supply

"Inefficient, antiquated energy supply stifles productivity."

United Nations Foundation, »Achieving Universal Energy Access«

Climate protection

"Europe will cut its greenhouse gas emissions by 40% by 2030 and will produce 27% of its energy from renewable sources."

The Guardian

Two Growth Areas as result of the global energy transition: Intelligent grids and consumer-centric business models

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Political Targets:

- Environment
  e. g. Decarbonization
- Competitiveness
- Security e. g. Resiliency

Breakthrough Technologies (performance & cost):

- Wind- and PV power generation
- Energy storage (Li-Ion)
- Digitalization

Small- and large-scale renewable

- Integration into the electricity grid (hydro, biomass, wind, photovoltaics)

Distributed Energy Systems to maximize:

- Energy system efficiency
- Local renewable integration
- Resiliency

Electrification of consumption

- Direct: Heat Pump, E-Car
- Indirect: P-to-Gas, synthetic fuels

Intelligent grids

Consumer-centric business models

Sustainability at Siemens

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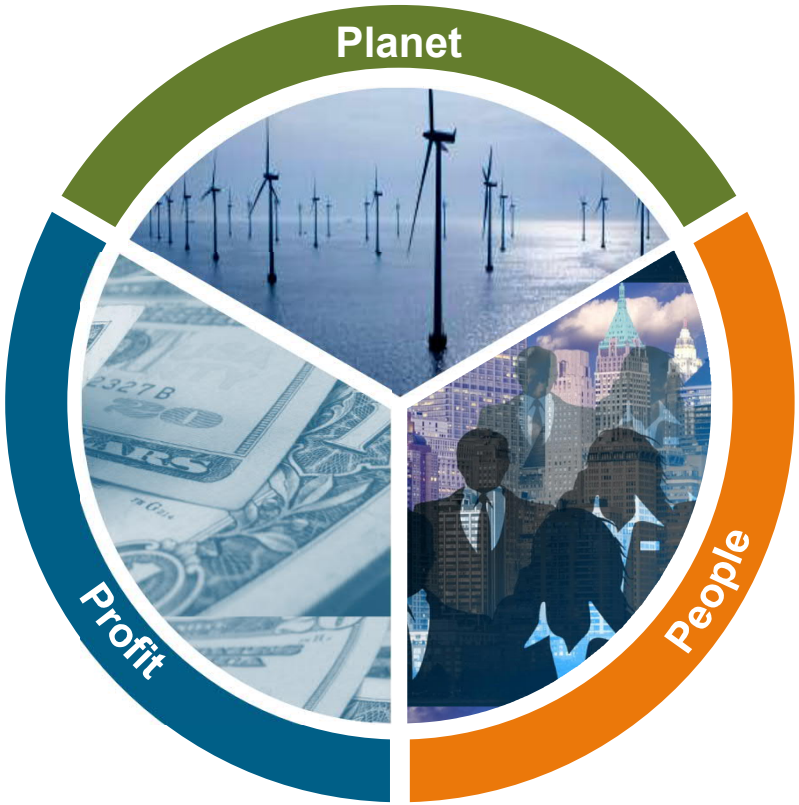
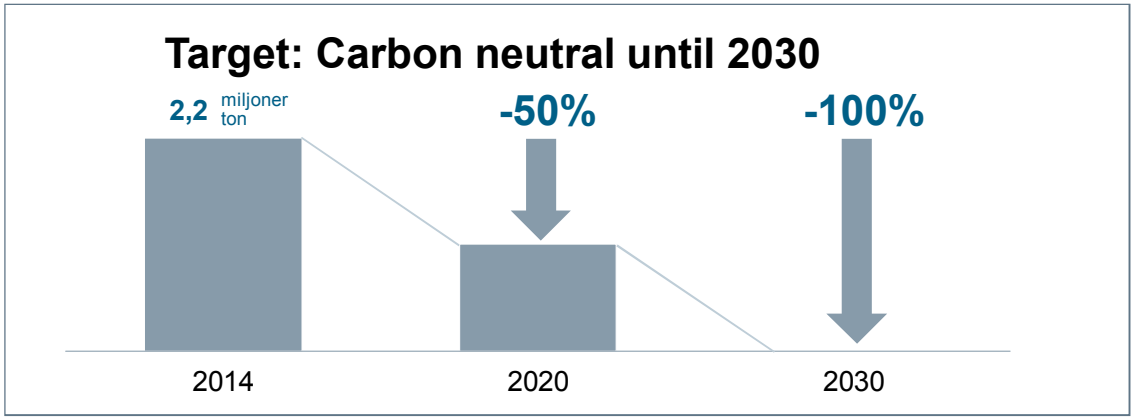


