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Digitalisering

"Möjligheter för de som vågar"

Erik Mårtensson
Siemens Smart Infrastructure
Creating environments that care

Agenda

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1 Market Trends

2 IoT MindSphere

3 Digital twin

4 What about AI and next steps

Trends

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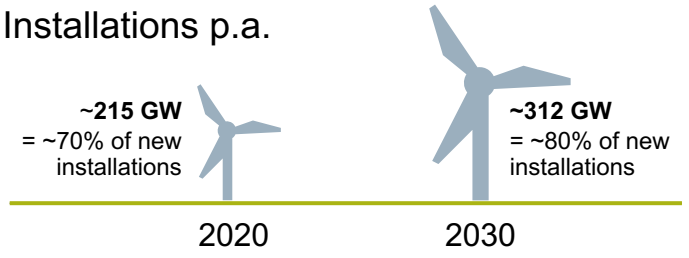
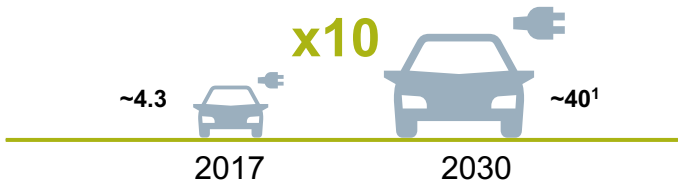
Decarbonization

Increase in renewables
Installations p.a.

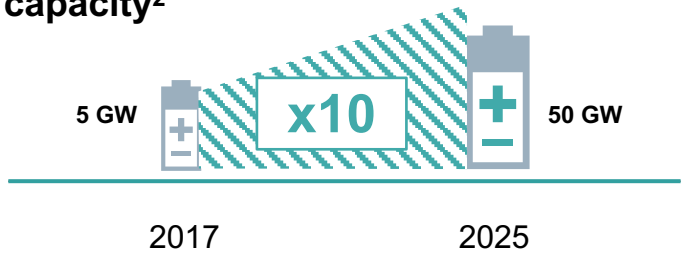


Electrification of transport
Global e-charger market
(M units, installed base)



Decentralization

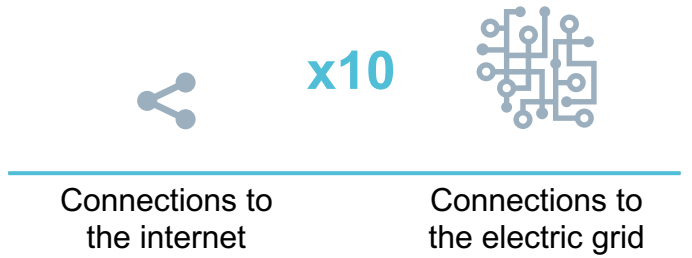
Grid-connected energy storage capacity[2]



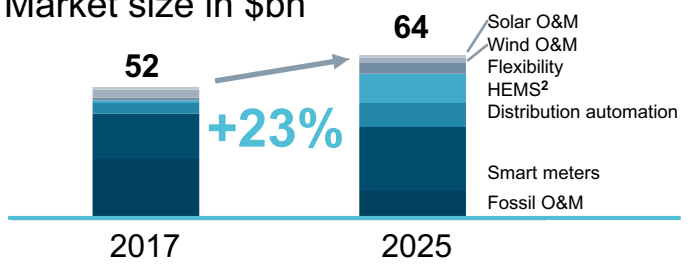
Global distributed power generation
New installations by 2020

Digitalization

Intelligent connectivity



Digital technologies in energy
Market size in $bn



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

Electrification .....

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

Digitalization changes everything

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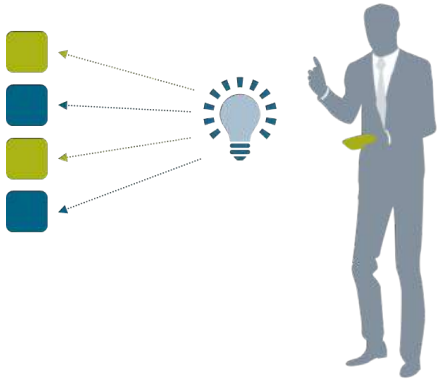
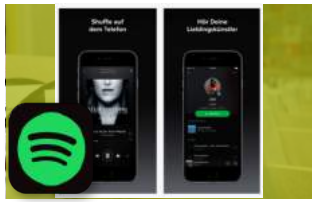
From hardware to software

Users become designers



New business models become possible



From the **record store** to **streaming**

From the **taxi** to **ride sharing**

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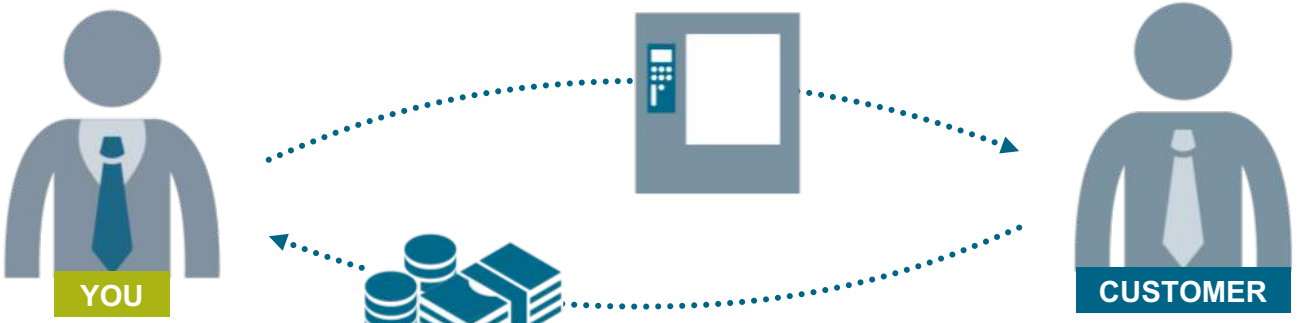
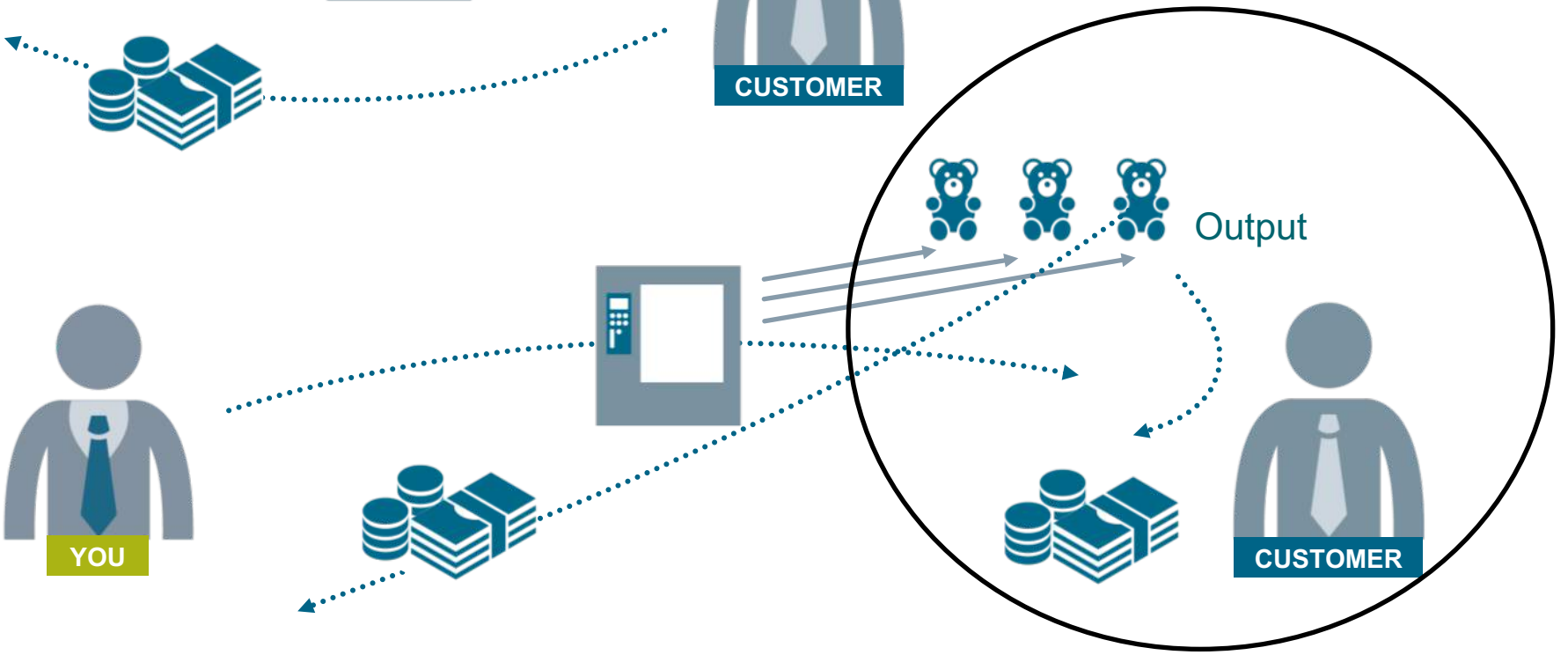
Yesterday:
Revenue through machine sales



