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Smart Grid Technologies

Sustainable Technologies – Integration of Renewable Energy

The Siemens Perspective

Technologies will improve energy efficiency, eco-friendliness and quality of life of cities

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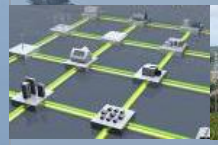
Energy


Power Generation & Distribution




Smart applications HVDC[1)]


Smart Grid Renewable

Transportation


High-speed train Traffic Mgmt


E-mobility Alt. drive system

Water & Waste


Waste, Water and Wastewater Mgmt


Health


Medical Technology Green Hospitals

Building,Lighting&Security



Smart and efficient buildings

Efficient lighting Safety Center

Growth of power demand is driving investment in transmission and distribution

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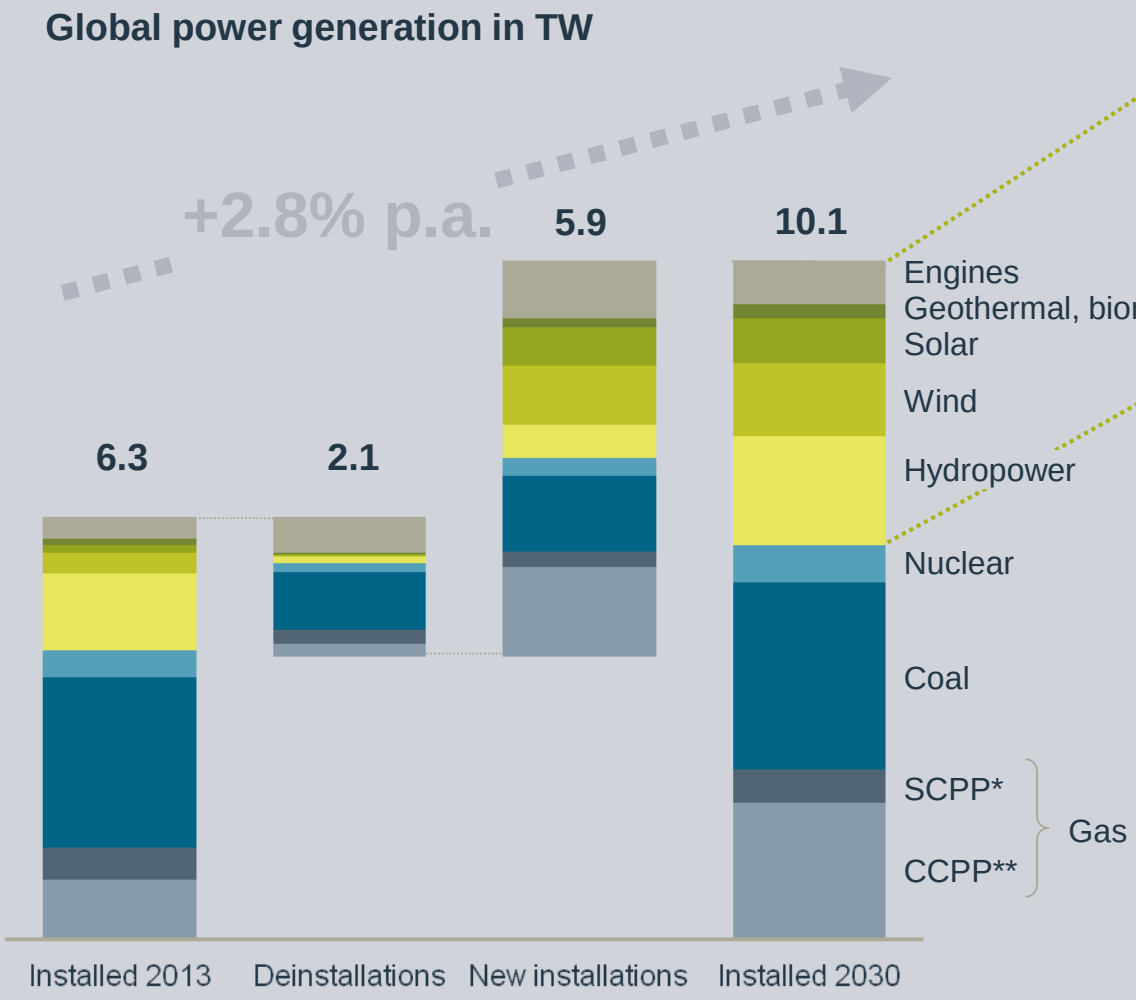
Global power generation in TW



