

Siemens perspektiv på den digitala utvecklingen inom Energisektorn

Energiforsk Workshop, Stockholm 7 December 2017
Erik Mårtensson, CEO Siemens Energy Management Sverige

Agenda

1

Market Trends

2

IoT MindSphere

3

Electrical Digital twin

4

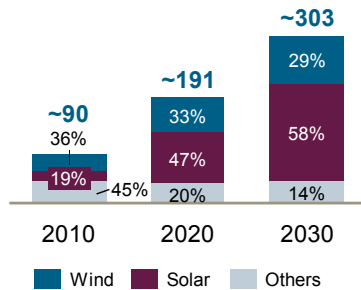
Blockchain & AI

The revolution of energy systems has just started...



Increase of Renewables

New installations in GW p.a.

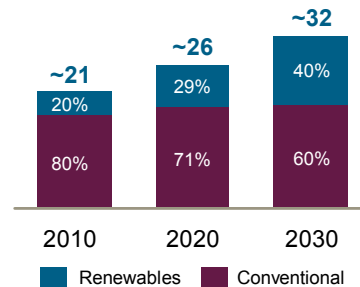


Increased distance to Load /
Need for Balancing

- **Reinforcing** national grids
- **Interconnect** national grids
- **Connect** large Renewables

Growing electricity supply

Generation in 1000 TWh

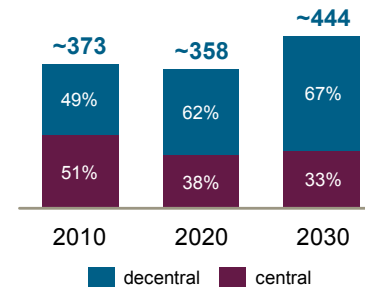


Increased electrification...

- in **emerging countries** e.g. China, India, Indonesia
- of **building heating** and **industrial processes**
- of **mobility** (eCars, eBus,...)

Distributed Power Generation

New installations in GW p.a.

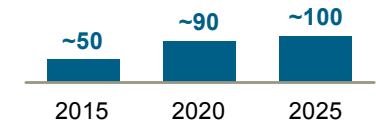


DES & critical power systems

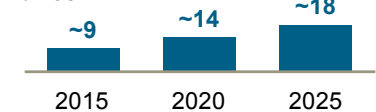
- **Energy storage** solutions
- **Micro- /Nanogrids** arising
- Low & Medium Voltage growth

Digitalization & Automation

New Smart Meter installations
(Electricity, Gas, Water) in mio units p.a.



Smart Grid IT Spendings
in bln USD



Drives **agility in energy systems**

- Sensors / meters provide data, IT solutions make it actionable
- New market participants
- New pricing / business models
- Efficient Asset Management

Note: Siemens assumptions based on market and industry analysts

We are at a tipping point.. - and the customer is creating chaos!

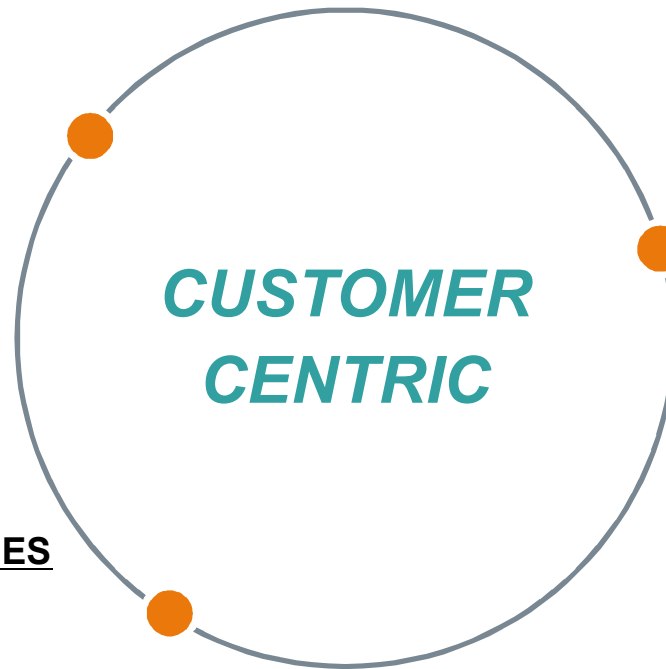
POLITICAL TARGETS

- De-carbonization
- Sustainability
- Energy Efficiency
- Resiliency

BREAKTHROUGH TECHNOLOGIES

(Performance & Cost):

- Wind- and PV Power Gen.
- Energy Storage (Li-Ion)
- Digitalization



MARKET DEMANDS

Large-scale Renewable

- Integration into the electricity system (Wind, PV, Hydro)

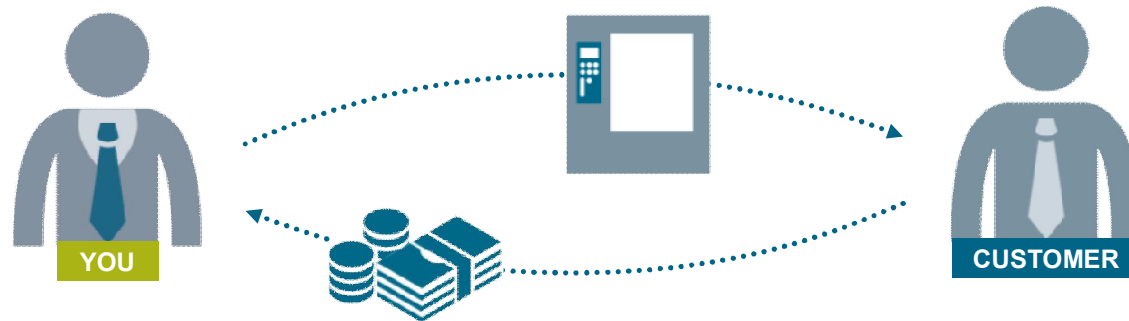
Distributed Energy Systems to maximize:

