

Digitalization changes Everything!

WISE – Nov 7th, 2018

Alif Gilani

1

Why Digitalization Matters

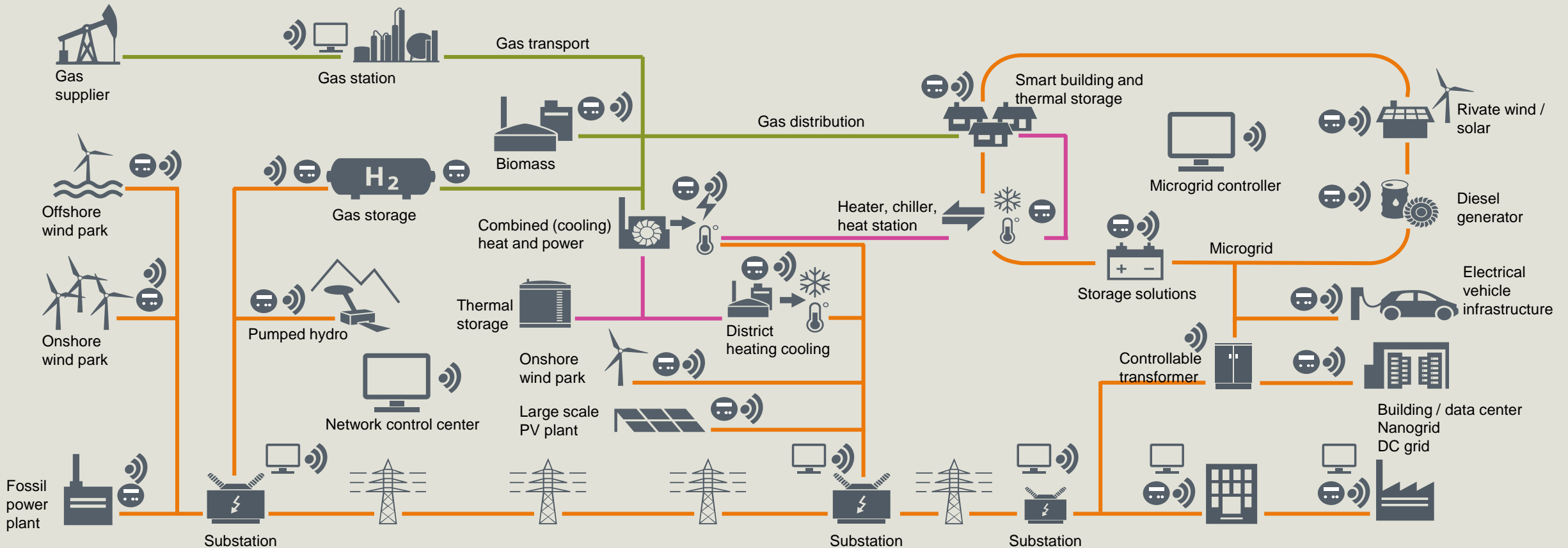
2

Digitalization Applications & Solutions

3

Outlook

Centralized – Unidirectional → Decentralized Bidirectional



1 Changing Generation Mix

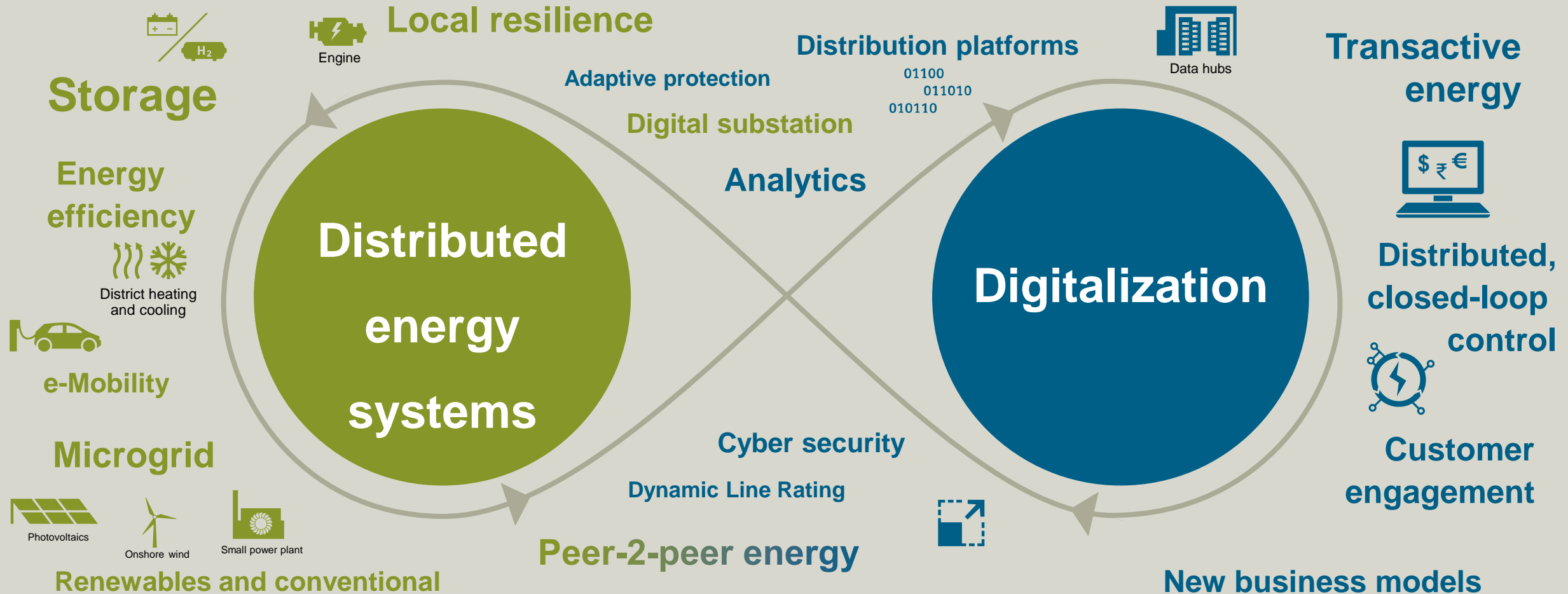
2 Generation Capacity Additions

3 Distance from Source to Load

4 Decentralization (Public/Private)

5 Refurbishment/Upgrades

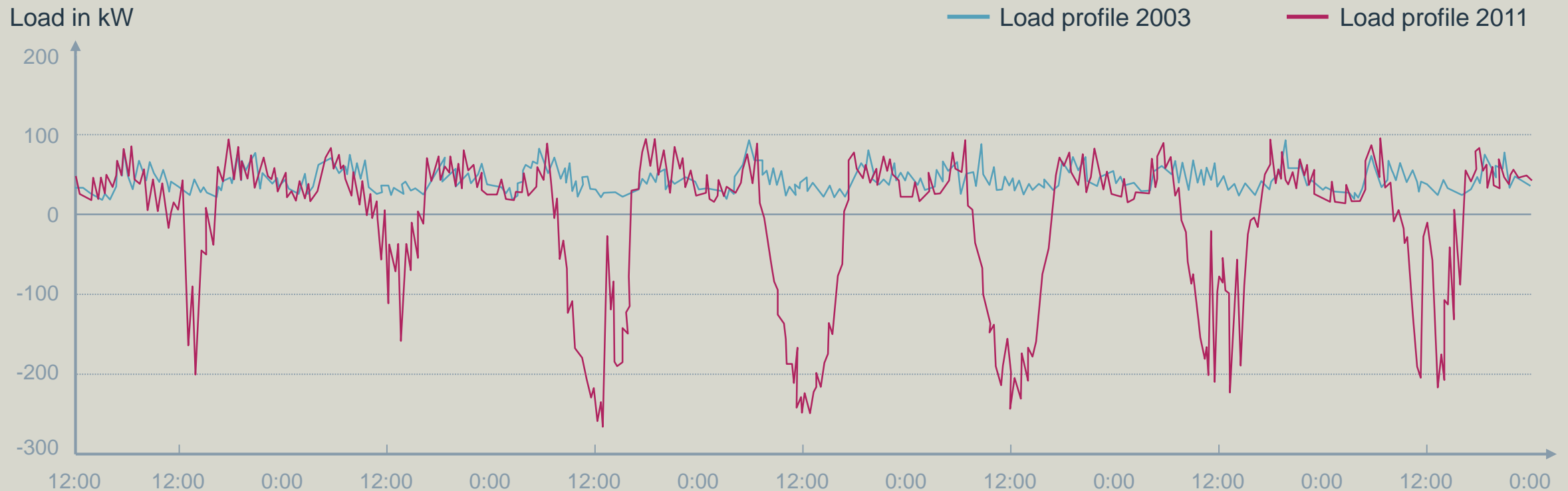
Two major trends are enforcing each other and are driving the digital transformation of the energy world