Renewables and distributed power generation grow above average

Main driver for the Energy Management market

* Simple cycle power plants **Combined cycle power plant

Source: Siemens Energy 2020 Project 2014 - Base Case Scenario

Growing share of renewables and distributed generation calls for end-to-end energy management

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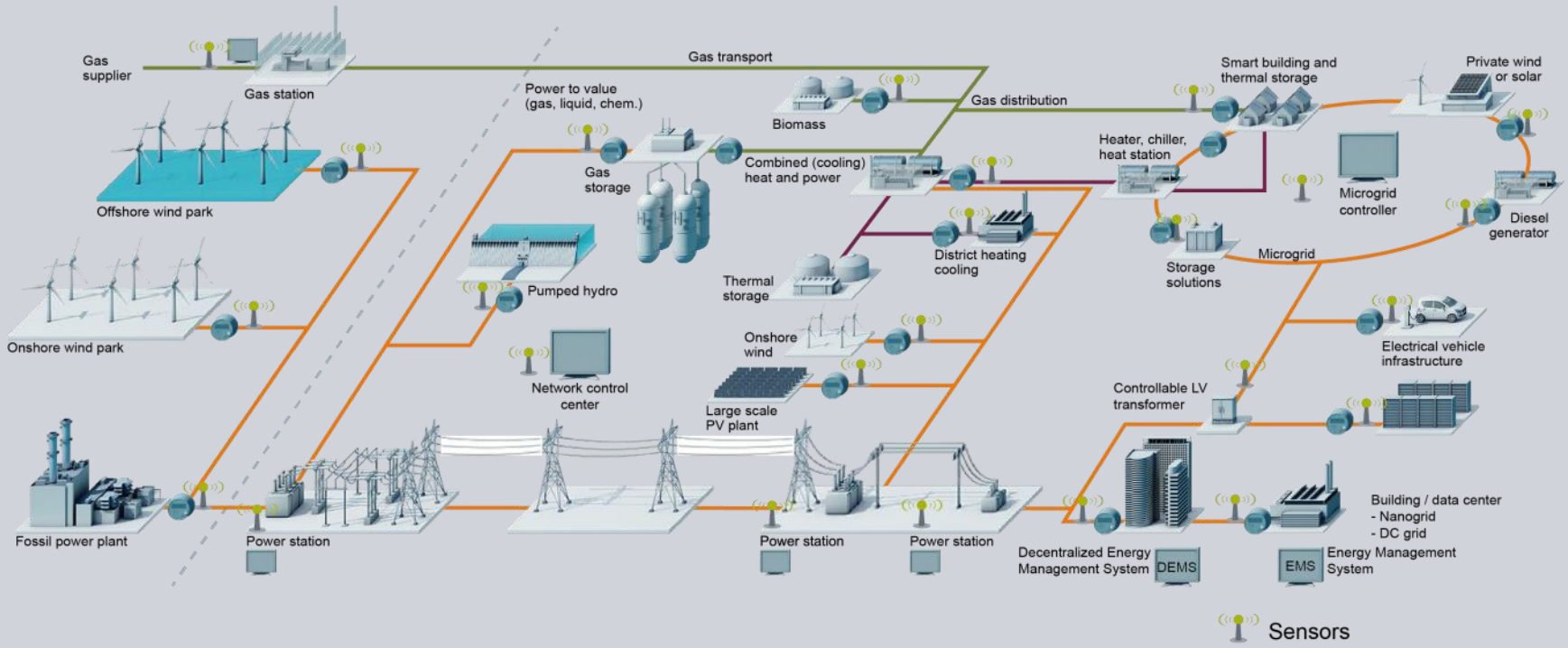

