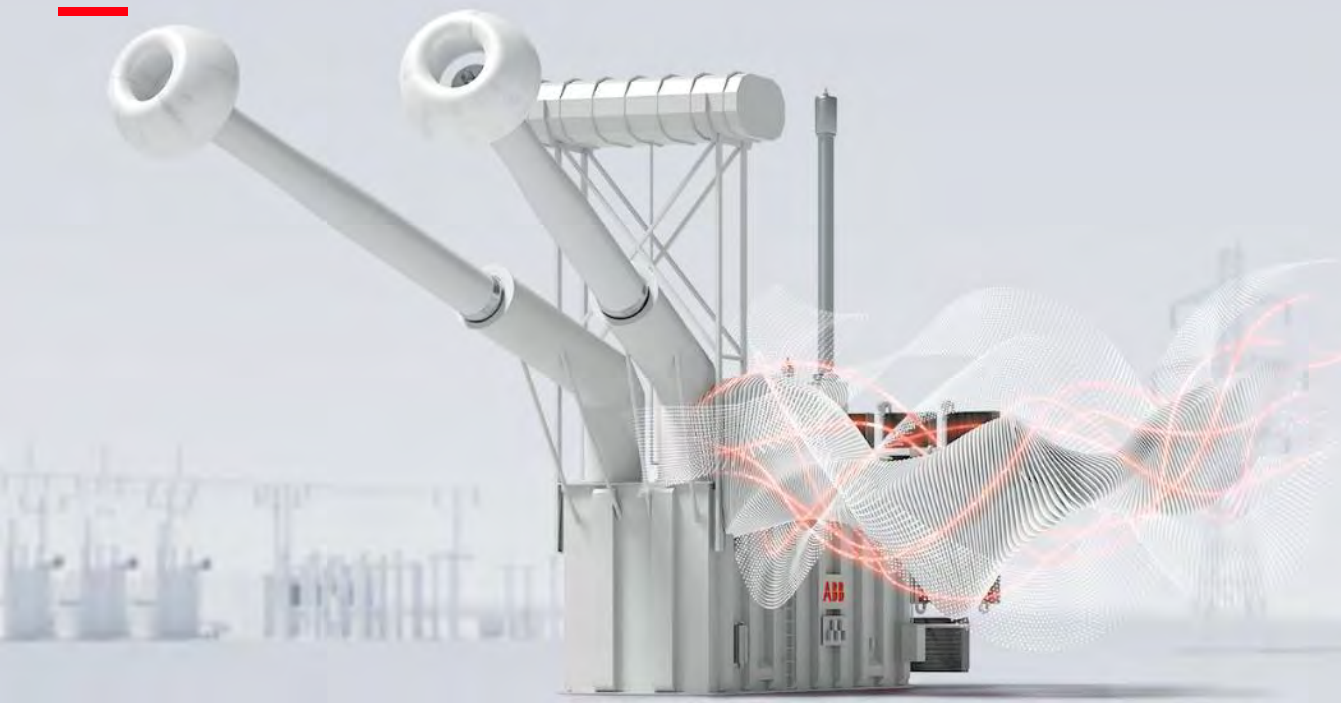


CIBO TECHNICAL FOCUS GROUP, MARCH 7, 2017

# Microgrid technology

## A case study

Mark Bitto, IAPG Global Product Marketing, ABB Inc.

# Safety moment

## International travel safety

### Before you leave

- Get a health check and keep yourself in good shape, it will make your travel easier
- Ask your doctor if there are any vaccinations you will need or other health alerts for area
- For your specific food allergies or medication requirements, learn how to pronounce these in the local language
- In case of illness during travel, pack a small first aid kit that includes items such as adhesive bandages, ibuprofen, allergy medication, anti-gas, and cold relief
- Pick a good seat and pack healthy snacks for the plane ride
- If you have trouble sleeping on long flights or pressure bothers your ears, bring along earplugs / noise cancelling headphones

### While you are traveling

- While traveling on plane or train, get up, walk around, and stretch every once in a while to keep good circulation
- If you do plan to sleep, make sure to use a head support to keep neck from cramping
- You do not want to get bored so bring some reading material or some music to listen
- Minimizing luggage is important to reduce clutter and ease of travel
- Make sure you have all your travel documents ready and available when traveling
- Leave a copy of travel documents, medical, credit card and emergency information with someone you trust in case something does not go well
- Separate your back-up credit cards and IDs in case your primary cards and passport are misplaced or stolen

Traveling is an integral part of our work. Traveling safely takes planning, consideration, and constant attention. Take time to keep your trip safe and enjoyable!

# Agenda

Microgrid overview

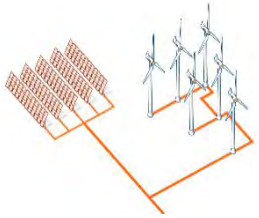
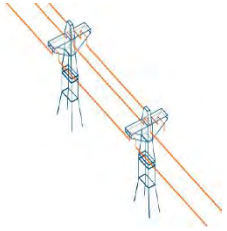
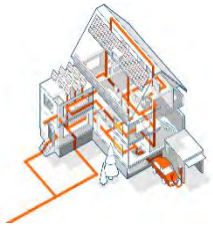
ABB in microgrid

Project case study

Summary

# Energy and grid transformation

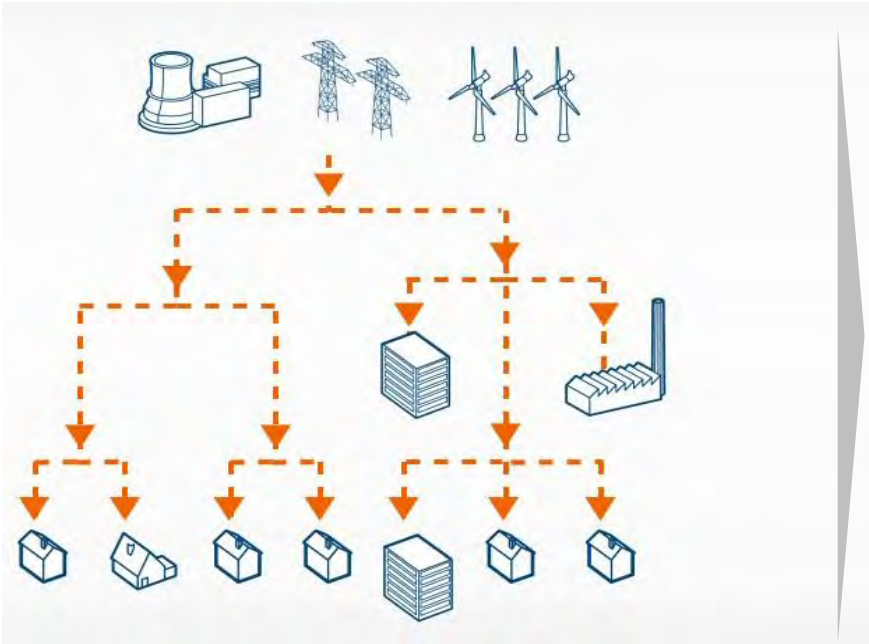
## Global trend – big shift in the electrical value chain

| | | |
|---|---|---|
| Generation mix |  | Renewable share: ~40% of capacity by 2035<br>Greater volatility, less predictability<br>More feed-in nodes |
| Power transmission and distribution |  | Increasing complexity<br>Control / information flow is key value driver<br>Transmission: longer distances, higher voltages |
| Micro- / Nano- grids |  | On- and off-grid<br>Control / automation on “local” level<br>Energy storage is key |