- Energy System efficiency
- Local Renewable integration
- Resiliency

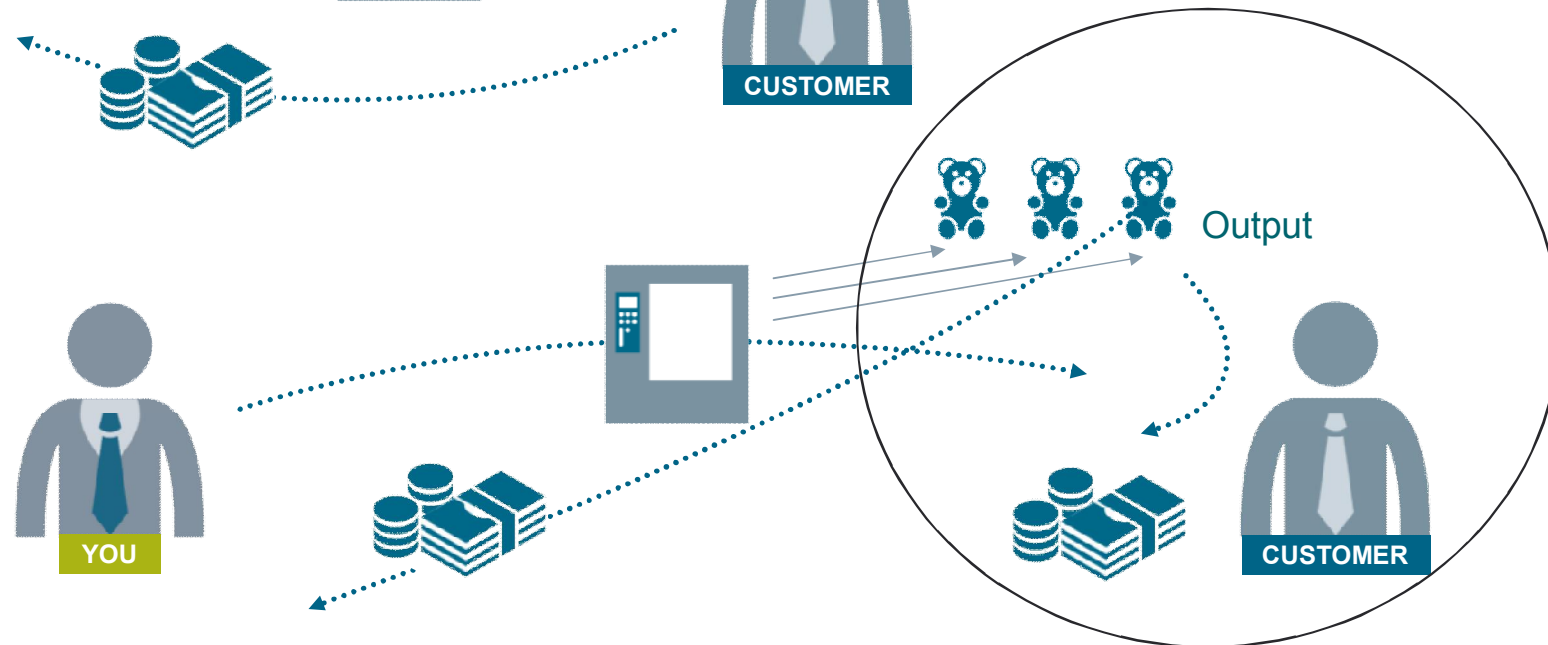
Electrification of Consumption

- e. g. Heat Pump, E-Car, E-bus, E-ferry ..

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

A future energy system must enable autonomous operation

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Past



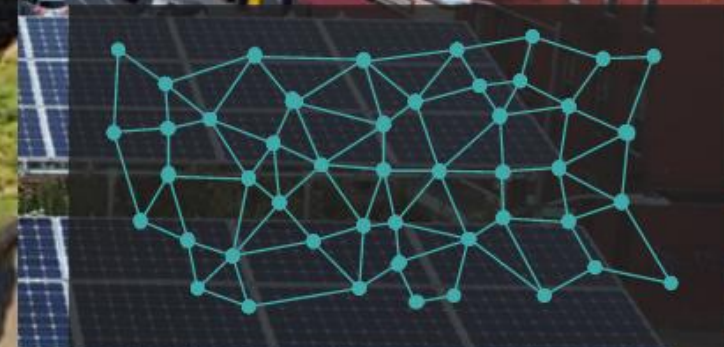
Central control

Present



Decentralized control

Future



Autonomous operation

Challenges

Energy System Stakeholder challenges

- Complexity and Uncertainty (Technology, Regulation)
- System Dynamics (Stability)
- Vulnerability (Physical and Cyber Attacks)

Competitive advantage through:

- Adaptability, flexibility, speed
- Forecasting accuracy
- Decision Quality

**Data Analytics
based on domain
& product know-
how will turn data
into knowledge**

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Blockchain & AI

Increase Performance ...

...powered by digital transformation

Build Digital Business ...

...through development of applications & digital services

Differentiate in the Market ...

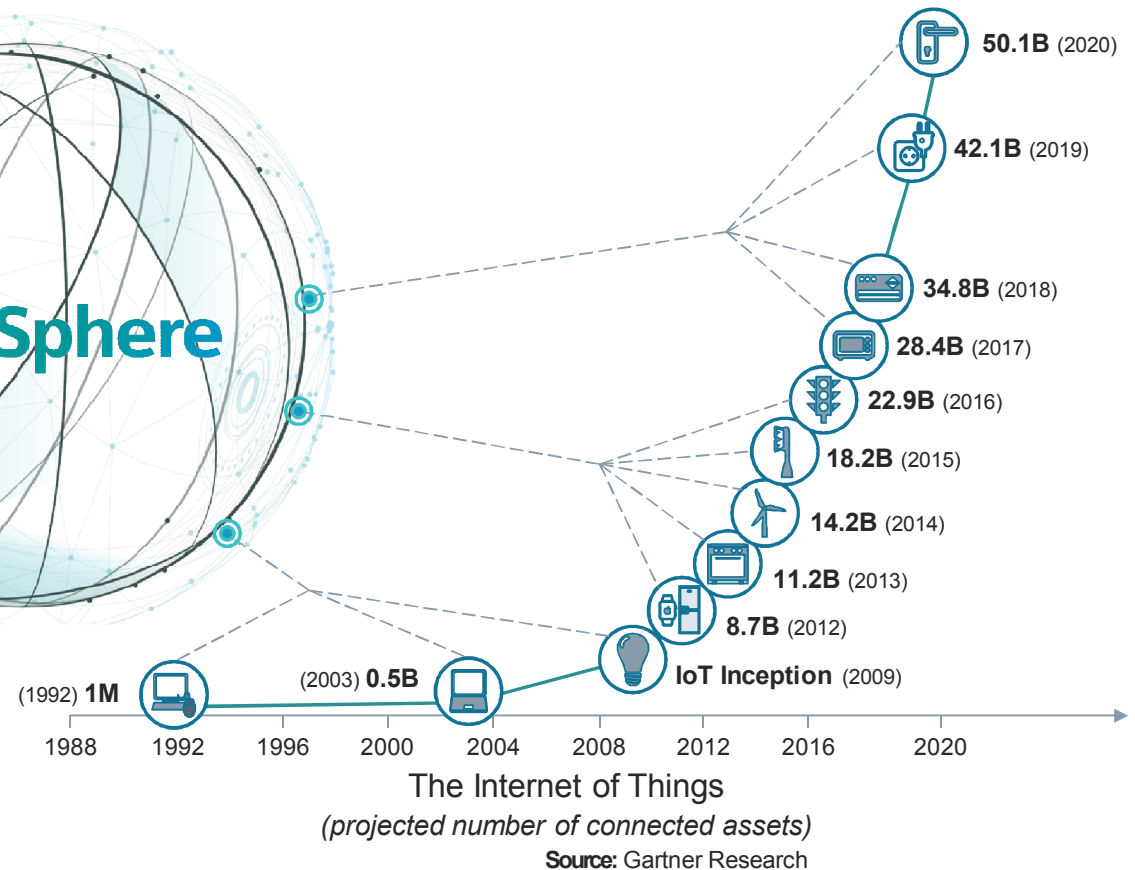
...through new service and business models

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

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MindSphere

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



Majority of all assets will be connected within a short time frame

Why Cloud?