Paradigm shift through de-central generation

Example:

Weekly loading of a transformer station in the rural area of LEW-Verteilnetz GmbH, Germany – 2003 and 2011



High Negative Impacts (Technical)

Technical

Grid instability increasing

The ever growing need for electricity in the world, combined with the **growing number of Decentralised Energy Resources, leads to increasing grid instability**. Since the current Power Quality in most Central European countries is very high, consumers in this side of the world aren't aware of the problems this instability can create.

smartdutch.nl

National Investigation Reveals Alarming Number of Attacks on U.S. Power Grid

An investigation by USAToday and more than 10 of its community newspapers and television stations across the country found that between 2011 and 2014 alone, there were **362 reported physical and cyberattacks by electric utilities** that resulted in partial power outages or disturbances.

theblaze.com

In the dark: 600 million people without electricity after world's biggest blackout

Half of India was plunged into darkness today when the world's biggest blackout left **620 million people without electricity**.

mirror.co.uk

Redispatching: conventional plants forced to ramp down

Last month, official statistics were published for "**redispatches**" in **Germany** – cases in which conventional power plants either have to reduce their power generation or be switched off entirely in order to protect grid stability. The **situation is escalating**.

Renewable International Magazine

High Negative Impacts (Economic & Strategic)

Economic and strategic

E.ON to Split Into Two Companies

FRANKFURT – German utility E.ON SE said late Sunday it will split into two companies, with one focused on renewables and the new one on conventional energy, as the power giant aims to **address rapid changes in the energy market** and facilitate the valuation of its assets.

The Wallstreet Journal

Rise of the Prosumer: Will Homeowners Ever Be More Important Than Power Plants?

A new report concludes that policymakers and regulators are **not prepared for consumer empowerment** on the grid.

Greentech Solar

Colorado wrestles with evolving utility business models

The electric industry is evolving. New technologies are available to make the system more reliable and less costly, improve service quality and lower carbon emissions.

New customer programs, utility business models and regulations are under development across the U.S. and internationally
[...]

greenbiz.com

NY regulators propose groundbreaking new utility models under landmark REV order

Today, **utility earnings are not aligned** with optimizing distributed energy resources.

Utility Dive

Digitalization is changing the energy world ...

“

The need to decarbonize our economies combined with the push from the rapid digitalization of the energy industry is irreversibly changing our sector.

”

Marie-José Nadeau

Chair of the World Energy Council 2013- 2016

“

Data is a key asset of the company's future and is vital in optimizing asset management, improving network operations and improving the investments.

”

Christian Buchel

Deputy General Manager and CDO Enedis

Digitalization enables you to turn challenges into opportunities



Challenges

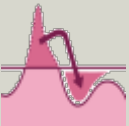
Balancing



CO₂ and cost avoidance



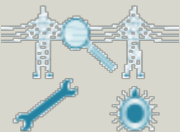
Peak avoidance



Loss prevention



Resilience



Distributed optimization



Business models



Customer focus



Solutions

Digital services



Vertical software



Digitally enhanced electrification and automation



Digitalization enables energy transition

Traditional



- Utilities focus on own assets and operation
- System view based on business model “generate, distribute, and sell energy”
- Value in copper, steel, concrete
- Customized, utility-specific “grid-size” solutions
- Manual operation
- Central generation, generation follows load

Digitalization

0101001010010110010101
1010110010101011010110
01010101010010
1011001010110110101100

Decarbonization

11001010101010010
0101001011001010110110
1011001010

Decentralization

0110110101100101010110
0101011011010110010100
1101011001010

Democratization

New



- Focus on customer assets, needs and requirements
- Local view, new customer-centric business models
- Value in Data and fast innovation
- Off-the-shelf, scalable solutions for many distributed sites
- Automated, highly efficient operation
- Distributed and renewable generation, flexible energy systems e.g. demand response
- New market participants, new roles

1

Why Digitalization Matters

2

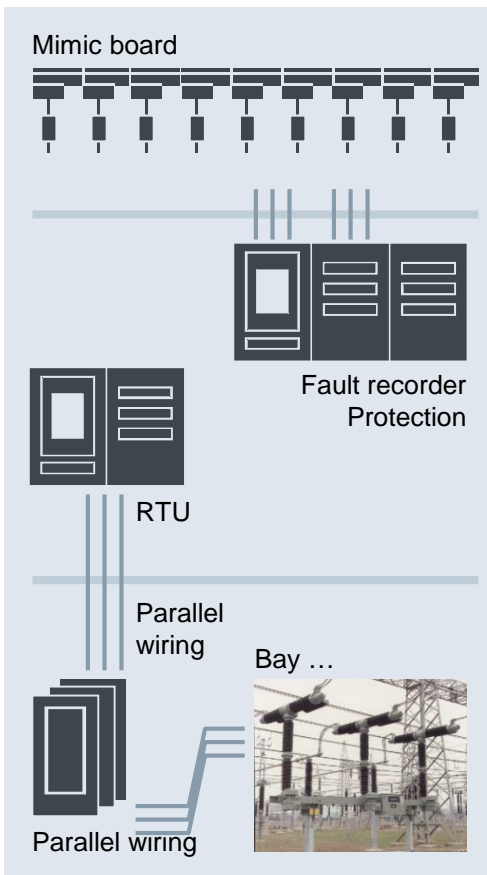
Digitalization Applications & Solutions

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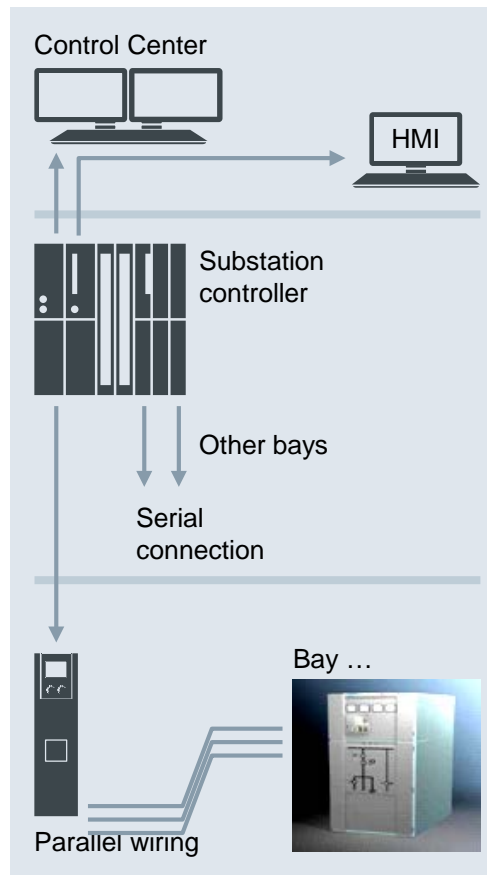
Outlook

Evolution in Substation Automation – Digital Substation 4.0 – Increased Adoption in North America