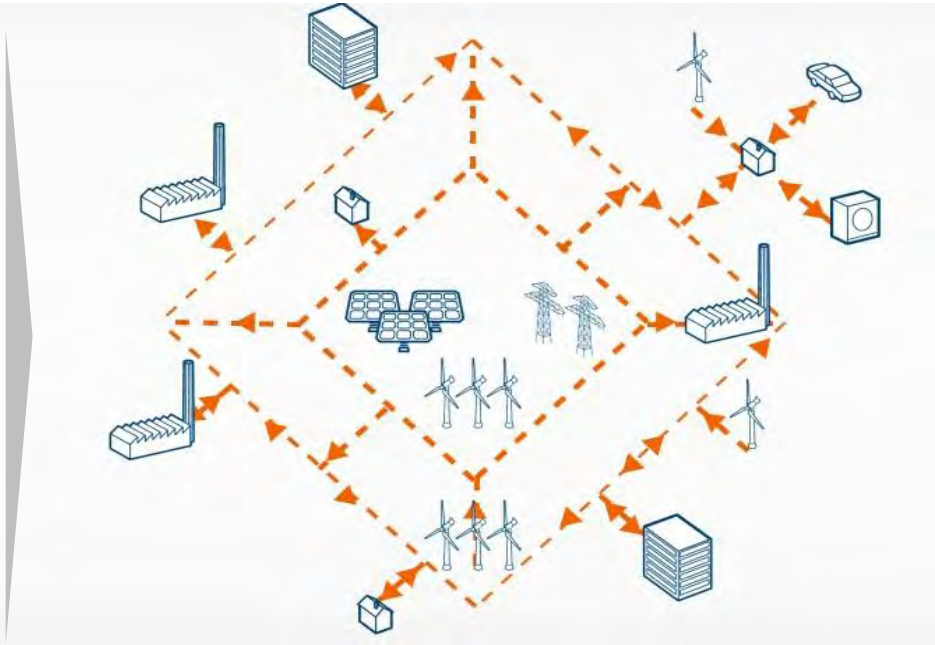
# Energy and grid transformation

## Transition from a centralized to a distributed grid

Traditional Grid



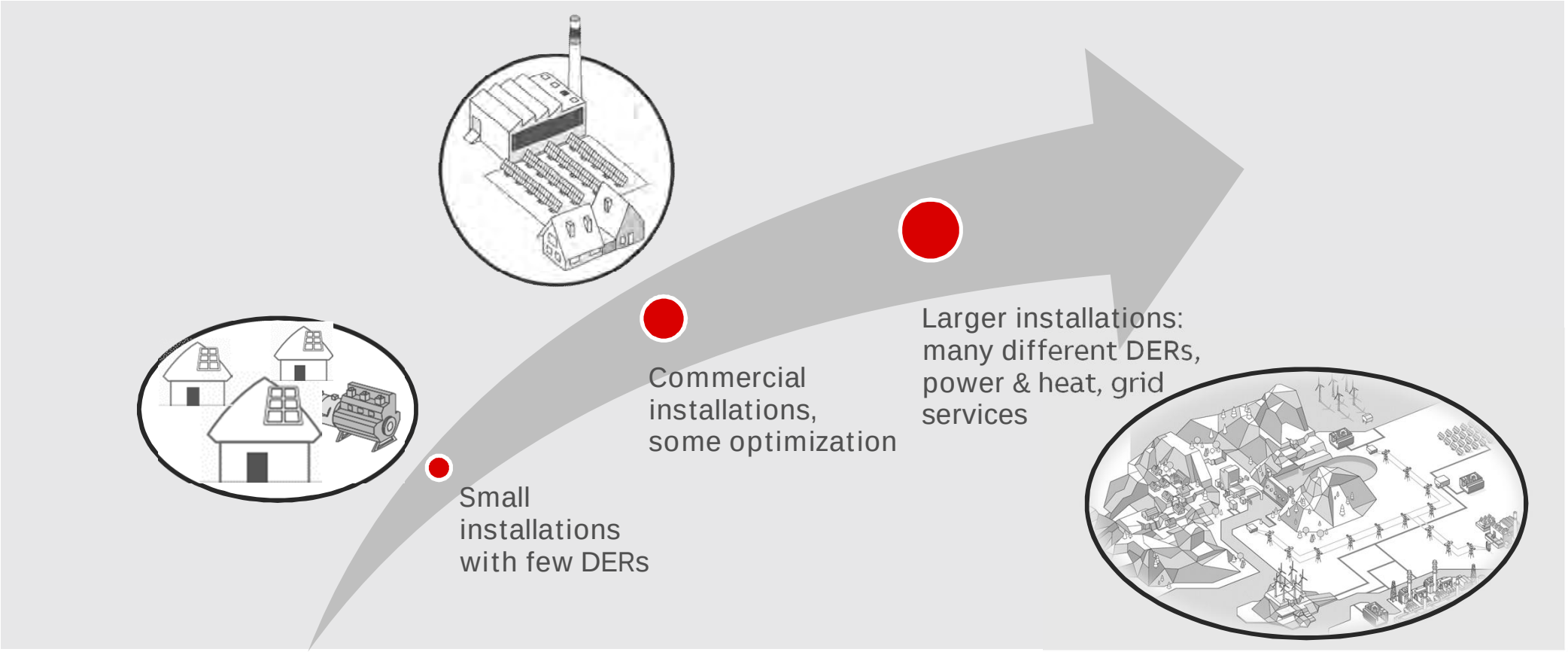
New Grid



New developments are accelerating the transition

# Energy and grid transformation

## Trending towards increased complexity and lower cost




DER: Distributed Energy Resources

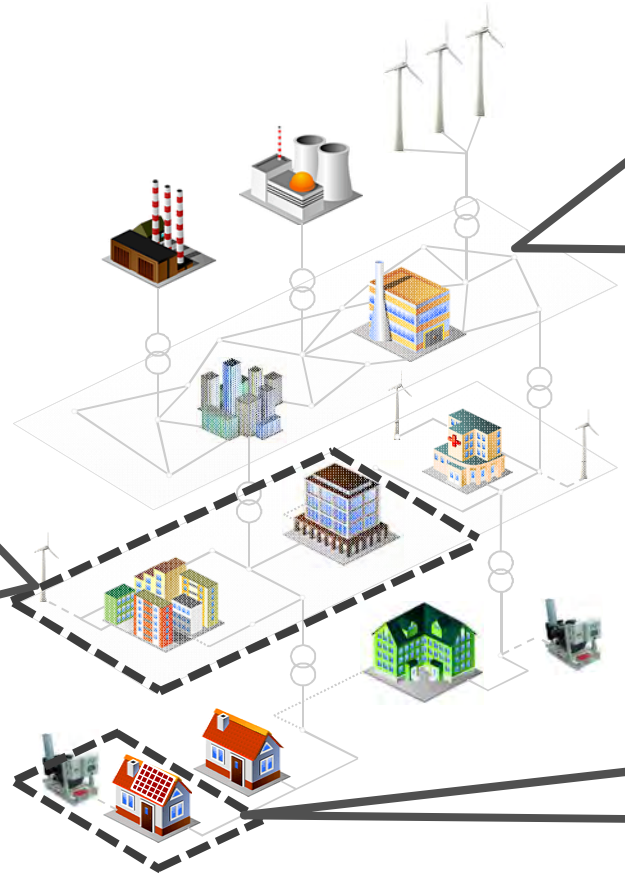
# Energy and grid transformation

## Microgrid participation

### Microgrid

Distributed energy resources and loads that can be operated in a controlled, coordinated way either connected to the main power grid or in “islanded”* mode.