Sustainable development is the means to achieve profitable and long-term growth. At Siemens we have a clear commitment to think and act in the interest of future generations, balancing **People, Planet** and **Profit.**



MEMBER OF
Dow Jones Sustainability Indices
In Collaboration with RobecoSAM

#2 with 89 points in "Industrial Conglomerates" 2016

Corporate Knights
The Company for Clean Capitalism

#1 the world's most sustainable company 2017

CLEAN200™

#1 Carbon Clean 200 list 2017

Electrification, an important part of the solution for the future environmental challenges

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Electric power projections

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Grid connected **batteries:**
x 16
2017 to 2025

Sources: IHS Markit, projections

Global **hydrogen** demand:
x 10
2015 to 2050

Sources: hydrogencouncil.com, projections

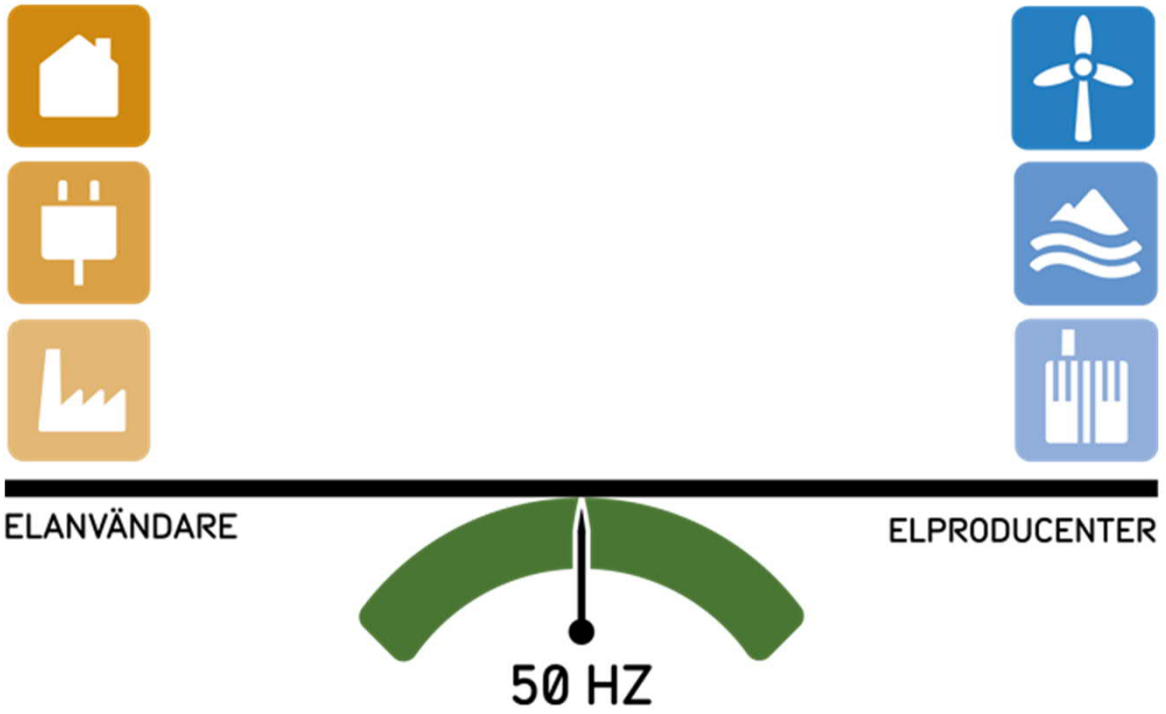
E-cars
on the road:
130 million
until 2030

Sources: BNEF, projections

Heat pumps
market:
+ 6% CAGR
2015 to 2021

Sources: heatpumptechnologies.com, projections

Challenge ...



