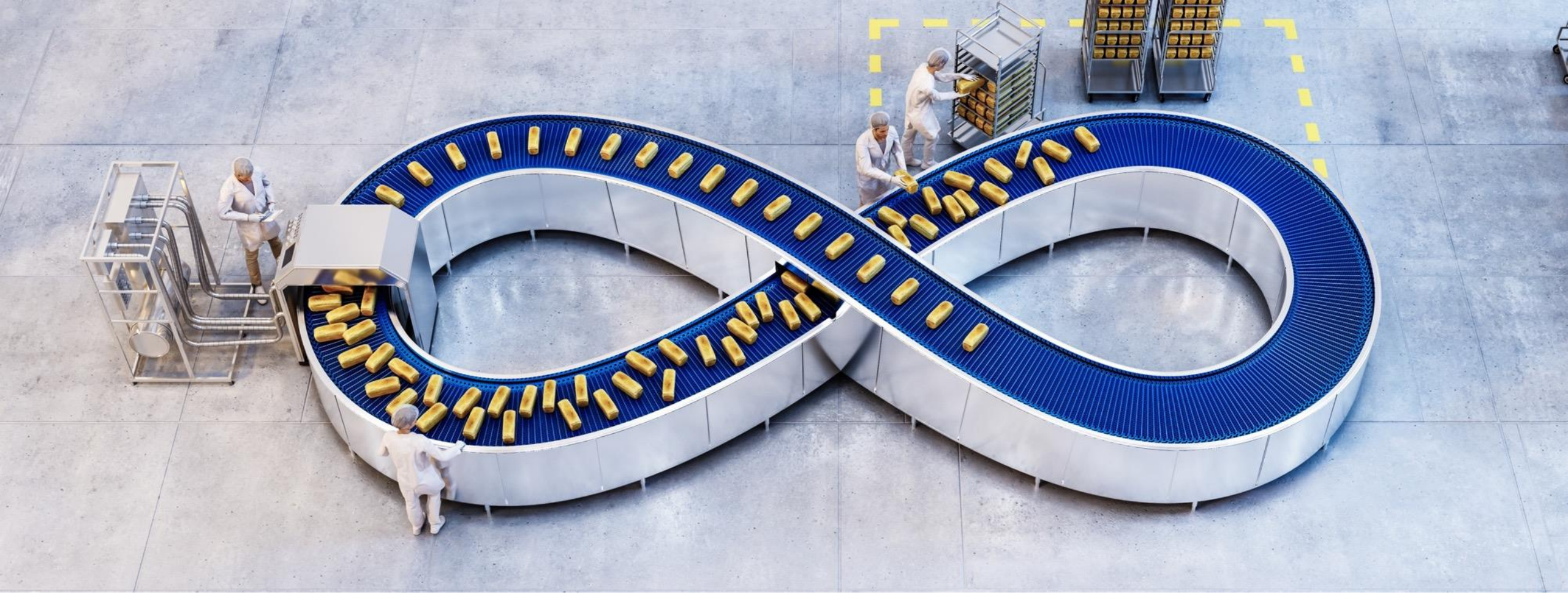


F&B CUSTOMER DAY 2018 | SURABAYA , SEPTEMBER 5, 2018

Microgrid and Distributed Generation Solutions

Reliable access to stable, cost-efficient and sustainable energy anytime, anywhere