Today and future:
New scope for value creation through the sale of machine output



New digital business models based on value creation for the customers

Siemens addressing these challenges using digital technologies
- Building on Electrification – Automation – Digitalization

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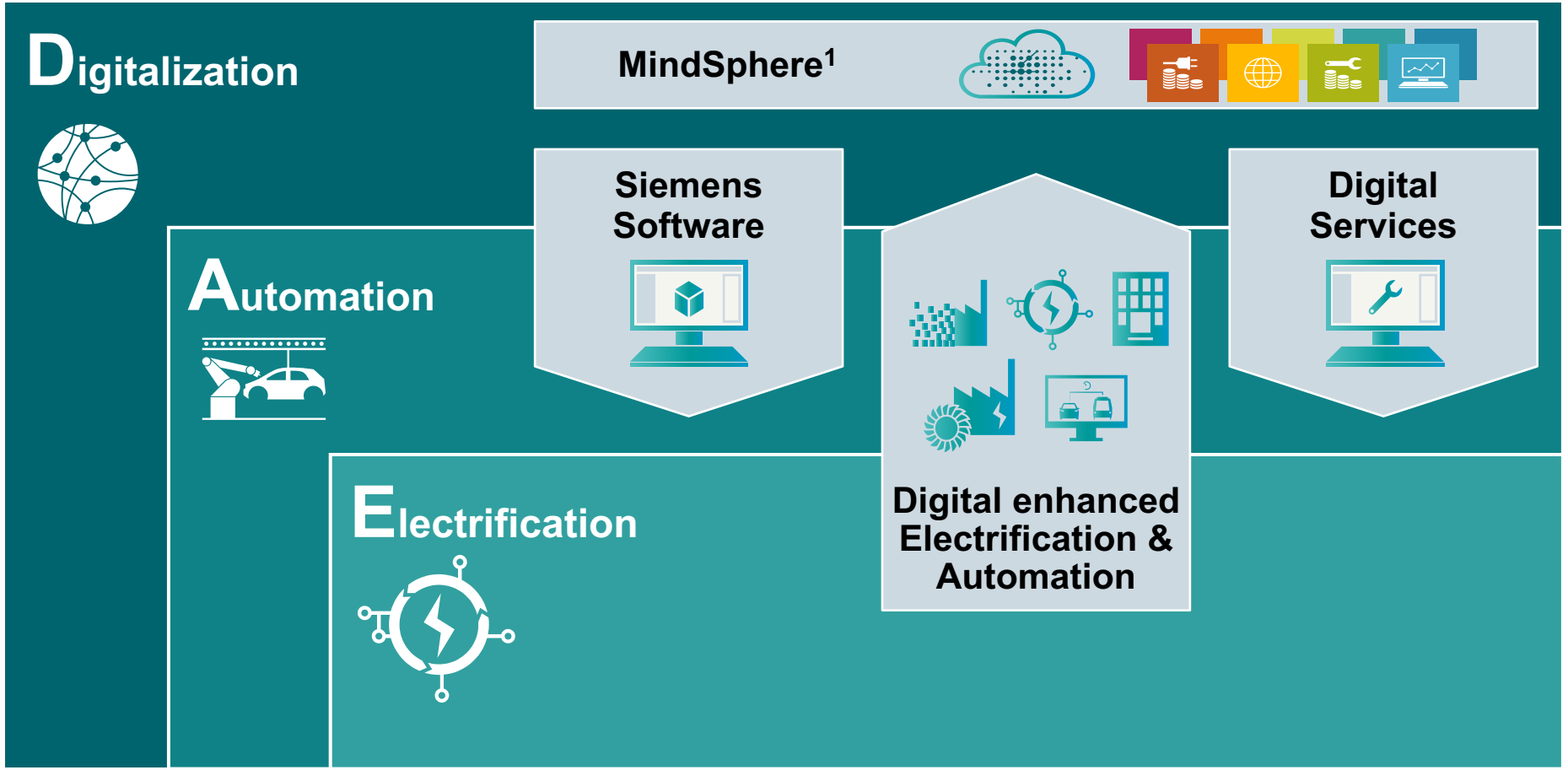

Digital Expertise

Domain Know-how

1) The cloud-based, open operating system

When we approach our customer with our Digital Enterprise, our focus needs to be the value we create for them

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Industry trends

Efficiency

- Resource and energy efficiency
- Demanded product/quantity
- …

Flexibility

- Individualized mass production
- Volatile markets
- …

Quality

- Closed-loop quality
- Traceability
- …

Time-to-market

- Fast innovation
- More complex products
- Lifecycle Management
- …

Security

HSSE – Health & Safety | Environment | Regulations/Standard | …

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A lot can happen in a year

90% of the data in the world today has been created in the last two years

Source: IBM, “10 Key Marketing Trends For 2017,”

A lot can happen in a day

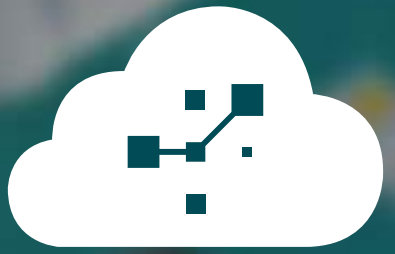
5.5 million new “things” get connected every day, and 50 billion by 2020

Source: Gartner Research

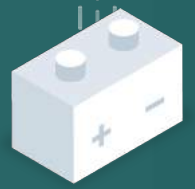
Planning, simulation and engineering

Automation and control

Maintenance, monitoring and service

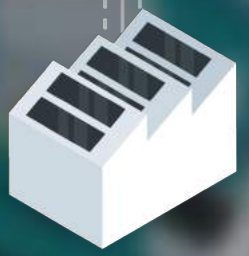


The cloud



connected grid assets

connected edge devices



connected industry

connected buildings

MindSphere – The cloud-based, open operating system for the Internet of Things – from Siemens

