



VAASA WIND EXCHANGE & SOLAR, MARCH 2018

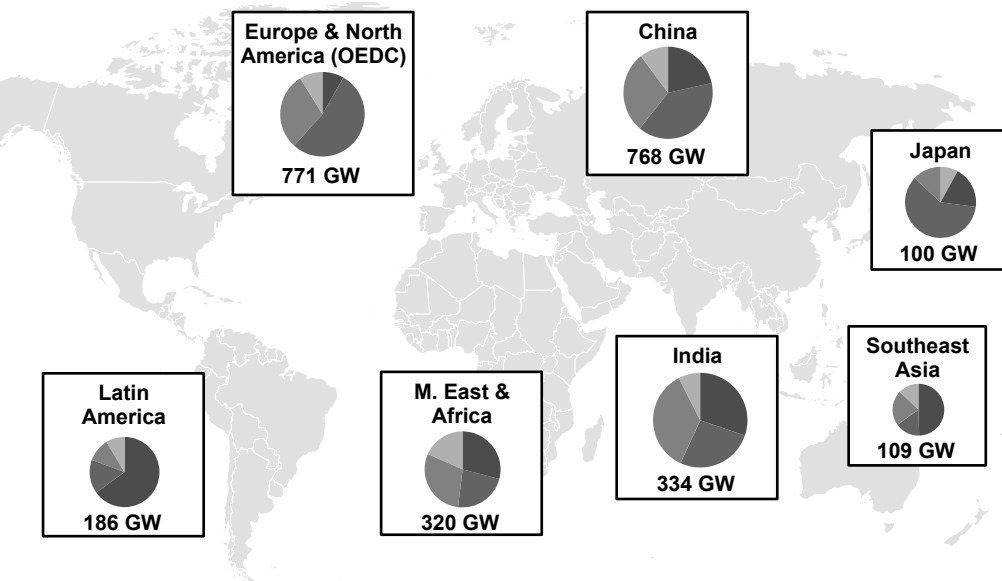
# Microgrids, Energy Storage and Renewable integration

ti Vaattovaara

# Renewable energy

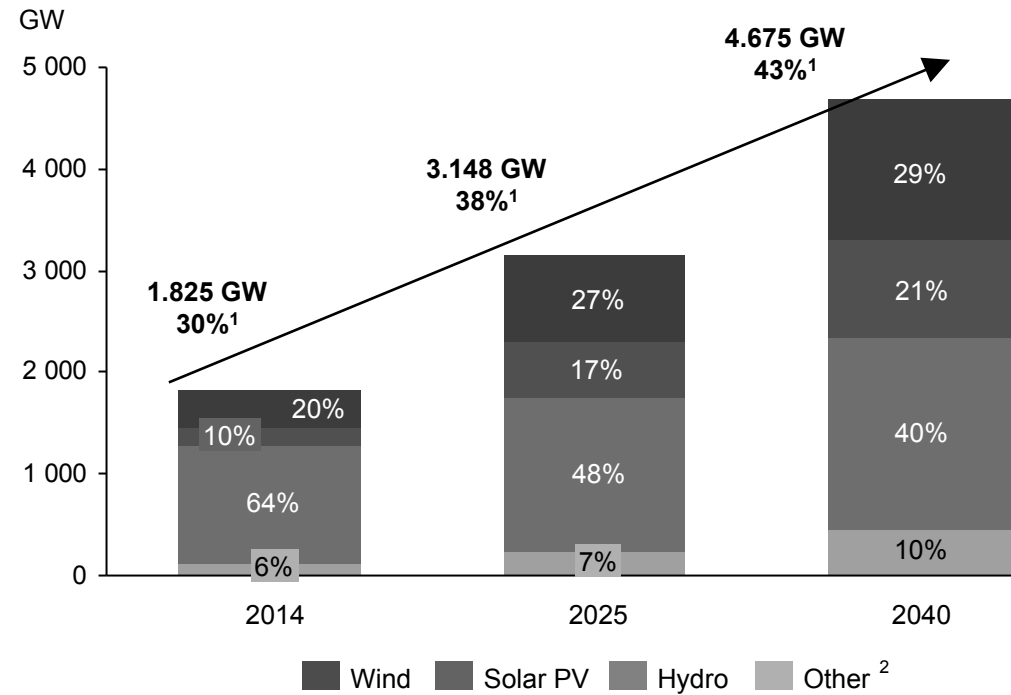
Global installed capacity more than double by 2040

## Renewable capacity additions 2014-2040



Low policies scenario

Hydro Wind Solar PV Other renewables



Wind and solar amount to 50% of total renewables in 2040

Source: McKinsey 2011, UNEP 2009, EIU 2012

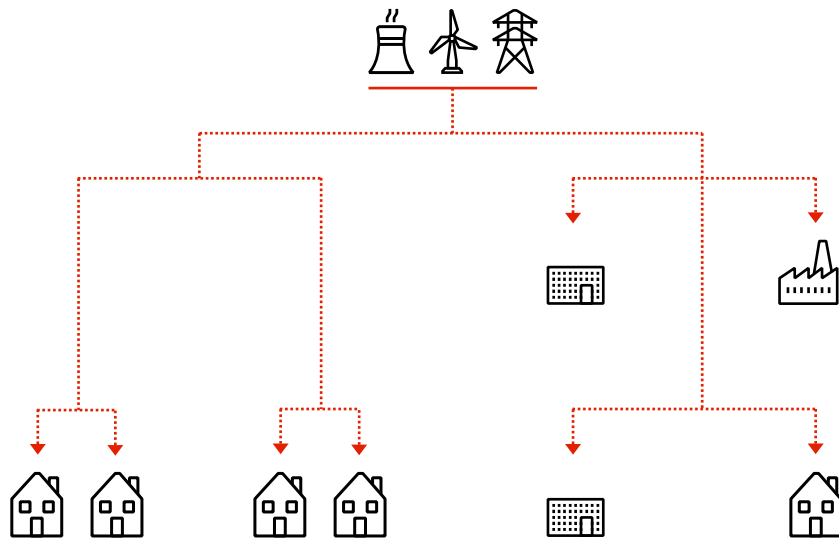
<sup>1</sup> Share of total power capacity