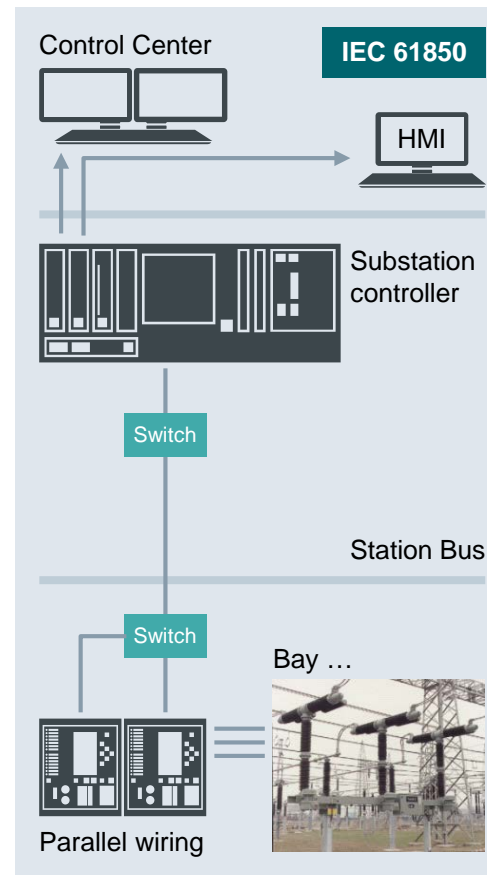
1st generation – Standard cabling



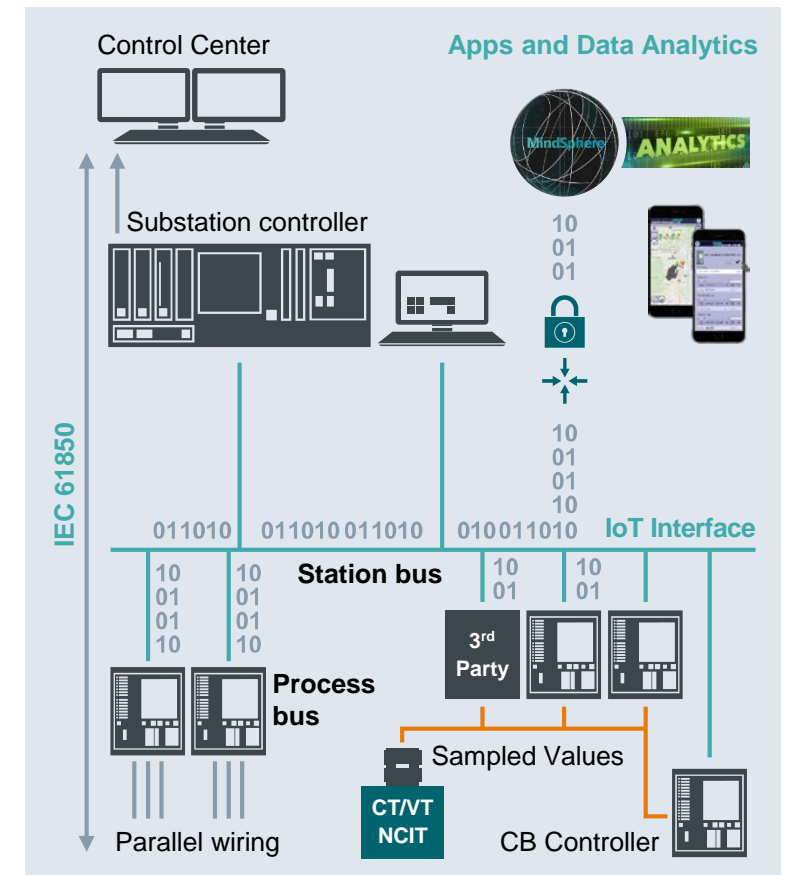
2nd generation – Point-to-point connections since 1985 ...



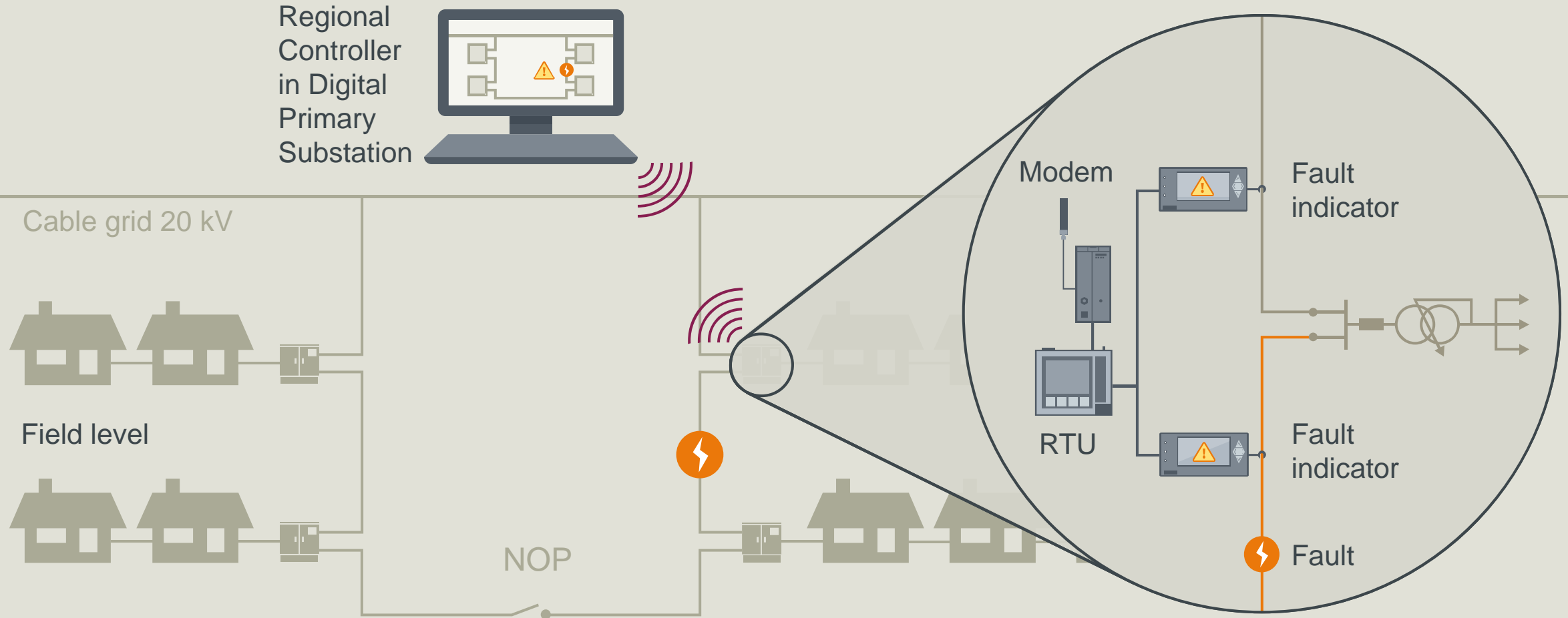
3rd generation – Digital Station Bus since 2004 ...



Digital Substation 4.0

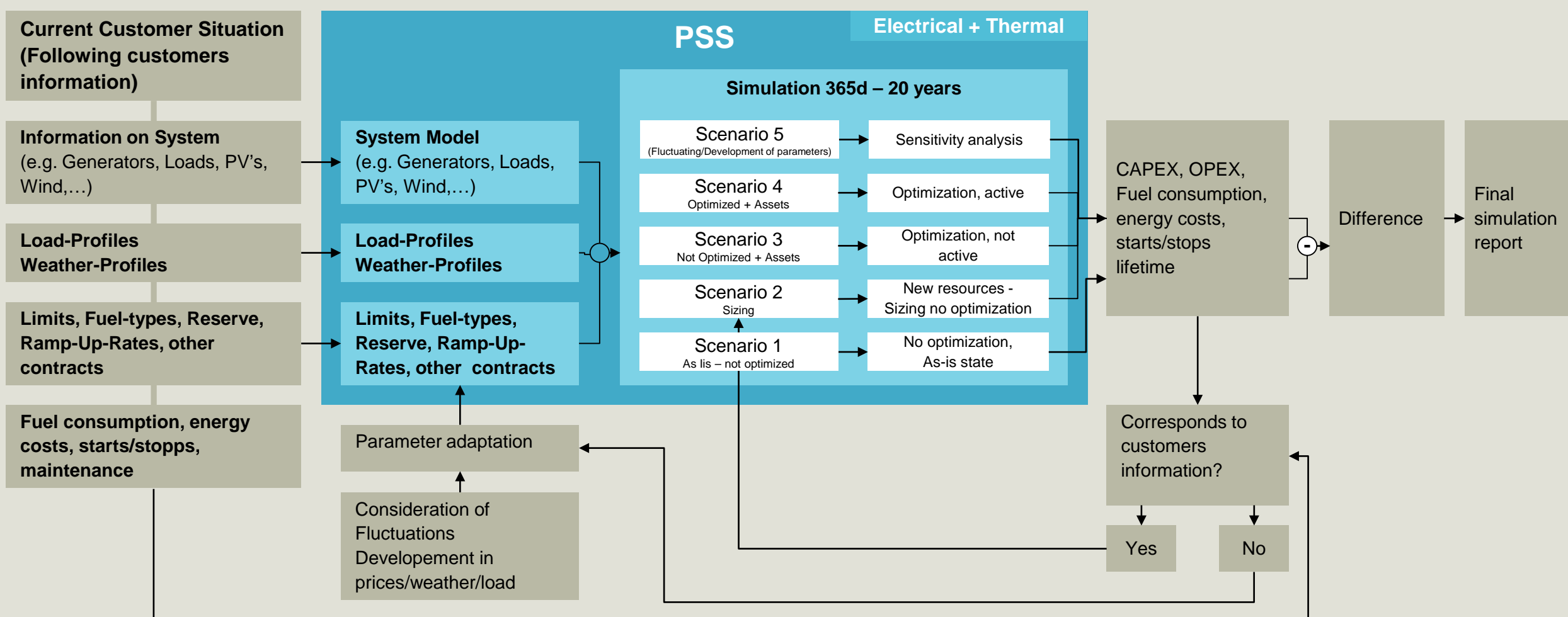


Siemens Distributed Automation Solutions Self Healing, FLISR, Voltage Control, etc..