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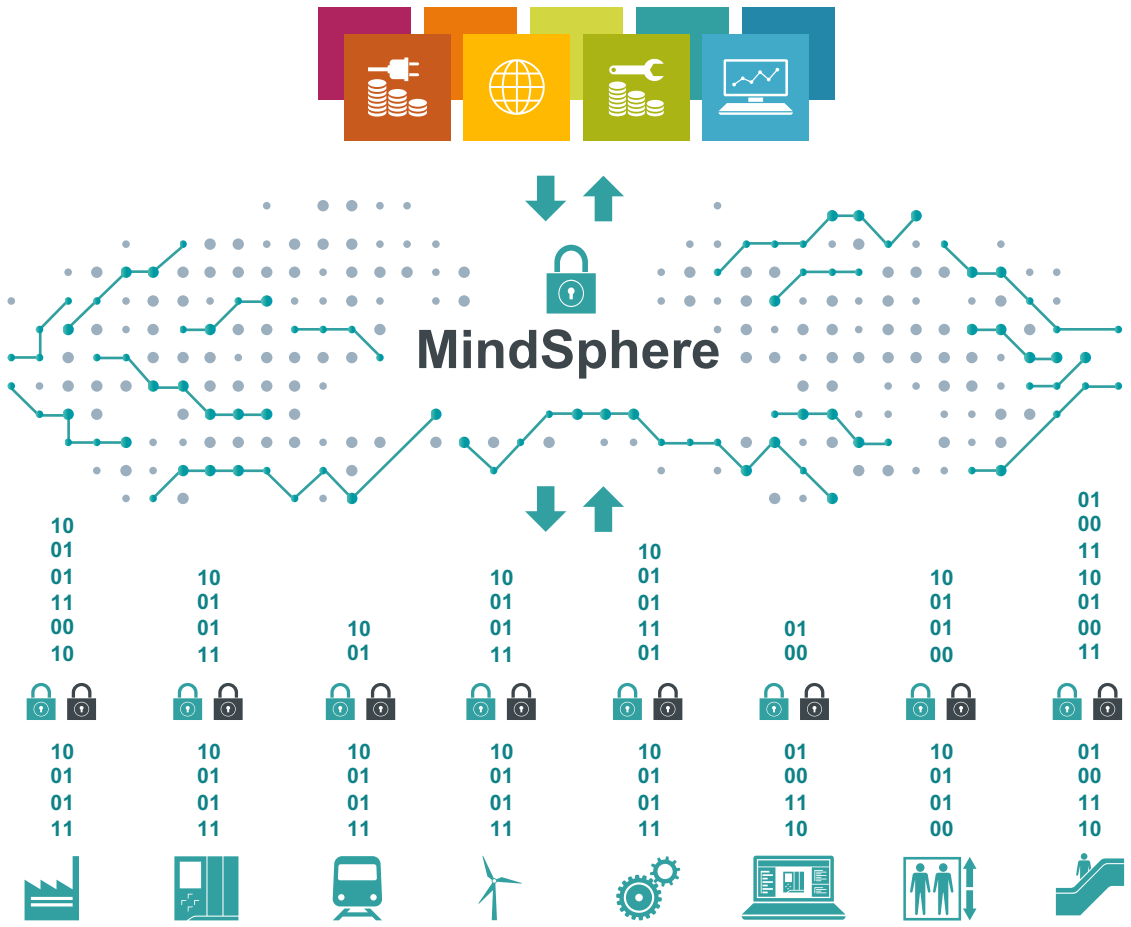

MindApps

- **Apps from OEMs, from end customers, from partners and from Siemens**
- **Transparency in plants and analytical insight (e.g. fleet management)**

MindSphere

- Open interface for developing customer-specific apps
- **Different cloud infrastructures: SAP, AtoS, Microsoft Azure** as public or private clouds or on the premises (planned)

MindConnect

- **Open standards** for connectivity, e.g. **OPC UA**
- **Plug & play connection** of Siemens and third-party **products**
- **Secure** and **encrypted** data communication

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Why Cloud?

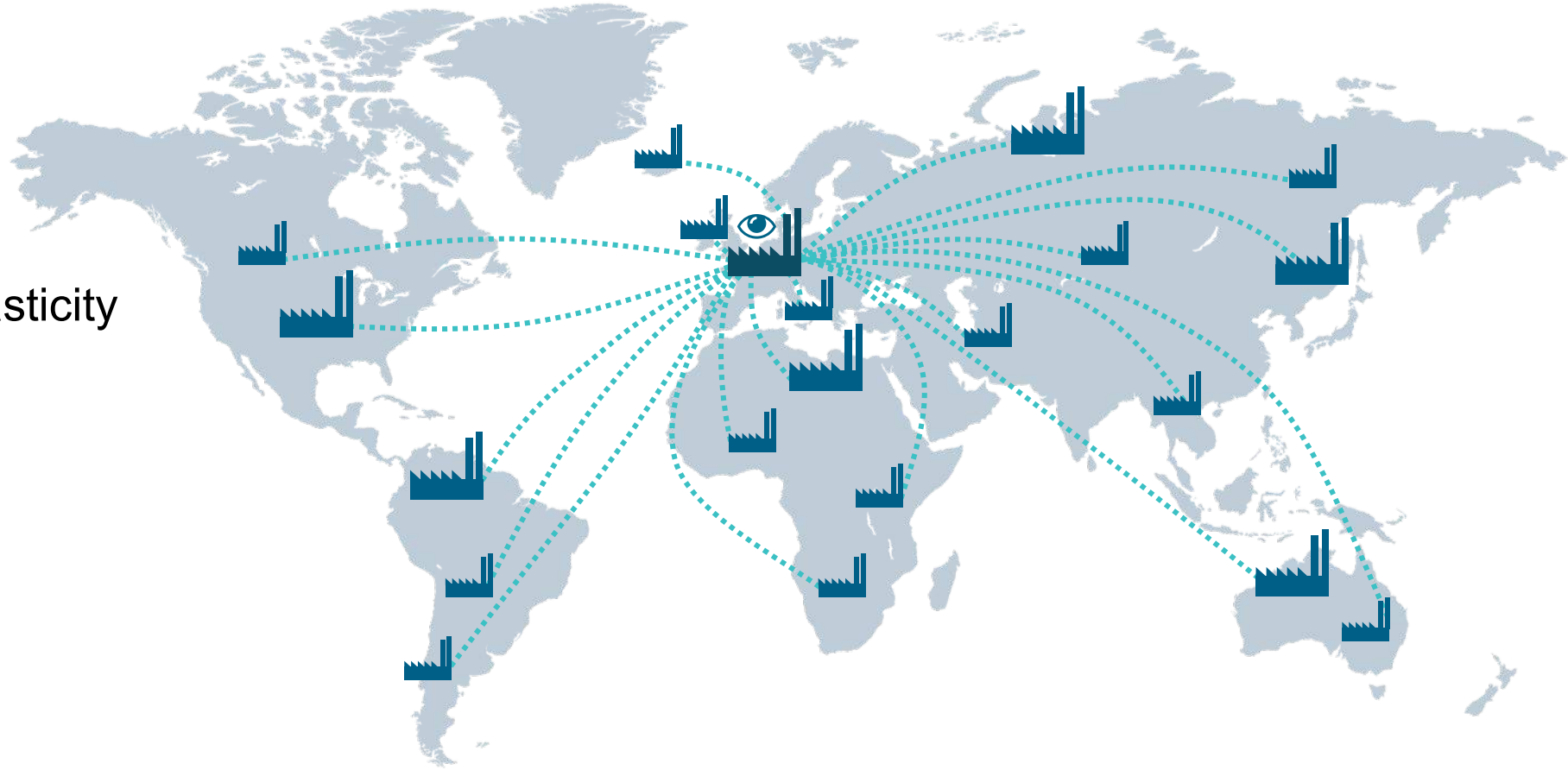
Connected global fleet

Seamless updates

Storage and computing elasticity

Pay-per-use

Data source integration



Strong open ecosystem emerging around partners

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MindSphere Changes Everything by:

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Quickly and easily **connecting real things to the digital world**