*Microgrids are low or medium voltage grids without power transmission capabilities and are typically not geographically spread out.*



### Power grid

Power grids are larger conventional and spread out grids with high voltage power transmission capabilities.

*Microgrid technology can be applied to weak grids making the network more robust.*

### Nanogrid

Low voltage grids that typically serve a single building.



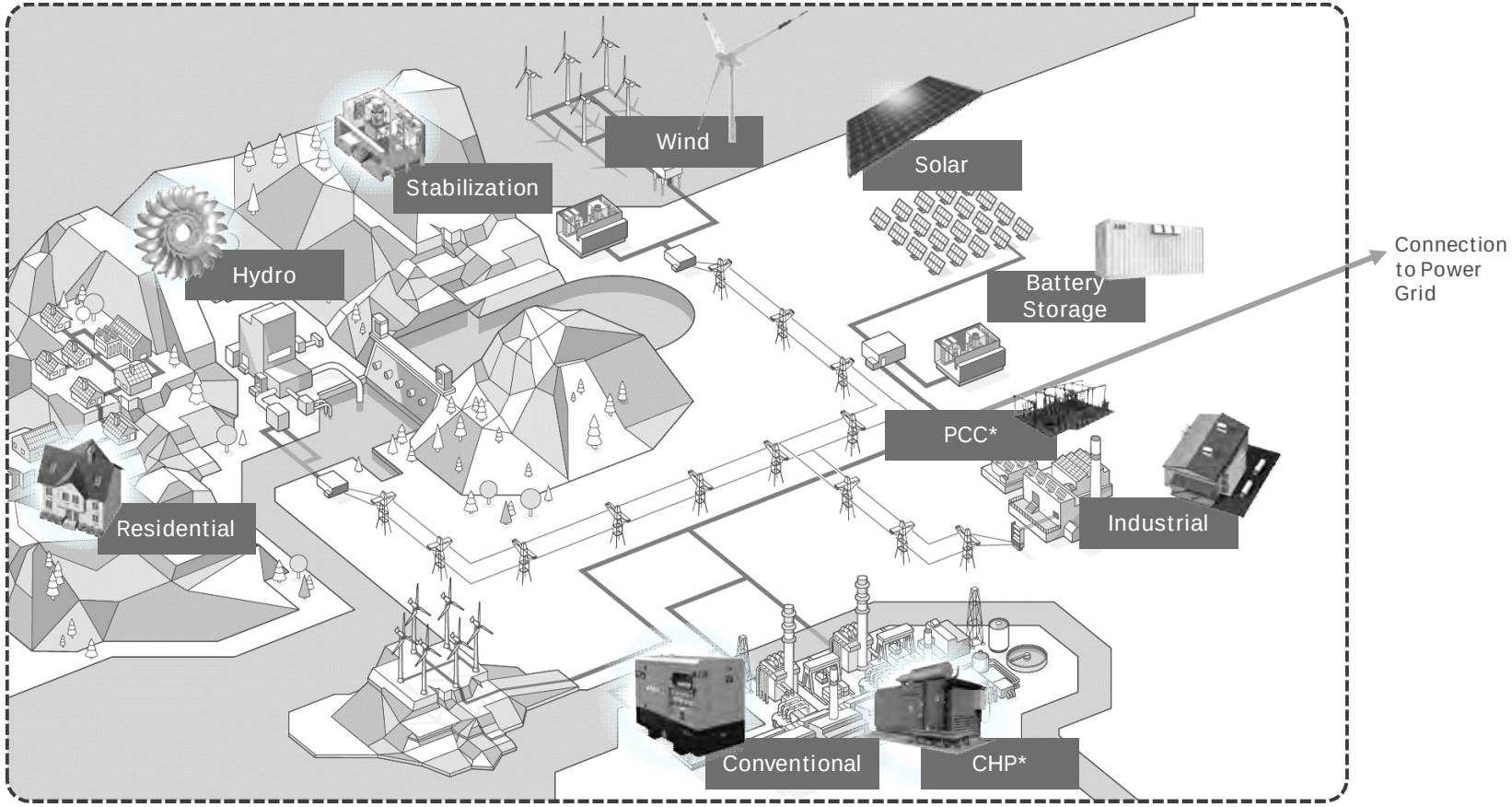
Islanded mode: ability to provide power independently from the main power grid

# Grid connected microgrid

## Grid resiliency, power quality, self consumption and lower environmental impact

### Key applications

- End of line applications
- Storm resiliency
- Reliability requirements
- Grid / commodity independence
- Leverage existing DG
- Defer / offset T&D upgrades




PCC: Point of Common Coupling
CHP: Combined Heat and Power
DG: Distributed generation

# Microgrid segments and main drivers

## Covering a diverse range of applications

### Benefits

Productivity: Reduced plant downtime and losses due to power outages

Lowers OPEX: Reduced cost of electricity through high renewable power penetration / ancillary services

Power quality: Increased grid resiliency, power quality, and reliability for end users and operators of the grid

Independence: Reduces dependency on unreliable local electricity supply conventional fuel price fluctuations

Sustainability: Reduces carbon footprint by maximizing renewable and local power and heat generation

| | | | Main drivers | | | | |
|---|---|---|---|---|---|---|---|
| | | | Social | Economic | Environmental | Operational | |
| | Segments | Typical customers | Access to electricity | Fuel & cost savings | Reduce CO2 footprint and pollution | Fuel independence | Uninterrupted supply |
| Off-grid | Island utilities | (Local) utility, IPP* | | P | P | P | (P) |
| Weak grid | Remote communities | (Local) utility, IPP, Governmental development institution, development bank | P | P | | P | |
| Grid-connected | Industrial and commercial | Mining company, IPP, Oil & Gas company, Datacenter, Hotels & resorts, Food & Beverage | | P | (P) | P | P |
| | Defense | Governmental defense institution | | (P) | (P) | P | P |
| | Urban communities | (Local) utility, IPP | | | (P) | | P |
| | Institutions and campuses | Private education institution, IPP, Government education institution | | (P) | P | | (P) |