Challenge …

Stockholm, Uppsala, Västerås, Malmö

Gävle, Göteborg, Södermanland/Östergötland
Östersund

Luleå, Skellefteå

More challenges to come ……

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Battery factory 300 MW

Data centers 15-200 MW x ?

Quickchargers 0,4 -1,5 MW x ?

Bus chargers 3-6 MW x ?

Home chargers 2-10 kW x ?

1 | Flexibility is key in the future electricity system

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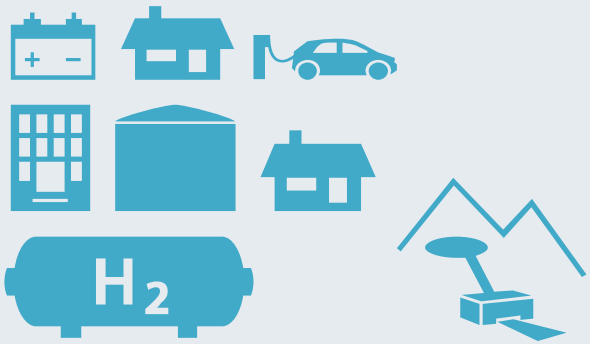
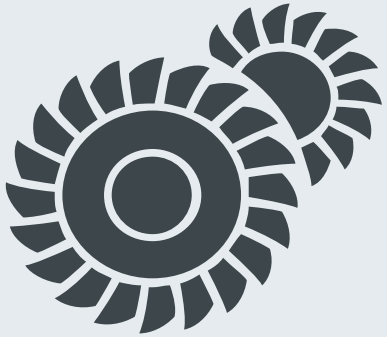
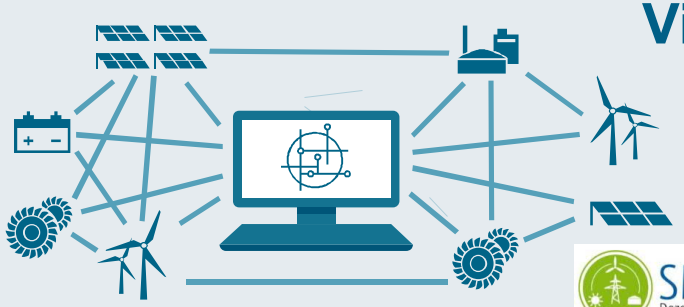


Storage



Gas-fired PP



Virtual PP

Demand Response

Growing investments needs in flexibility solutions challenges the current kwh-based electricity market design