Creating a strong partner ecosystem **with Open Platform as a Service (PaaS)**

Enabling unmatched closed-loop innovation **with the complete digital twin**

Driving business success with powerful applications and digital services

IoT to manage and enable “Smart Infrastructure”

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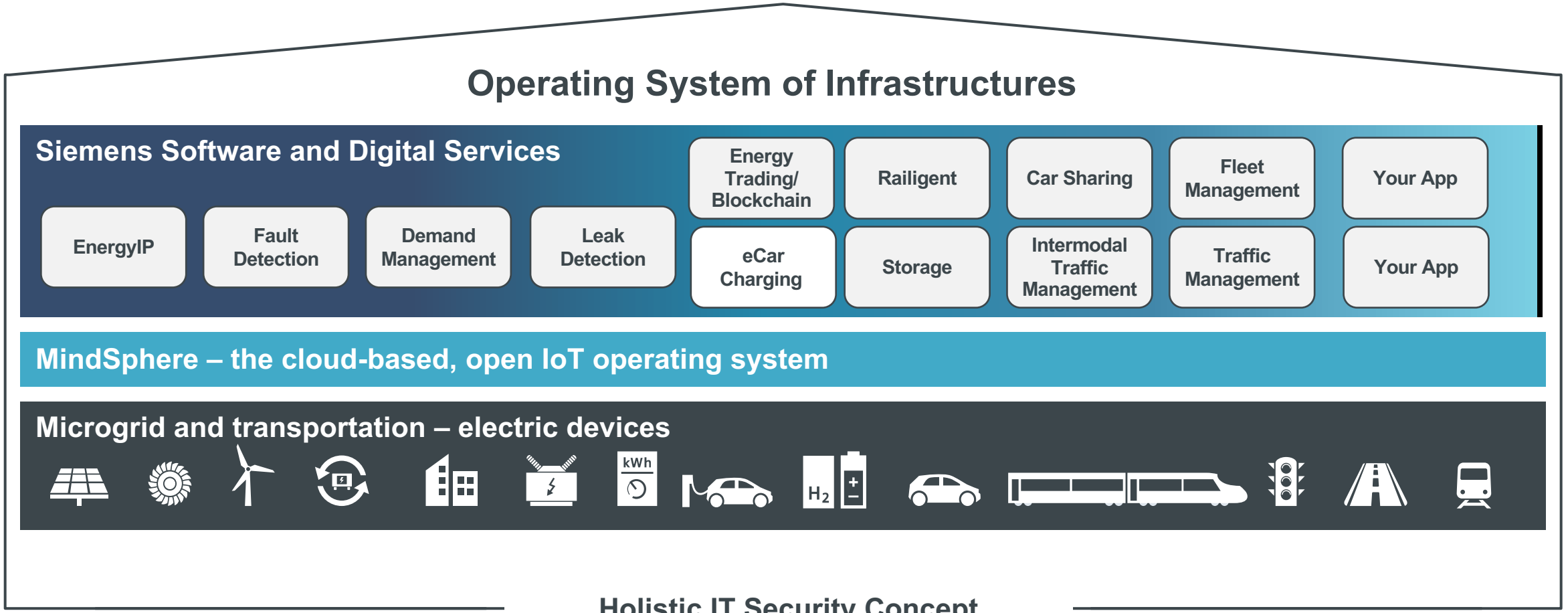

Key areas of digitalization – IoT use cases for the consumer-centric energy world

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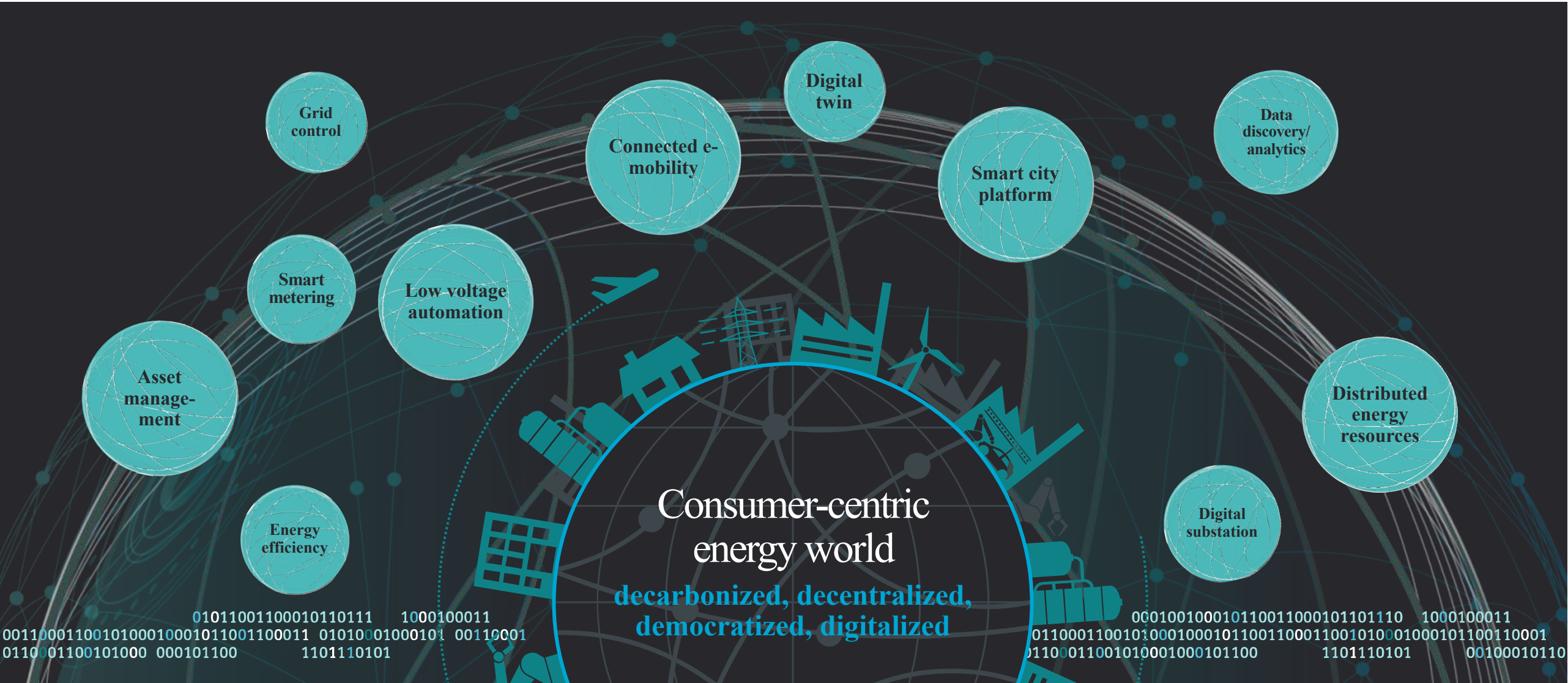

MindApps for energy

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Flexible Payment Revenue Protection EnergyIP Prepay	**Analytics** EnergyIP Analytics	**Energy Efficiency Analytics** EnergyIP EEA	**Planning and Outage Intelligence** Omnetric PnOI	**Asset Per-formance Manage-ment** RCAM	**Performance Analytics and Manage-ment** EnergyIP PAM
Metering/ Meter Data Manage-ment EnergyIP MDM	**Market Transaction Management** EnergyIP MTM	**Distributed Energy Optimization** EnergyIP DEOP	**Distributed Energy Resource Manage-ment** EnergyIP DEMS	**Substation Device Monitoring** EnergyIP SDM	**EnergyIP Consulting, Services and Training**

MindSphere
for energy

Smart meters	**Smart inverters, storage**	**Consumers**	**Distributed generation**	**Trans-mission Distribution**	**Other Siemens and 3rd party devices**