Zelayna Claudia, Grid Automation business unit

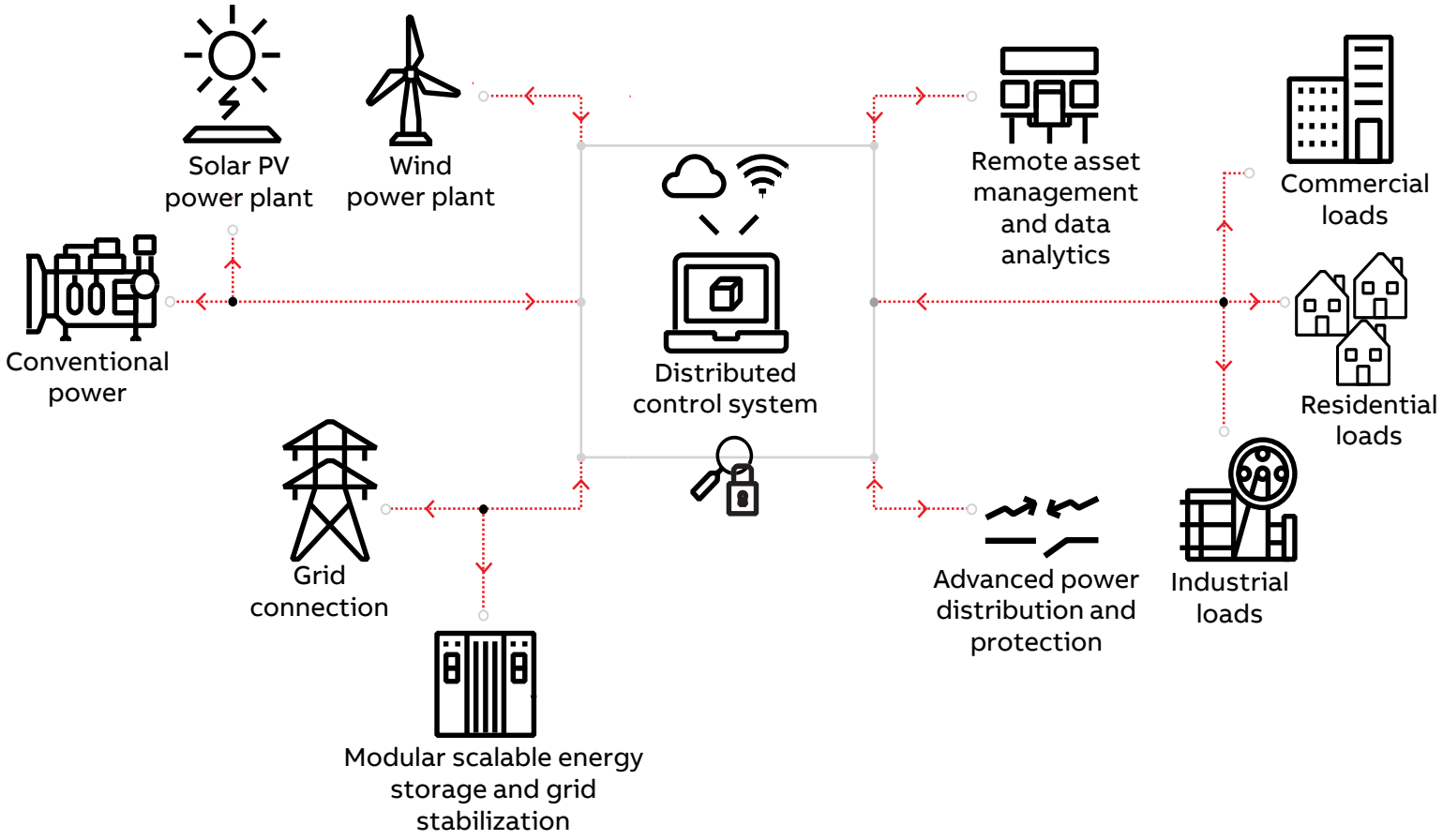
What is Microgrid?

Microgrid

Generation at the point of consumption and always available

Microgrid definition

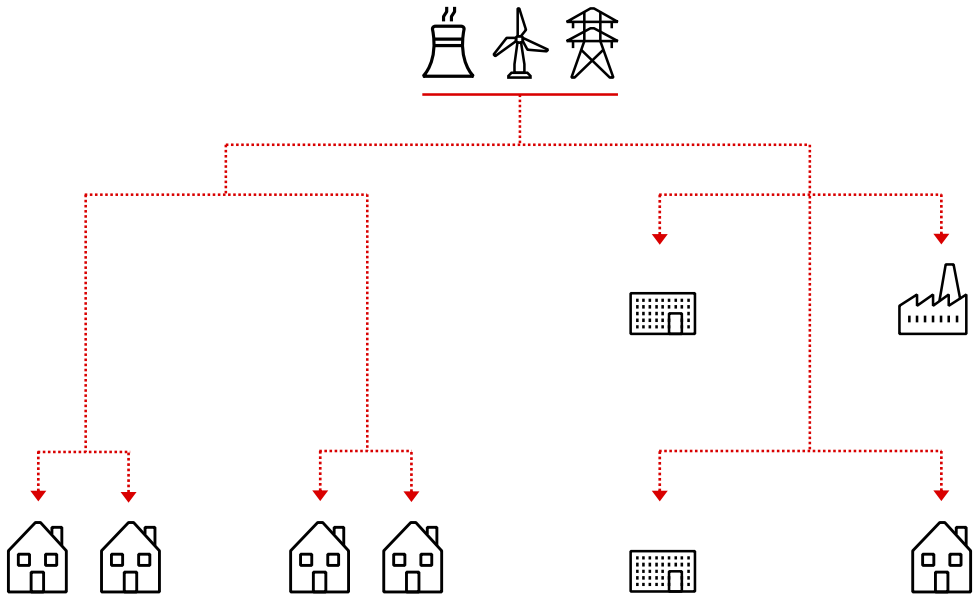
Distributed energy resources and loads that can be operated in a controlled, coordinated way either connected to the main power grid or in “islanded”* mode.