Microgrid Simulation Software

PSS-DE Energy Twin: Builds your business case for microgrid



PSS-DE Energy Twin: Snapshots (1)

Project Resources Equipment Topology Simulation & Dispatcher Search space Run Simulations

Time series

Generate weather data Add time series Export time series Remove time series

| Name | Type | Unit | Scale factor | Annual multipliers | Additional parameters | Time step (s) |
|---|-------------|------|--------------|--------------------|-----------------------|---------------|
| LoadProfile | Power | | | | | 900 |
| PV for replacement cost | Normed out | | | | | 248314 |
| [56.930000 N, 113.450000 W] Direct radiation | Irradiation | | | | | 60 |
| [56.930000 N, 113.450000 W] Diffuse radiation | Irradiation | | | | | 60 |
| [56.930000 N, 113.450000 W] Ambient temperature | Temperature | | | | | 3600 |
| [56.930000 N, 113.450000 W] Wind speed | Wind speed | | | | | 3600 |
| LoadProfile_corrected | Power | | | | | 900 |

Time series for :

- Solar /Wind irradiation
- Grid price
- Temperature
- Loads (Elec. and heat)
- ...

Automatic generation of weather data and irradiation or import of PVsyst files

Build-in Tool for detailed visualization of time series

View time series ...

Time series: LoadProfile_corrected (unit: kW)

Statistics

Maximum scaled (unscaled) **152.12 (152.12)**

Easy visualization of data

Fuels

| Name | Density (kg/m^3) | Annual multipliers | Lower heating value (MJ/kg) | Carbon content (%) | Quantity available | Sulfur content (%) | Unit |
|------------|------------------|--------------------|-----------------------------|--------------------|--------------------|--------------------|------|
| Diesel | 830 | -- | 43 | 88 | 100000 | 0.33 | l |
| HFO | 990 | -- | 40.6 | 52 | 100000 | 0.33 | kg |
| Gas_LNG | 740 | -- | 49.11 | 1 | 100000 | 1 | kg |
| NaturalGas | 0.74 | -- | 49 | 1 | 1e+08 | 1 | l |

- Fuel type and characteristics (Heating value, density, sulfure content...)
- Fuel price

PSS-DE Energy Twin: Snapshots (2)

The screenshot displays the PSS-DE Energy Twin software interface. At the top, there are tabs for Project, Resources, Equipment, Topology, Simulation & Dispatcher, Search space, and Run Simulations. Below the tabs are checkboxes for 'Show frame lines', 'Show names', and 'Show descriptions'. On the right side, there are controls for 'Load background image', 'Remove background image', 'Background opacity', 'Fit in view', and 'Scale background'.

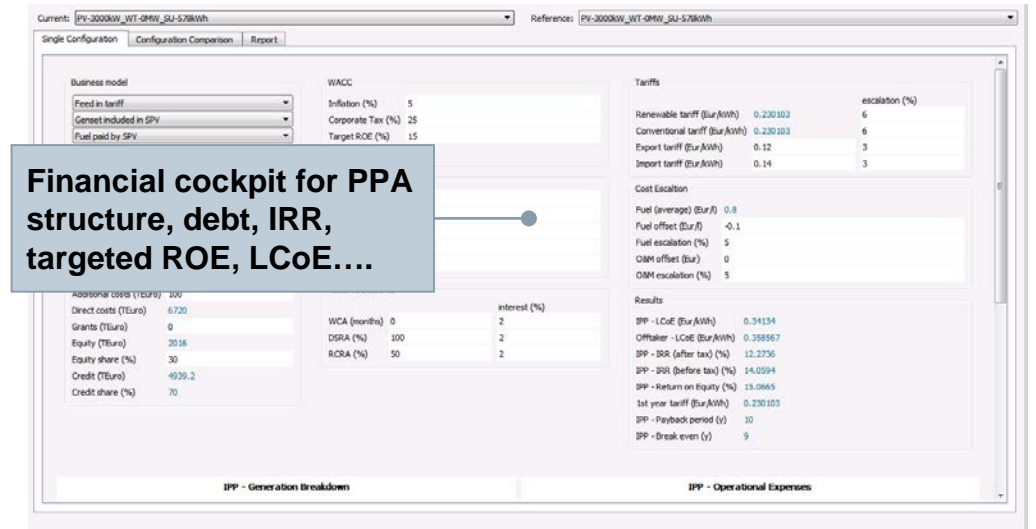
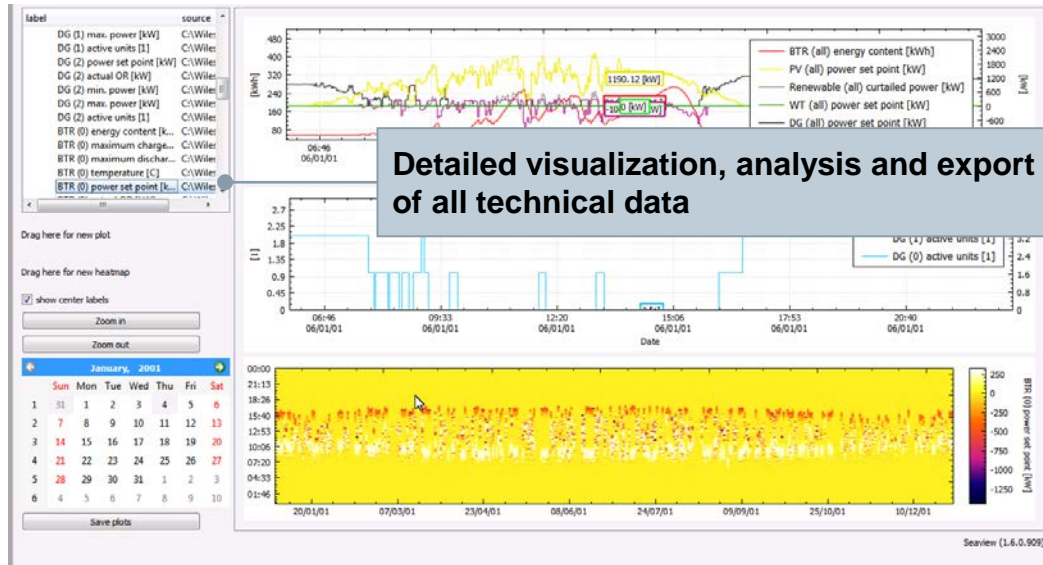
The main interface is divided into three main sections:

- Component Library:** A list of components categorized by type. The categories include Conventional Generators, Photovoltaic Systems, WindTurbine, Energy storage system, and Battery. Each category lists specific component models.
- Topological View:** A map-based visualization of the energy system. It shows a network of busbars and lines overlaid on a background image of a city street grid. Key components are labeled, such as 'Central Eléctrica', 'PV1', and 'PV2'. A red house icon is also visible.
- Parameter Configuration Window:** A detailed view of a component's parameters. It includes a table for 'Cost matrix' and a list of various parameters like 'Number of strings', 'Nominal module voltage', and 'Max discharge current [A]'. The 'Hour of day losses [kW]' section shows a blue line graph.