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, …

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

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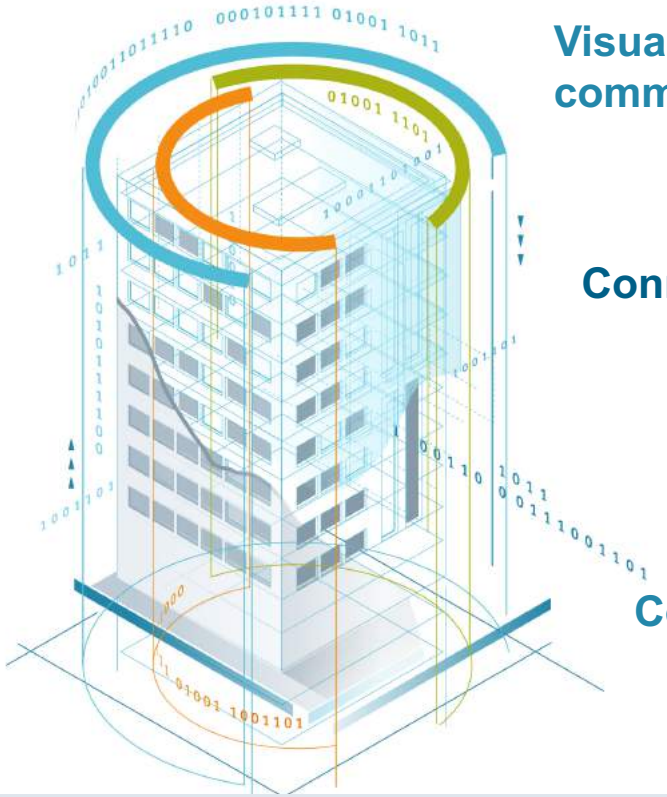
From building data…



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

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Create transparency in an open and standard-based end-to-end architecture from field level to applications and services

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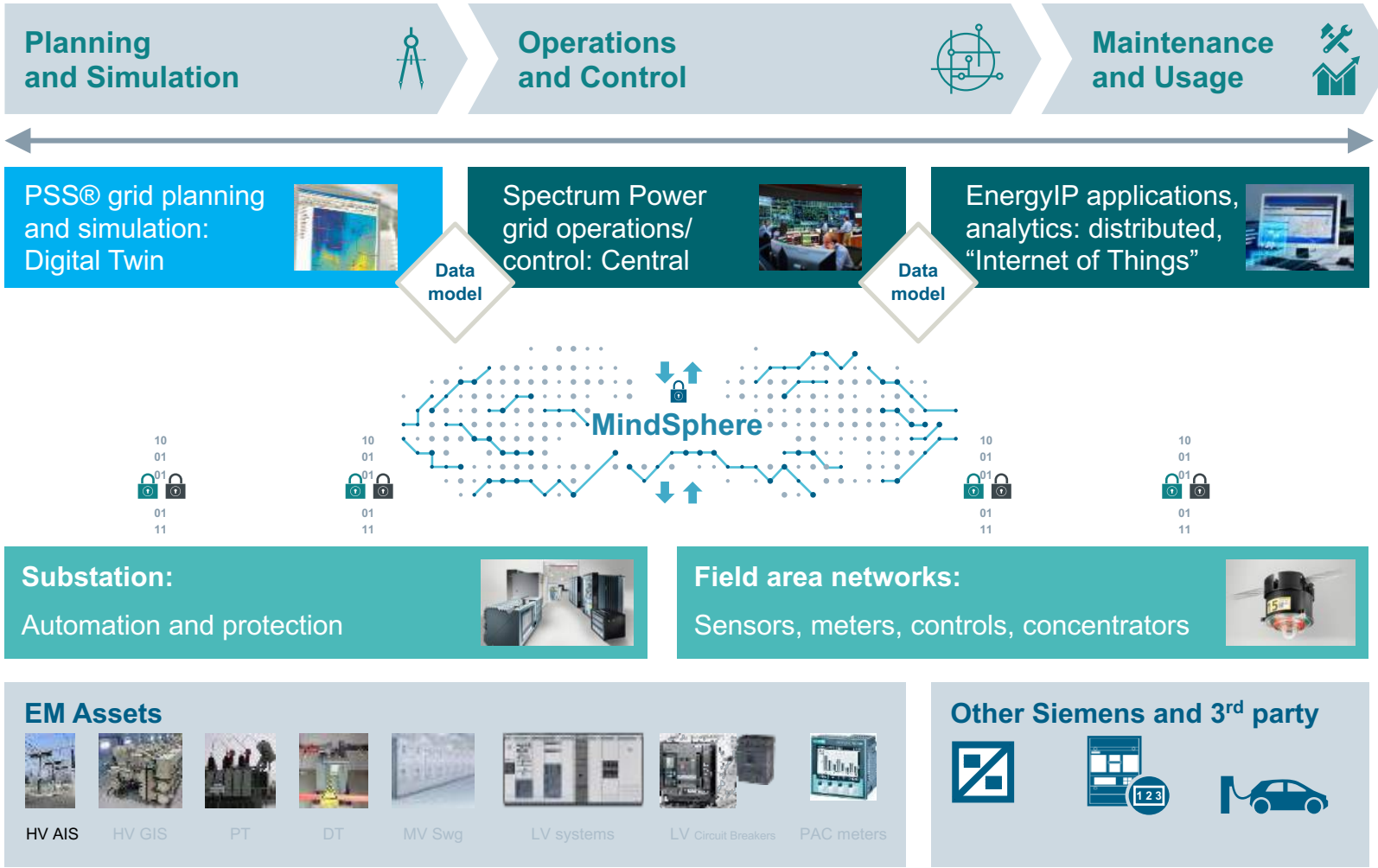
DIGITALIZATION
Software and Services

AUTOMATION

ELECTRIFICATION



Closing the Loop with the Digital Twin

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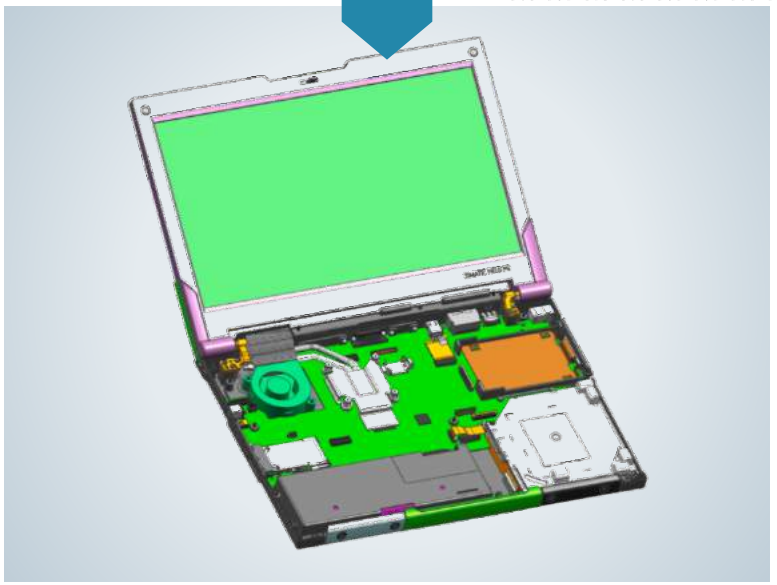
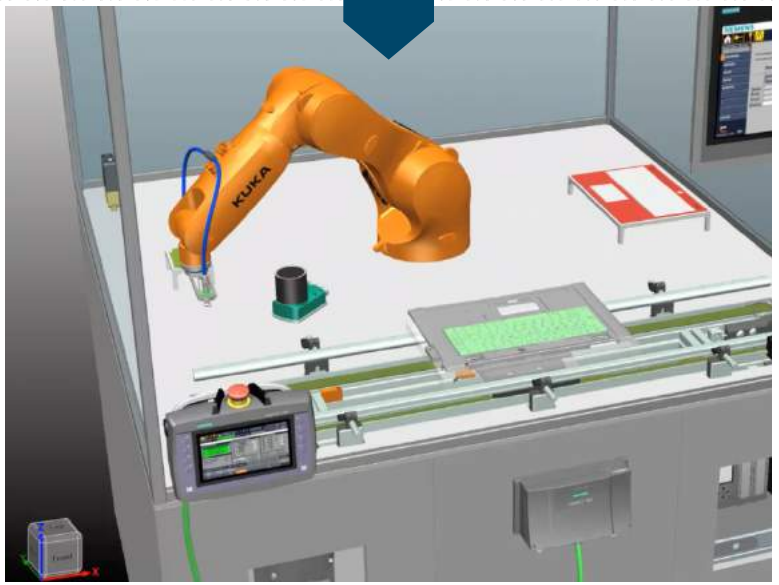
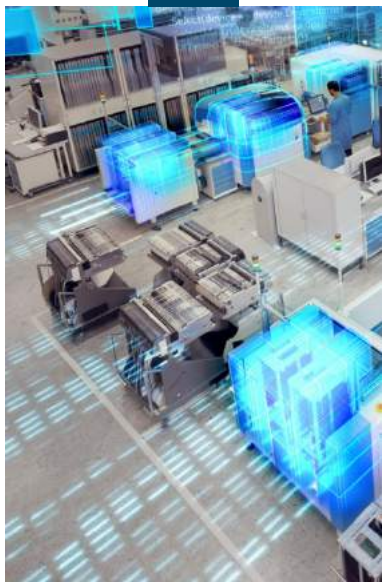
MindSphere