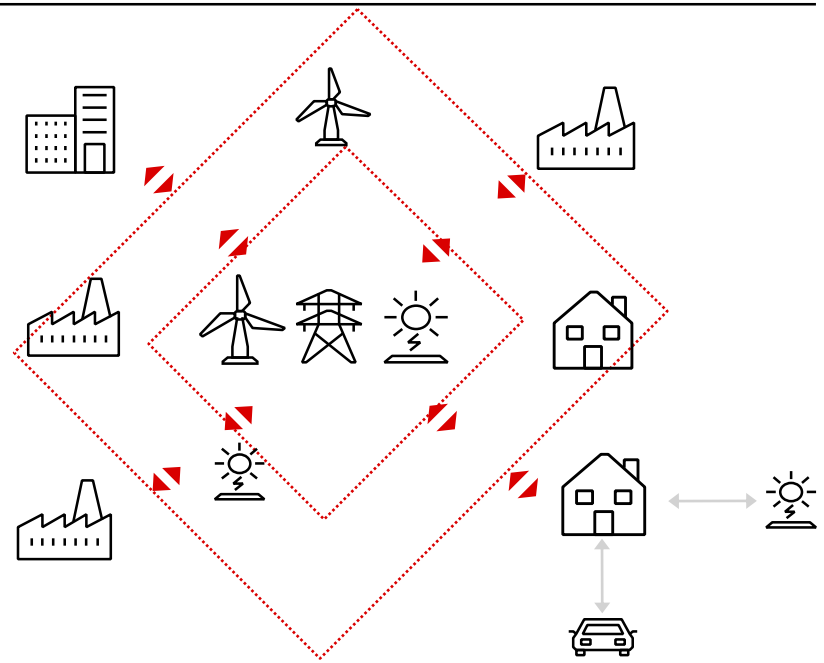
Energy and grid transformation

Transition from a centralized to a distributed grid

Traditional grid



New grid



New developments are accelerating the transition

Microgrid segments and main drivers

Microgrid segments and main drivers

Covering a diverse range of applications

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

IPP: Independent Power Producer

✓ : Main driver

(✓) : Secondary driver

Microgrid segments and main drivers

Covering a diverse range of applications

Off-grid / Weak grid / Grid-connected

Segments	Typical customers	Main drivers: Social – Access to electricity	Economic – Fuel & cost savings	Environmental – Reduce CO2 footprint	Operational – Fuel independence	Operational – Uninterrupted supply