Three callout boxes provide additional information:

- Component Library Callout:**
 - Component library with extensive data base for power and heat components
 - New components can be added at any time
 - Choice of Control Strategy (PLC based, 24h forecast optimization)
- Topological View Callout:**
 - Highly detailed models for each components to provide realistic digital twin of energy system
- Parameter Configuration Callout:**
 - Topological view of system
 - Multiple bus bar (coming soon)
 - Load background image for spatial asset visualization

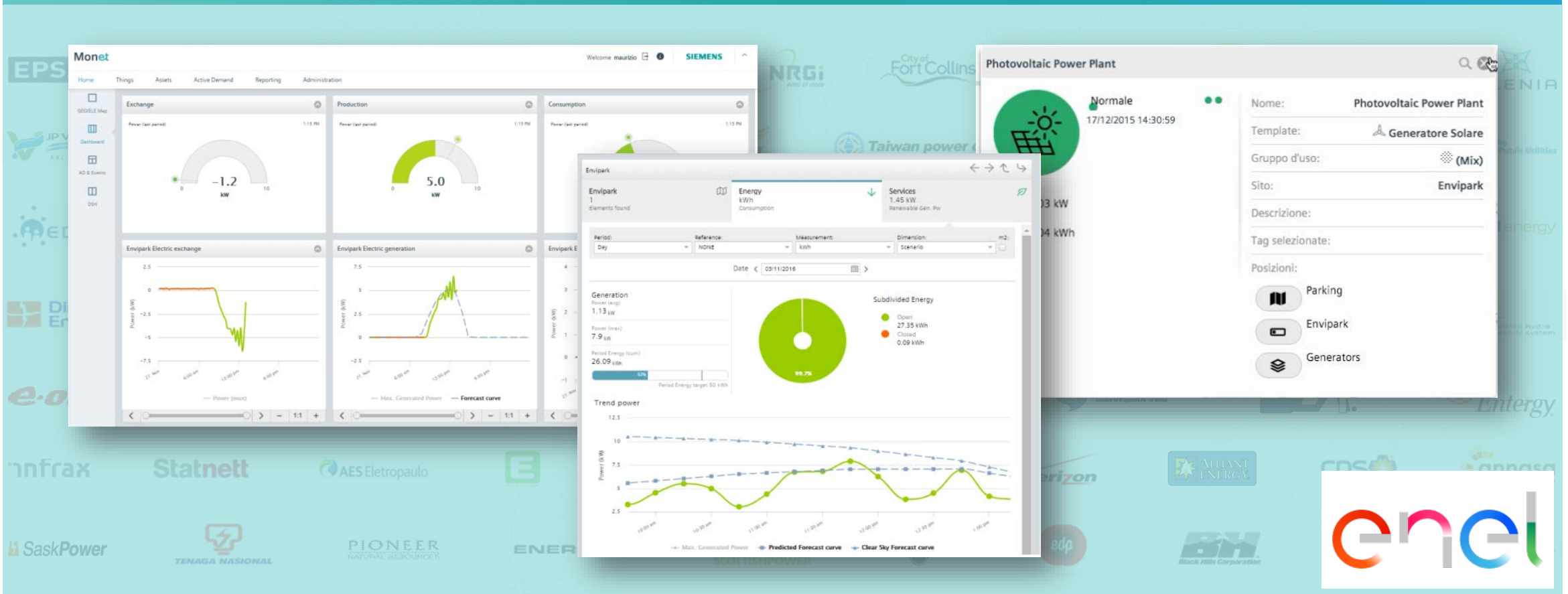
PSS-DE Energy Twin: Snapshots (3)



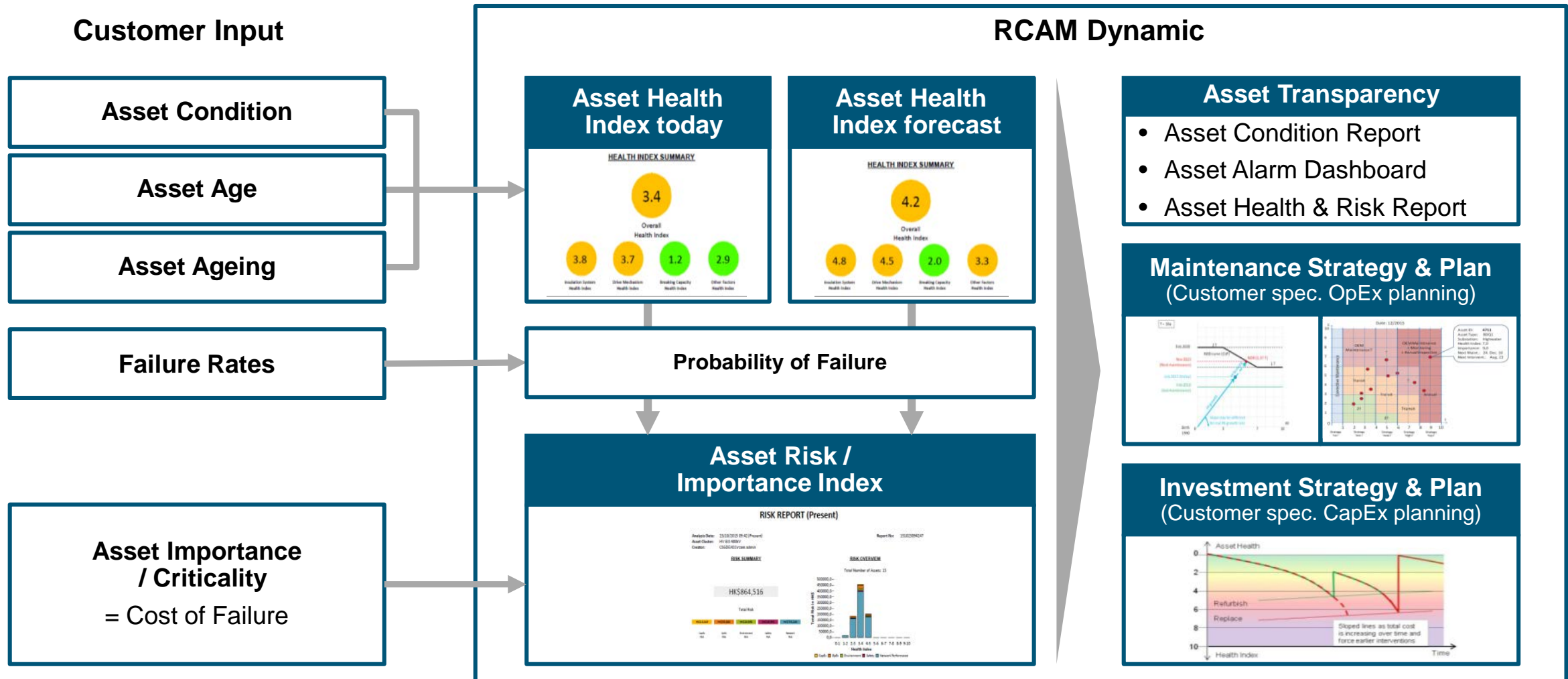
Energy IP DEOP – Distributed Energy Optimization Control Center for DES Solutions