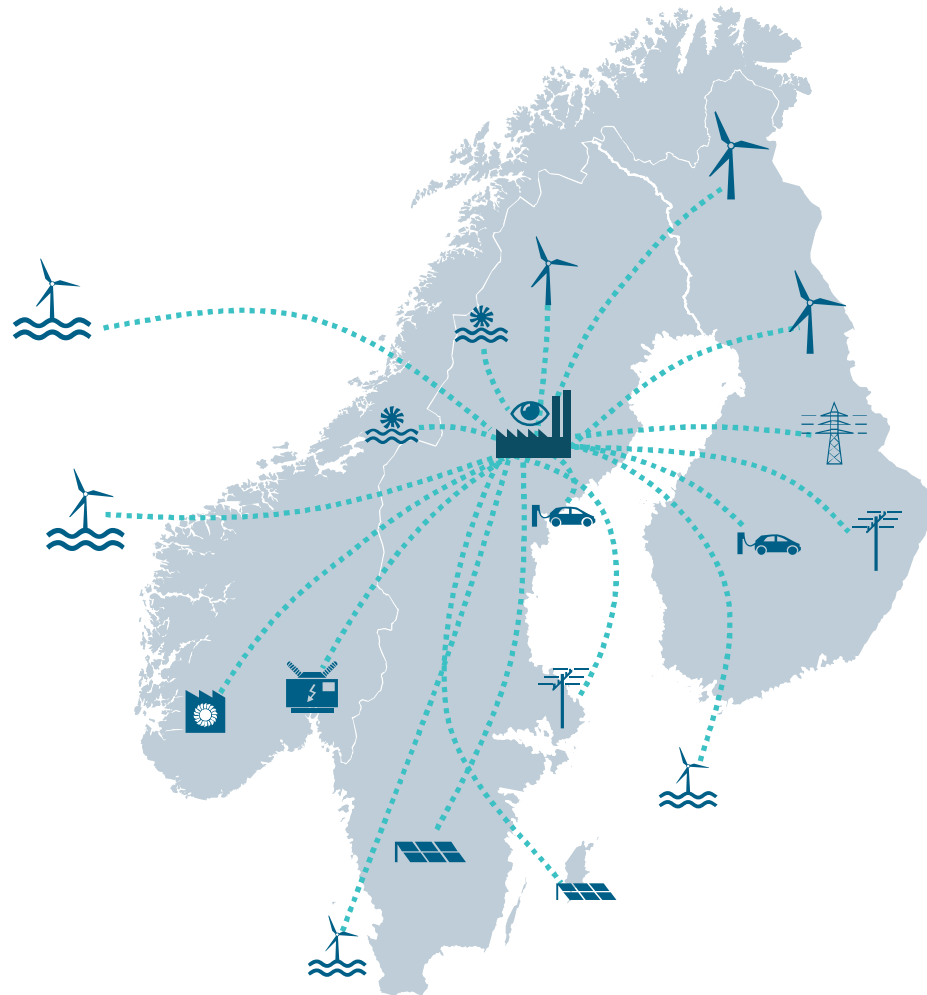
Entire fleet connected

Seamless updates

Storage and computing elasticity

Pay-per-use

Data source integration

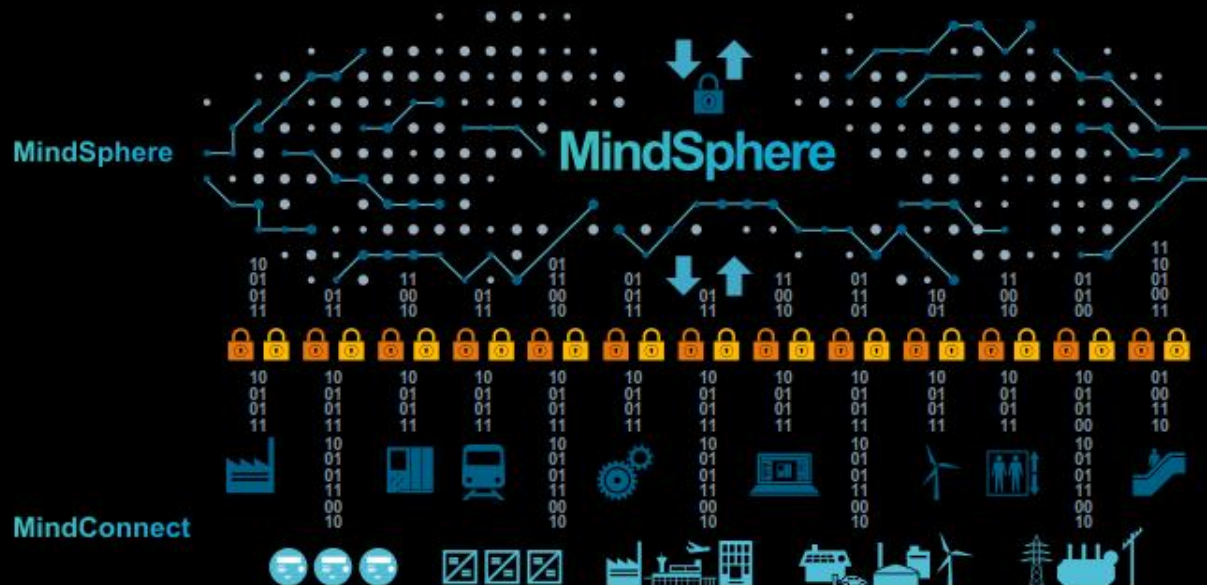


Increased asset transparency in one system securely stored in one place

EM applications powered by MindSphere - The open, cloud-based IoT operating system

MindApps

EnergyIP Meter Data Management / Meter-2-cash	EnergyIP Analytics Suite	EnergyIP Non-Technical Losses	EnergyIP Advanced Device Management for Meters	EnergyIP Planning and Outage Intelligence for TSO/DSO
Asset Condition Monitoring	Distribution Grid Analytics Medium Voltage and Low Voltage	Distribution Fault Management	eCar Operating Center	EnergyIP Energy Efficiency Analytics for Industry



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DEEP

domain knowledge

Connectivity: Power grid assets, electrical infrastructure assets, grid edge devices
Driving business success: Powerful energy applications, digital energy services

BROAD

end-to-end solutions

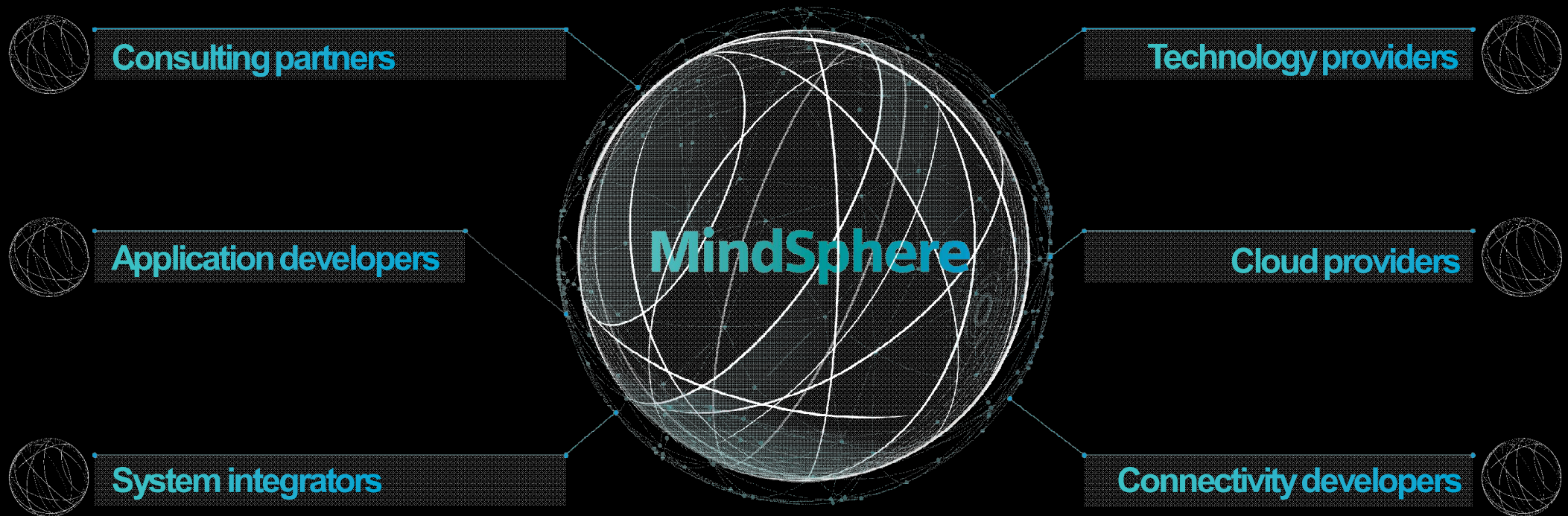
Value chain optimization, cross industry, sector coupling, common data models, industry standards, connected e-mobility, city platforms

