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Microgrids and Relevance to the Australian Energy Market

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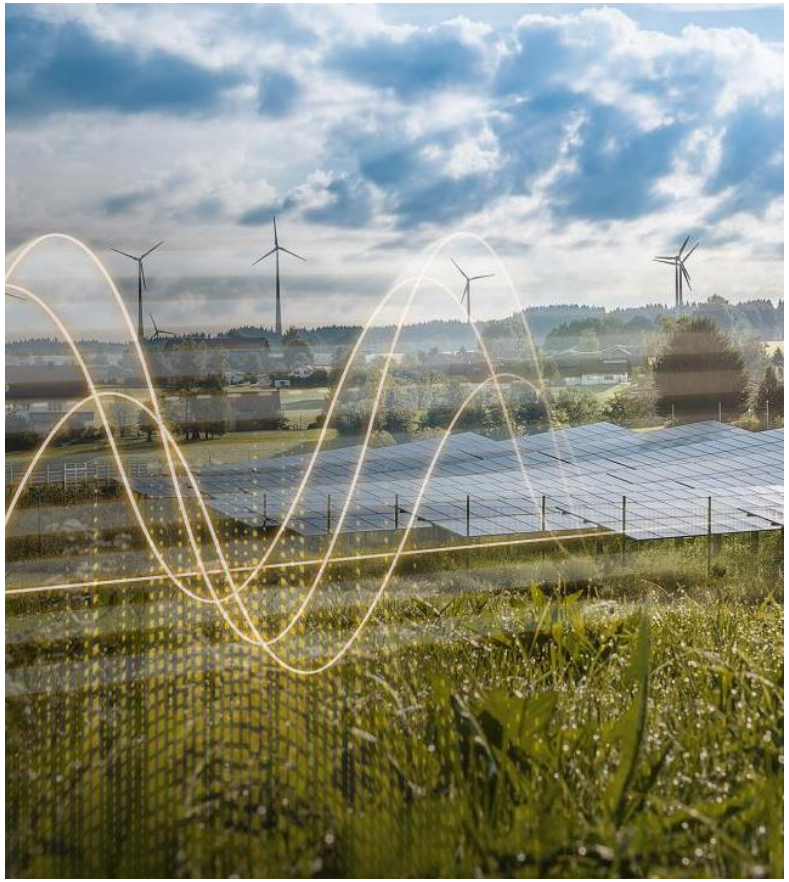
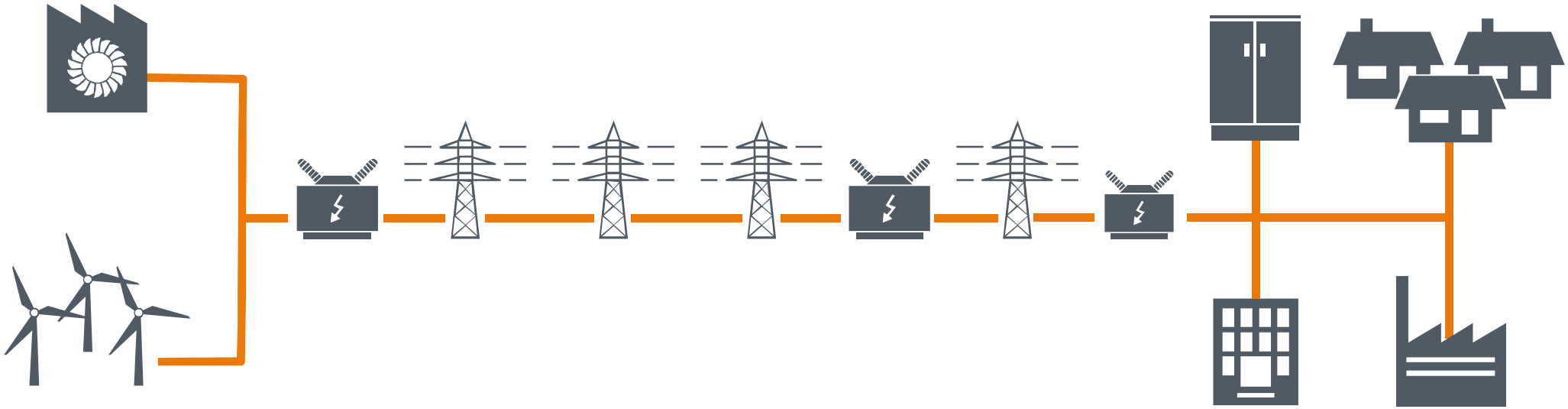