<sup>2</sup> Other include bioenergy, geothermal, CSP and marine

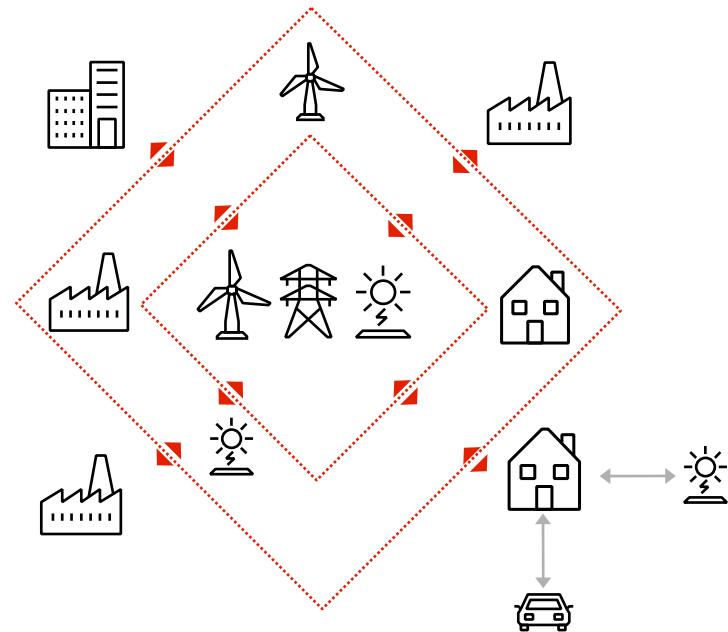
# Energy and grid transformation

Transition from a centralized to a distributed grid

## Traditional grid



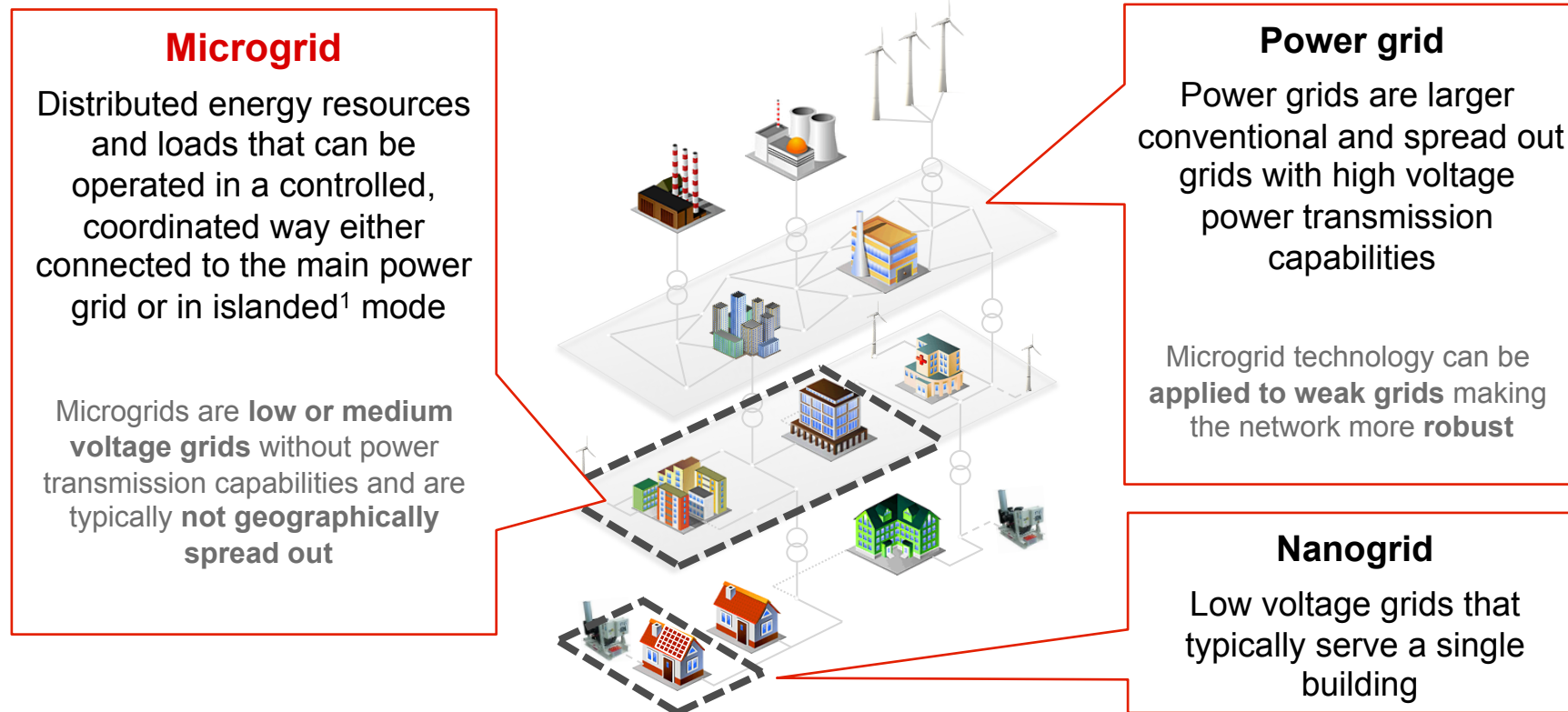
## New grid



More local than centralized, consider also loads as a resource for the control