OPEN

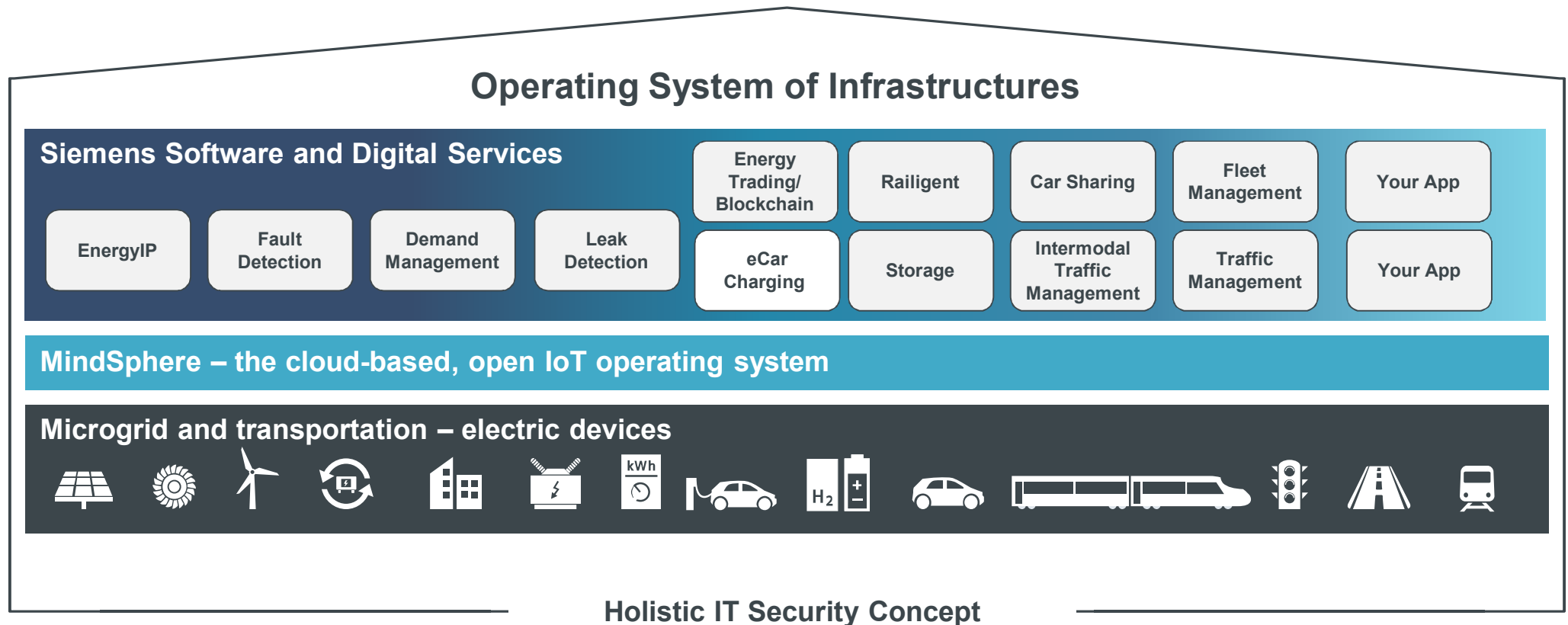
platform and ecosystem

Open API, open connectivity,
open partner network, open ecosystem

Strong open ecosystem emerging around partners



IoT to manage Infrastructure and enable “smart cities ”



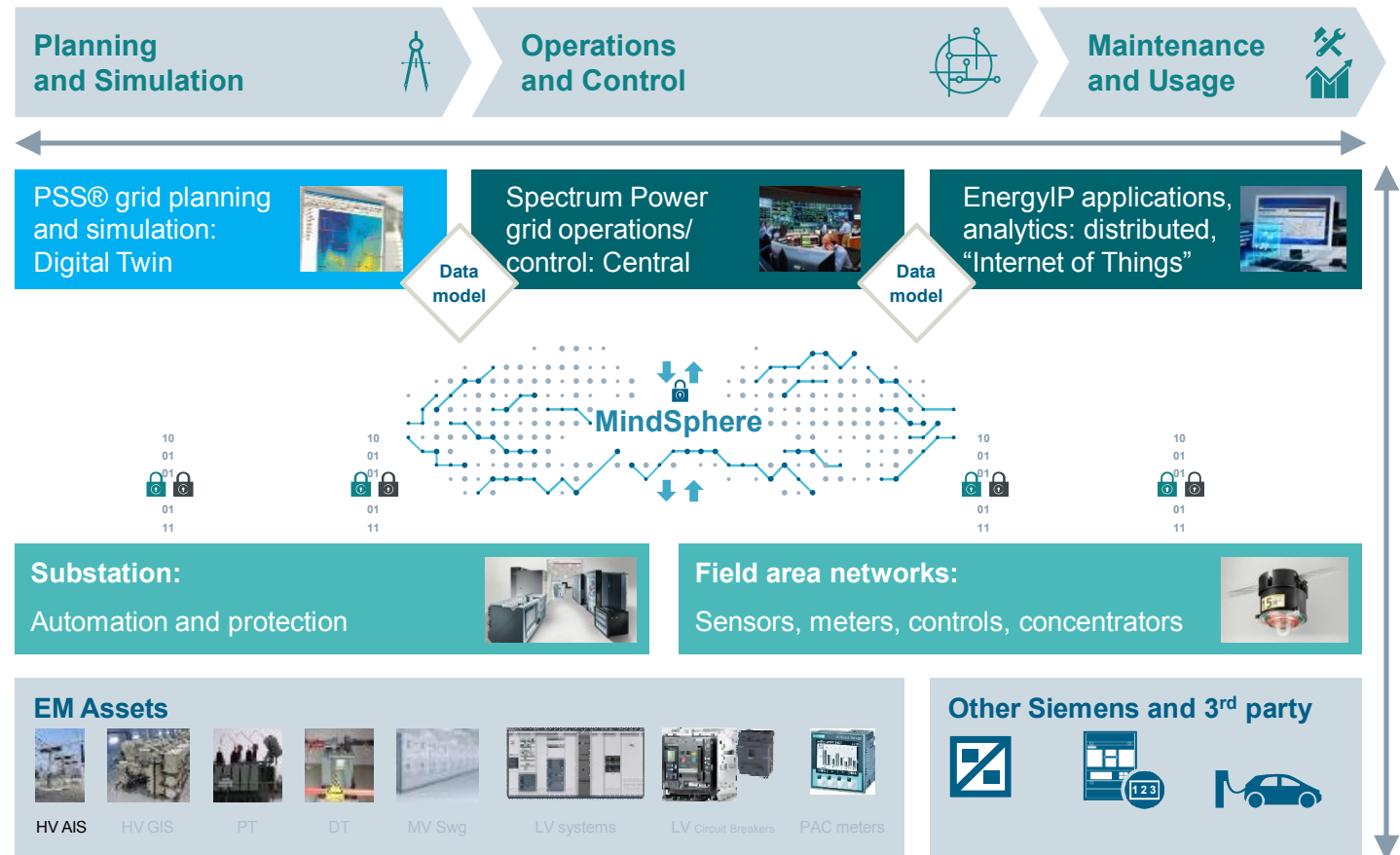
Energy Management requires an open and standard-based end-to-end architecture from field level to applications and services