Island utilities	(Local) utility, IPP*		✓	✓	✓	(✓)
Remote communities	(Local) utility, IPP, Governmental development institution, development bank	✓	✓		✓	
Industrial and commercial	Mining company, IPP, Oil & Gas company, Datacenter, Hotels & resorts, Food & Beverage		✓	(✓)	✓	✓
Defense	Governmental defense institution		(✓)	(✓)	✓	✓
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	Defense	Governmental defense institution		(✓)	(✓)	✓	✓
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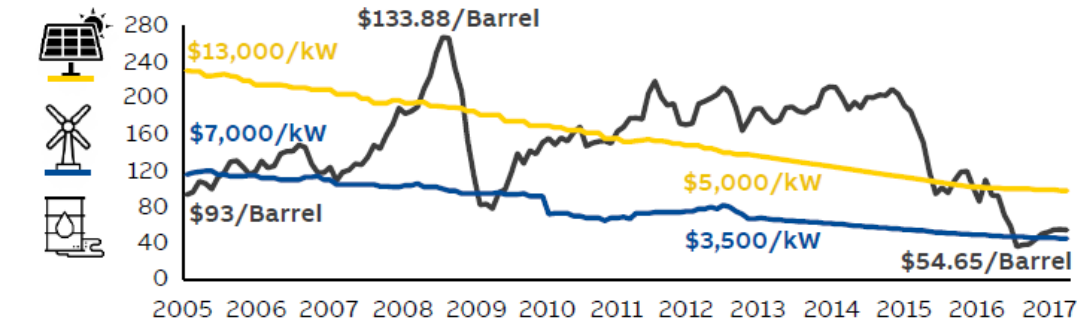
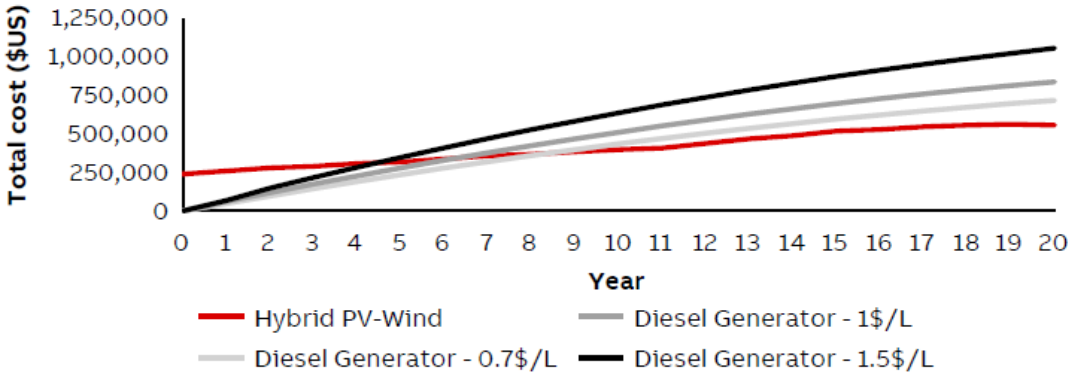
Fuel and Cost Saving

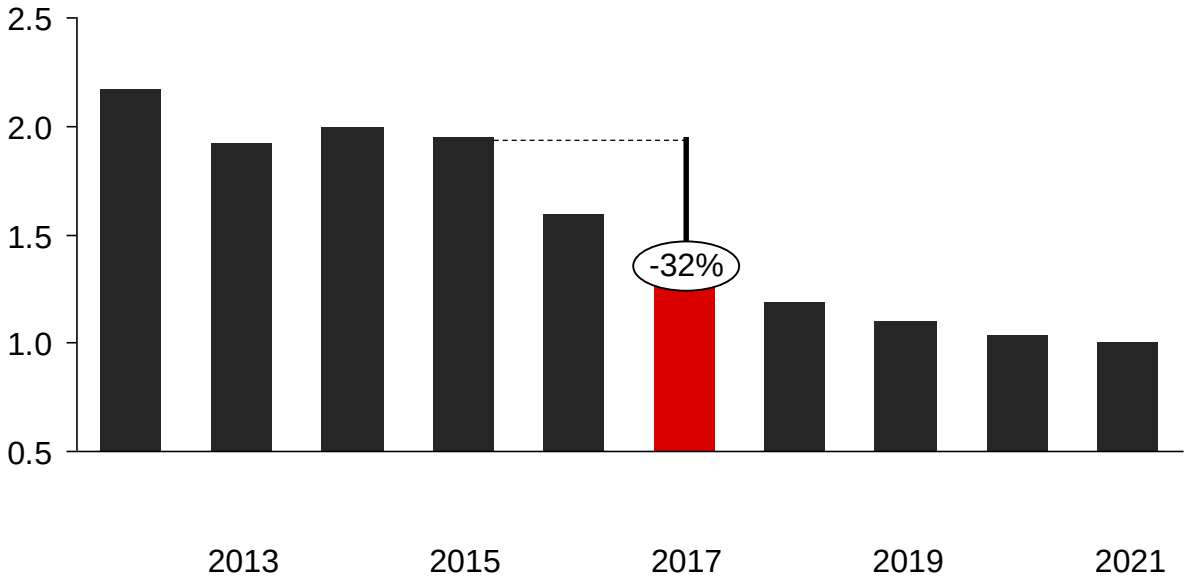
Average Oil price USD$/Barrel is volatile