Yesterday: Centralized, unidirectional grid …



Today: Microgrids

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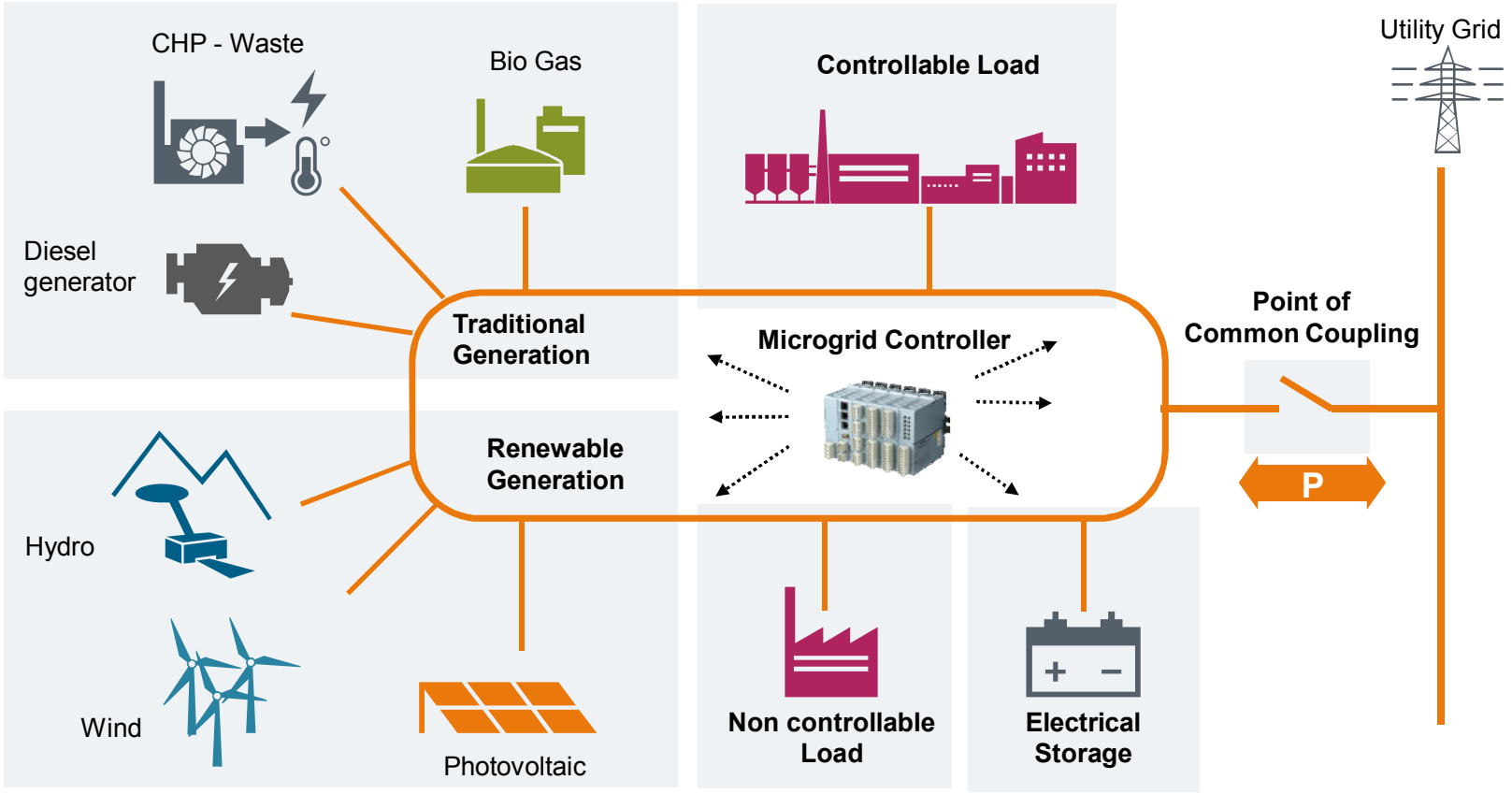
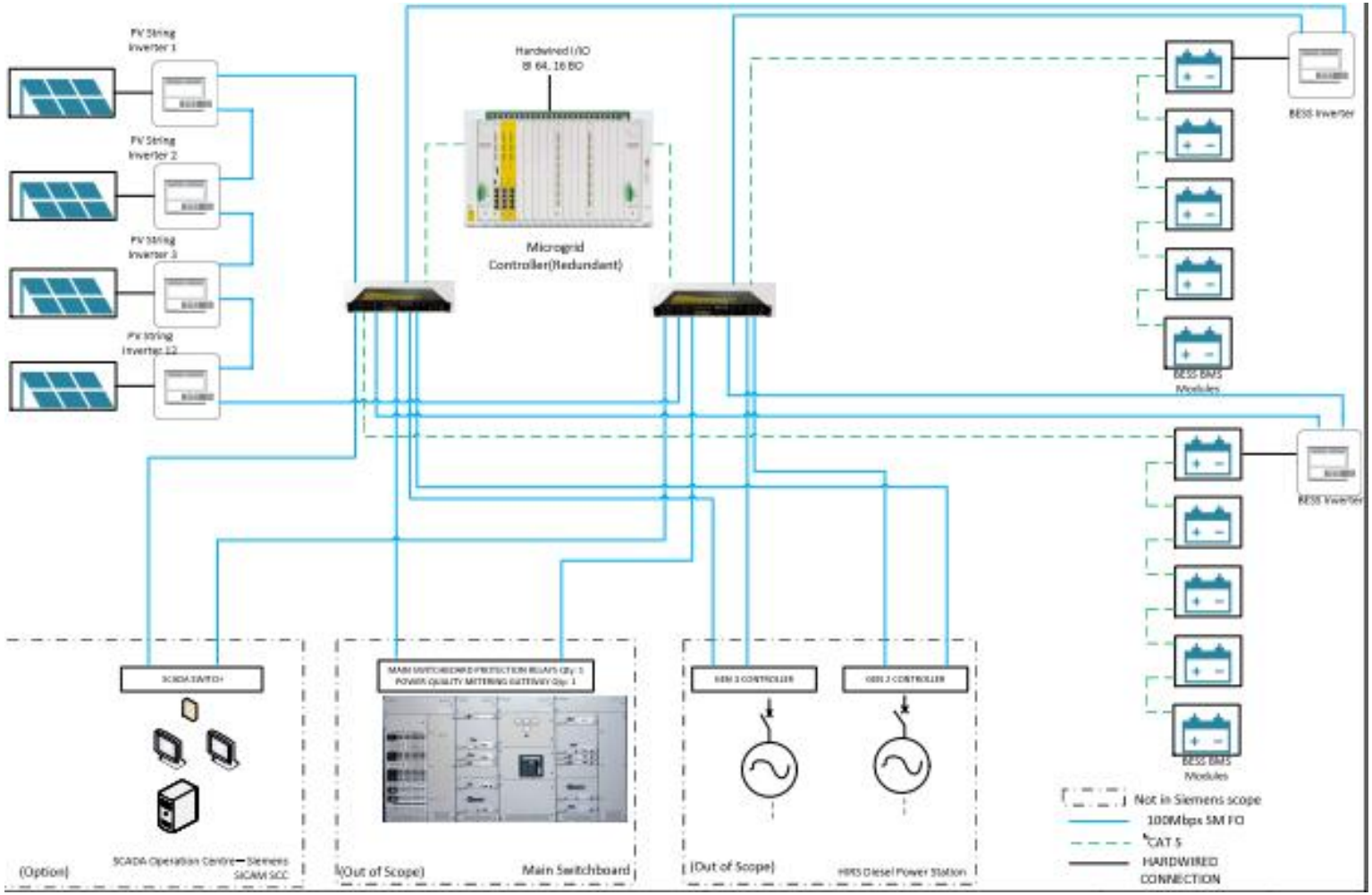
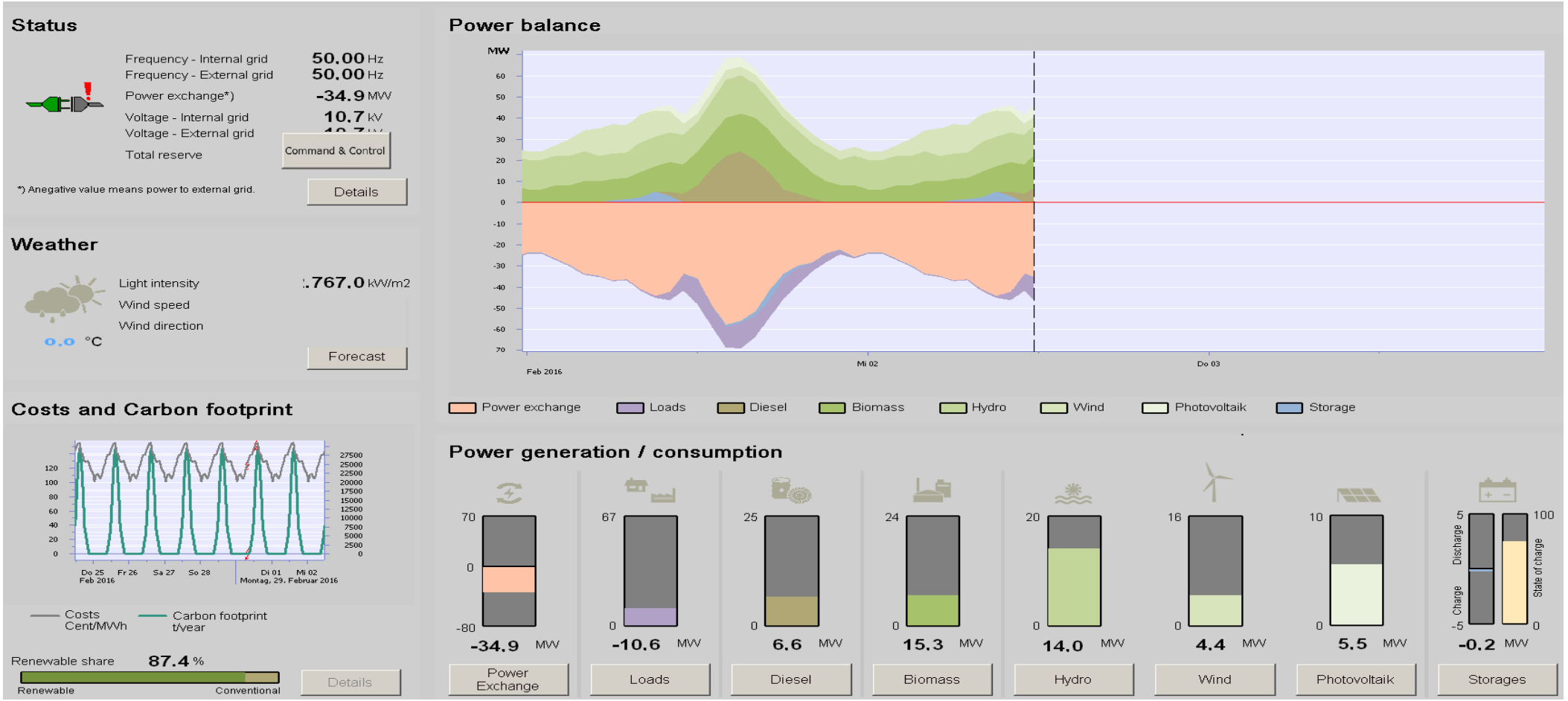