feed back insights to continuously optimize product and production







Product Digital Twin

Production Digital Twin

Performance Digital Twin

1 Product design → 2 Process & plant design → 3 Engineering & commissioning → 4 Operation → 5 Service

The digital twin is the “heart” of the smart factory

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Benefits

- Virtual model
- Personnel deployment planning
- Definition of multidisciplinary work packages
- Visualization of construction status
- Planning of mechanical finishing
- Definition of work packages for finishing/commissioning
- Library of industry-specific checklists

Movie: Volvo Cars Group

Siemens' integrated technologies, Maserati was able to reduce development time considerably while increasing production output

Challenge

Maserati hopes to booster its position in the premium market with the new Ghibli and multiply its sales figures in the process

Solution

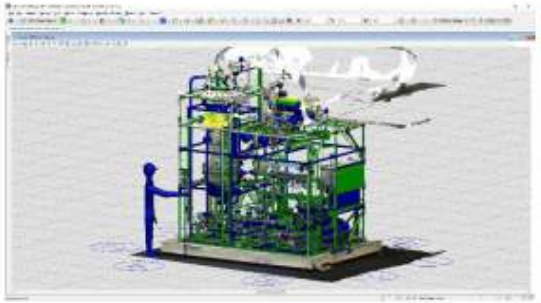
Siemens supports Maserati along the complete product development and production process from product design to production planning, engineering, production execution and services

Outcome/benefit

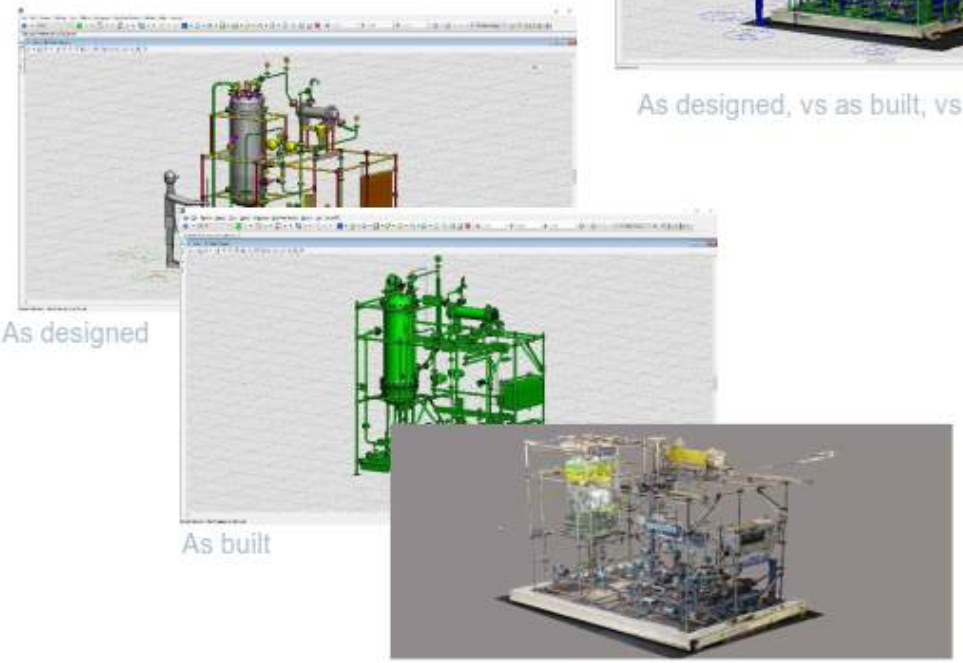
- Reduced time to market due to shorter development time
- Integration of suppliers
- Increased efficiency through integration of two new assembly lines into the existing factory

Visual Operations

MindSphere MindApp & Reality Models



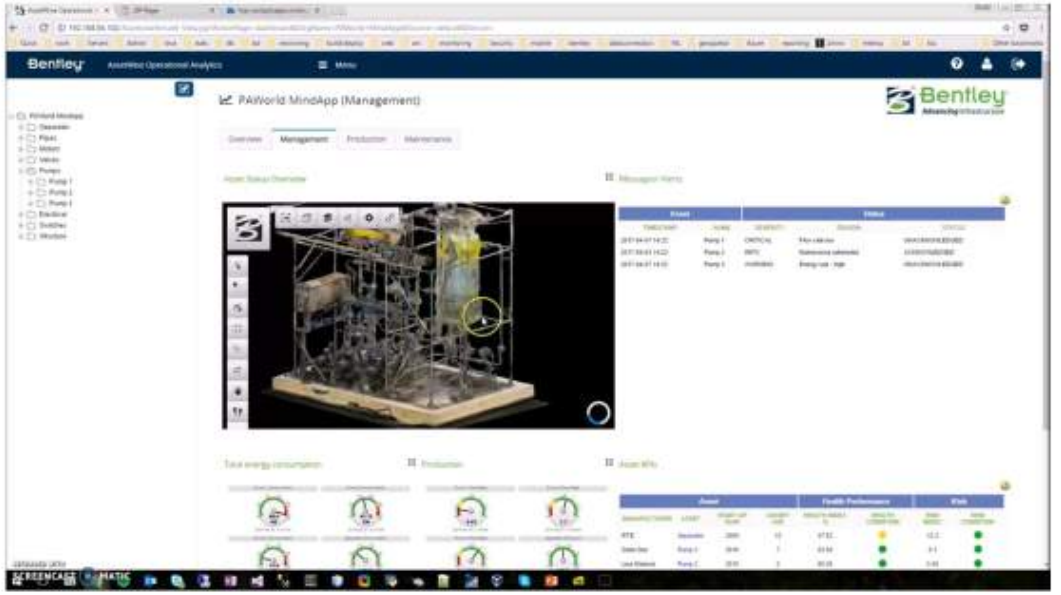
As designed, vs as built, vs as operated



As designed

As built

As operated



Twins here to stay...