More electrification

- Further development of electrification levels in emerging economies
- Grid modernization required in many regions

Distributed generation

- Increasing level of renewable and distributed generation
- Grid stability challenges

Siemens Energy Management lives up to future challenges with the most comprehensive portfolio

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Large power generation | TSOs | DSOs and municipalities | Distributed generation | Oil and gas | Industries | Infrastructures / construction

Software/IT

Grid control – big data analytics – grid application

Automation

Communication, automation, protection, and field devices

Electrification

Electrification solutions

High-voltage direct current (HVDC) transmission – grid access – FACTS – air-insulated/gas-insulated substations – power systems solutions – microgrids / nanogrids

Products and systems

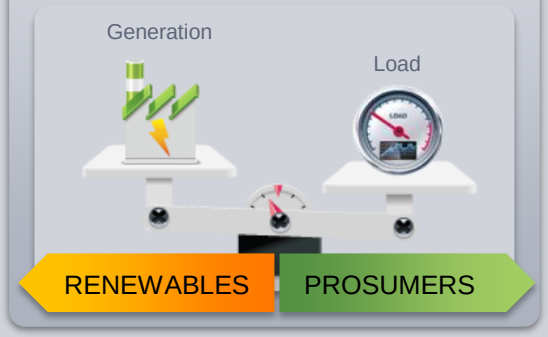
High-voltage switchgear and systems – power transformers – medium-voltage switchgear – distribution transformers – low-voltage circuit breaker

Services and security

[1] Transmission system operators [2] Distribution system operators

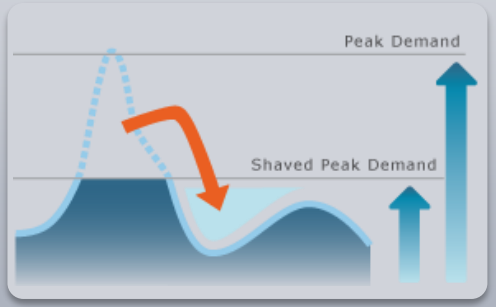
What problems are we trying to solve?

Integrating Renewables

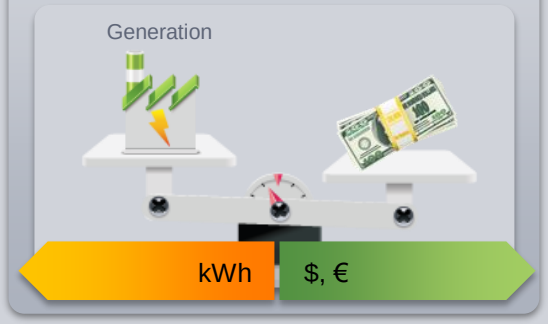


Customer Operations

Load Shifting



Reduction of System Losses



Outage Prevention / Restoration

Efficiency

New challenges for grid management due to growing need for integration of renewable generation

Increasing installation of renewable energies

No clear direction of power flow

Violation of voltage limits

Overload situations

Observability improvement

Volt-/VAR management

Capacity management

Spectrum Power Active Network Management
Releasing hidden capacity by Active Network Management