Microgrid definition

- Delimited geographical area
- Generation and consumption within area
- Can be connected or not connected to the main grid on a single point
- Power can flow in both direction when connected to the grid
- Asset coordinated by microgrid controller

MGC Overview





Tomorrow: A complete decentralized bidirectional network!

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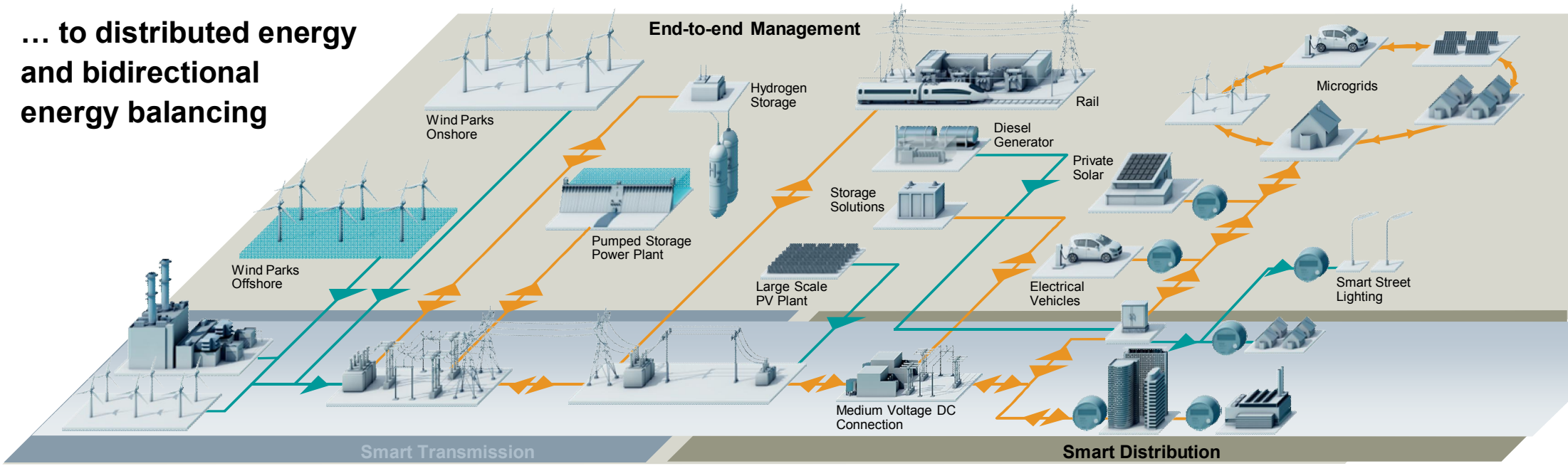
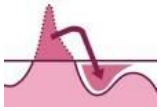
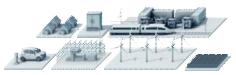
… to distributed energy and bidirectional energy balancing





Three major factors are driving the revolution of energy systems

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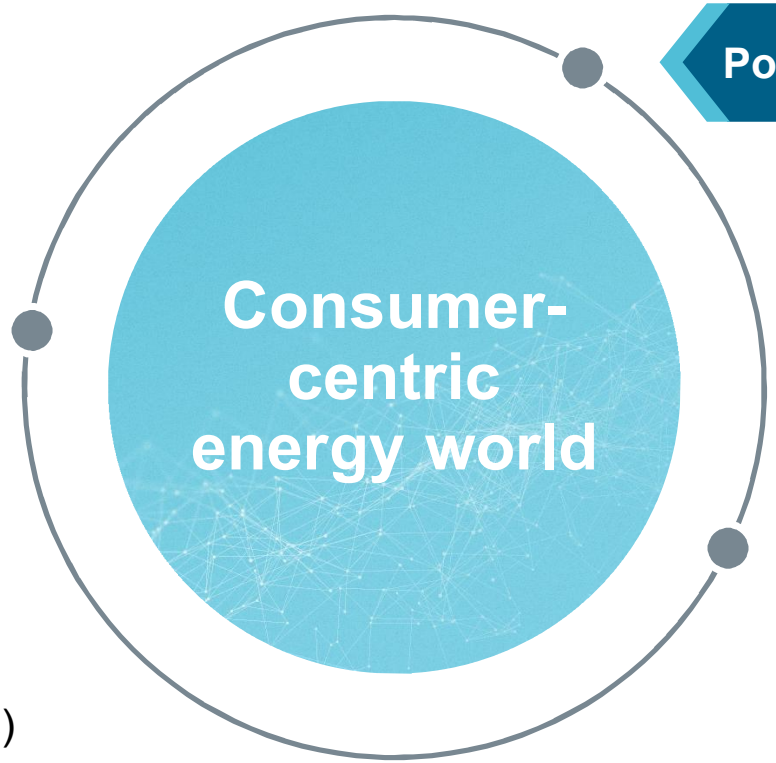