P: *Main driver*
(P): *Secondary driver*
IPP: Independent Power Producer

# Agenda

Microgrid overview

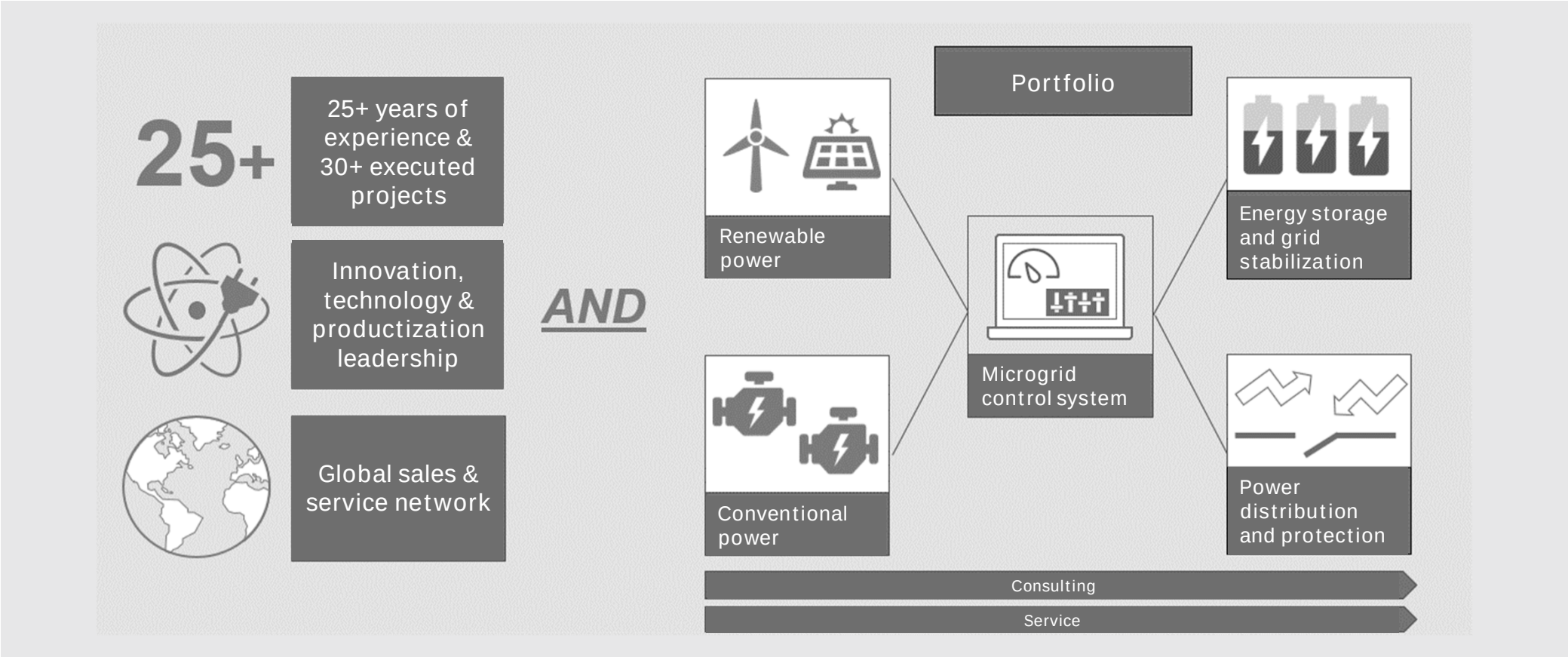
ABB in microgrid

Project case study

Summary

# ABB in microgrid

## A leader in technology, solutions and execution



# ABB in microgrid

## Comprehensive offering

### Conventional & renewable power generation

Comprehensive scope of plant electrification and automation systems including life cycle management services.

- Systems: Automation, optimization and control and remote monitoring
- Products: Control systems, drives, instrumentation, motors and generators, power converters and inverters

### Power distribution & protection

An industry leader in power products, grid connection and integration solutions providing a full range of protection, control and measurement solutions.

- Switchgears
- Transformers
- Circuit Breakers
- Substations
- Protection and control
- Measurement and monitoring

### Grid stabilization & energy storage

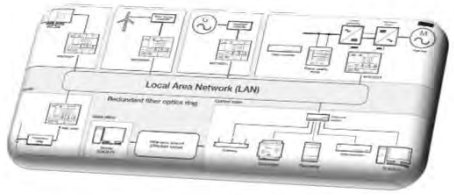
Compact and versatile grid stabilizing system capable of stabilizing power systems against fluctuations in frequency and voltage.

- Can stabilize an electricity network by rapidly absorbing power surges or by injecting power to make up for short term decline
- Battery or flywheel based and includes state-of-the-art inverters and virtual generator control software
- Applicable to isolated grids or in grid support mode


### Control systems

Specially designed networked control system responsible for efficient and reliable power flow management.

- Maximizes fossil fuel savings
- Optimizes use of renewable energy
- Guarantees optimum loading and spinning reserve in fossil fuel generators
- Distributed logic enhances reliability and scalability for future system expansions
- Modular and scalable




### Consulting & remote services

Consulting and design capabilities and tools support users to plan and operate their microgrid reliably and at maximum economic benefit.

- Feasibility studies and simulations
- Grid studies
- Renewables engineering

Comprehensive offering of remote services for Operation and Maintenance of unattended sites to increase productivity, improve energy efficiency and reduce operational costs.

- Energy production reports
- Interventions
- Energy production forecasts
- Real time data production
- List of customers and plant

A leader in technology, solutions and execution




For more information, visit us at http://new.abb.com/microgrids

# ABB in microgrid

## Global references

### Learn more

**Marble Bay (Video)**
Solar / PowerStore-Flywheel / Diesel with Microgrid Plus

**Faial Island (Video)**
Wind / HFO managed by Microgrid Plus

**SP AusNet (Video)**
Grid / PowerStore-Battery / Diesel managed by Micrgrid Plus

**Kodiak Island (Video)**
PowerStore-Flywheel

**Canary Islands (Video)**
PowerStore-Flywheel

# Agenda

Microgrid overview

ABB in microgrid

Project case study

Summary

# Microgrid project case study

## Understand your objectives and your resources first

### Key questions

What are the goals of your microgrid?

- Reliability:  Islanding duration and frequency
- Sensitivity:  Transition requirements
- Independence::  Commodity exposure
- Carbon:  Renewable content
- Cost:  LCOE

What are the characteristics of your site?

- Load sensitivity
- Space availability
- Resources availability
- Distribution network structure

Generation / storage mix and dimensions should be tailored once these are fully understood



LCOE: Levelized cost of electricity

# Microgrid project case study

## How much does a microgrid cost?

### Well, it depends…every project is different

Project costs depend on:

- Size of microgrid
- Asset selection
- Presence of existing assets
- Distribution configuration requirements
- Load sensitivity
- Load control opportunities