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Ingenuity for life

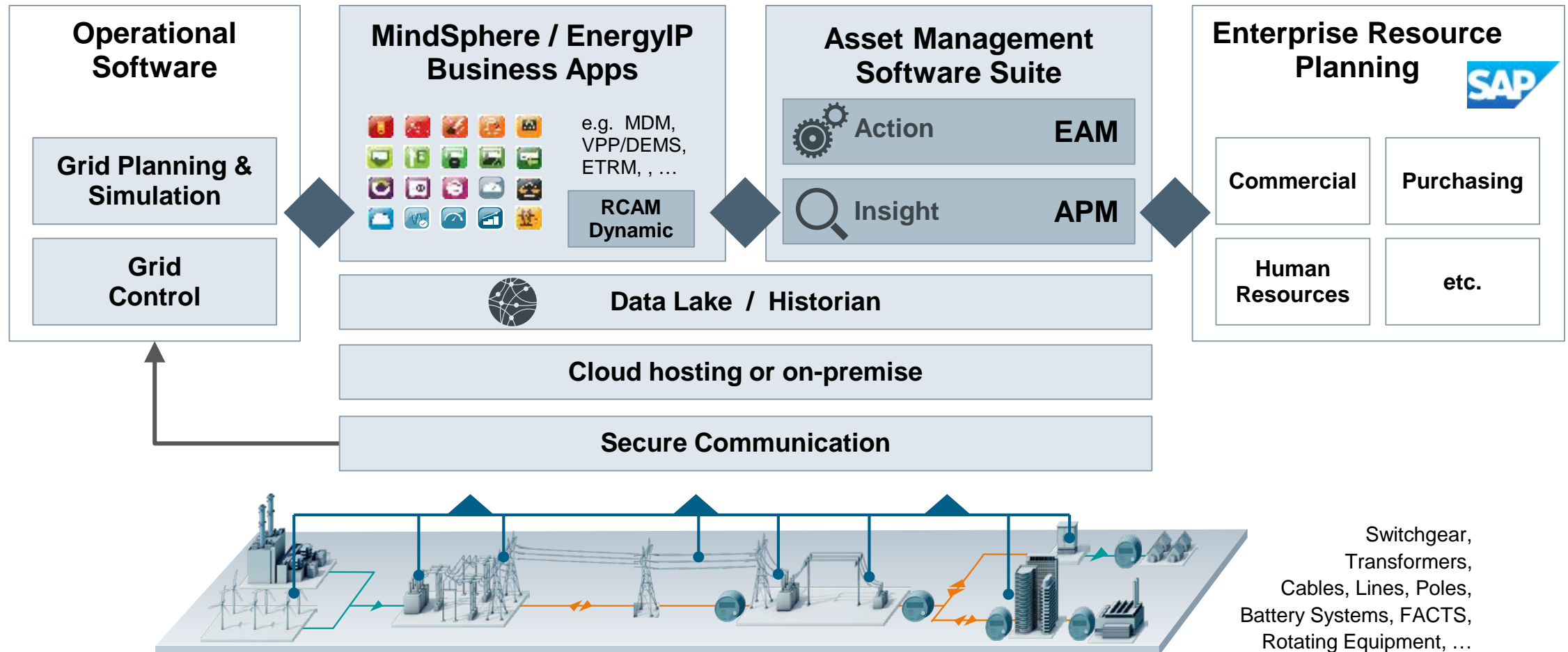
Siemens EnergyIP platform and applications are proven worldwide



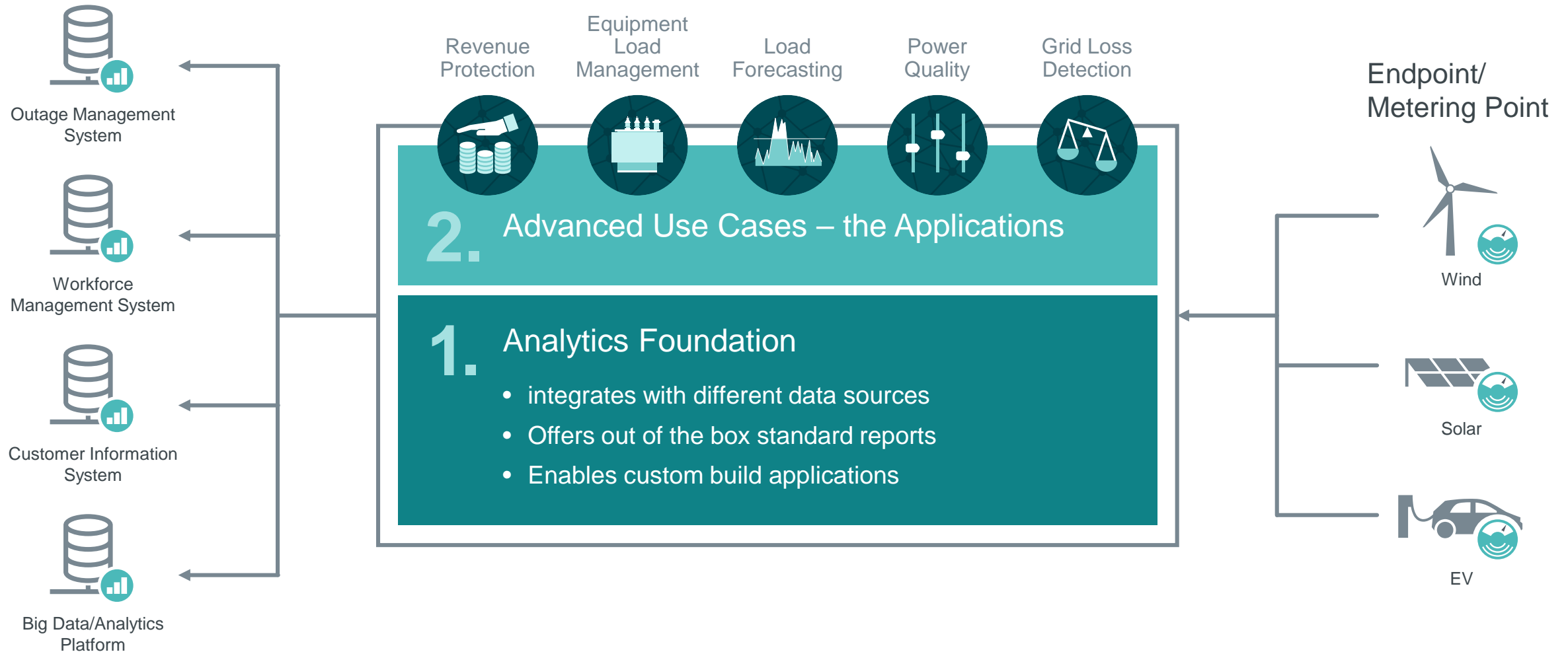
Asset Management Solutions: RCAM Dynamic Optimization - Maintenance & Investment Planning for T&D Assets



Asset Management Software and Data in the MindSphere



Energy IP – Leveraging Analytics to Increase Efficiency



DEMS – Distributed Energy Management System Forecasting, Optimization and Marketing of Energy



Siemens EnergyIP platform and applications are proven worldwide

The screenshot displays the Siemens EnergyIP platform interface, which is used for demand response management. The interface is divided into several sections:

- Top Navigation:** Includes tabs for Demand Response Overview, Events, Participants, Aggregations, Program, and Analysis.
- Left Panel:**
 - Service Point Map:** A map showing the geographical distribution of service points.
 - Data Visualization:** A line chart showing demand response data over time, with a legend for Baseline (BR), Actual (AR), Forecast (FR), Forecast with Standard Deviation (SD), and Load Control (LC).
- Right Panel:**
 - Participant List:** A table listing participants with columns for Customer Name, Service Point Address, Service Point Type, and Service Delivery Point.
 - Event List:** A table listing events with columns for Service Point Group No., Program Name, Status, and Start Date.
 - Program Details:** A form for configuring a program, including fields for Name, State, Dispatch Type, Reference Baseline, Settlement Required, and Event Start Advance Notification Time.
 - Market Rules:** A section for configuring market rules, including Bid Block, Bid Interval, Multiple Bid Allowed, Min Bid Amount, Max Bid Amount, Bid Increment, Consider Energy Flexibility, Is Asset Gradients Considered, Is Asset Pre-qualified Power Considered, Opening Hours Prior to Delivery, Closing Hours Prior to Delivery, Publication Hours Prior to Delivery, Placing, Remuneration, Is Holiday Sensitive, Calendar ID, Merit Order Offer Resolution, Offer Collateralization n-1, Offer Collateralization Percentage, Merit Order Offer Segmentation, Product Differentiation, TSO, DSO, Grid Location, Market Mechanism, LP Side Constraint Parameters, Reserve Activation Time, and Portfolio ID.