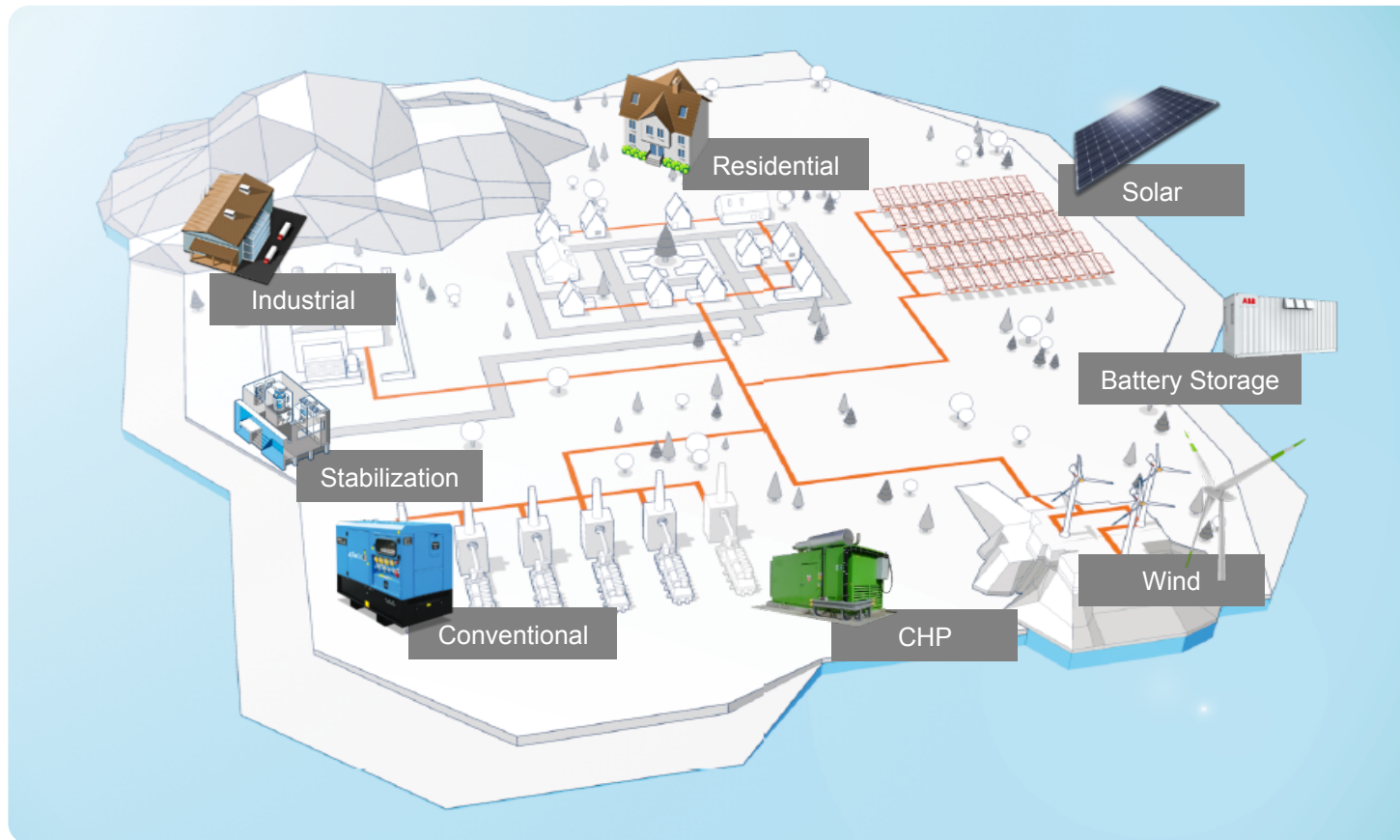
# What is a Microgrid?

Modern, localized, small-scale grids



# Hybrid or Islanded Microgrid

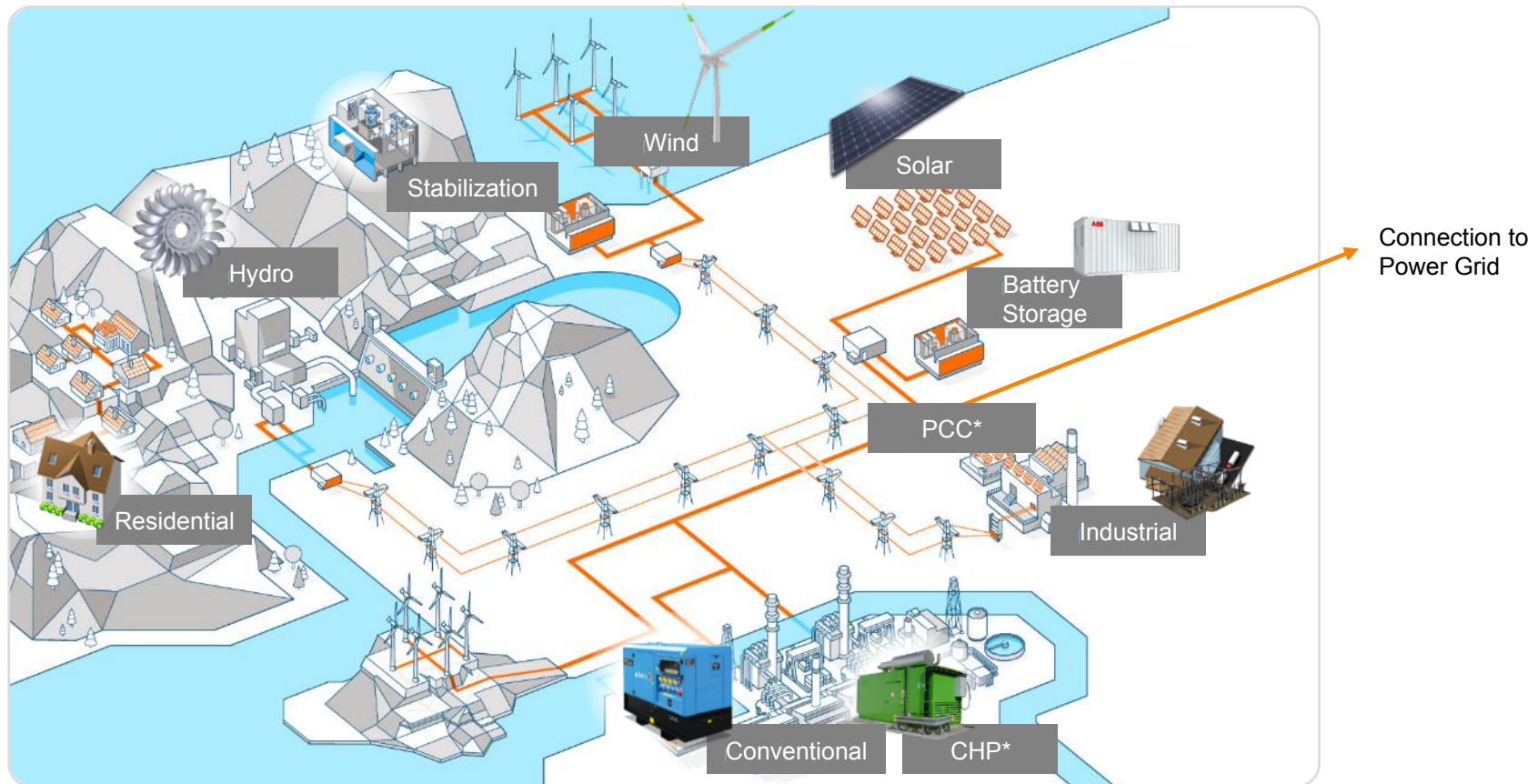
Access to power in remote locations, power quality plus lower cost and environmental impact