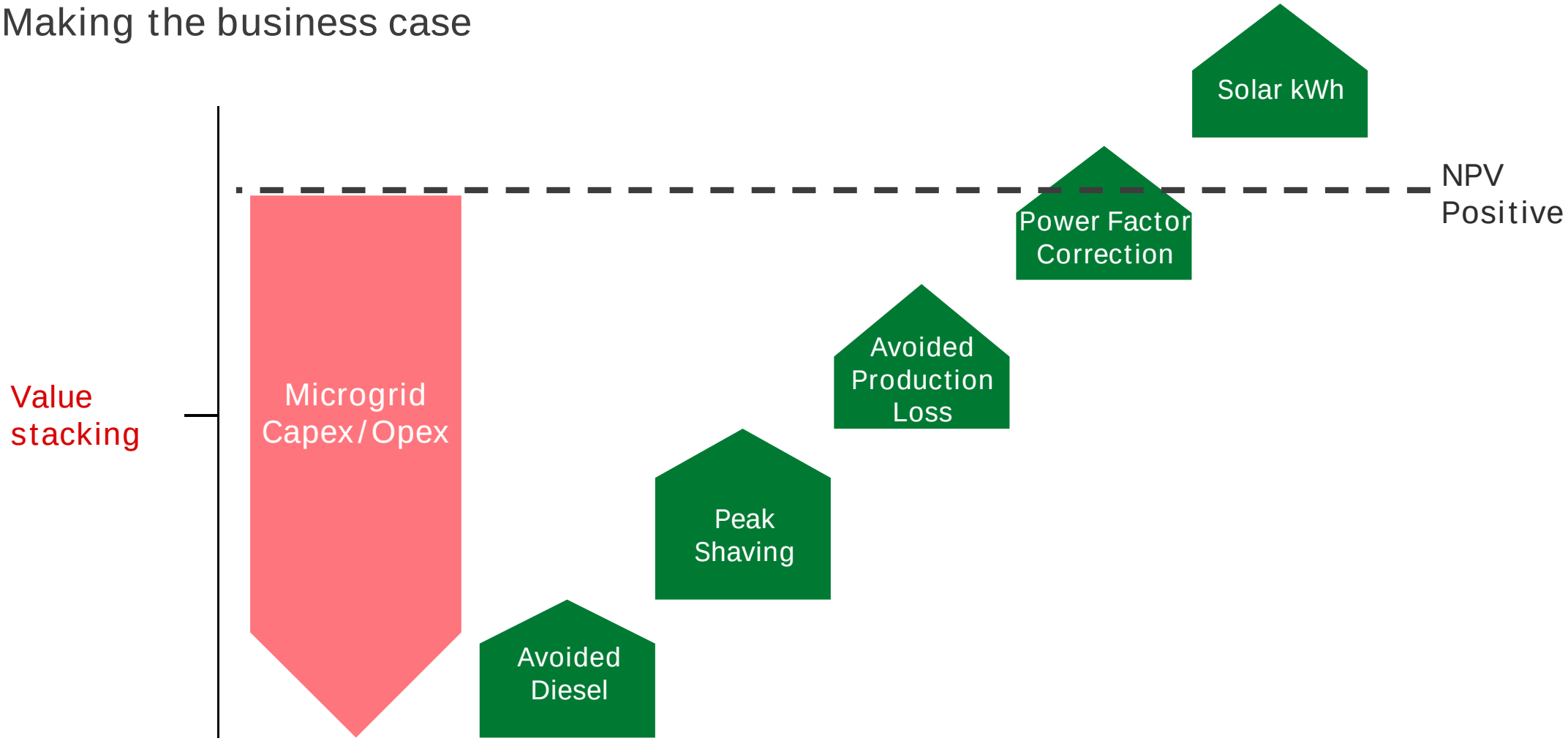
What is a useful metric? LCOE, Capital Cost, Net Present Value?



LCOE: Levelized cost of electricity

# Microgrid project case study

## Making the business case



# Microgrid project case study

## Longmeadow microgrid project

# Microgrid project case study

## Longmeadow microgrid project

### Background

Energy demand at Longmeadow has been relatively constant over the last four years. However, due to the country energy crisis, energy costs are increasing steadily.

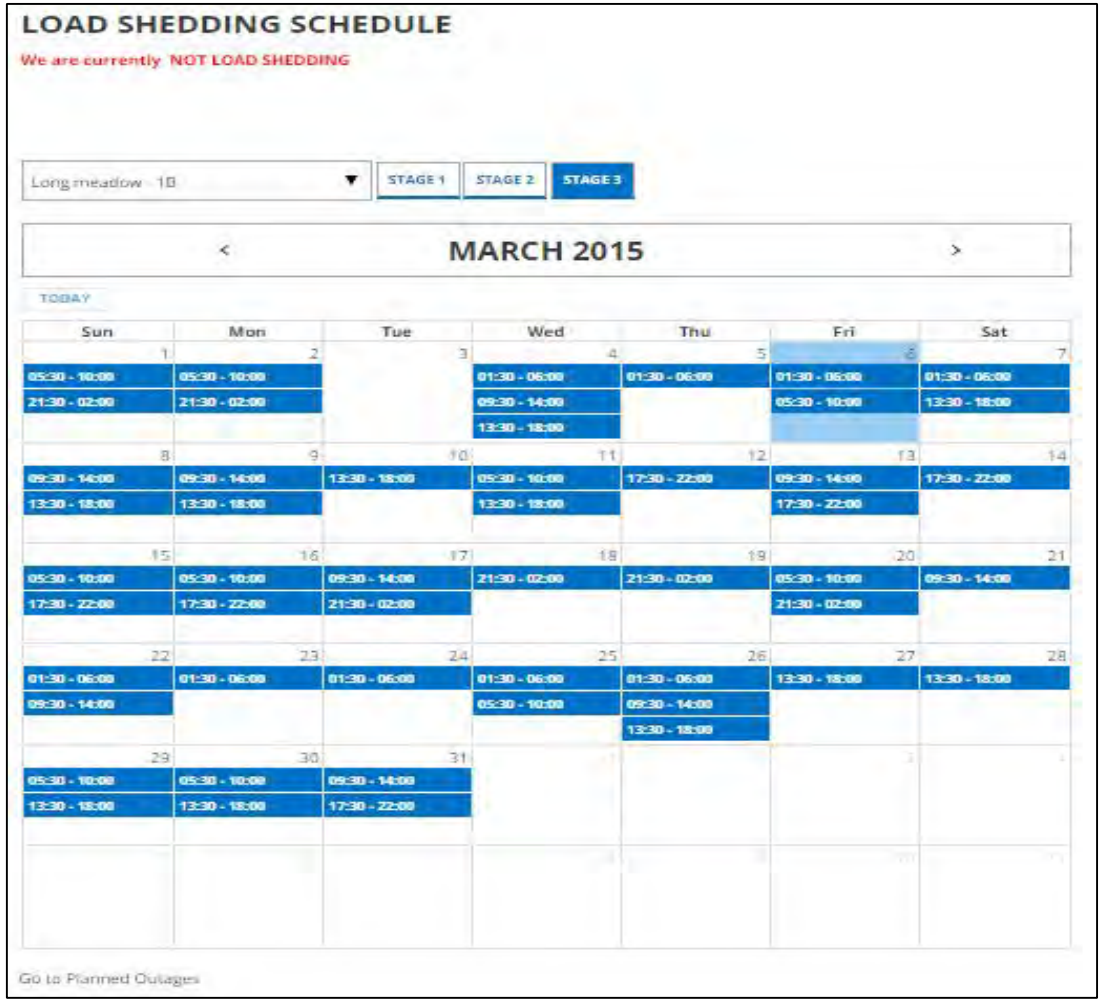
Due to rising demand and insufficient generation capacity, utilities are capping power consumption or imposing high demand charges.