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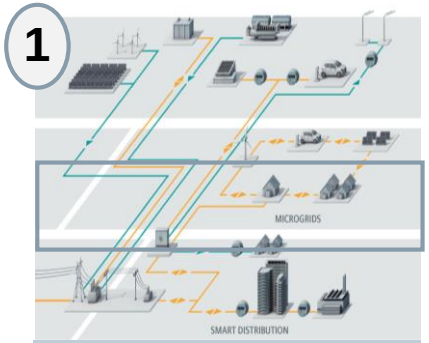
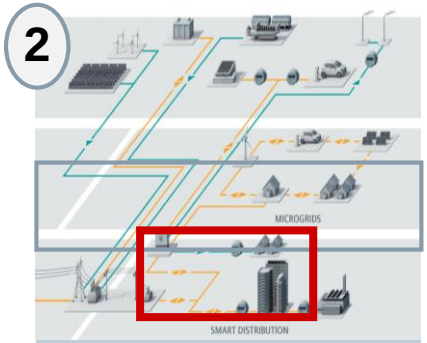
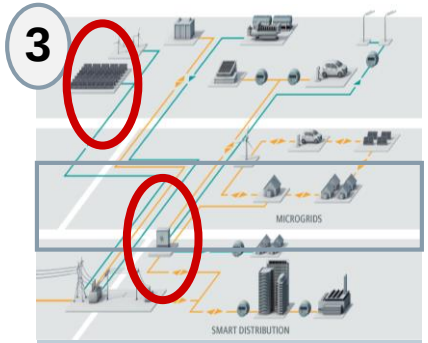


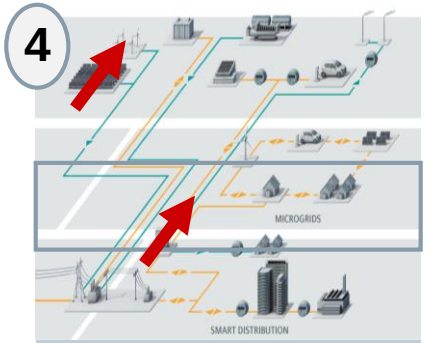
Network state



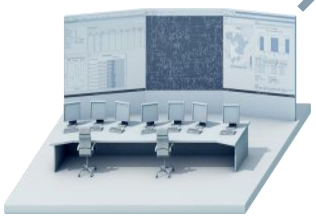
Problem detection



Decision making



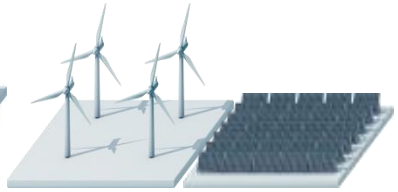
Set-point command



Active Network Management System

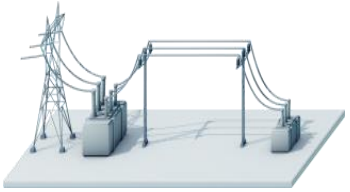
Energy storage

Voltage control device



Controllable generation

Controllable loads



Real time thermal rating

Spectrum Power Active Network Management
Active Network Management based on real time state estimation