CHP: Combined Heat and Power

# Grid connected Microgrid

resiliency, power quality, self consumption and lower environmental impact

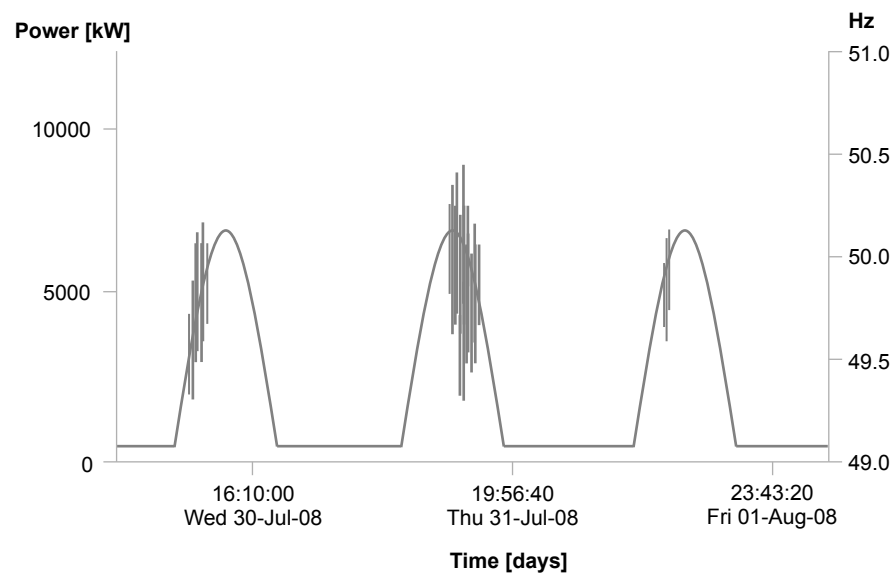


PCC: Point of Common Coupling, CHP: Combined Heat and Power

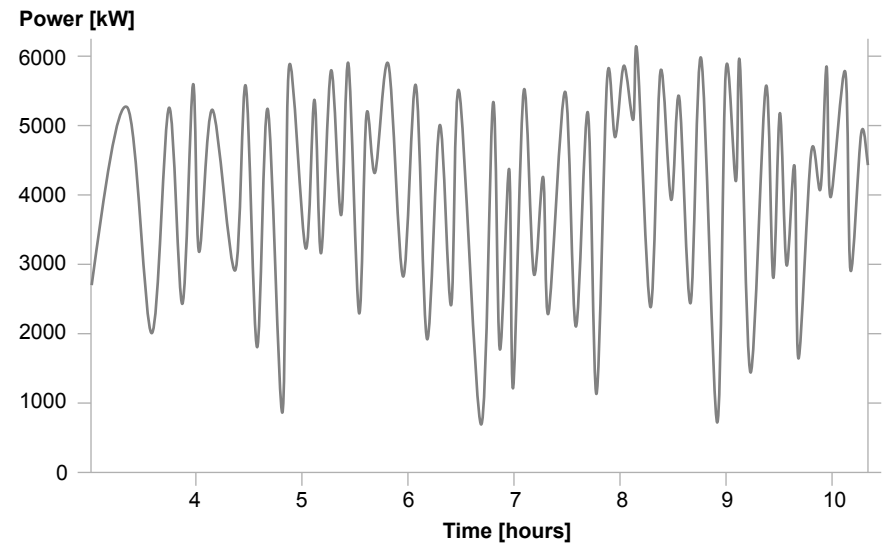
# Power: Uninterrupted power supply

Managing power fluctuations from renewables

## Solar power variations



## Wind power variations



Inherent volatility of renewables can compromise grid stability

Grid stability requirements are traditionally fulfilled by diesel generation (base load)