Political targets

- Energy efficiency leads to increasing electrification
- CO_2 reduction targets lead to increasing renewable power generation

Breakthrough technology

- Wind Power Generation
- Photovoltaic Power Generation (PV)
- Digitalization
  Upcoming: Artificial Intelligence
- Energy storage (Li-Ion Batteries)
- e-Mobility
- Power-to-x

Changing customer behavior

- From passive consumers to active participants
- Own energy generation systems

But we still have the Energy Trilemma…

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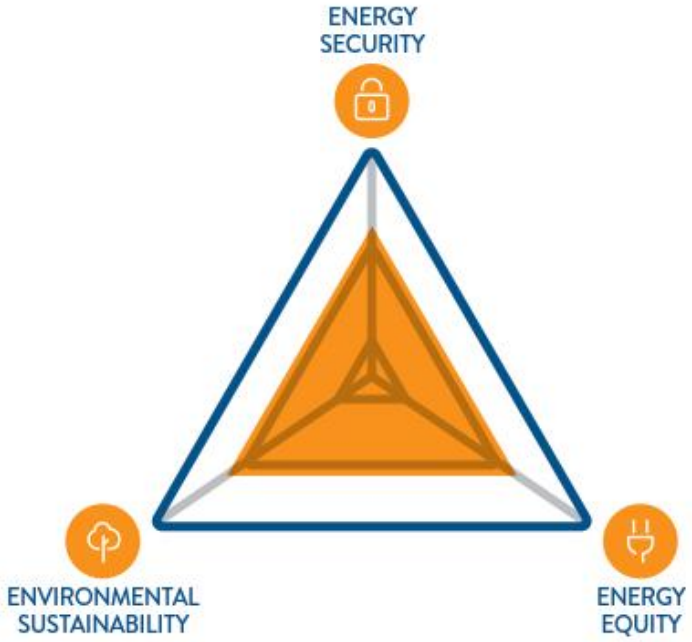


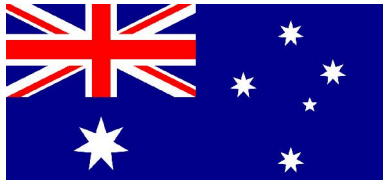
ENERGY SECURITY
Effective management of primary energy supply from domestic and external sources, reliability of energy infrastructure, and ability of energy providers to meet current and future demand.

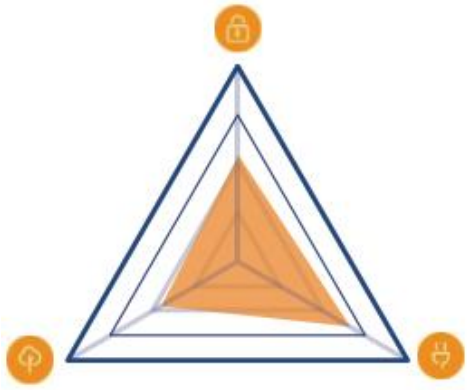
ENERGY EQUITY
Accessibility and affordability of energy supply across the population.

ENVIRONMENTAL SUSTAINABILITY
Encompasses achievement of supply- and demand-side energy efficiencies and development of energy supply from renewable and other low-carbon sources.

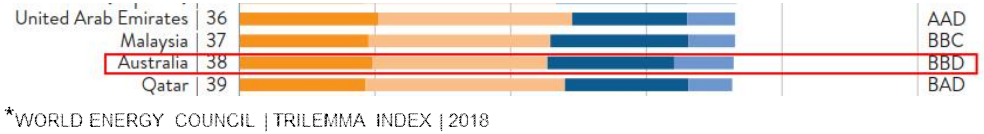
*WORLD ENERGY COUNCIL | TRILEMMA INDEX | 2018

Where are we?





Rank : 38th in the world.
Energy Security = B
Energy Equity =B
Environmental Sustainability = D



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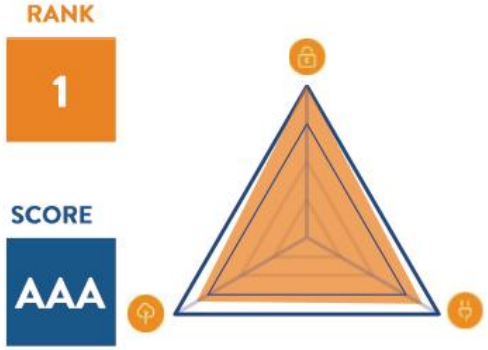
Ideal Model



Rank : 1st in the world.
Energy Security = A
Energy Equity =A
Environmental Sustainability = A

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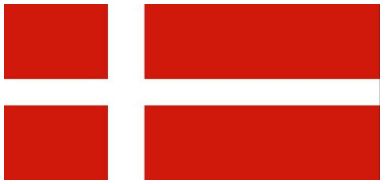

How do we get there?

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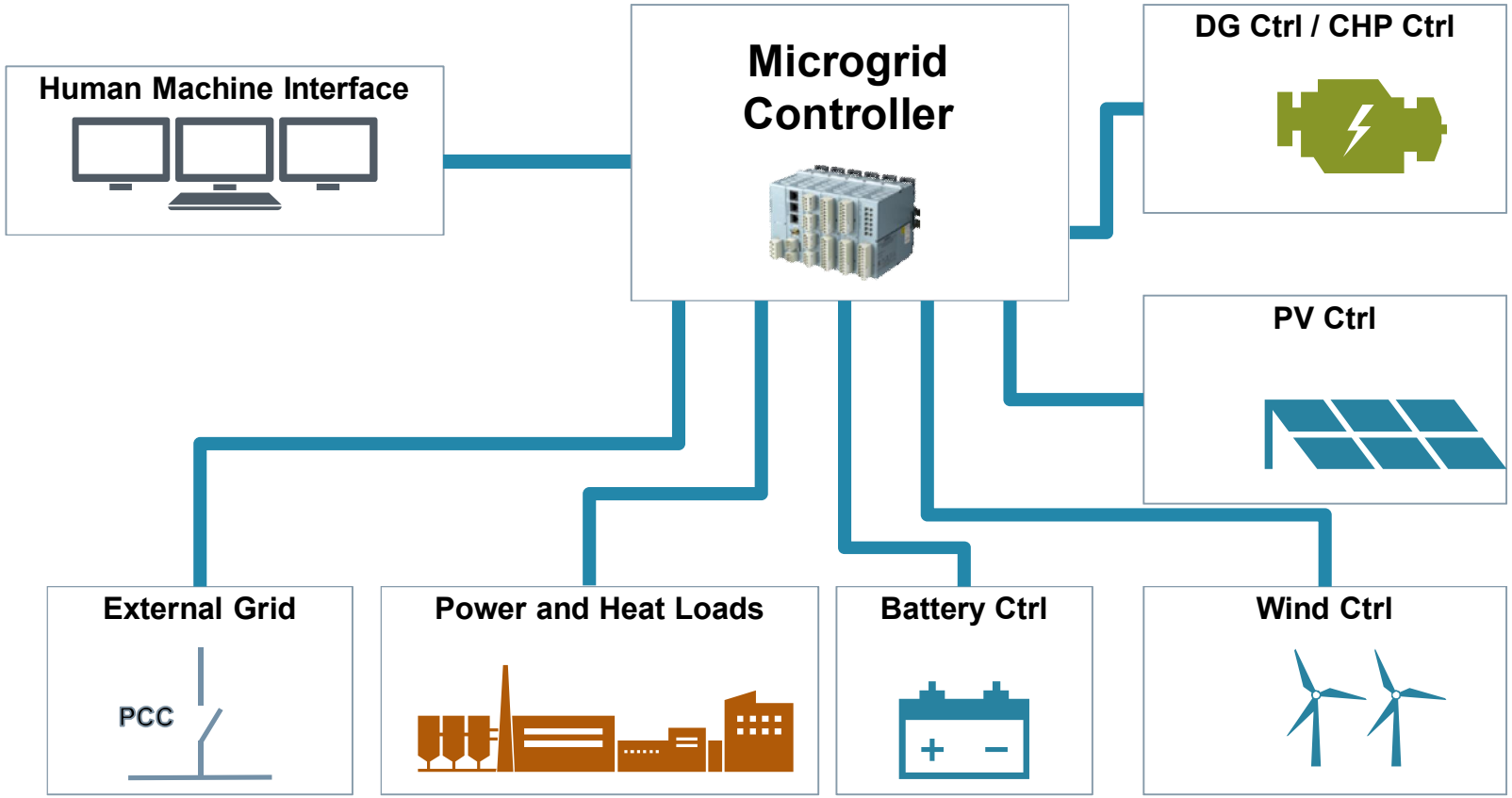