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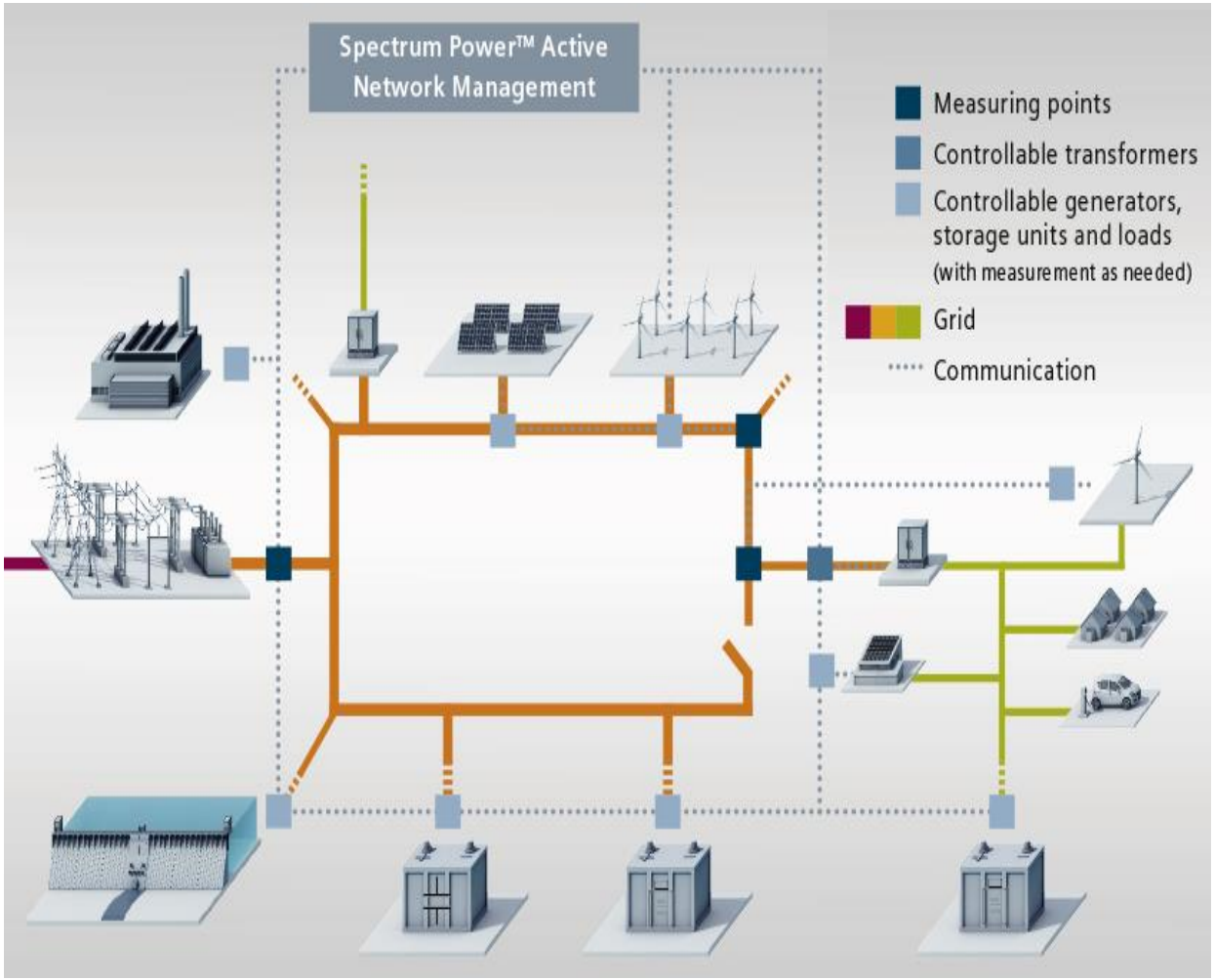