Optimized microgrid solution maximizes ROI\* and fuel savings

ROI: Return of Investment

# Microgrid

eneration at the point of consumption and always available

## Microgrid tasks

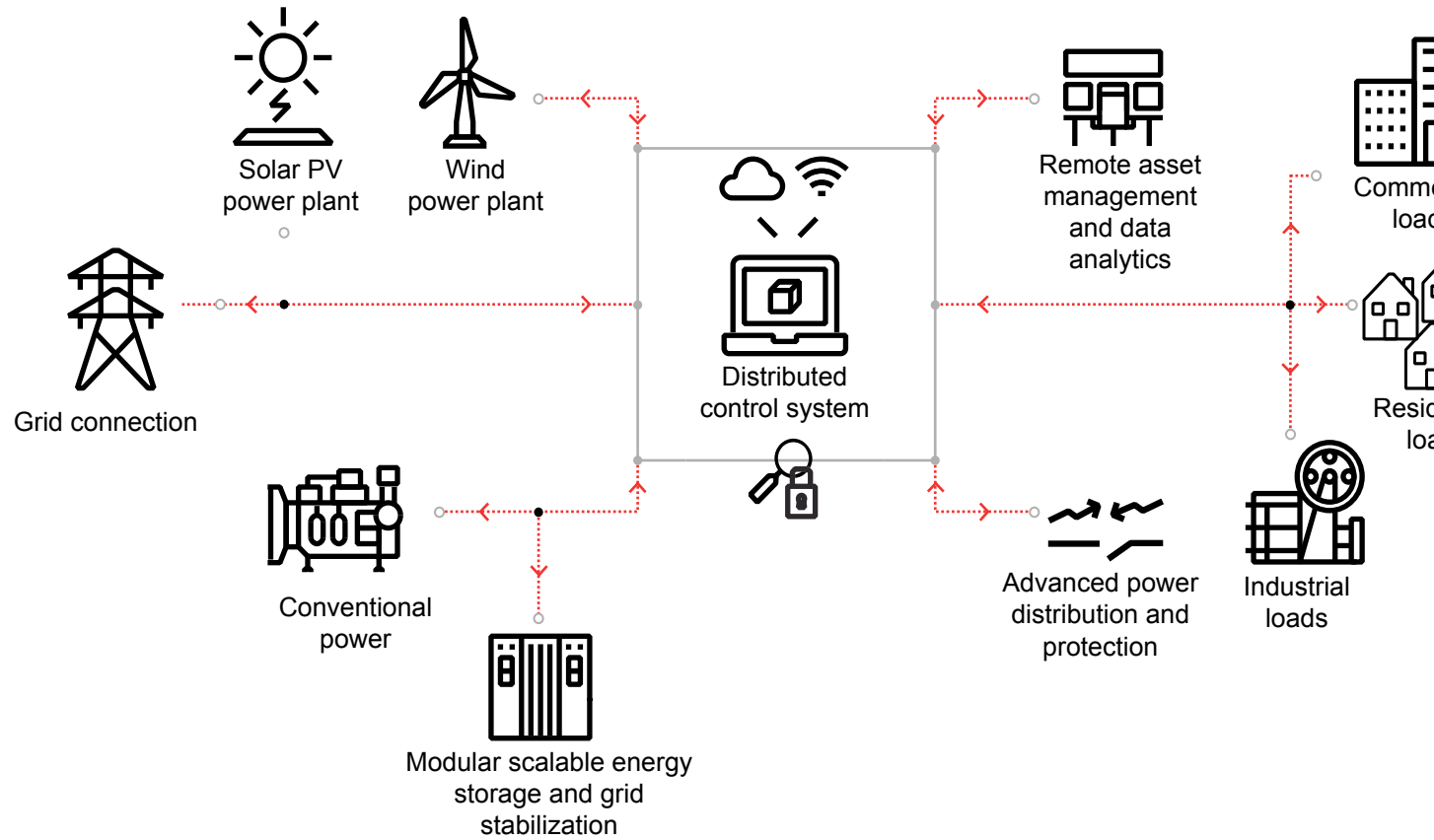
Frequency control

Voltage control

Balance demand and production

Optimize production by forecasting loads and renewable production

Avoid fossils or reduce consumption by optimized use





# PowerStore™ Energy storage & controller for microgrids

“plug and play” solution, easily configurable to adapt your unique needs

## Climate Control

Optimizing temperature inside container within an optimal operating limit at all times

## Advanced Lithium Ion Batteries

Energy module, Racks, and Energy Management System Interface  
Easy maintenance  
Online replaceable  
Hot-swappable

## 100%

PowerStore™ Conversion  
Inverter  
Available  
Modular  
Cold Forming  
Dual Generator



## Health Safety and Environment (HSE)

Ensure health and safety appropriateness for all individual components and entire system of PowerStore™

## Remote Monitoring

Comprehensive solutions for unattended sites to increase productivity.

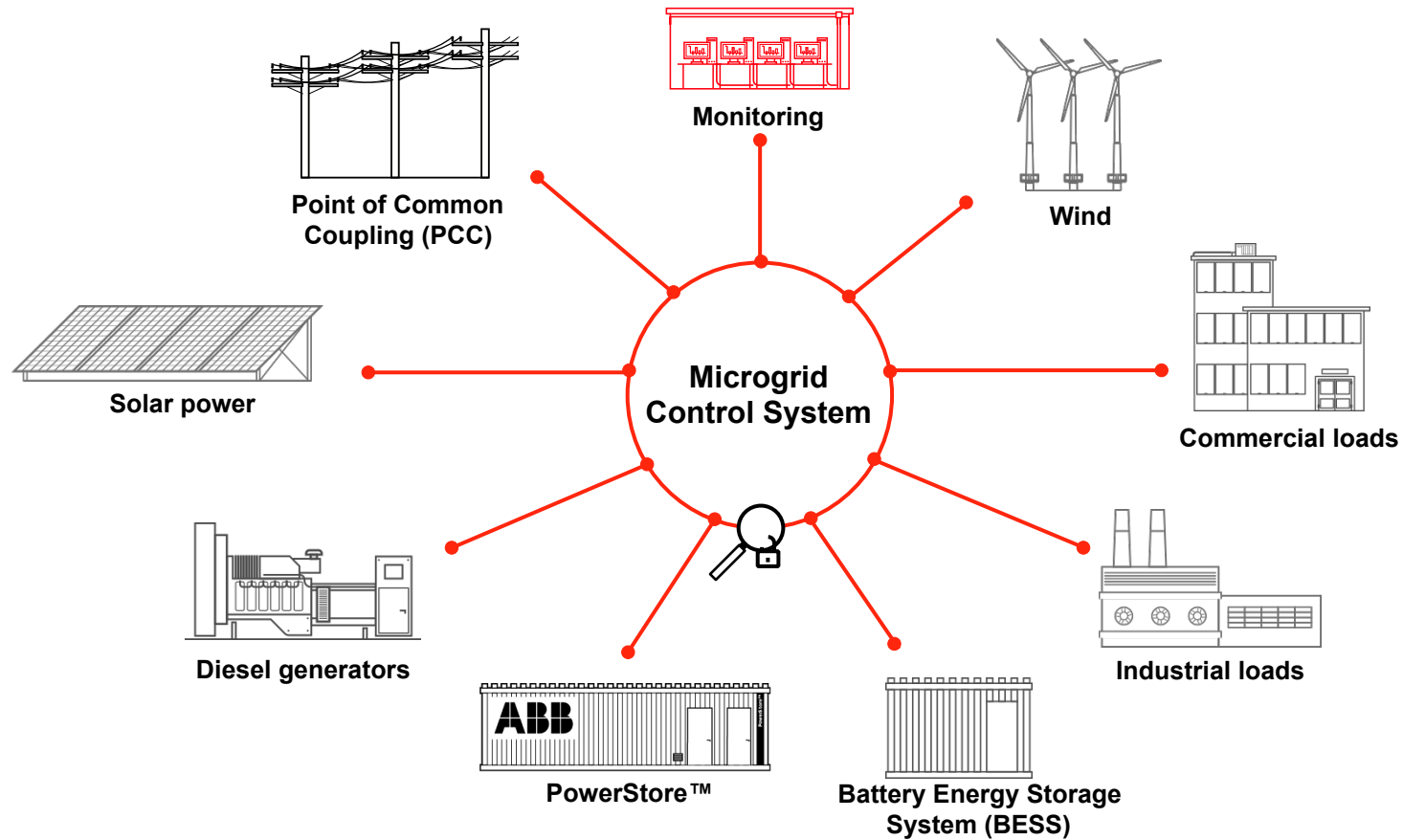
- Key Performance Indicators
- Real-time & historical trends
- Configurable data sampling rate
- Support predictive, preventive and corrective maintenance