Microgrid controller

- Coordinate all the assets
- Ensure that load and generation are always balanced
- Define optimal operational setpoints based on resiliency, economics and sustainability
- Interact also with grid when MG connected

Microgrid Control for monitoring and control

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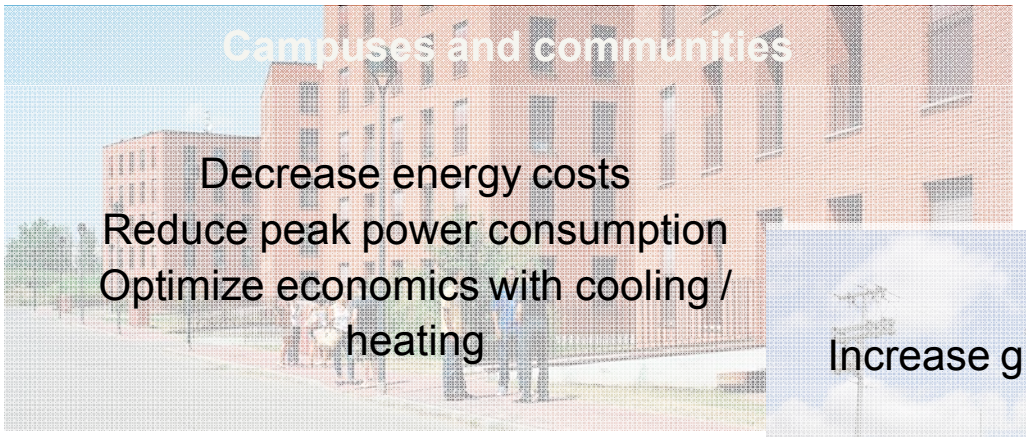
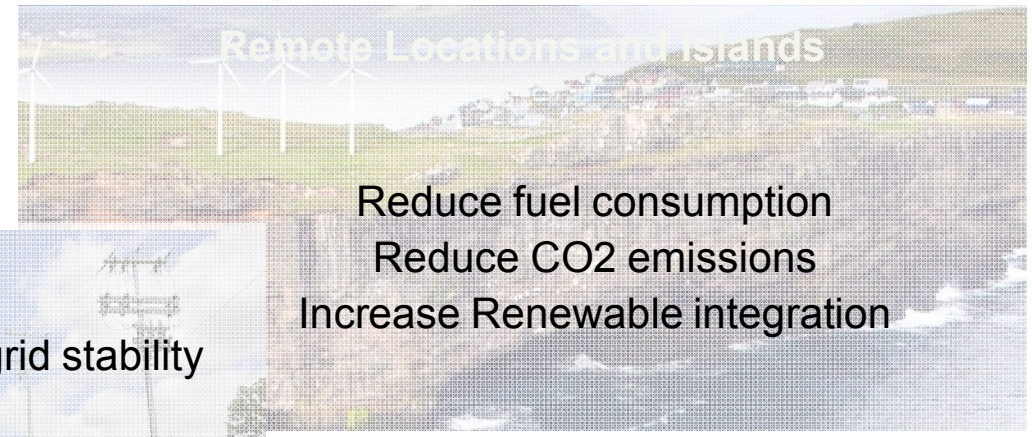
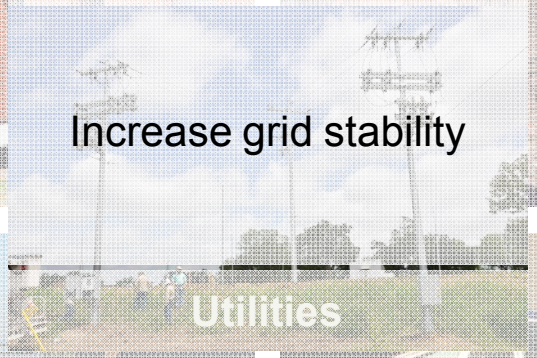
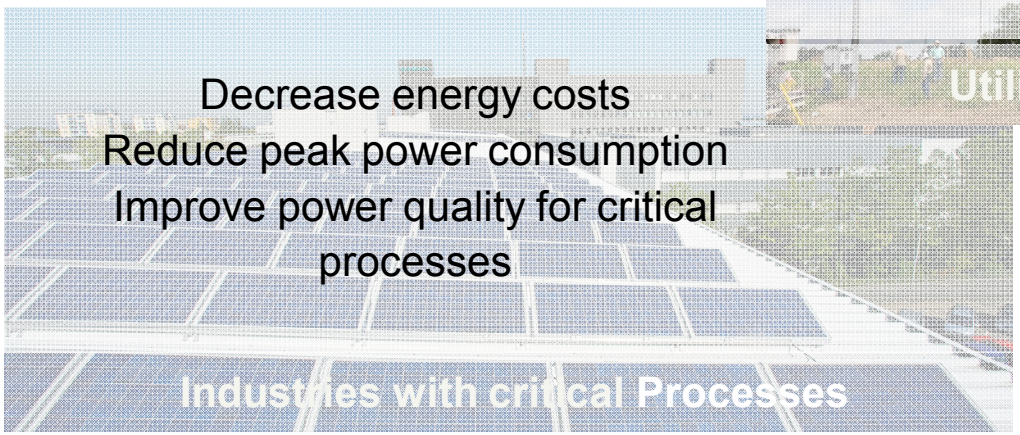
- Asset Monitoring
- Blackout detection, black start and automated grid modes
- Automatic start of backup generators
- Generation-offsetting and balancing
- Reserve management
- Peak shaving
- State-of-Charge management
- Economic and environmental indices