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Decentralization + Renewable + Prosumer

Digital Twin = mirror of real system

Enable digital life-cycle planning

“Single Source of Truth”

Agenda

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Evolution of AI will surprise us more than we know today

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Definition of AI Creating machines that perform functions that require intelligence when performed by people (Kurzweil, 1990)

Before 2011

1946: Zuse's *Z3*, first programmable electronic computer

1997: IBM Deep Blue defeats world's chess champion Kasparov

2005: Honda's humanoid robot *Asimo* comes to life

2011 – 2016:

2011: Watson wins *Jeopardy!* against most successful contestants

2014: Alexa, Amazon's intelligent assistant debuts

2016: AlphaGo beats Lee Sedol in a Go match

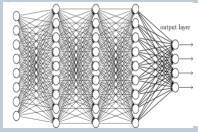
Expected by 2030+

~2020: All-over virtual personal assistants as interface for consumers

202x: Fully autonomously driving cars become market-ready

20xx: Robots may build robot "children" on their own

Major breakthroughs



Algorithmic advances in **deep learning**

Increasing **computing power**

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Usage of huge **datasets** leverage full potential of AI

Open platforms and data bases

Application of Artificial Intelligence (including Machine Learning)

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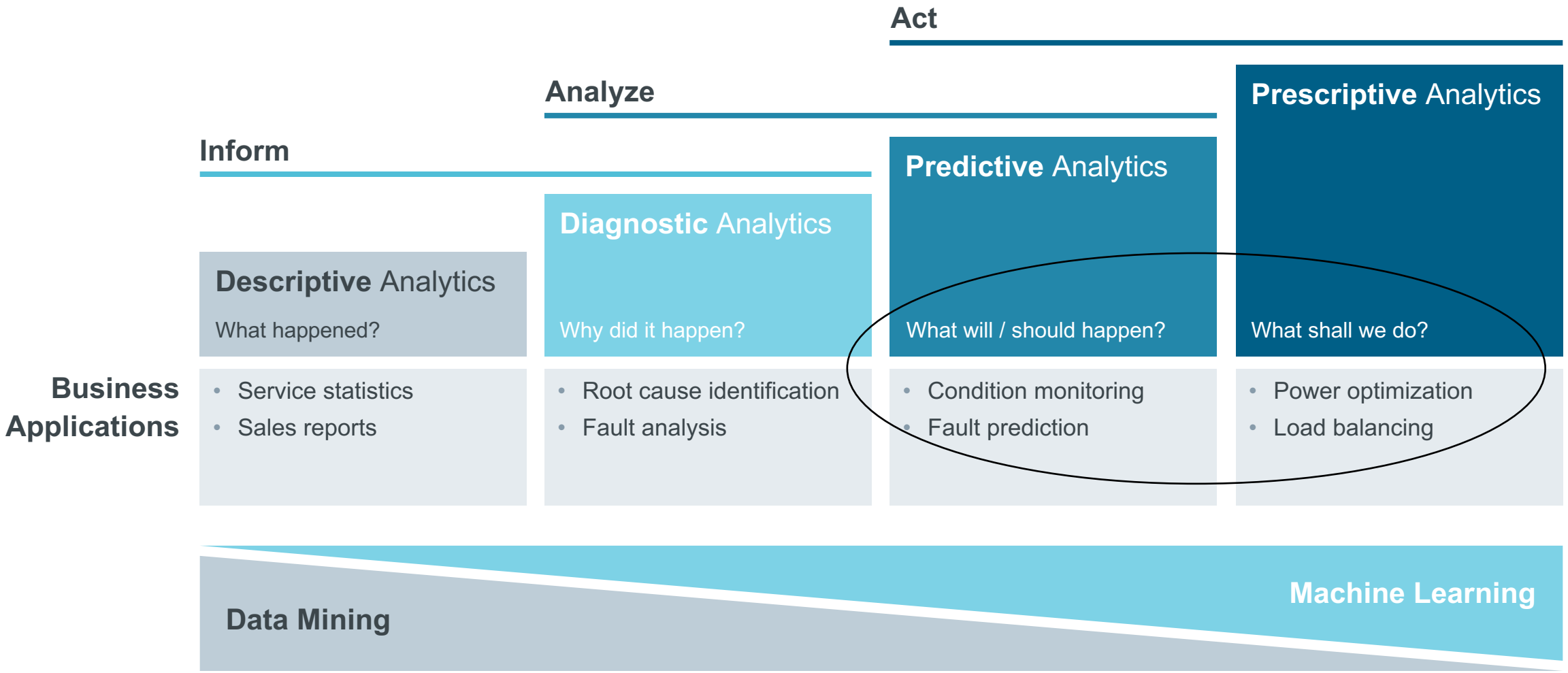
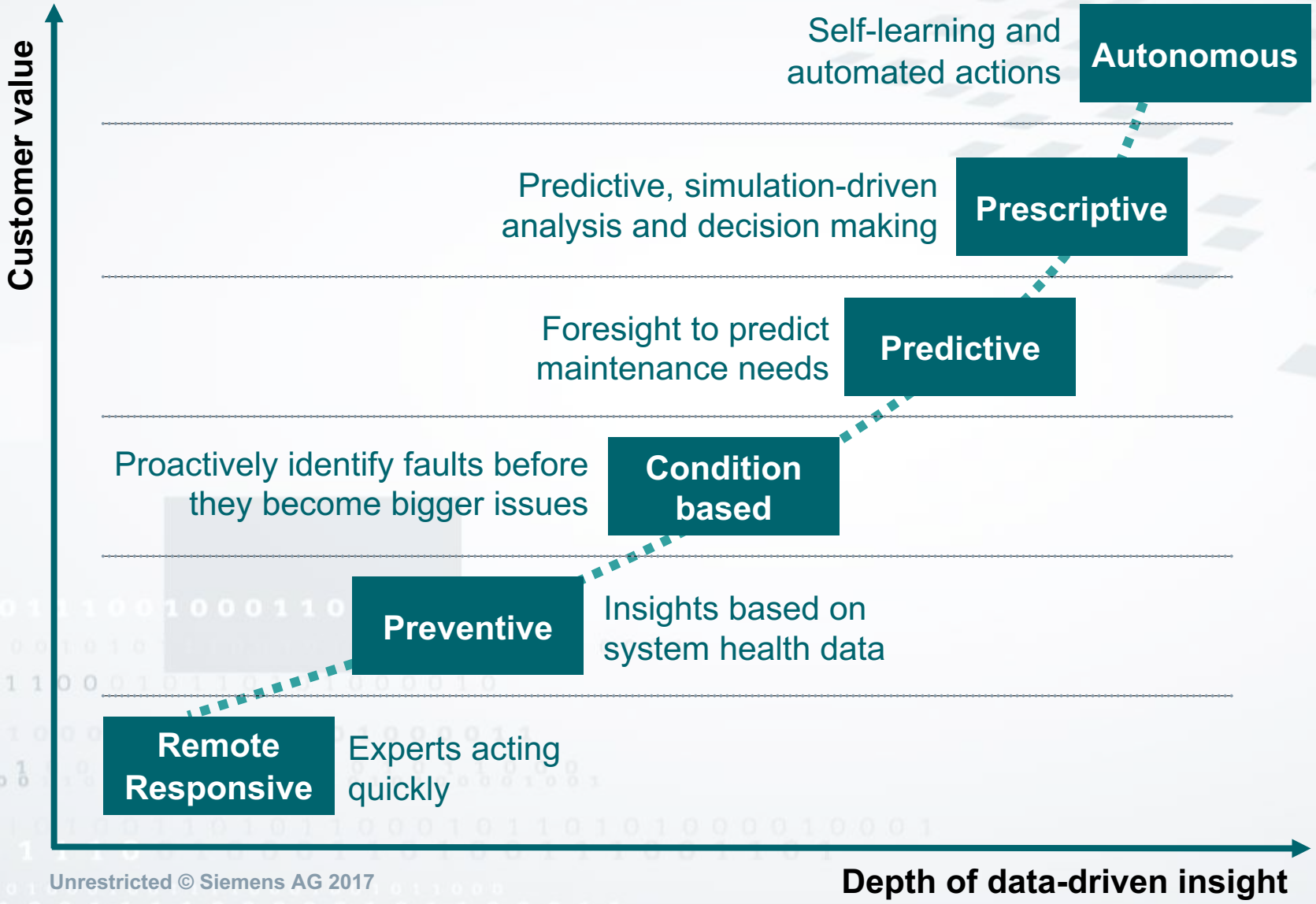


What's next?