## Built-in PowerStore Automation

Dedicated Microgrid plus system delivered pre-programmed to meet the application needs

# Automation

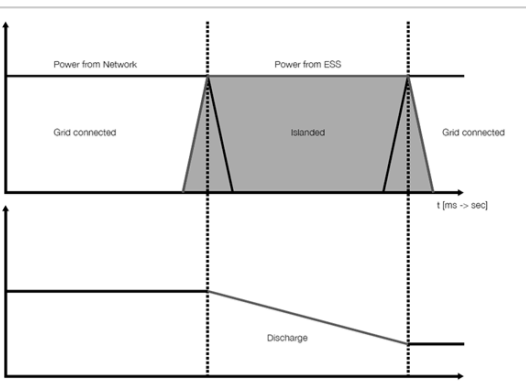
Control battery, generation assets and controllable loads to control and optimize the system



# Automation for various needs

... to handle fast and slow variations

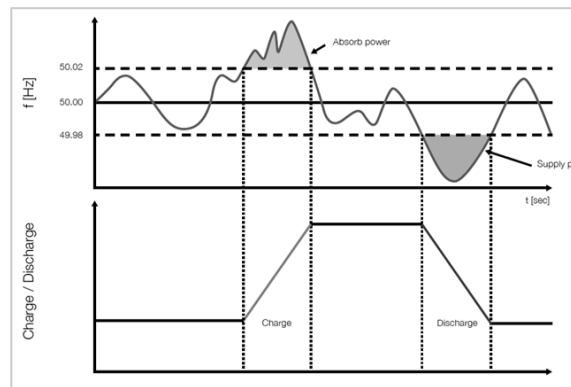
## Grid connection and synchronization



## Seamless transition from grid connection to islanded mode

... the challenges for robust power supply  
... transition from national grid infrastructure  
... gain control of your power needs on  
... ' level

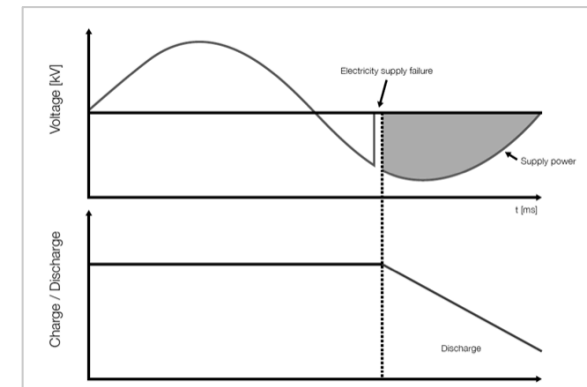
## Grid Stabilization



## Quality and reliability of electricity

Stabilizes an electricity network by rapidly absorbing power surges or by injecting power to make up for short-term decline, in order to maintain high quality

## Load levelling



## Enabling increased renewable utilization

Acts as "Virtual Generator" and can form a grid, handling up to 100% renewable energy

# Remote operation & maintenance

Efficient asset management

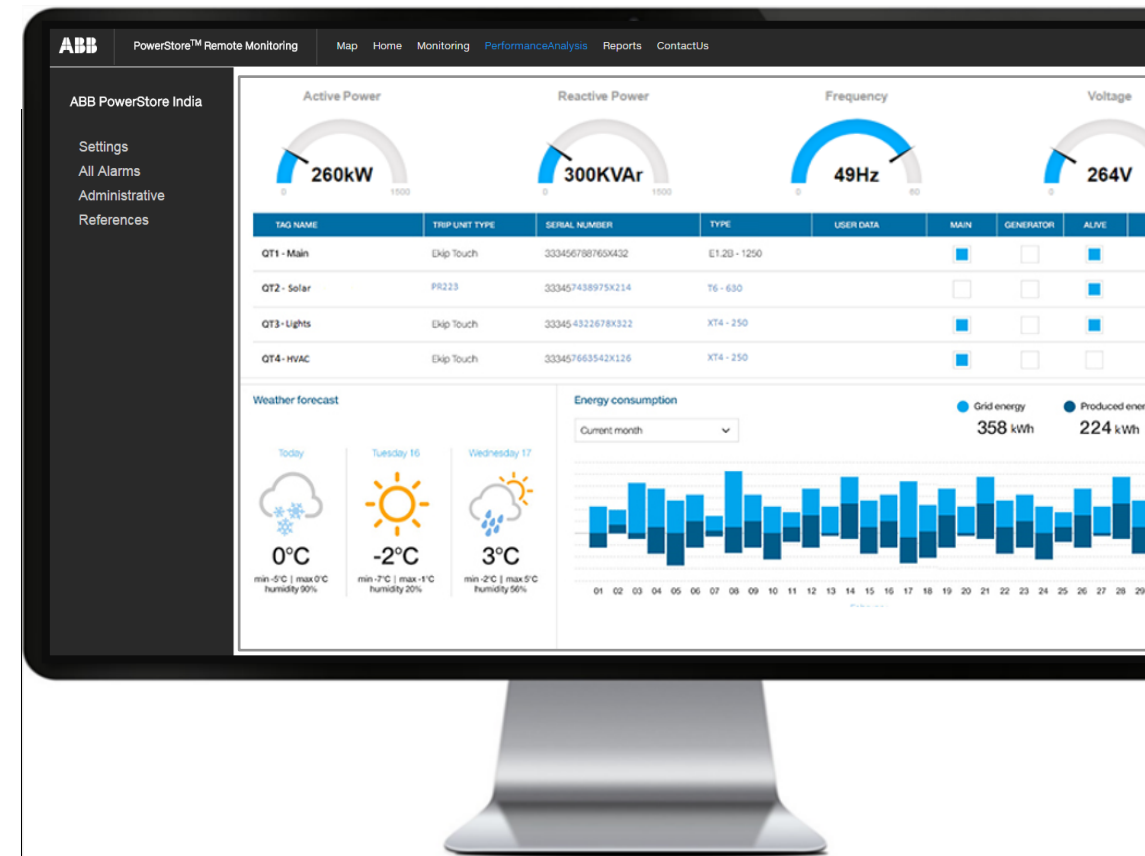
## Cloud based solutions for efficiency and competence