Implementation landscape divided 5 main categories

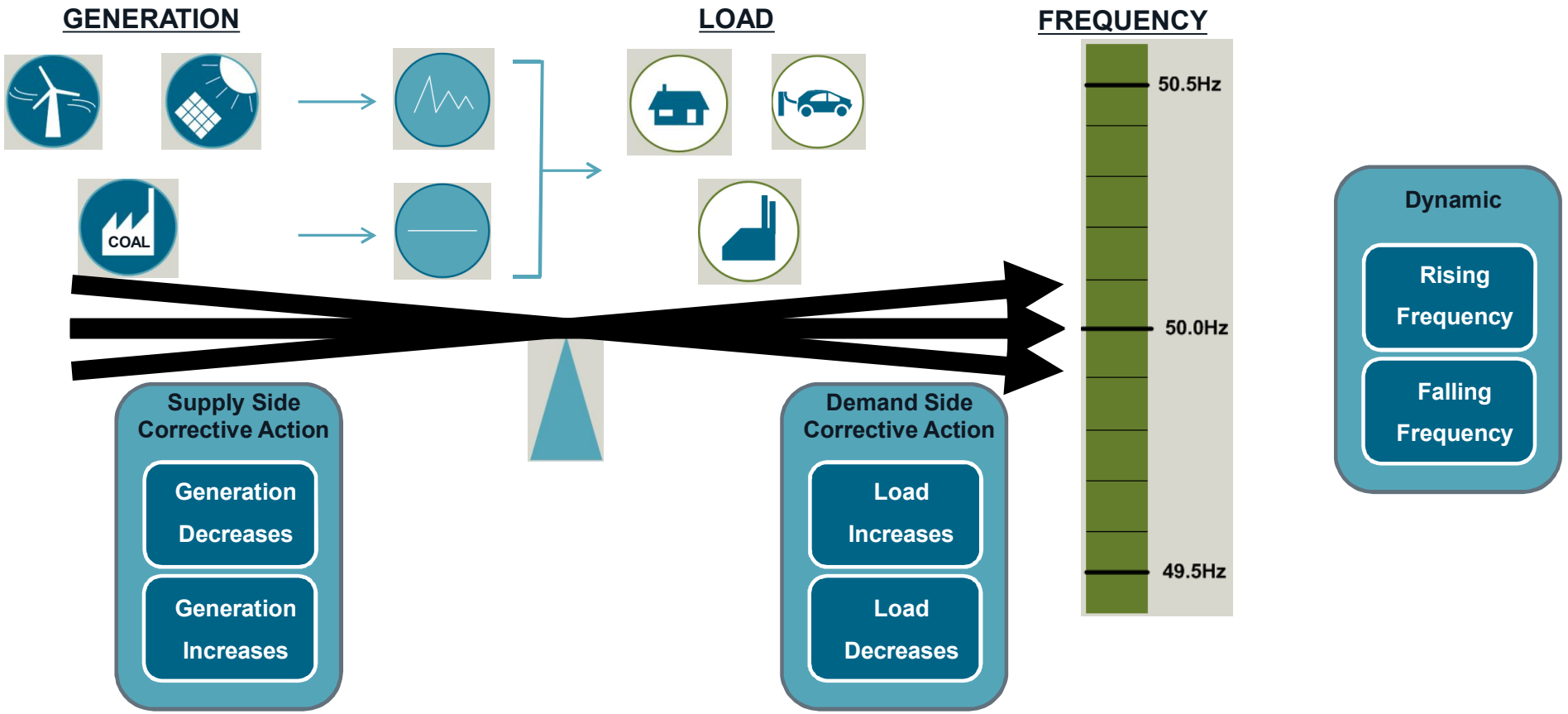








However…….Balancing Supply and Demand:- Second by Second!



Modular and scalable Control/Automation & digital offering for distributed energy systems

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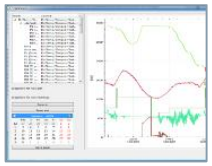
Simulation services

Simulate project, Evaluate DES baseline and DES solution benefit (hardware and software)



Managed services

Customer DES solution, operation recommendations

Simulation services

Historical or predictive data: Evaluate best solution configuration (incl. the optimum function setting for the control) and operation minimizing operation cost and verifying grid stability

MG controller offering

Simulation data to design optimized control functionalities in a modular way

Consulting

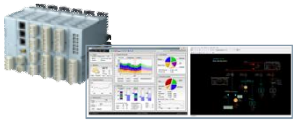
Consulting offering: Energy site improvement recommendation and services based on data

DER Performance Monitoring and Analytics

Campus/C&I/IPP Performance monitoring plus data analytics

Microgrid and PV controller portfolio

Reliability, energy efficiency, market interaction and data gathering



Decentralized Energy Monitoring Optimization

DES Data gathering, reporting, benchmarking data analytics (Actual vs. Historical, Simulation baseline, anomalies detected)