The solution: energy storage for very different purposes

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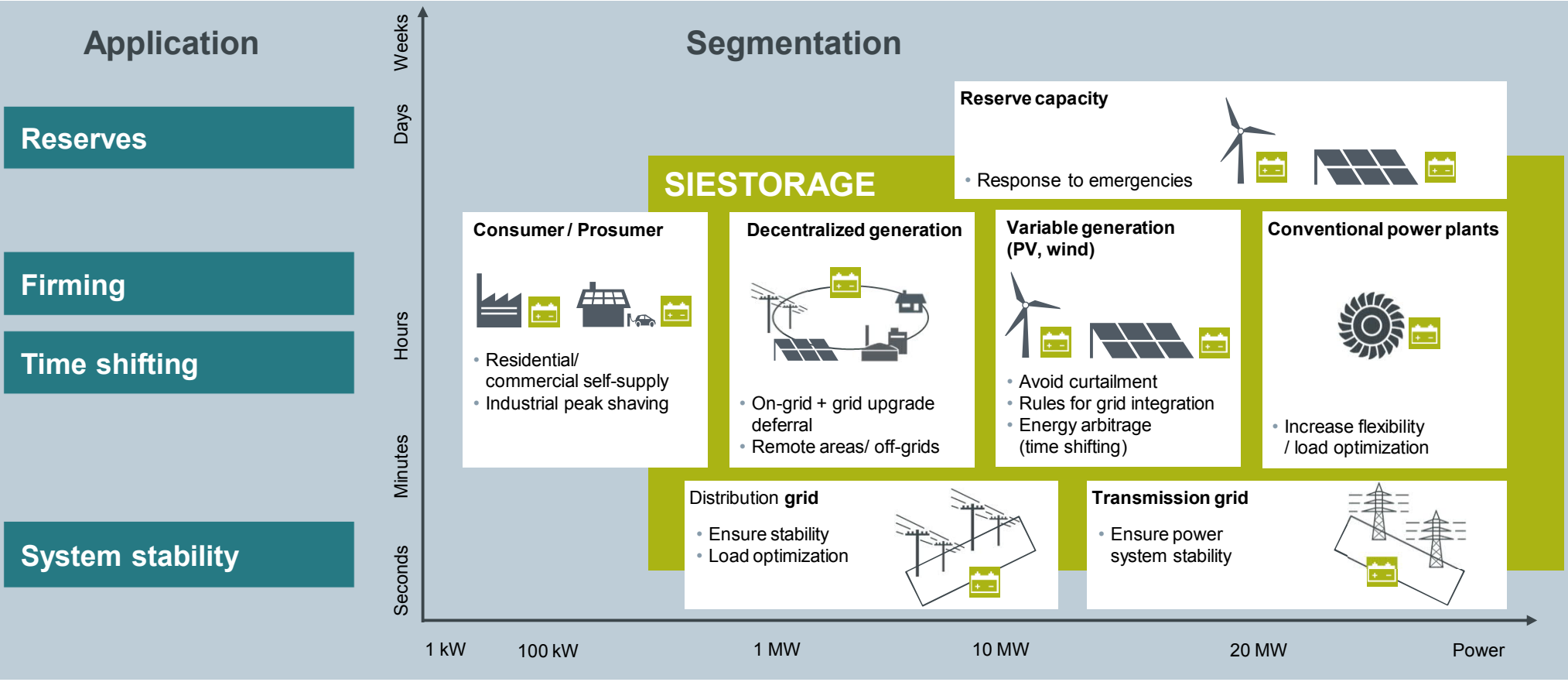

2 | Digitalization - The energy system will be an element of an economy-wide IoT infrastructure

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Productivity and time-to-market | **Flexibility and resilience** | **Availability and efficiency**

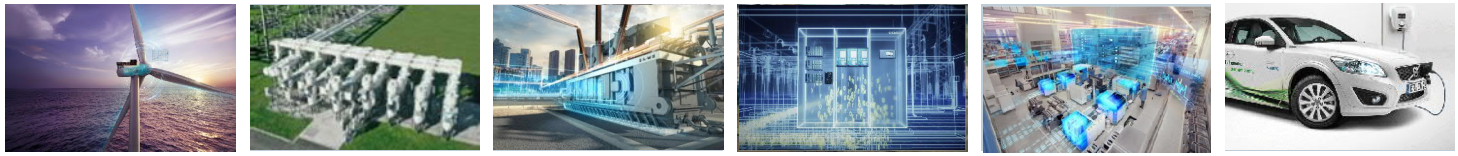
Planning, simulation & engineering → Automation & control → Maintenance, monitoring & service

Use cases, applications

Digital twin | Grid simulation | Grid planning | Grid control | Grid diagnostics | Asset management | Digital substation | Virtual power plant | Smart metering | Monitoring DER[1)] | Energy efficiency and analytics

Cloud-based operating system for IoT
e.g. MindSphere

Connected power assets and … | … connected industry | … connected edge devices



Generation | **Transmission / Distribution & Smart Grid** | **Consumption / Prosumption**