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

A future energy system must enable autonomous operation

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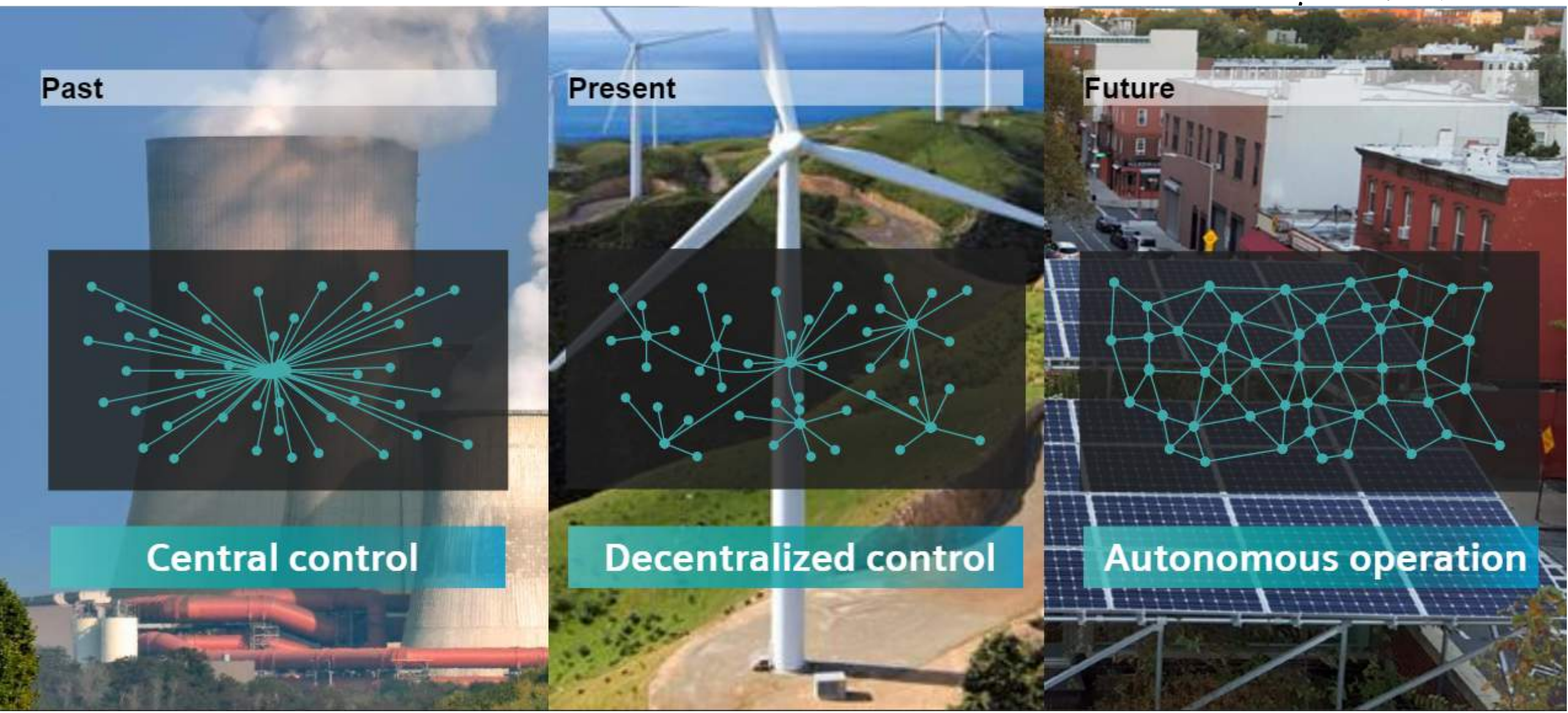

Only together we will make success

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

Creating environments that care

Thank you!

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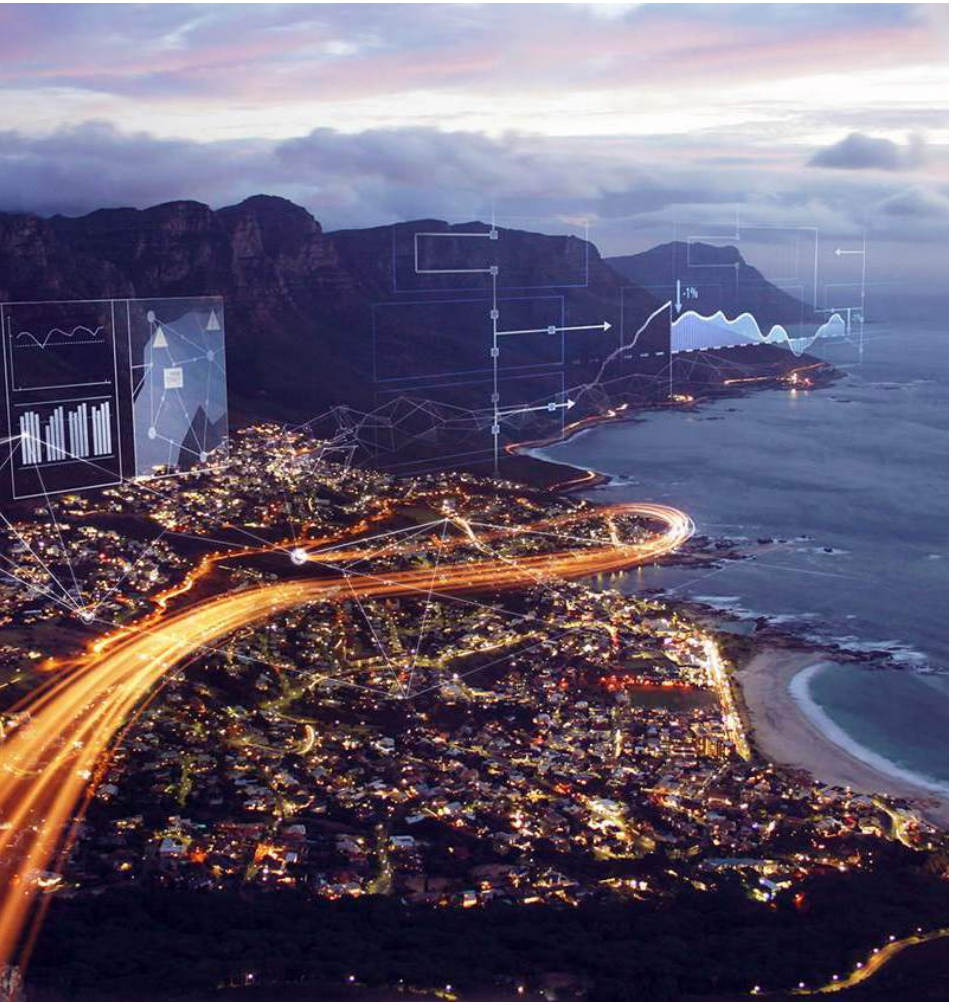

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Setting the Scene
- Cyber Security needs to be addressed holistically

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Security
Availability, Integrity,
Confidentiality & Privacy

Technology Implication

- Remote access
- IT / OT convergence; utility connectivity
- Use of public networks
- Increasing usage of IT components

Trends
Renewables, Pro-/Consumer Markets, Network Optimization