1 Network state

→ **Processing of measurements, status indications and network topology**

2 Problem Detection

→ **Real time state estimation using P, Q, I, V**

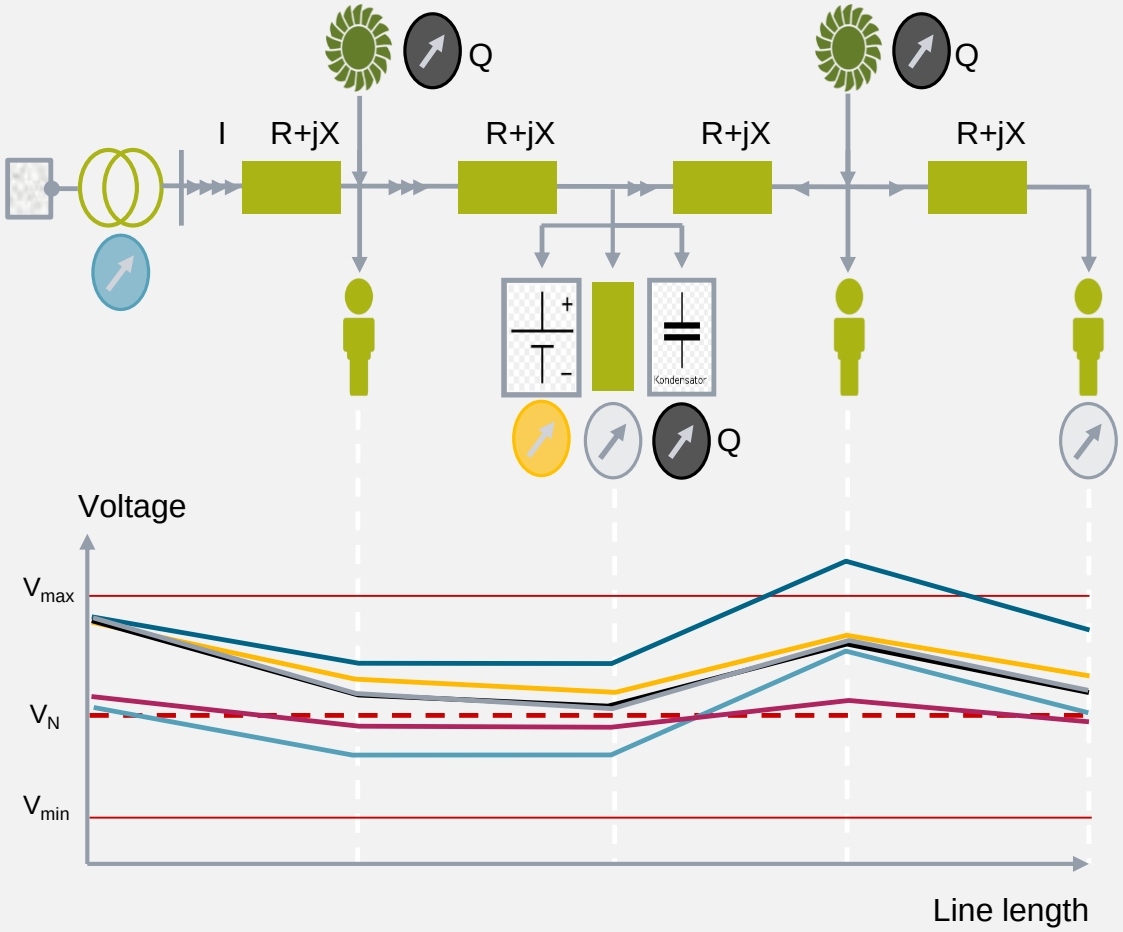
3 Decision making

→ **Generic on-line optimization, Minimizing limit violations, losses, operational cost; conservation voltage reduction**

4 Set-point command

→ **Closed loop execution of calculated set-point commands**

Active Network Management
Smart voltage control and conservation voltage reduction



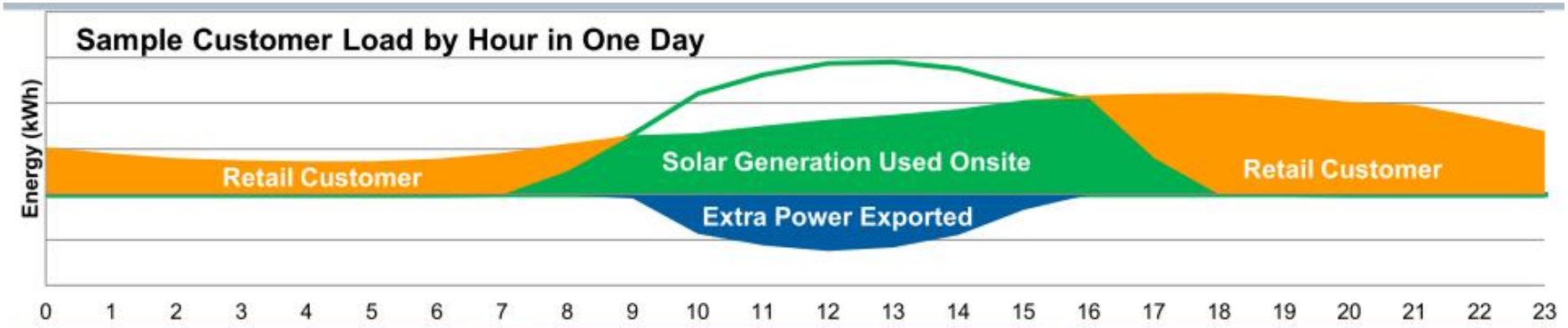
Generators

Line Sections

Consumers

- Consumers & distributed generation no control
- with transformer tap control
- with storage control
- with VAR control (generators, capacitor banks)
- with load control
- smart control – combination of control devices
- smart control – conservation voltage reduction (CVR)

How does NEM work..