Typically unmanned sites

Technically demanding, need support

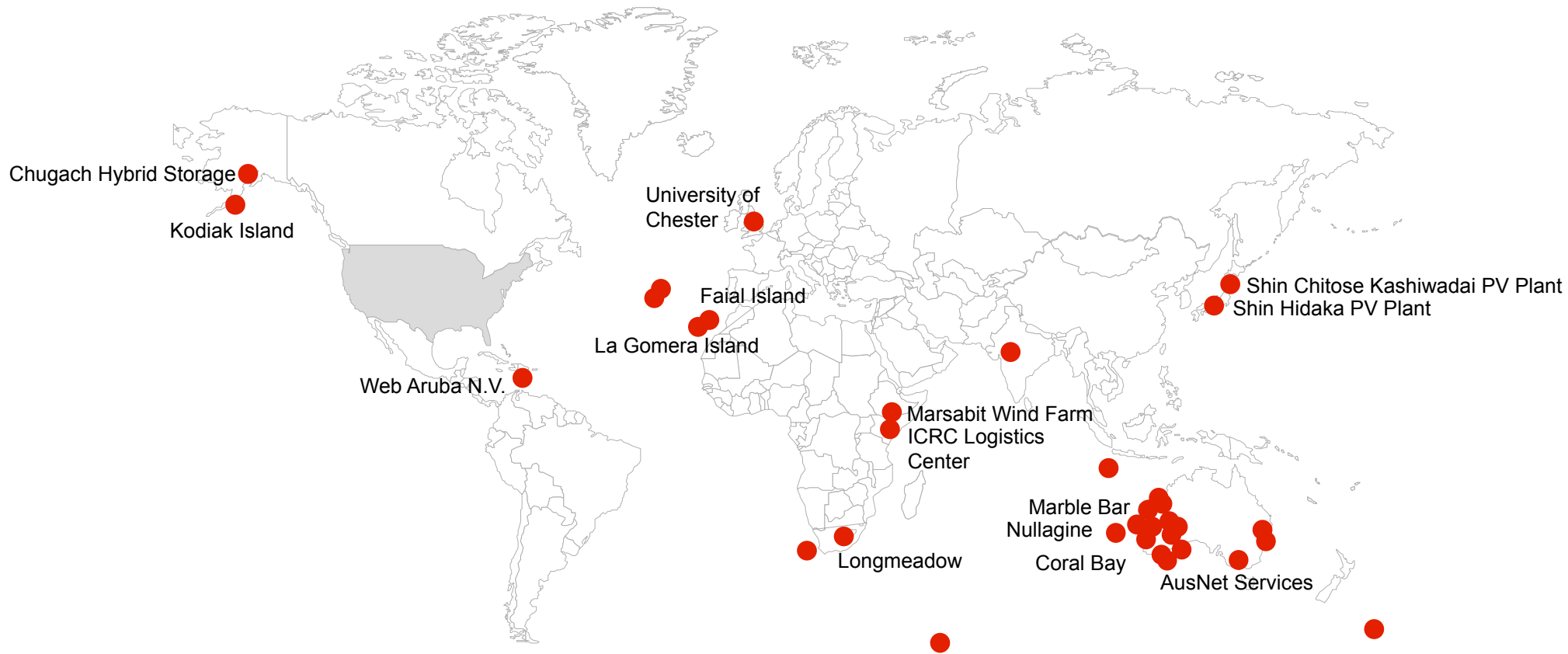
Cloud based solutions

Cyber security compliance



# B Microgrids

## Global References



# and Utilities

Kodiak Island, PowerStore/Wind/Hydro/Diesel → 99% renewable

## ut the Project

- **Project name:** Kodiak Island
- **Location:** Alaska, United States of America
- **Customer:** Kodiak Electric Association (KEA)
- **Completion date:** 2015

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### The resulting Microgrid system consists of:

- PowerStore Flywheel (2 MW/ 33 MWs)
- Wind (6 x 1.5 MW)
- Hydro (3 x 11 MW)
- Diesel (1 x 17.6 MW, 1 x 9 MW, 1 x 3.6 MW, 1 x 0.76 MW)

## ution

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- Stabilizing - frequency regulation
  - Provide frequency support for a new crane
  - Help to manage the intermittencies from a 9 MW wind farm
  - Reduced reliance on diesel generators

## tomor Benefits



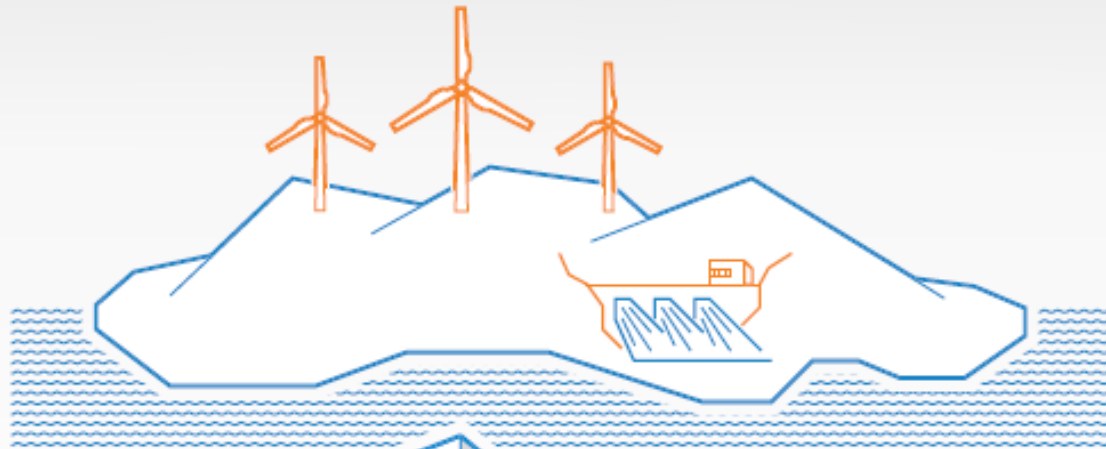
[Press Release](#)  
[Infographic](#)  
[Video](#)