Siemens E-Car Operation Center Solution for E-Mobility Infrastructure Management

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Ingenuity for life

Siemens EnergyIP platform and applications are proven worldwide

SIEMENS ECAR-Operation Centre

Welcome a [Language Selection: IT, ES, EN] [Go] [Home] [Help] [Logout]

Home

Asset configuration | Contract operations | Recharges | Tickets | Dashboard | Stakeholders | Administration | System v6.1.0

World

| Country | Avail. | Rech. | Main. | Tot. |
|------------------|-------------|------------|----------|-------------|
| Spain | 251 | 6 | 0 | 257 |
| Italy | 975 | 106 | 1 | 1082 |
| Tot. | 1226 | 112 | 1 | 1339 |
| Tot.World | 1226 | 112 | 1 | 1339 |

Dashboard

- 88.658 recharges
- 312.472 kWh
- 382.154 Kg saved

Ongoing recharge sessions | All CUs | Alarms List

Results 1 - 6 of 149. Tot pag: 25

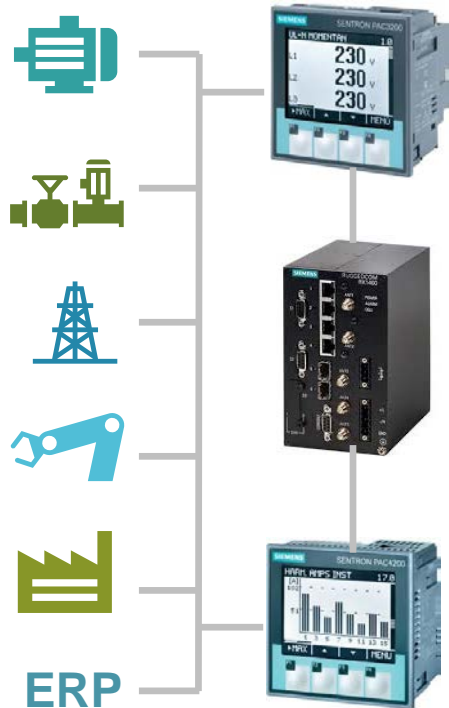
| ID | S/N | address | City | start | elapsed | kWh | plug | use | RFID | rate |
|-------|-----------|--------------------|----------|-------------------|------------------|-------|--------|------|---------|------|
| 48926 | N.11ZH21M | Via Sandro Bottice | TORINO | 14/12/12 10:36:04 | 2496 h, 21', 53" | 0,417 | SCAME | Home | 1000053 | - |
| 59246 | N.11ZP22M | Air de Gabriel Roc | Palma | 17/01/13 12:07:50 | 1678 h, 50', 8" | 0,000 | - | Home | 1000099 | - |
| 64031 | N.11ZP22M | Calle de José Jes | Seville | 29/01/13 17:43:48 | 1385 h, 14', 10" | 0,281 | Schuko | Home | 1000094 | - |
| 66295 | N.11ZP22M | C.C. B Ostio C/1 | Valencia | 31/01/13 18:28:11 | 1336 h, 29', 41" | 0,428 | Schuko | Home | 1000095 | - |
| 67188 | N.11ZP22M | Cm. De Buzon C | Medid | 02/02/13 10:48:29 | 1263 h, 0', 24" | 8,171 | Schuko | Home | 1000096 | - |

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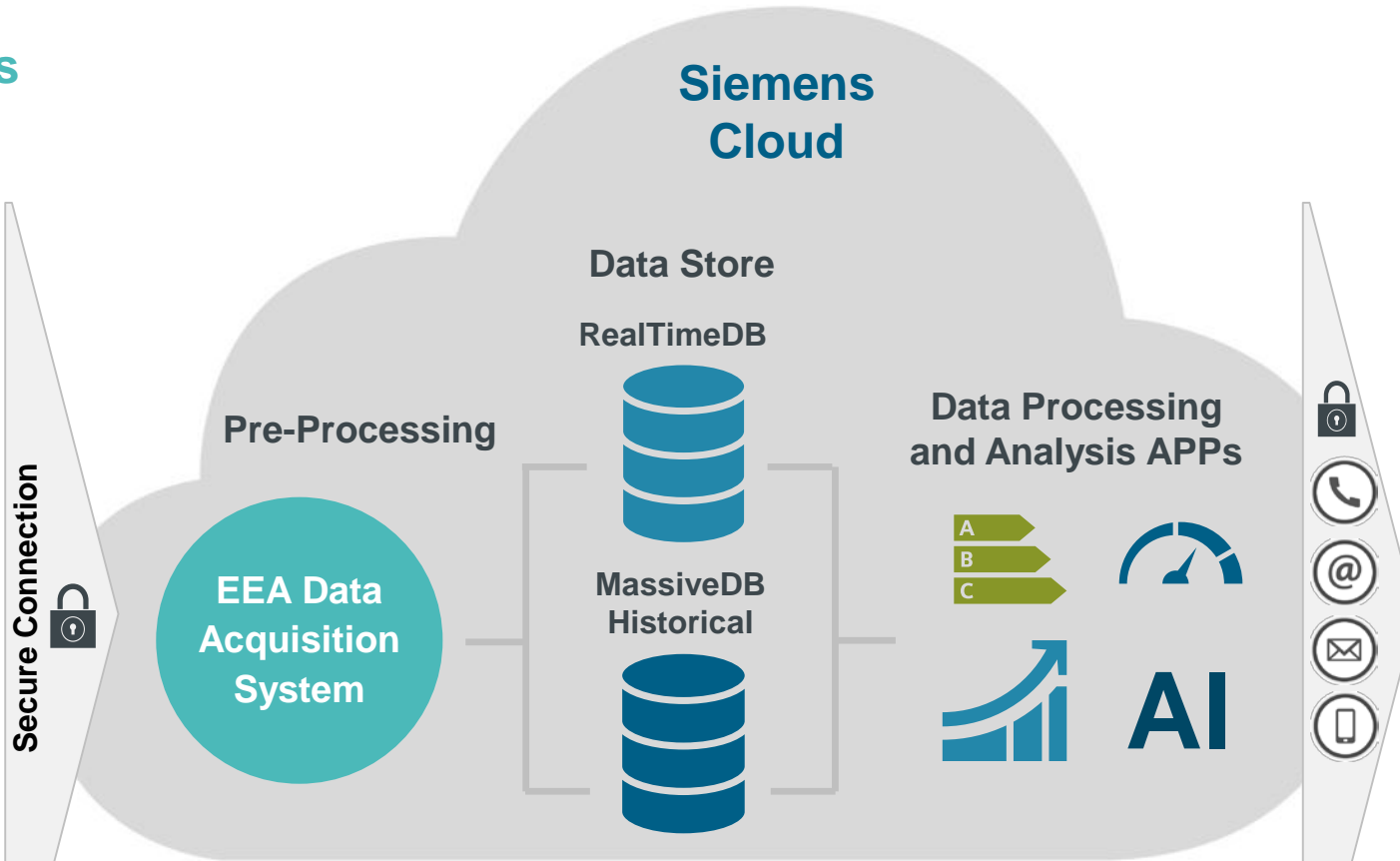
Siemens EEA – Energy Efficiency Analytics



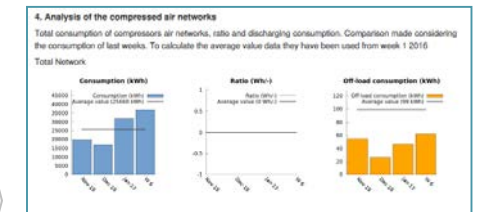
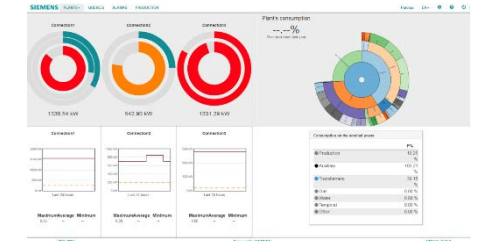
Customer's Facilities



Siemens Cloud



Customer's Interface



B. Power factor average and total power factor

In the table below weekly power factor (PF) value of each transformer is shown. A deviation under 0.95 might mean it there is penalties risk due to reactive power consumption.

| Equipment | PF | Notes | Equipment | PF | Notes |
|-----------|------|-------|-----------|------|-------|
| TF-01 | 0.88 | | TF-05 | 0.80 | |
| TF-02 | 0.89 | | TF-06 | 0.98 | |
| TF-03 | 0.99 | | TF-07 | 0.98 | |

Integration with 3rd parties.
Modbus , BACnet,
Profinet, Profibus, OPC...