Microgrid Lifecycle

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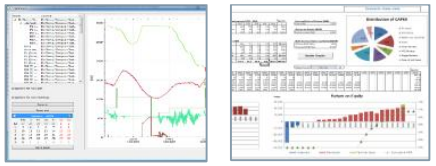
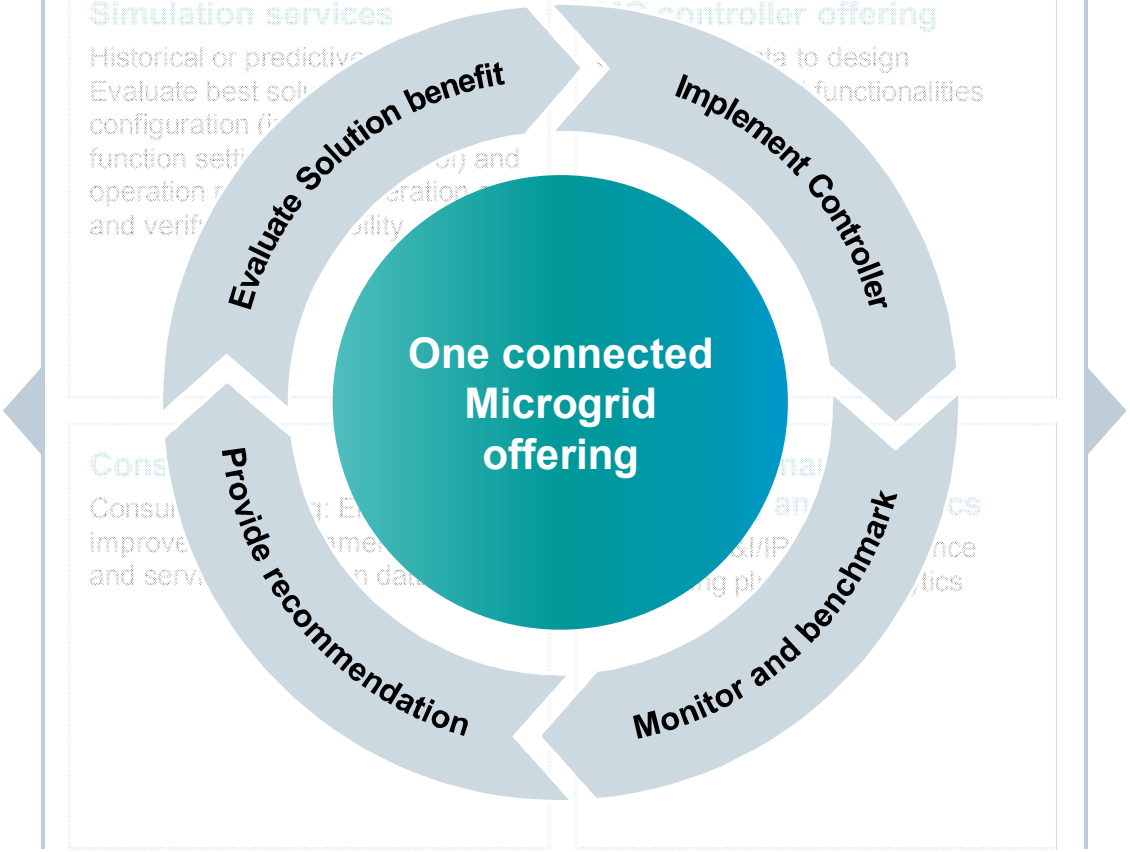
Simulation services

Simulate project, Evaluate DES baseline and DES solution benefit (hardware and software)



Managed services

Customer DES solution, operation recommendations



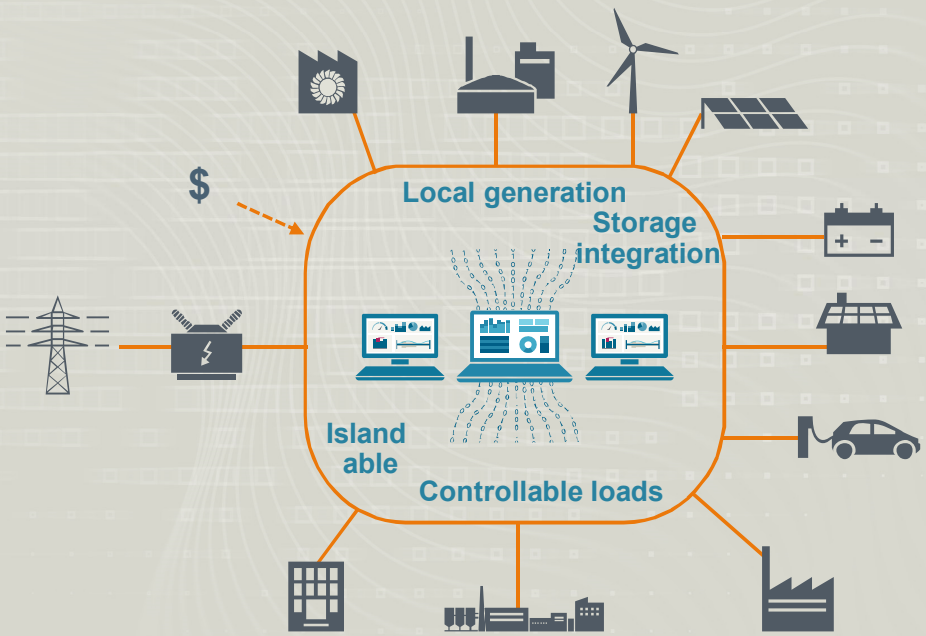
Microgrid and PV controller portfolio

Reliability, energy efficiency, market interaction and data gathering

Decentralized Energy Monitoring Optimization

DES Data gathering, reporting, benchmarking data analytics (Actual vs. Historical, Simulation baseline, anomalies detected)

The 3 major value propositions….



Economic & Energy efficiency

- Forecasting
- Distributed generator control
- Load / storage control

Reliability, resilience

- Black start
- Network synchronization
- Online Control via HMI / Grid Monitoring and Control

Sustainability

- Generation / load forecast
- Dynamic grid constraint consideration using state estimator function

Use Case1 :Ottawa, Ontario, Canada: Algonquin College

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4MW
Energy Centre
(Cogeneration)

200 k$
annual savings through
DG Control integration

Replication

Value of Optimization – Campus Simulation

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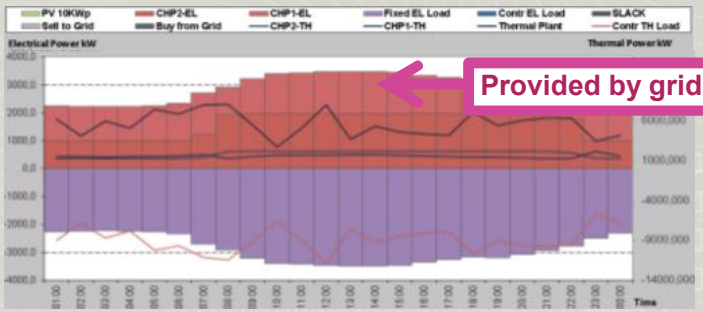
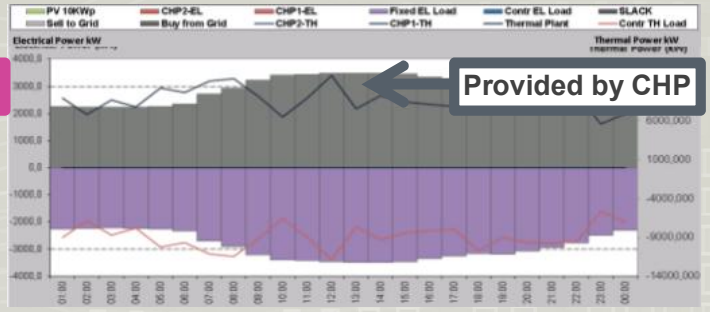
Scenario 1: Base Case



Simple campus energy model – Entire Campus is supplied from the grid and thermal load is provided by a gas powered plant.