DIGITALIZATION

Software and Services

AUTOMATION

ELECTRIFICATION



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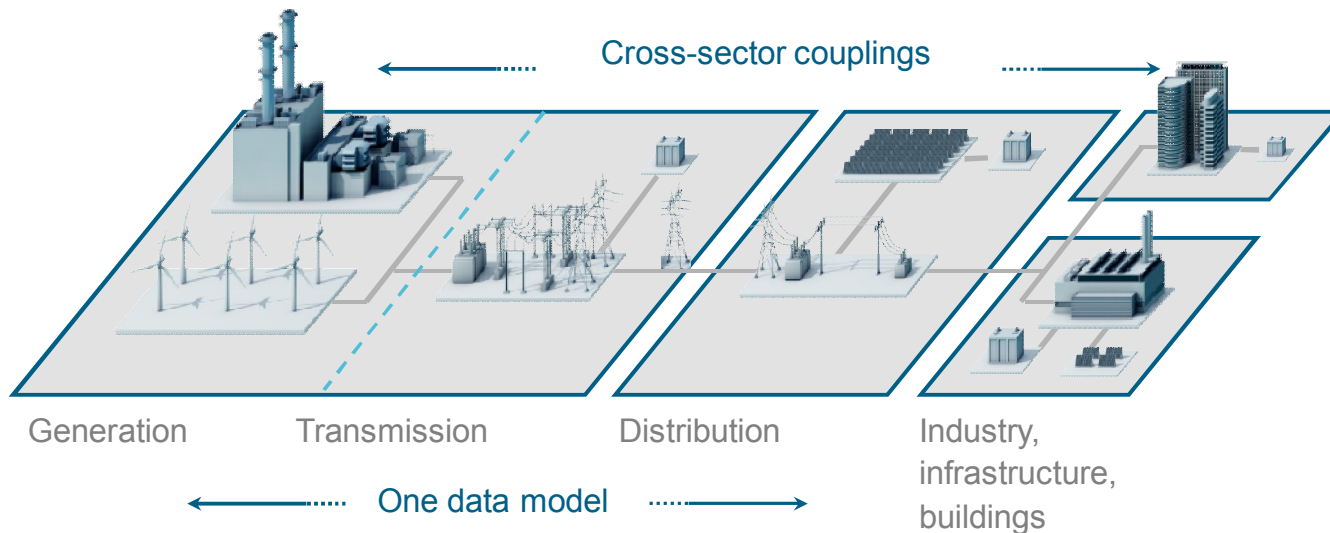
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Electrical Digital twin

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Blockchain & AI

What is the “Electrical Digital Twin”?

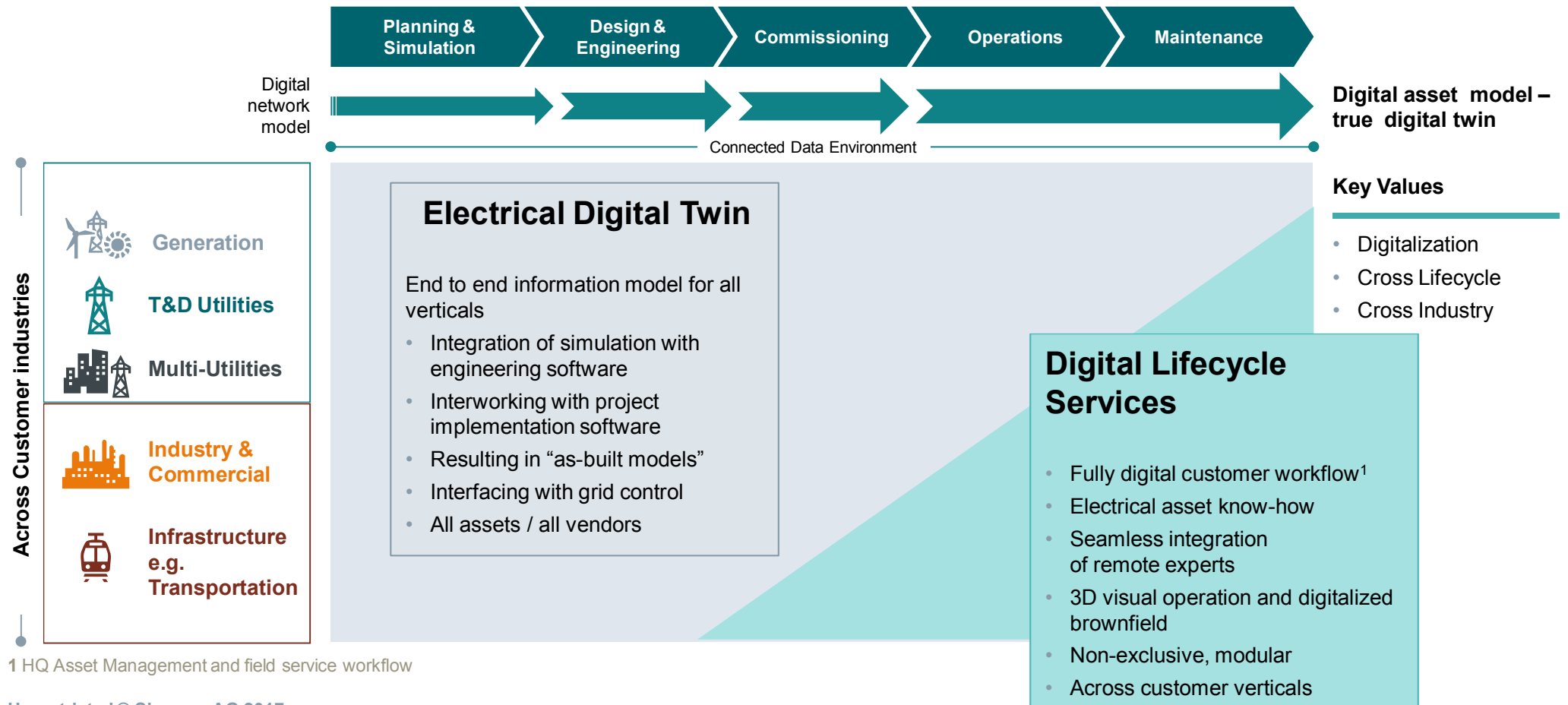


An **Electrical Digital Twin** provides a digital representation of the grid and the major assets in it.

The digital twin facilitates the **simulation** of all aspects relevant for reliable, efficient and secure electrical system **planning, operation & maintenance**.

The value lies in providing a “single source of truth” to different functions in e.g. Planning, Operations, Asset Management, Protection, **enabling efficient business workflows and collaboration across departments and market players**.

Electrical Digital Twin and Digital Lifecycle Services



T&D brownfield opportunity jointly addressed by EM Customer Services and Bentley

Typical situation today



Pain points

- "Undocumented" assets
- Fragmented, iterative workflows
- Aging infrastructure vs. need for resilience
- TOTEX challenge

Customer has to deal with complexity

Targeted situation: Integrated digital workflow



Take care of T&D assets & service processes on behalf of the customer while minimizing his efforts

Visual Operations

MindSphere MindApp & Reality Models

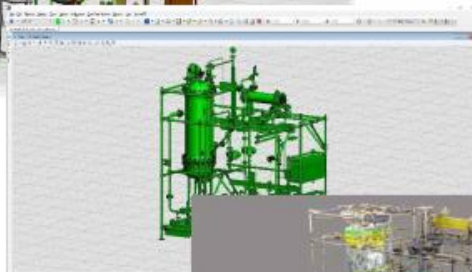
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As designed



As designed, vs as built, vs as operated



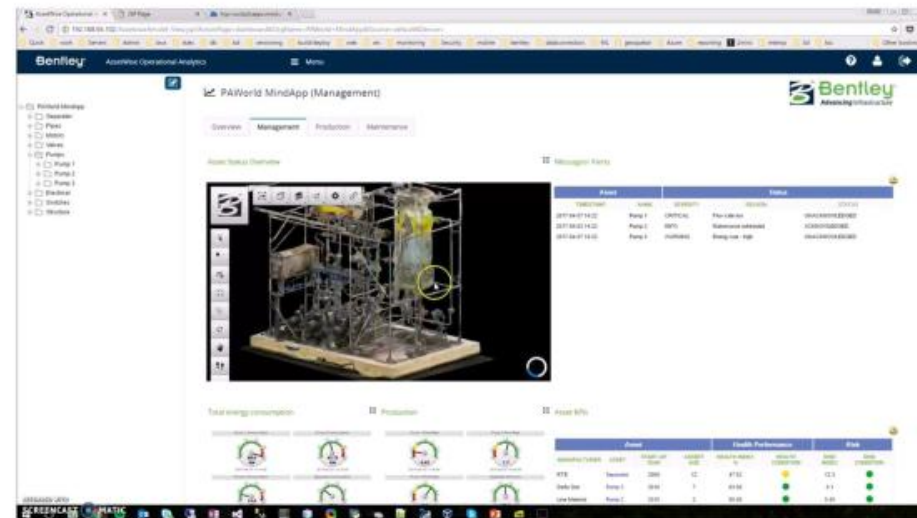
As built



As operated



Step 1: Take Pictures



Digital Twin Example (PSS®ODMS Grid Data Management)

Fingrid – Finland (TSO)

Grid Data Management and Simulation solution...