Two PowerStore Flywheels act in parallel in order to deliver optimal grid stabilization on Kodiak Island

Almost all of Kodiak Island's

# 42 MW

of electricity capacity is generated by hydropower and wind

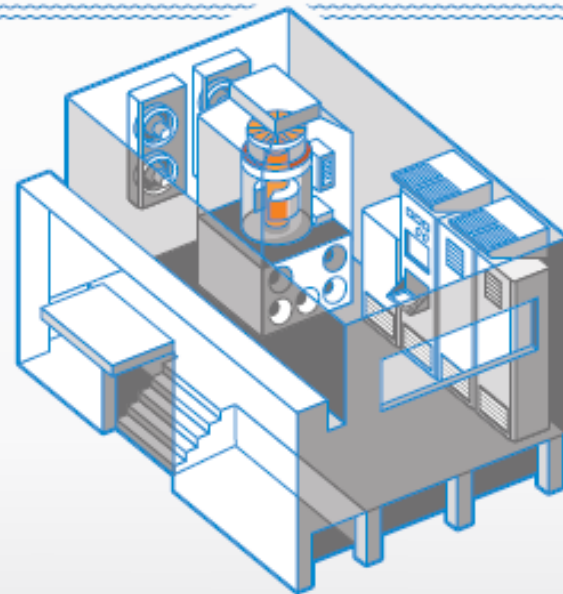


Renewable energy can supply more than

# 99 %

of islanders' electricity needs

Remote locations such as islands may be rich in renewable energy sources, but their intermittent nature makes their integration into the power grid a challenge.



ABB's solution incorporates two flywheel energy-storage devices

with inverters to deliver power to

# 15,000

 inhabitants

living in 7 communities on Kodiak Island.

# Remote Communities

## Marble Bar, PowerStore/PV/Diesel

### About the Project

- **Project name:** Marble Bar
- **Location:** Western Australia, Australia
- **Customer:** Horizon Power, Government of WA
- **Completion date:** 2010

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#### The resulting Microgrid system consists of:

- PowerStore Flywheel (500 kW/ 16.5 MWs)
- Microgrid Plus Control System
- Solar PV (1 x 300 kW<sub>p</sub>)
- Diesel (4 x 320 kW)

### Operation

### Customer Benefits

- Minimize diesel consumption - 405,000 liters of fuel saved annually
- Minimum environmental impact - 1,100 tons CO<sub>2</sub> avoided annually
- Reliable and stable power supply
- 60% of the day time electricity demand is generated by the PV plant



[Press Release](#)  
[Video](#)

Marble bar and Nullagine are the world's first high penetration, solar photovoltaic diesel power stations



# Integration of renewables in a mining site

## DeGrussa Mine, PV/Diesel/Storage



SANDFIRE  
RESOURCES NL

juwi



### Project name

DeGrussa Copper-Gold Mine

### Country

Western Australia, Australia

### Customer

Juwi Renewable Energy

### Completion date

2016

### ABB solution

PV/diesel Microgrid with PowerStore grid-stabilizing technology and Microgrid Plus System

#### The resulting Microgrid system consists of:

- PowerStore Battery (2x2 MW/1.8 MWh)
- Microgrid Plus Control System
- Solar PV (10.6 MW<sub>p</sub>)
- Diesel (22 MW)

### Customer benefits

Expected diesel fuel saving: 5 million liters per year, a 20% reduction

Expected CO<sub>2</sub> reduction: 12,000 tons

### About the project

The new hybrid solar facility is the largest integrated off-grid solar and battery storage plant in Australia

# Reliable power in presence of a weak grid

Cross Logistics Center (Kenya), PV/diesel/Storage and grid



## Project name

Red Cross Logistics Center

## Location

Nairobi, Kenya

## Customer

International Committee of the Red Cross

## Completion date

2017

## ABB solution

Supply, installation and commissioning supervision of a PowerStore-battery.

### The resulting Microgrid system consists of:

- PowerStore Battery (150 kW/100kWh)
- Microgrid Plus Control System
- Solar PV (1 x 30 kW<sub>p</sub>)
- Diesel (1 x 150 kW)

## Customer benefits<sup>1</sup>

Reliable and stable power supply despite outages and power quality issues.

Reduced fuel costs and carbon footprint

## About the project

“Reliable power is essential for our staff to continue their life-saving work uninterrupted in the field. (...) the ABB microgrid solution is in line with the ICRC’s goal to use environmentally friendly technologies. Solutions like this are proof that cooperation between the corporate and humanitarian sectors is not only possible, but imperative”

*Peter Maurer, ICRC President*

<sup>1</sup> []

# Microgrid Market

Global market size, growth and forecast

Microgrid market is expected to reach **\$8.99 Billion** by 2022, at a CAGR of 2.45%<sup>1</sup>

Global Microgrid capacity is expected to grow from 1.4 GW in 2015 to **7.6 GW** in 2024<sup>2</sup>

More than **400** individual projects are currently in operation or under development worldwide<sup>3</sup>

Microgrid market to expand at an extraordinary **20.70% CAGR** owing to Development of Renewable Energy Technologies<sup>4</sup>

Global market for energy storage in microgrids is expected to grow CAGR of more than **27%** by 2019<sup>5</sup>

Global outlook of the Microgrid market by various analysts

1- Source - MARKETANDMARKET

2, 3- Source - Navigant Research

4- Source - Transparency market research

5- Technavio



**ARBI**