Key areas to step up

Enhanced electrification

Automation

Digitalization

- Sensing
- Connectivity / IoT
- Monitoring
- Controlling
- Managing
- Digital twin

1) DER: Distributed energy resources like smart meters, inverters for photovoltaics, e-mobility assets, storage systems, microgrids, …

Charter of Trust – joint initiative for a secure digital world

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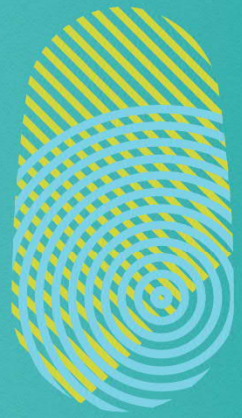

Charter of Trust

charter-of-trust.com

Objectives

1. Protect the data of individuals and companies
2. Prevent damage to people, companies and infrastructures
3. Establish a reliable foundation on which confidence in a networked, digital world can take root and grow

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enel · IBM · Munich Security Conference msc Münchner Sicherheitskonferenz · NXP · SGS · T · TOTAL · TÜV SÜD

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Examples and summary

Connecting multiple prosumers in smart urban districts

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Connecting buildings, grids and markets using an intelligent grid infrastructure and data analytics in the cloud

Increased flexibility
for power grids

Improved transparency
through prediction of consumption

Integration of other energy sectors
e.g. e-Mobility

Exploration of **new digital end-user services**

Generation → Transmission → Distribution → **Consumption**

Shopping mall optimizes energy consumption and contribute to national power grid stability

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Challenge

- Increase energy savings, indoor air quality, comfort and a sustainable profile

Solution

- DEMS platform for management of the distributed energy sources
- Siestorage battery unit, 1.68 MVA/2.0 MWh
- BMS contributes with contracted energy savings
- SFS financing 50% of total project costs

Sello shopping mall, Espoo, Finland

Benefits

- €480,000 per year gains in energy market
- 470 MWh per year energy production
- 281 tons CO_2 per year emission reduction
- €118,000 per year savings in energy efficiency and maintenance

Why Siemens?

- Able to deliver complete solution
- Seamless integration between building automation and energy management system
- SFS financing solution

Building technology components in the microgrid
Load to be provided from Sello to the reserve market

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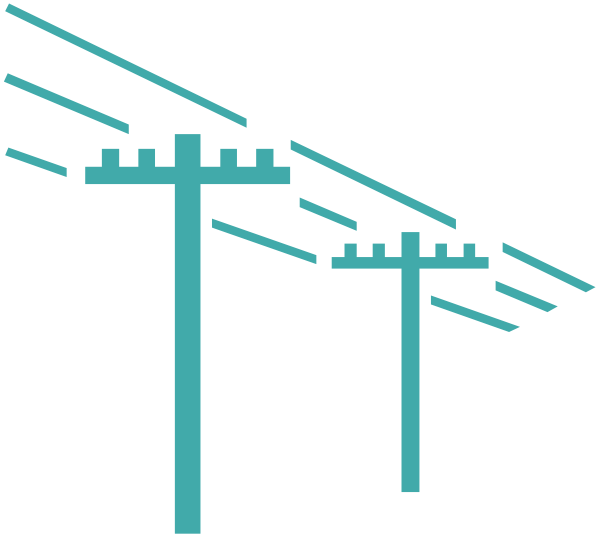
- Battery SieStorage (2 MW, 2,1 MWh)
- LED lightning dali control (3000 pcs)
- Fans (0-848 kW scale)
- Ground heater electric (0-390 kW scale)
- Ground heater pump (0-35 kW scale)
- Generators (1330 kW)
- Solar power (0-750 kW scale)
- EV charging (0-300 kW scale)

Next steps, Cooling 3 MW
Other assets 1 MW



First virtual power plant in Finland

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Challenge

- Delivering software able to aggregate loads and bid on Fingrid power market

Solution

- DEMS platform
- Configuration of assets including
  - Illumination
  - Back up generators
  - Electric heaters
  - Battery at 1.2 MVA/0.6 MWh

Benefits

- Successful tryout project which was extended to commercialization
- Forerunner in innovation amongst Finnish energy retailers
- Decreased need for a central power reserve
- Increased support for a more intermittent power grid

HELEN

Why Siemens?