...connects a variety of IT-systems, enabling most efficient data utilization in one integrated solution

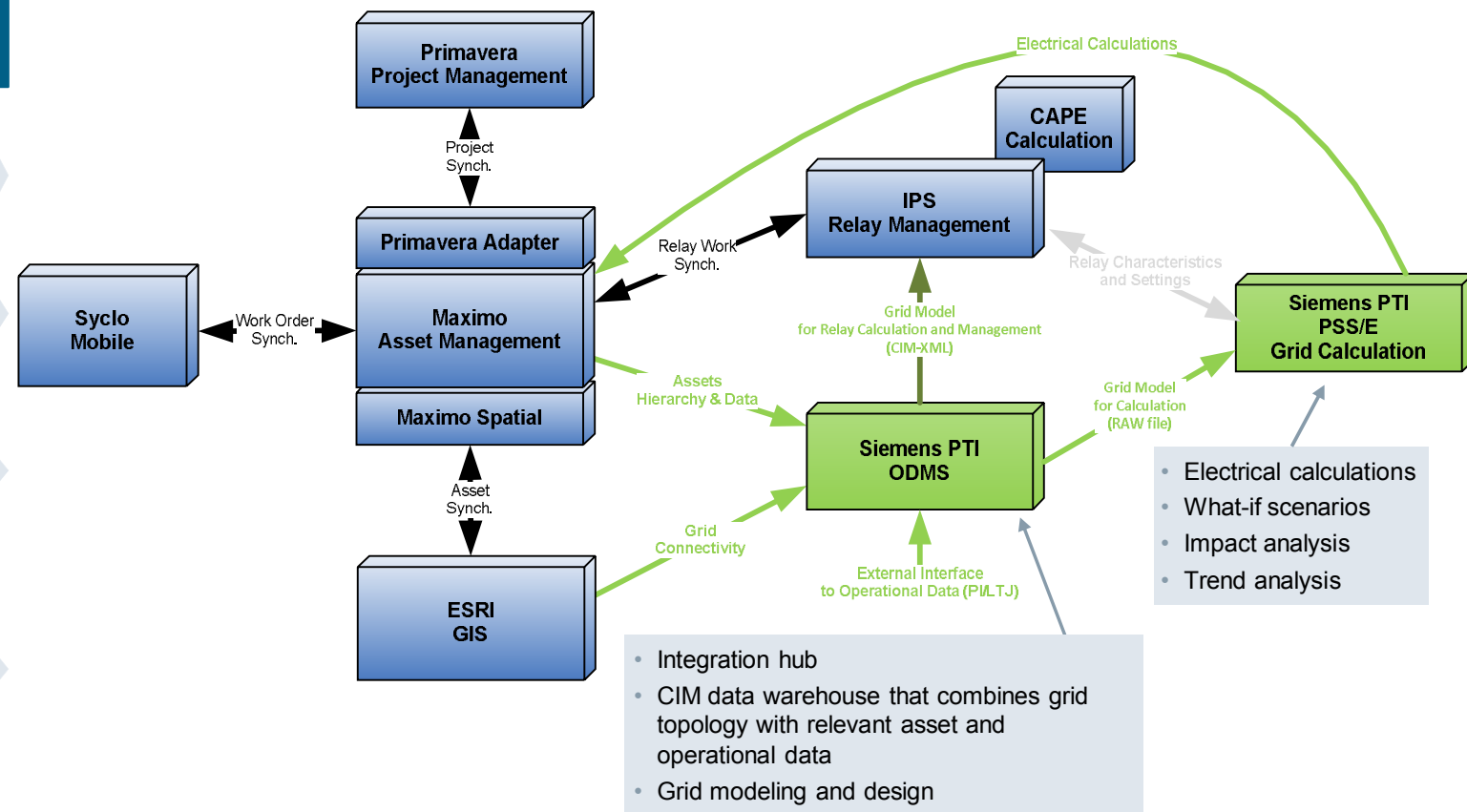
... improves processes and reuses data to **optimize system planning**

... realizes end-to-end protection asset data management & relay coordination by linking network and protection models

... establishes the “**single source of truth**” for all data across operations, planning, protection, and market domains

Source: Siemens

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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

Advanced digital use cases, e.g. for Asset optimization

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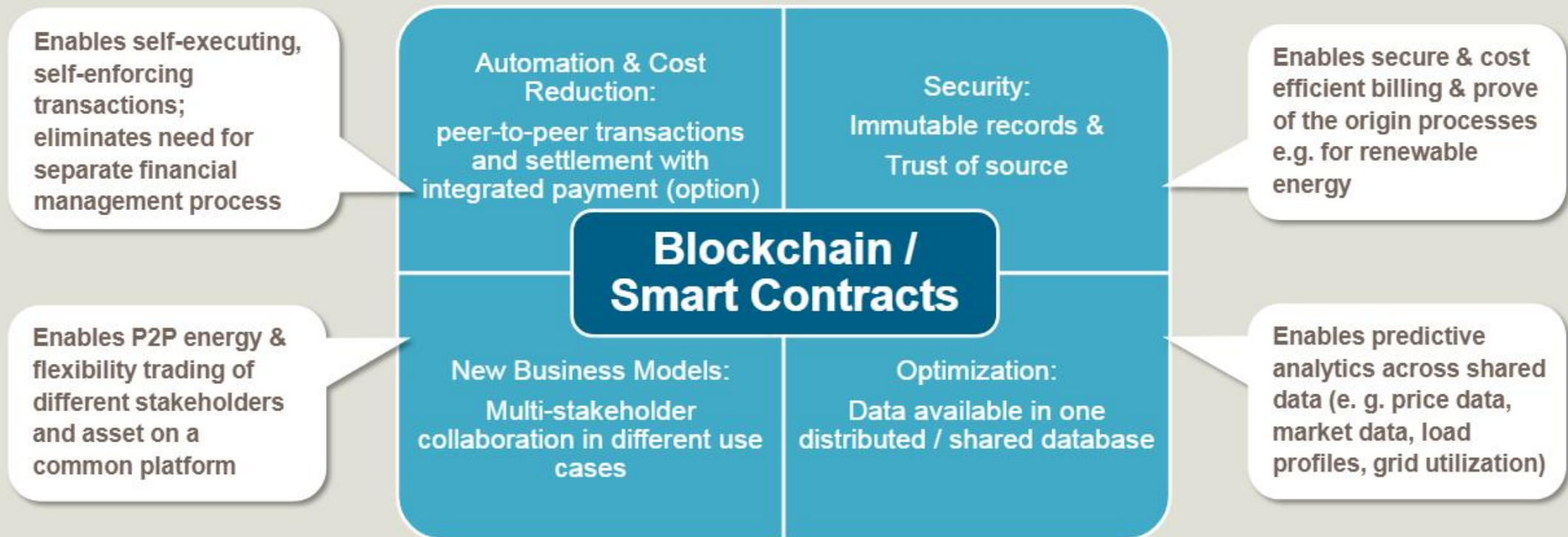
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Electrical Digital twin