Nonetheless, grid outages have been increasing in South Africa and the reliance on backup diesel generators has increased energy cost for the Longmeadow plant.

This situation is common across Africa as well as numerous other countries where utilities are not able to meet rising load demand with infrastructure development.

The market is looking for innovative solutions which would guarantee a reliable access to electricity while reducing electricity costs.

**The Longmeadow facility deployed an innovative microgrid project that solves these challenges**



# Microgrid project case study

## Longmeadow microgrid project

### Concept

Rooftop PV reduces consumption of:

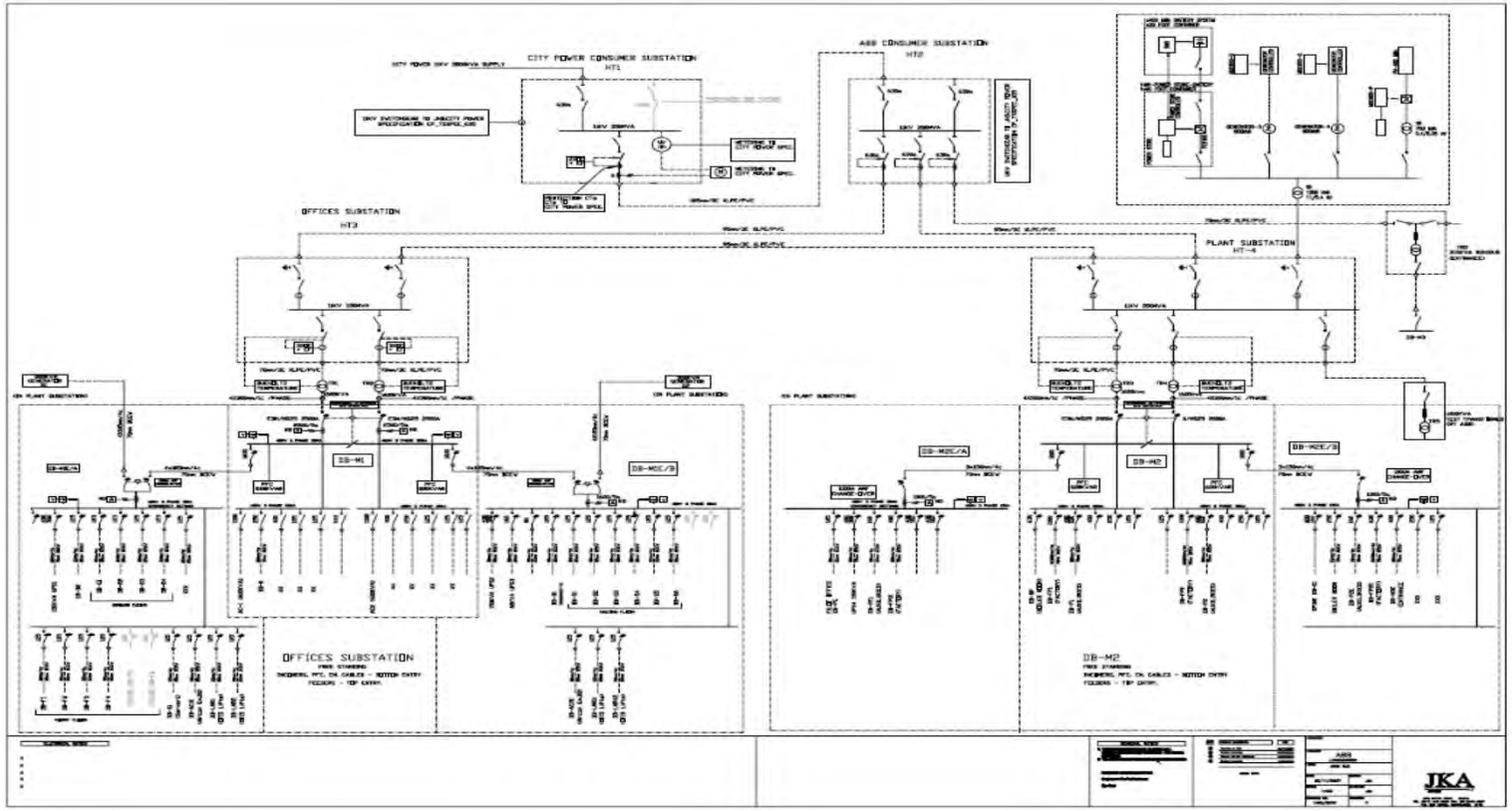
- Eskom grid electricity
- Diesel fuel

PowerStore-Battery ensures:

- Smooth transition during outages
- Peak lopping during peak consumption times
- PV energy shifting to peak production times
- Optimal operating conditions for diesel gensets

Microgrid Plus System enables:

- Microgrid energy management
- Smooth transition to and from island mode




**Outcomes: Reliable Electricity, Energy Independence, Renewable Energy Integration**

# Microgrid project case study

## Longmeadow microgrid project

### Project specifications

Rooftop PV:
750 kW solar plus ABB PVS800 inverter station

- The PV field size was dimensioned to maximize solar energy consumption by the Longmeadow facility while keeping curtailed PV energy to less than 3%
- Since PV power cannot be exported to the grid, PV power has to be curtailed at times of peak production and low consumption