Data is securely collected and stored in Siemens's Data Centers. The use of the latest technology in data storing and computing allows scalability and speed in processing and visualization. **EnergyIP EEA** collects **one data point per second**

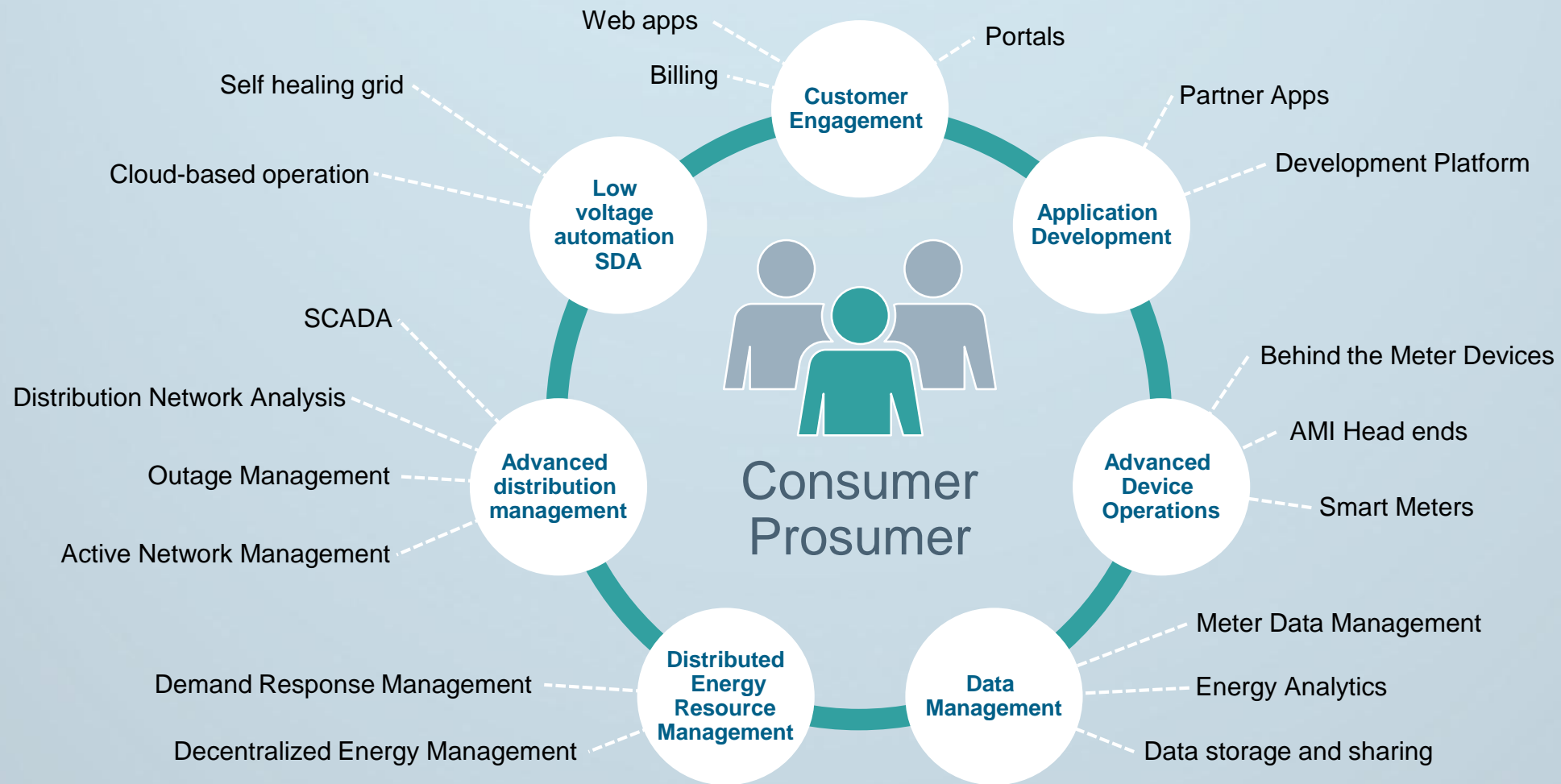
Web Access for monitoring and visualization, periodical reports, alarms via message, call or mail

1 Why Digitalization Matters

2 Digitalization Applications & Solutions

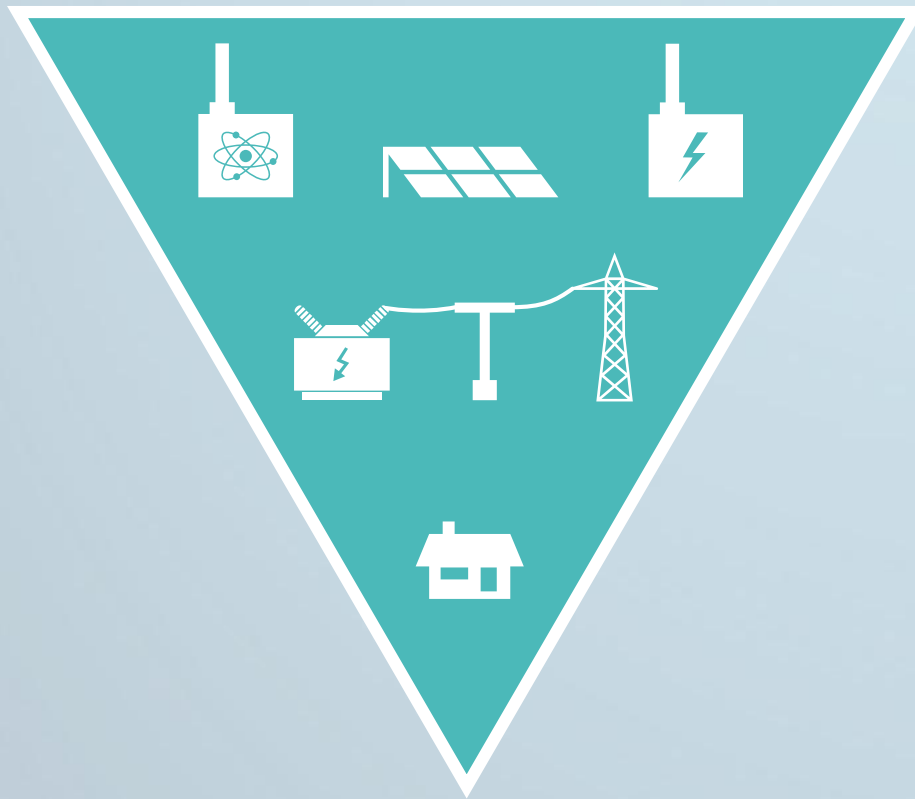
3 Outlook

Distribution operations ecosystem – customer centric

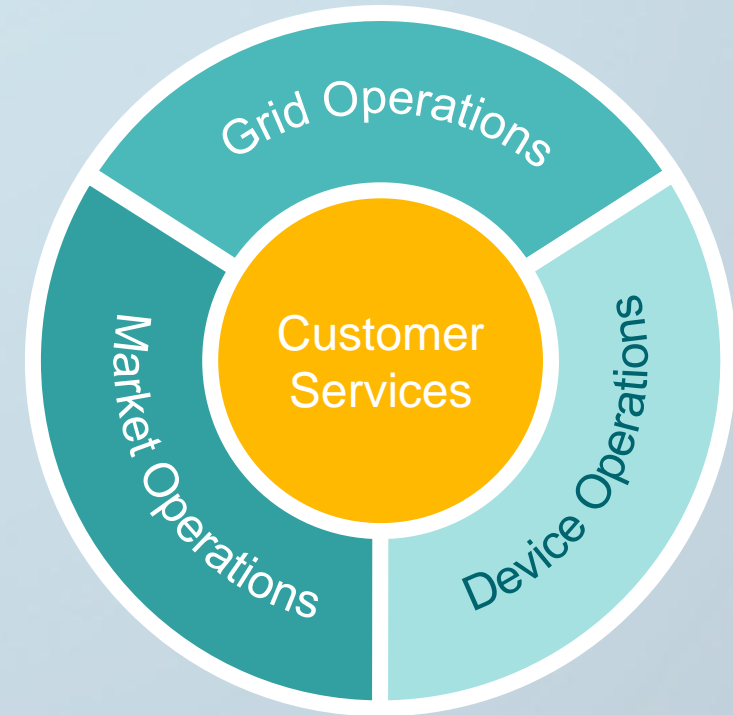


Disruptive trend from topology-based to transaction-based Business Models – the dramatic shift in perspective

Traditional top down topologies



Customer-centric transactional grid



1 Digitalization is a Key Enabler (Adopt to gain competitive advantage)

2 Situational Awareness (forecasting, prediction, visual representation)

3 Distributed Energy Systems will play an increasing role

4 Industry participation is on the rise (required to stay competitive)

5 Artificial Intelligence & Analytics continue to gain momentum

Contact Information



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