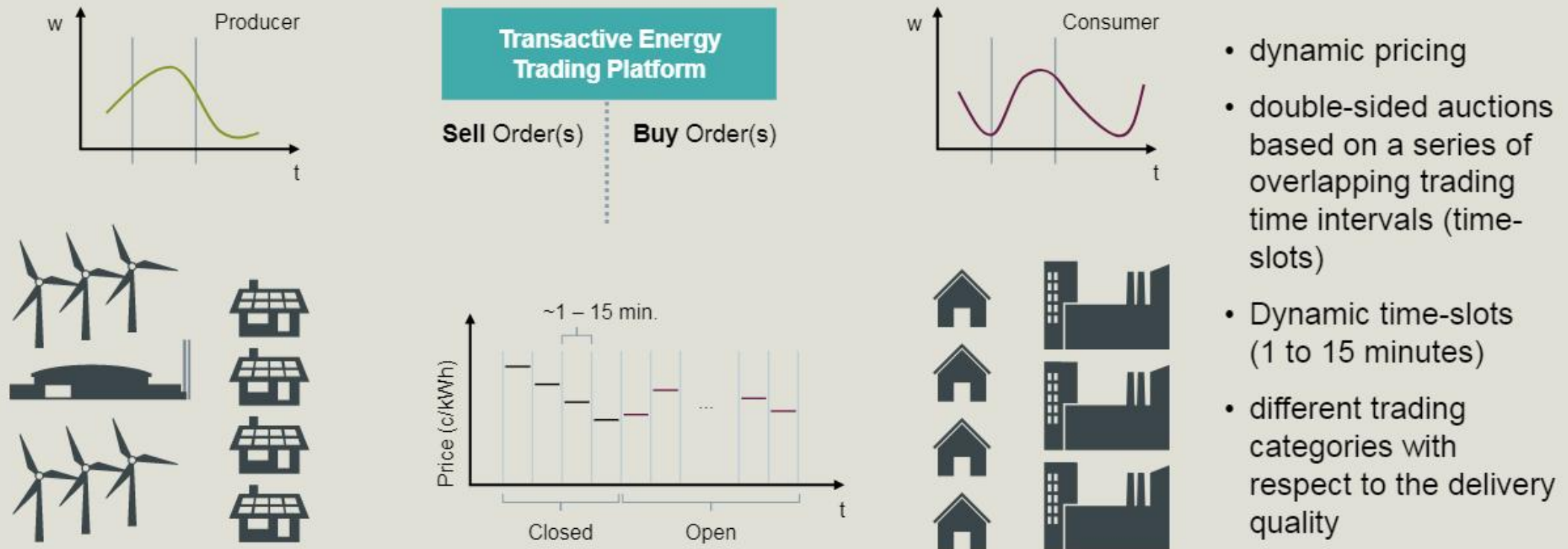
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Blockchain & AI

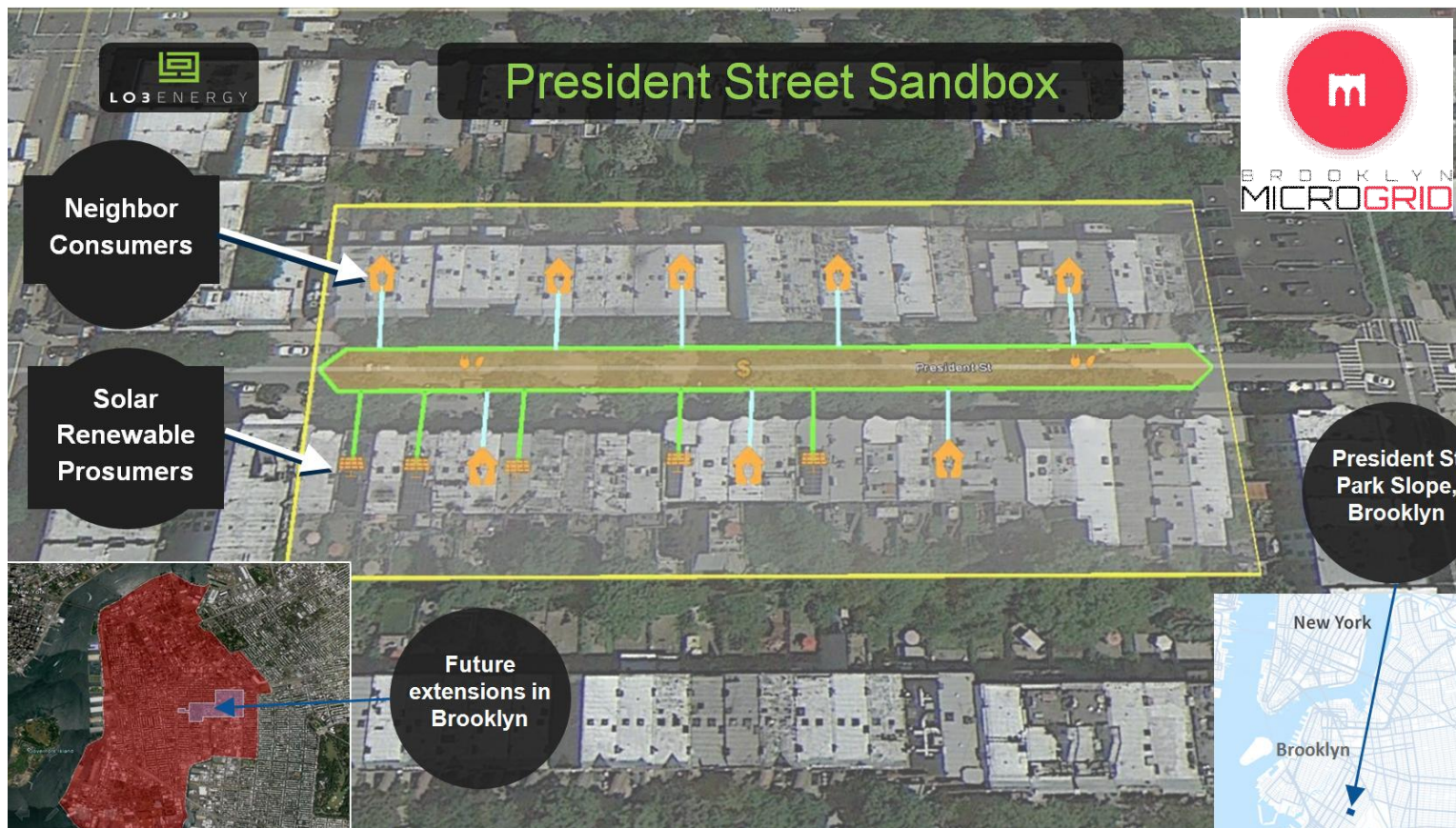
Blockchain and associated smart contract technology offers key functionalities required for transactive energy systems



Principle of the Trading Platform



Innovative Microgrid solution using blockchain technology supporting New York's Reforming the Energy Vision (REV) program



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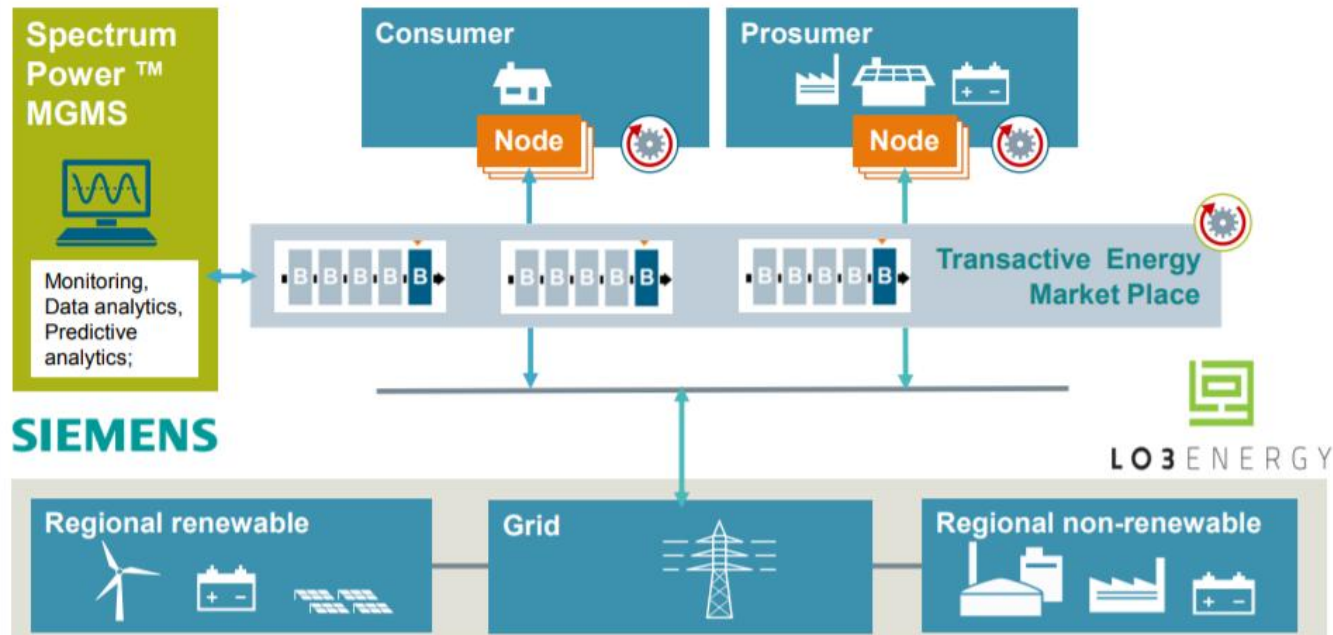