**Optimally dimensioned system for reliable performance and maximized returns**

# Microgrid project case study

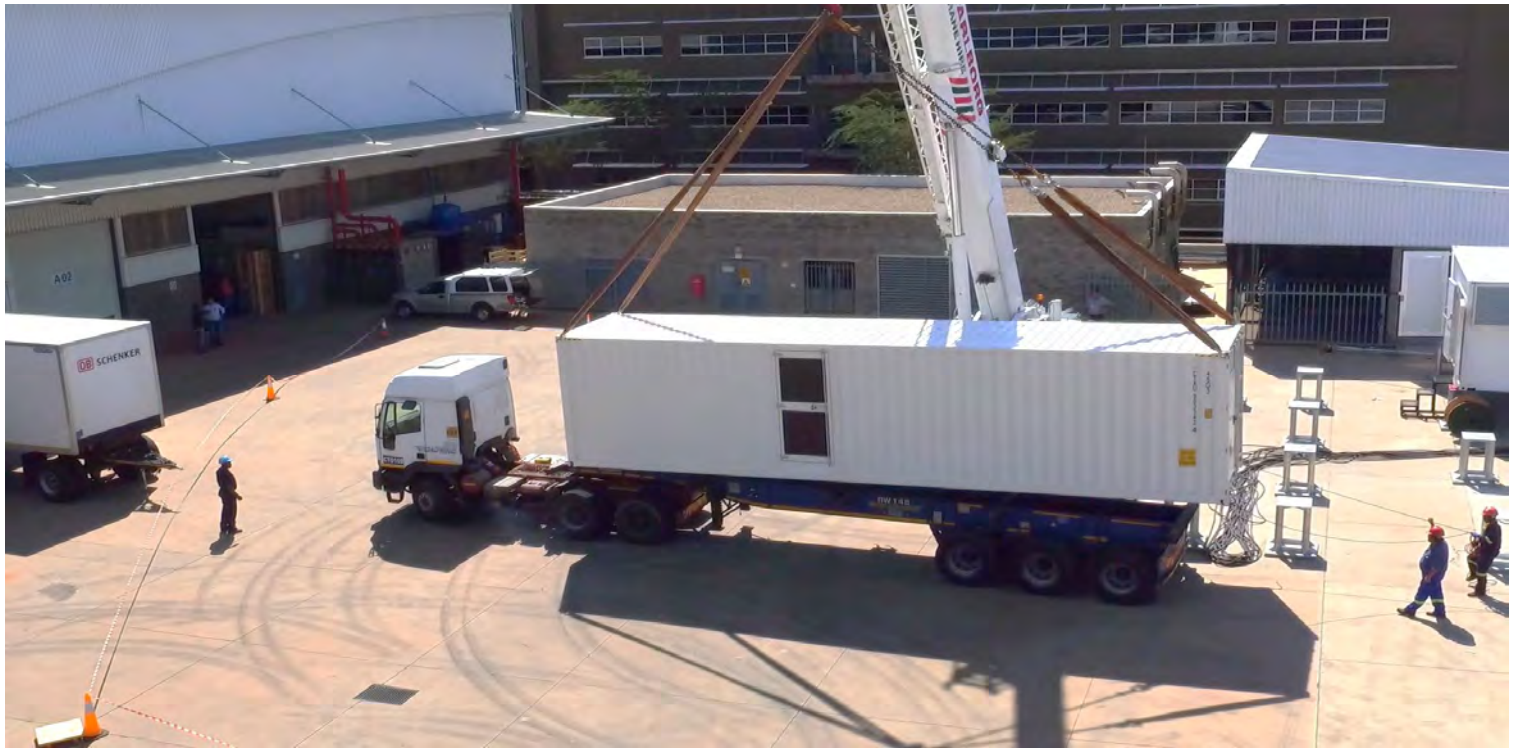
## Longmeadow microgrid project

### Project specifications

Storage:
ABB 1.3MW PowerStore battery system,
380 kWh Samsung lithium ion

- The PowerStore was dimensioned to be able to provide power to the entire microgrid in the event of an outage
- The PowerStore is also capable of providing peak lopping as well as storing excess PV power not consumed by the office.
- The Samsung batteries have been dimensioned/optimized for outage transition, peak lopping and solar shifting