- Technically sophisticated solution
- Local technical support and development
- Proven knowledge and technology

Industry district increases self sufficiency

Challenge

- Decrease dependency on grid for energy while contributing to grid stability

Solution

- DEMS platform for management of the distributed energy sources
- Siestorage battery unit, 2.4 MVA/1.7 MWh
- Hybrid power plant management system
- Switchgears, transformers and protection relays
- Pre study performed by Siemens Power Technologies International

Lempäälän industry district

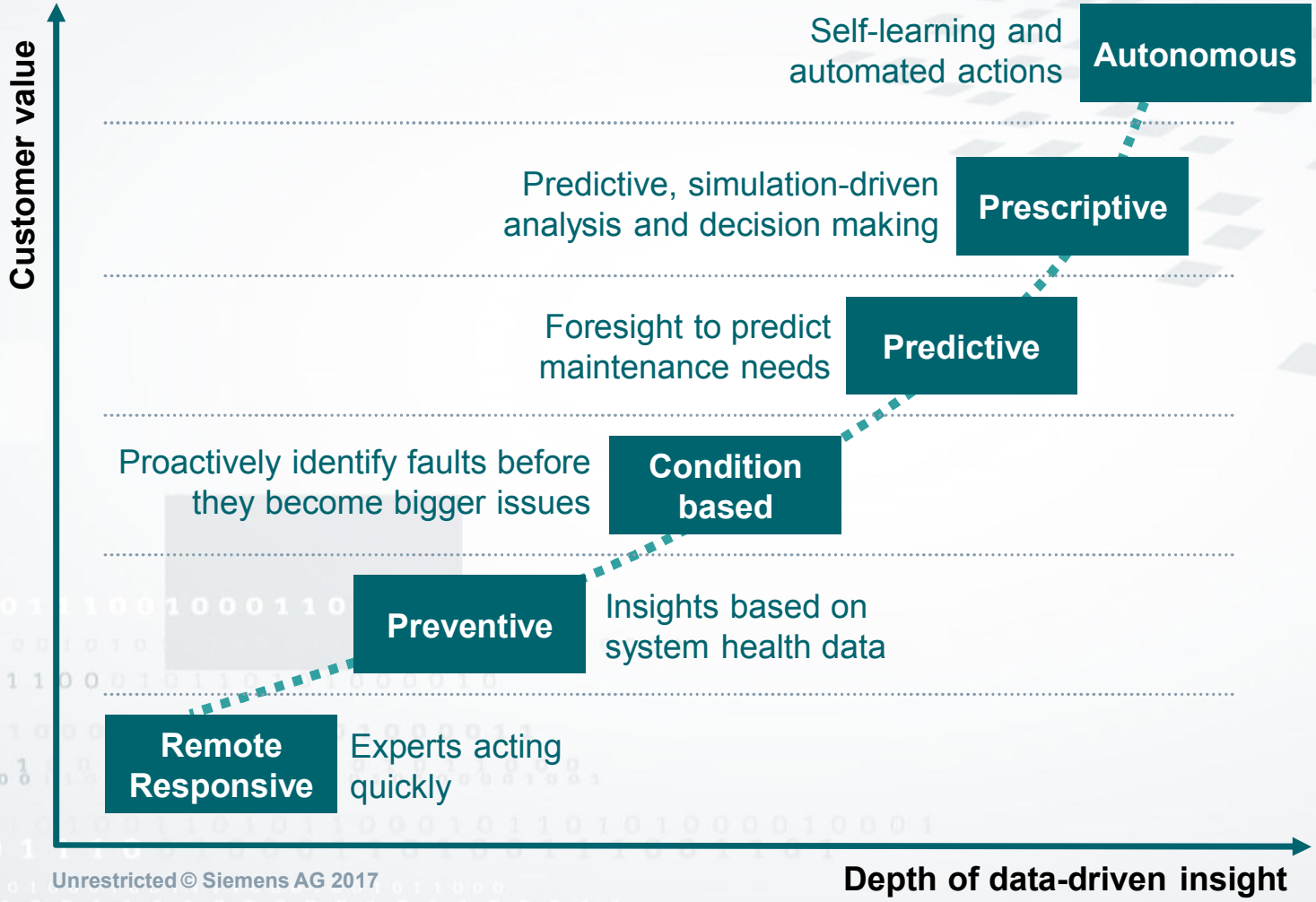
Benefits

- Fully developed the district will be mainly self sufficient on energy
- Lower energy costs for the tenants
- Participation on power market will stabilize national power grid while decreasing time for return of investment
- Increased penetration of renewable generation
- Strengthen sustainability and innovation of the industry district

Why Siemens?