LO3 ENERGY



Example Brooklyn Microgrid → flexibility / freedom / rewards

Virtual Microgrid enabling energy trading between community members



Transactive Grid & Smart Meter enables:

- Solar surplus & consumption tokenized;
- Surplus & Flexibility traded in Community Energy Market;

Consumers and prosumers can decide which sources to buy energy from (e. g. local PV, local CHP, regional Wind, natural gas, coal, etc.)

Consumers get the opportunity to earn rewards for negawatts they do not consume during certain high peak times

Operator will be able to track energy flow within virtual microgrid, interchange with external grid and to predict future energy flows

Evolution of AI will surprise us more than we know today

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

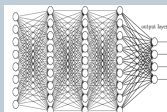


202x: Fully autonomously driving cars become market-ready



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

Major breakthroughs



Algorithmic advances in **deep learning**



Increasing **computing power**

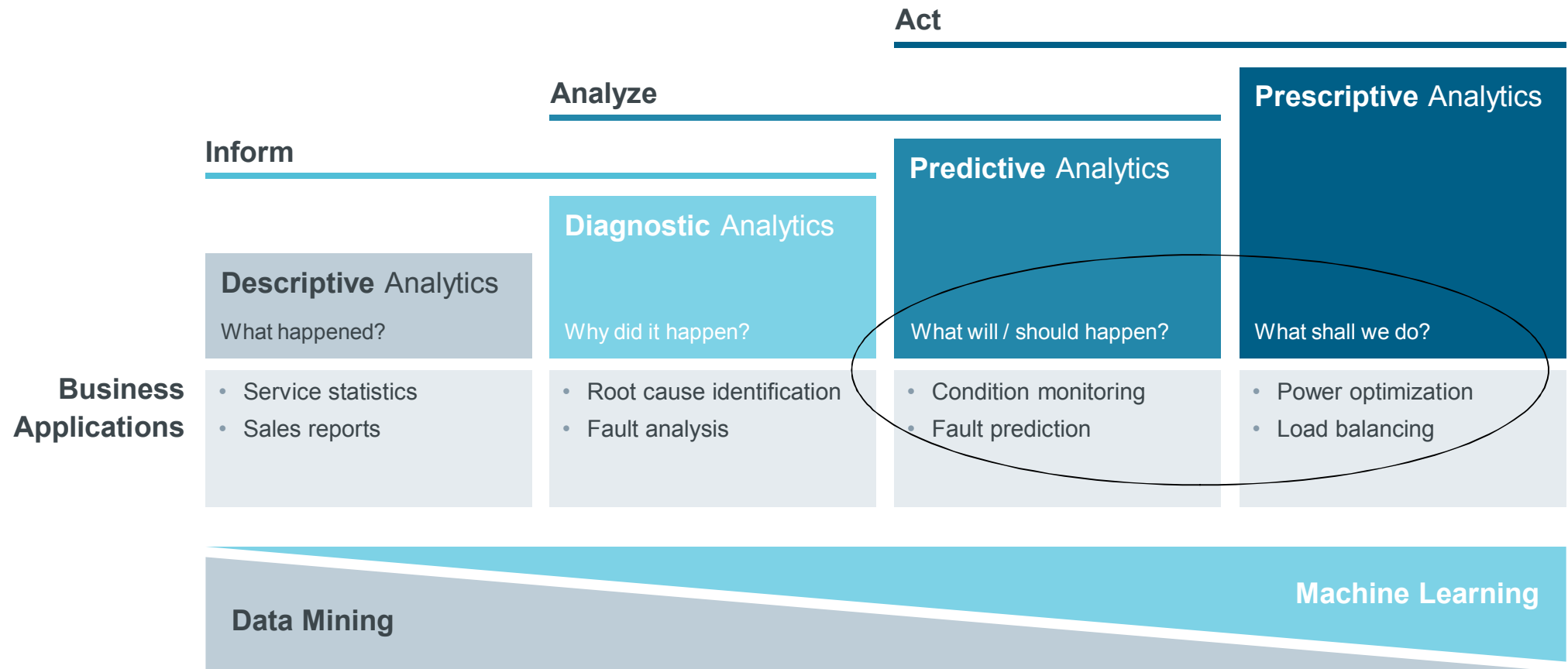
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Usage of huge **datasets** leverage full potential of AI



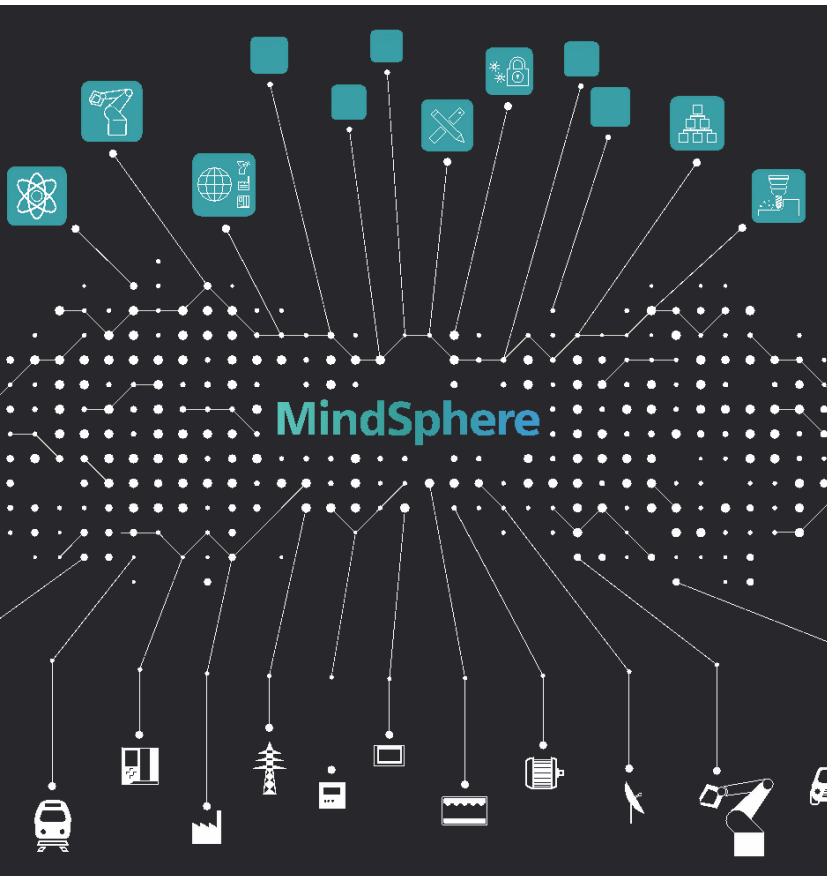
Open platforms and data bases

Application of Artificial Intelligence (including Machine Learning)



Thank You!

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