Control System:
ABB Microgrid Plus control system




**Optimally dimensioned system
for reliable performance and maximized returns**

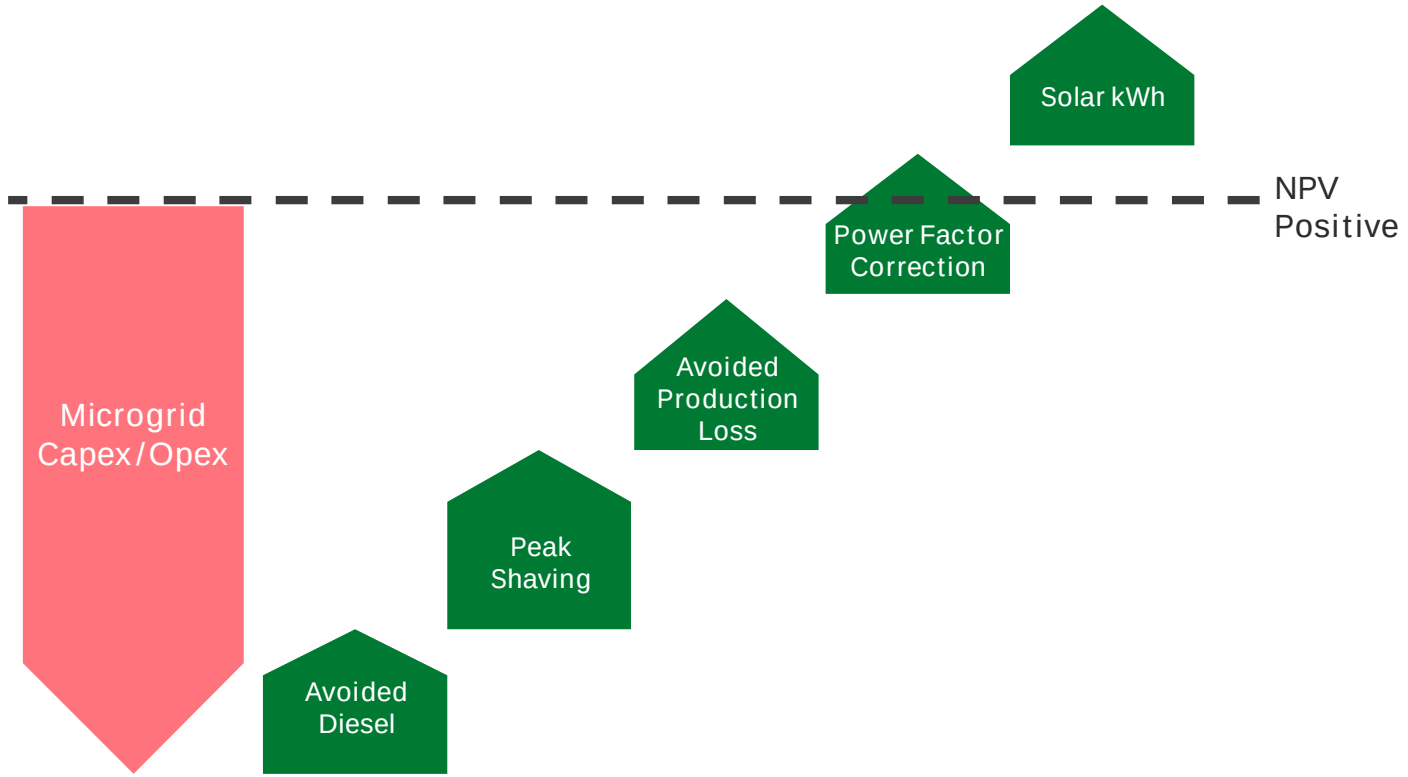
# Microgrid project case study

## Longmeadow microgrid project

### Making the case for microgrid

Value stacking

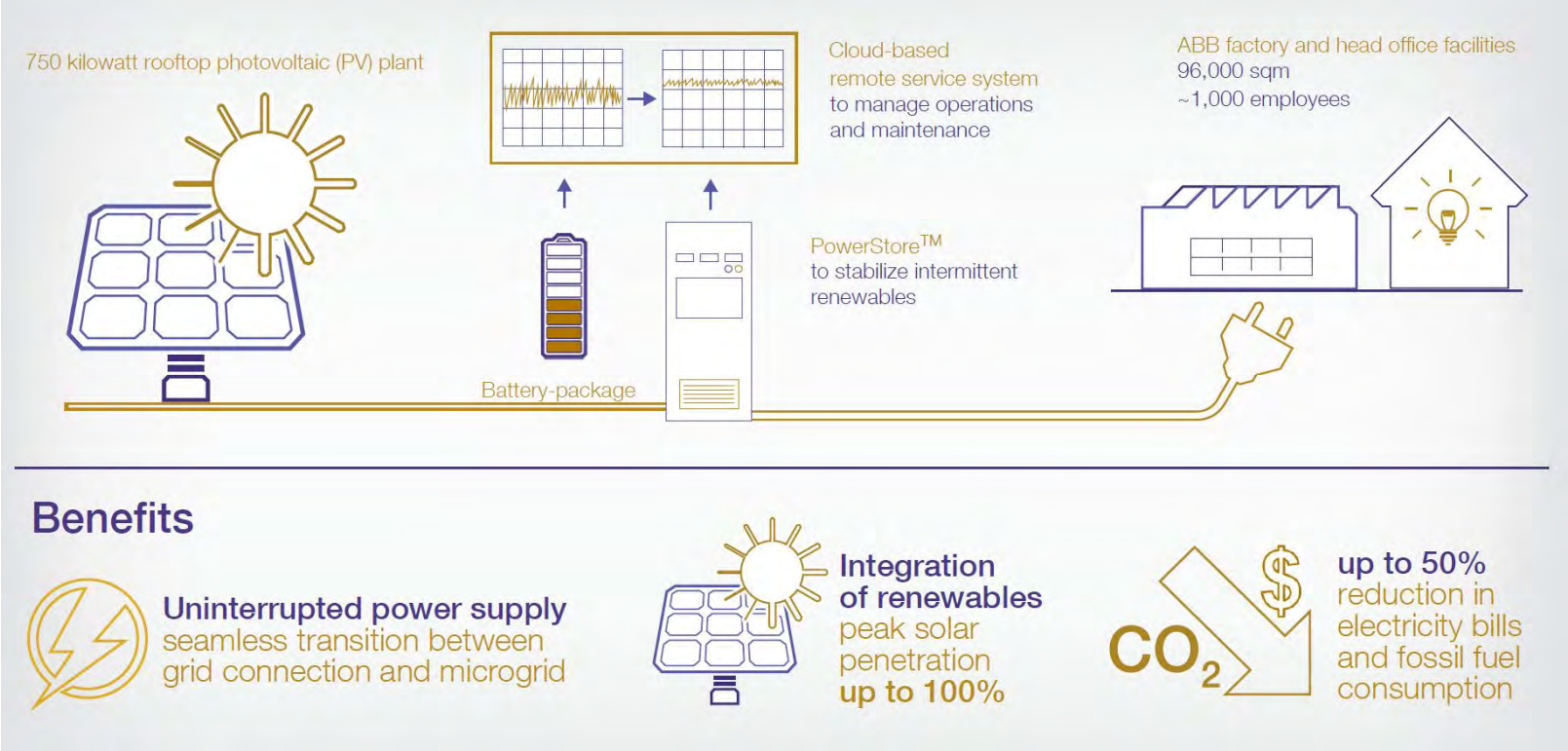
- Reliable and stable power supply
- Optimized renewable energy contribution to the facility
- Ability to island from the grid in case of outage
- Up to 100% renewable energy penetration / minimized use of expensive diesel fuel
- CO2 reduction over 1,000+ tons per year



# Microgrid project case study

## Longmeadow microgrid project

### Providing uninterrupted power supply and integrating renewables



# Agenda

Microgrid overview

ABB in microgrid

Project case study

Summary

# Summary

## Key takeaways

### Microgrid benefits

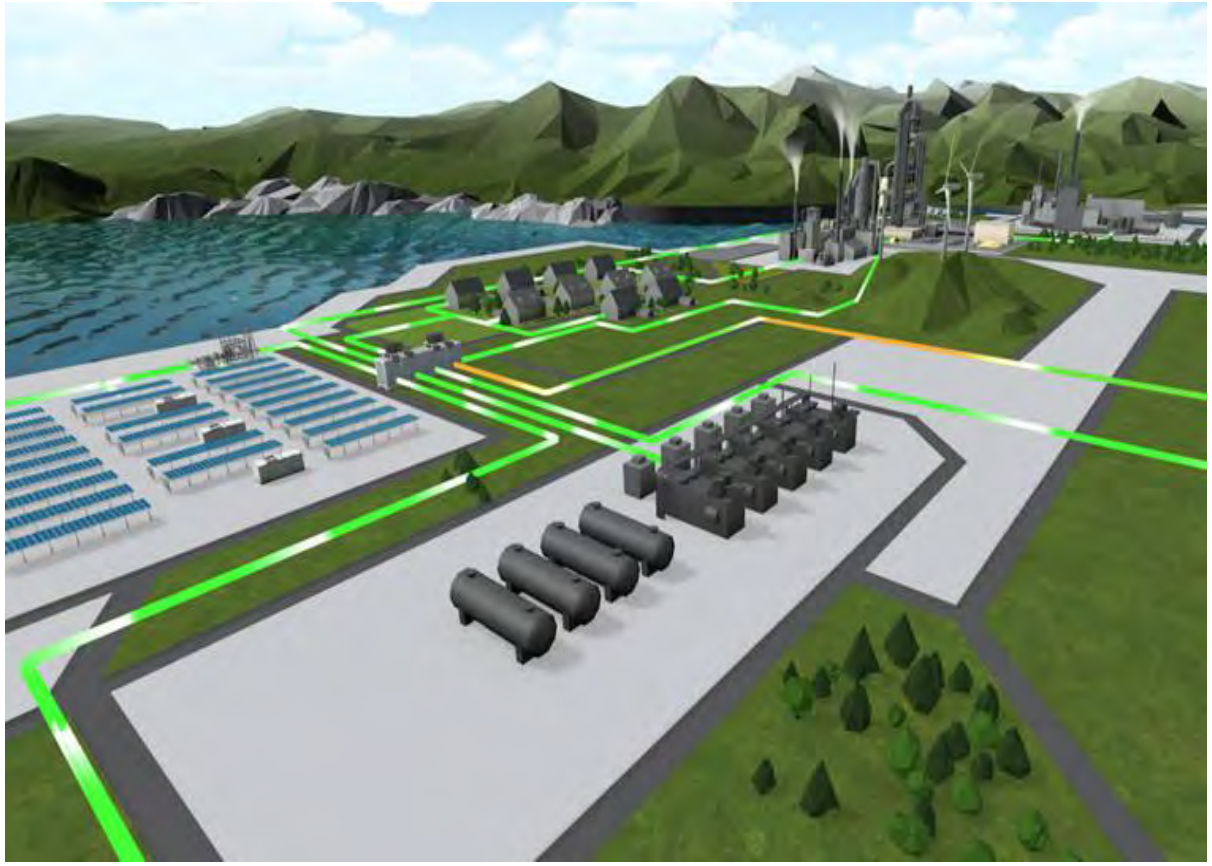
Microgrid technology can allow your plant to:

- Achieve higher productivity with less downtime
- Lower your overall cost of electricity
- Increase power quality at the plant
- Achieve high level of energy independence
- Support your sustainability goals through increase in renewable energy usage and reduction of carbon footprint

### ABB in microgrid

Leading provider of microgrid solutions

- 25+ years experience and 30+ executed projects globally
- Full range of enabling technologies including conventional and renewable power generation, automation, grid stabilization, grid connection, energy storage, intelligent control technology, and consulting and services for the entire lifecycle



# Q&A and Contact information

If you have questions, please contact me further

## Contacts


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ABB Longmeadow case study: http://www.abb.com/cawp/seitp202/6574F5E34521FD29C1257FCC0026C27F.aspx