- Project finalized and executed in cooperation with customer
- Local capabilities
- Most refined and intelligent solution

What's next?



- **Artificial intelligence**
- **Partnership eco-system**
- **Indoor positioning**
- **Digital twin**
- **Software as a Service**

Vision of the future energy networks –

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- Further **decentralization** and fragmentation with (semi-)autonomous local energy systems lead to **need for local rebalancing and sector coupling**
- Electrical and connected infrastructure
- Role of **energy network provider** changes from operator to system provider and **platform facilitator**

Only together we will make success

- …..together with customers
- …..together with partners in the eco-system

Creating environments that care

Thank you!

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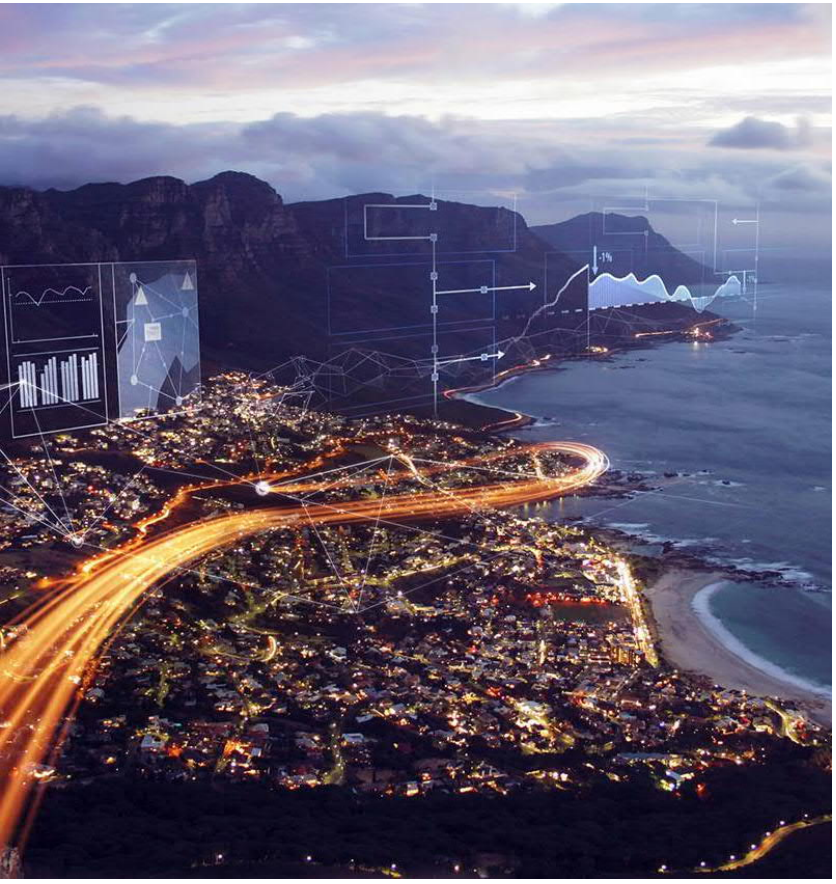

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