Morning

In the morning hours when the solar system produces less electricity than needed, the customer will pull electricity from the grid.

Mid-day

In the middle of the day when the solar system produces more energy than is needed onsite, the extra power is exported to the grid and the meter runs backward, building up a credit with the utility. Typically only ~1/3 of a system's power supply is exported to the grid.

Evening

In the evening and night hours, the customer will again pull electricity from the grid. Credits from the exports go toward "netting out" usage on a month-to-month or annual true-up.

NEM vs FiT

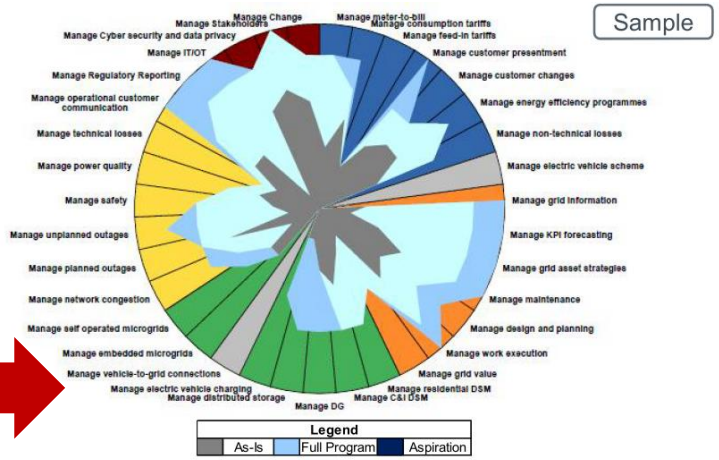
- FiT
  - *the **value** of electricity produced by the consumer's DER system is more known and more precise*
  - *the revenue stream is **predictable** and does not vary in response to consumer's energy usage*
  - *prosumers will make their DER system as **large** as possible, maximizing efficient use of space and leveraging fixed costs such as inverters*
  - *FiT payments are **independent** of changes in utility rates*
  - *regulators/legislators are **reluctant** to change FiT amounts and do so infrequently*
  - *the consumer gets the same financial savings from **energy efficiency** as other consumers*

- NEM
  - *utilities are **not locked** into long-term, potentially uneconomic contracts*
  - *regulators are not prevented from providing **rate relief** to correct tariff issues (e.g., modify fixed charges, pay for excess energy received from the prosumer at the then-current utility avoided cost)*
  - *a **single**, existing meter is sufficient for billing*
  - *for monthly-balancing NEM, **no changes** to the billing system are needed*
  - *electricity rates are based on utility **costs** reviewed and approved by regulators, not legislative fiat*

- In the end, **the numbers** are what matter most in driving adoption of DER
  - *investment costs for the prosumer*
  - *price of utility-provided electricity, which determines the prosumer's avoided energy purchase costs*

While the Smart Grid concept is accepted, some questions will still remain……

Orientation	Destination	Routing
Where do I want to go? (strategy)	**What does make sense?** (qualitative design)	**How do I realize it?** (quantitative planning)
▪Which objectives do I want to achieve? ▪Which levels of process sophistication do I aspire?	▪What is the perceived value of the initiatives? ▪What is the required effort to implement initiatives and technologies? ▪Which scenarios end up with a positive business case? ▪What budget should I plan for the coming years?	▪Do the numbers make sense? ▪Which steps do I have to take in which timeframe? ▪Which skills do I need? ▪How can I integrate existing programs?



Thank You!

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