Energy cost: $3M per year

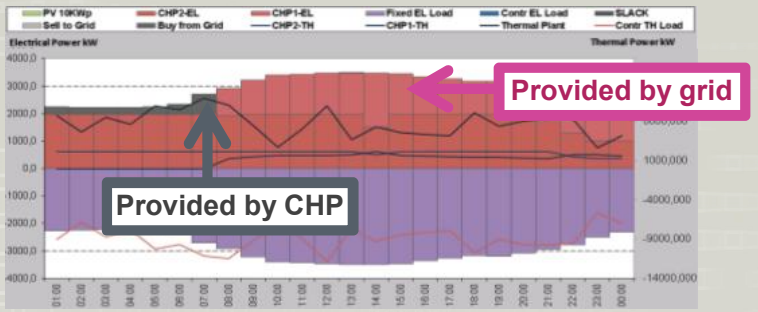
Scenario 2: CHP



Full CHP utilization – Savings through maximum CHP utilization without optimization

Energy cost: $2.2M per year
Savings: $800K per year

Scenario 3: CHP & Microgrid Control



Microgrid optimization – Additional savings through optimizing energy intake from either CHPs or grid with the Sicam Microgrid Control

Energy cost: $2M per year
Savings: $1M per year
$200K additional savings due to optimisation

IREN2 research project: operation of a microgrid Wildpoldsried, Germany

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Challenge

- Operate an existing grid as a microgrid with a high share of renewable energy sources in the form of a self-sufficient island grid
- Use as topological power plant
- Ensure stable and economical grid operation based on renewable energy sources

Solution

- Hybrid structure of wind turbines and photovoltaic systems, combined heat and power plant, vegetable oil aggregate, load bank, DC back-to-back link, and battery storage system
- Control and monitoring for stable grid operation

Benefits

- Operation of the microgrid as a self-sufficient island grid, disconnected from the main grid and while using renewable resources
- Stable and economical operation of the microgrid
- Provision of system services to the superimposed grid
- Five times more energy than the community itself consumes in grid-connected operation

Project partner: IREN2 Consortium
Country: Germany

Educational Institution, 2014-2017

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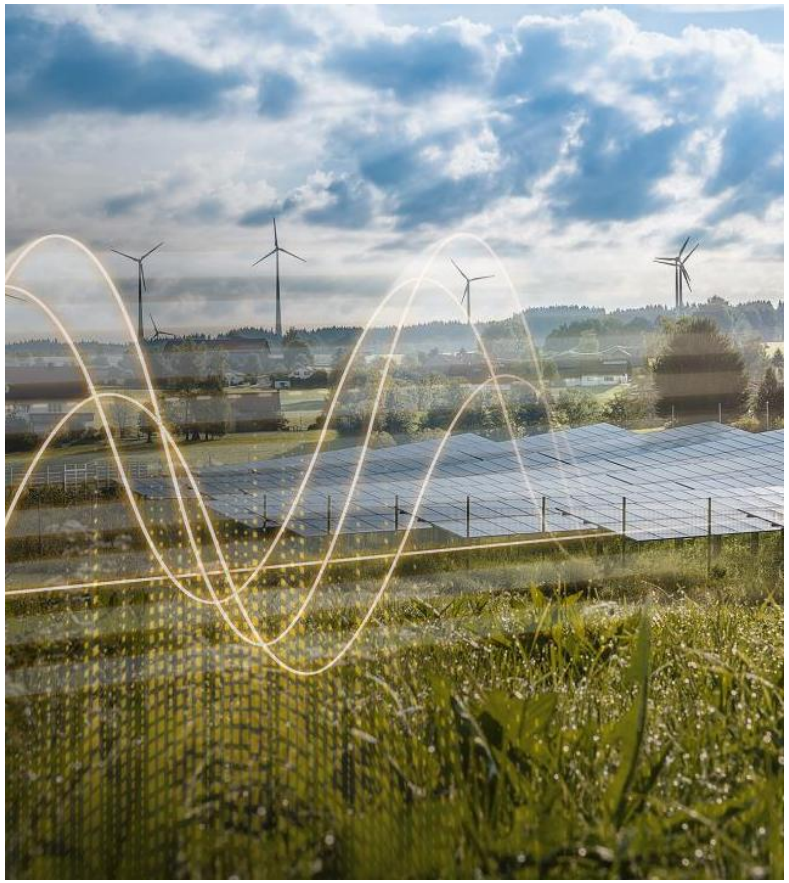
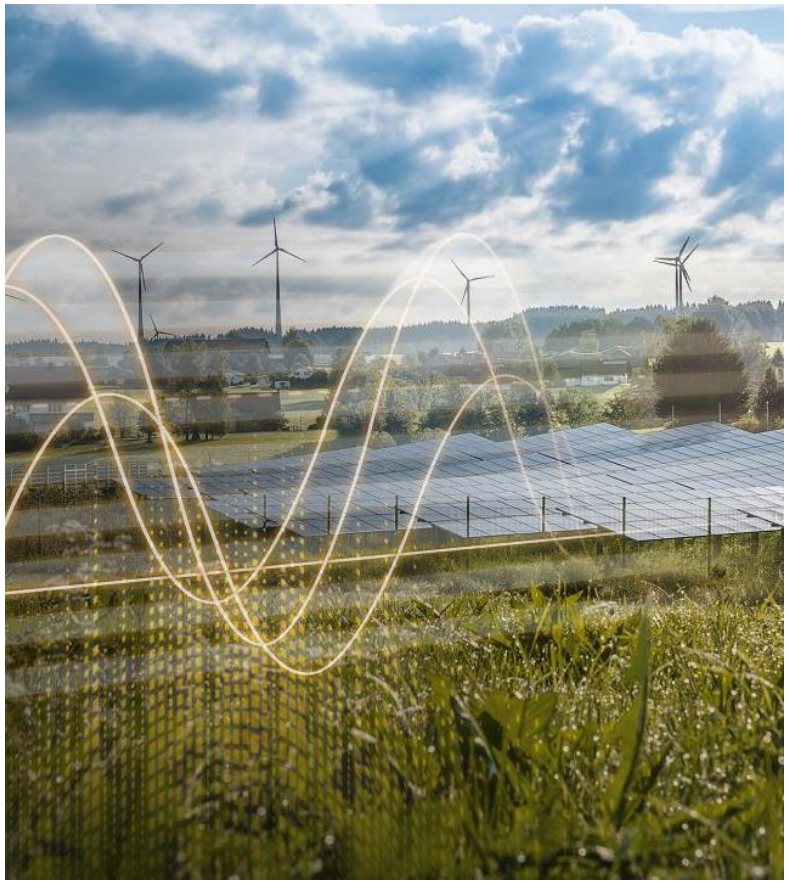


Summary

- **Changing Market and Prosumer Trends are leading the shift from HUB and SPOKE configuration to a development in Distributed Systems.**
- **To overcome the ever changing challenges CONTINOUS IMPROVEMENT, Siemens Microgrid lifecycle from Consulting- Implementation – Data Analytics - Improvement tackles this issue and provides constant improvement.**
- **Microgrid Controller is the key element in the development in the advanced automation and control required in these dynamic systems.**

Contact



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