LCOE: Levelized Cost of Electricity

Rapidly decreasing Solar PV costs supporting business case



– PV prices have reduced over 30% in past 2 years and continue to fall globally

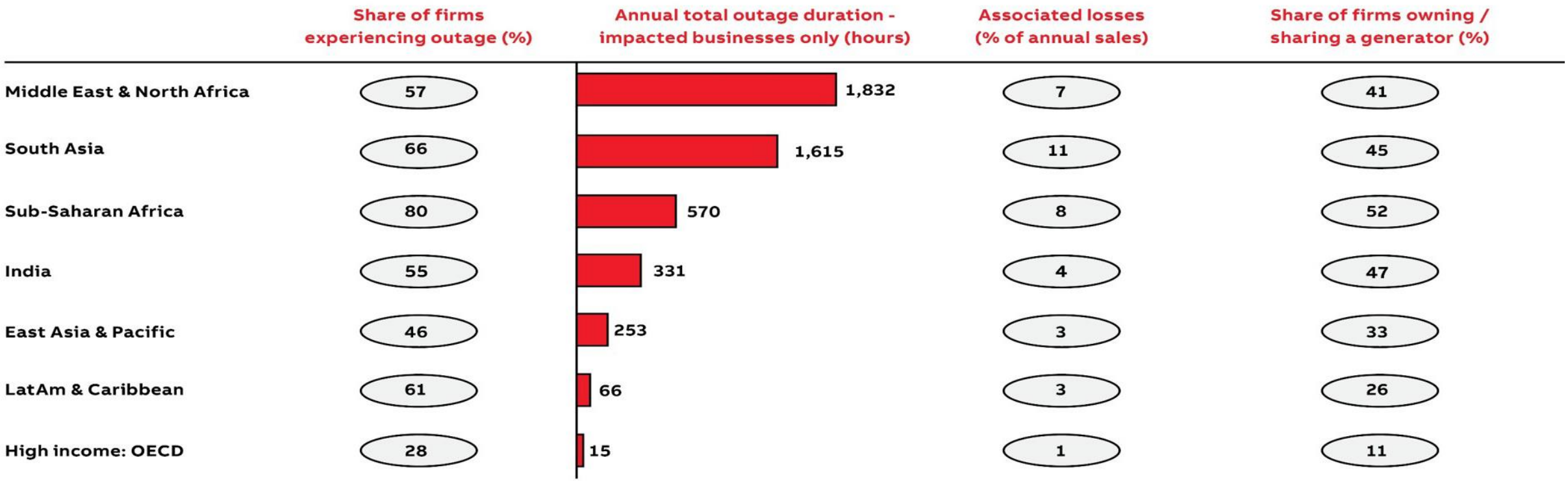
Source: IHS PV Demand Market Tracker - Q2 2017

[1] https://www.greentechmedia.com/articles/read/Sunshot-1-Per-Watt-Solar-Cost-Goal-Mission-Accomplished-Years-Ahead-of-S

“The challenges for Commercial and Industrial (C&I) sites are usually the same: lost production, lower workforce efficiency and potential damage to their process equipment. In many cases power outages on critical manufacturing lines will also damage the work-in-process, further impacting operational costs”

Power Outage Issues for C&I plants

Outages, costs and generator ownership



Source: Bloomberg/Slide 5 World Bank (2010-2017)

ABB in Microgrid

ABB in Microgrids

Pioneer in technology, solutions and execution

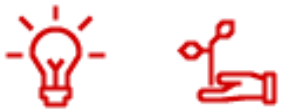
25+			50+	
25+ years of experience	Innovation and technology leadership	Reliable and proven portfolio	40+ successfully executed project	Global sales and service network

ABB in microgrid

Comprehensive product and solutions portfolio

Consultancy & design

EBoP and plant automation

Microgrid control system

Solar PV inverters

Energy storage & grid stabilization

Power protection & distribution

Substations

Remote monitoring & service

EBoP: Electrical Balance of Plant

PowerStore™

“Plug and play” solution for mature & emerging markets

Instant power wherever and whenever it is required

Key Offers:

- A reliable, modular, containerized “plug and play” solution
- Virtual generator, handling up to 100% of renewable energy
- Standardized products in the range of 60 kW to 5600 kW, scalable unlimited

PowerStore™

"Plug and play" solution, easily configurable to adapt your unique needs

Climate Control

Maintaining temperature inside the container within an acceptable operating limit at all times

Lithium Ion Batteries

Battery module, Racks, and Battery Management System (BMS) Interface

- Easy maintenance
- Online replaceable
- Hot-swappable

PCS100

PowerStore™ Conversion System

- Scalable
- Modular
- Grid Forming
- Virtual Generator

Health Safety and Environment (HSE)

Ensure heath 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 data trends
- Configurable data sampling rate
- Support predictive, preventive and corrective maintenance

Built-in PowerStore™ Automation

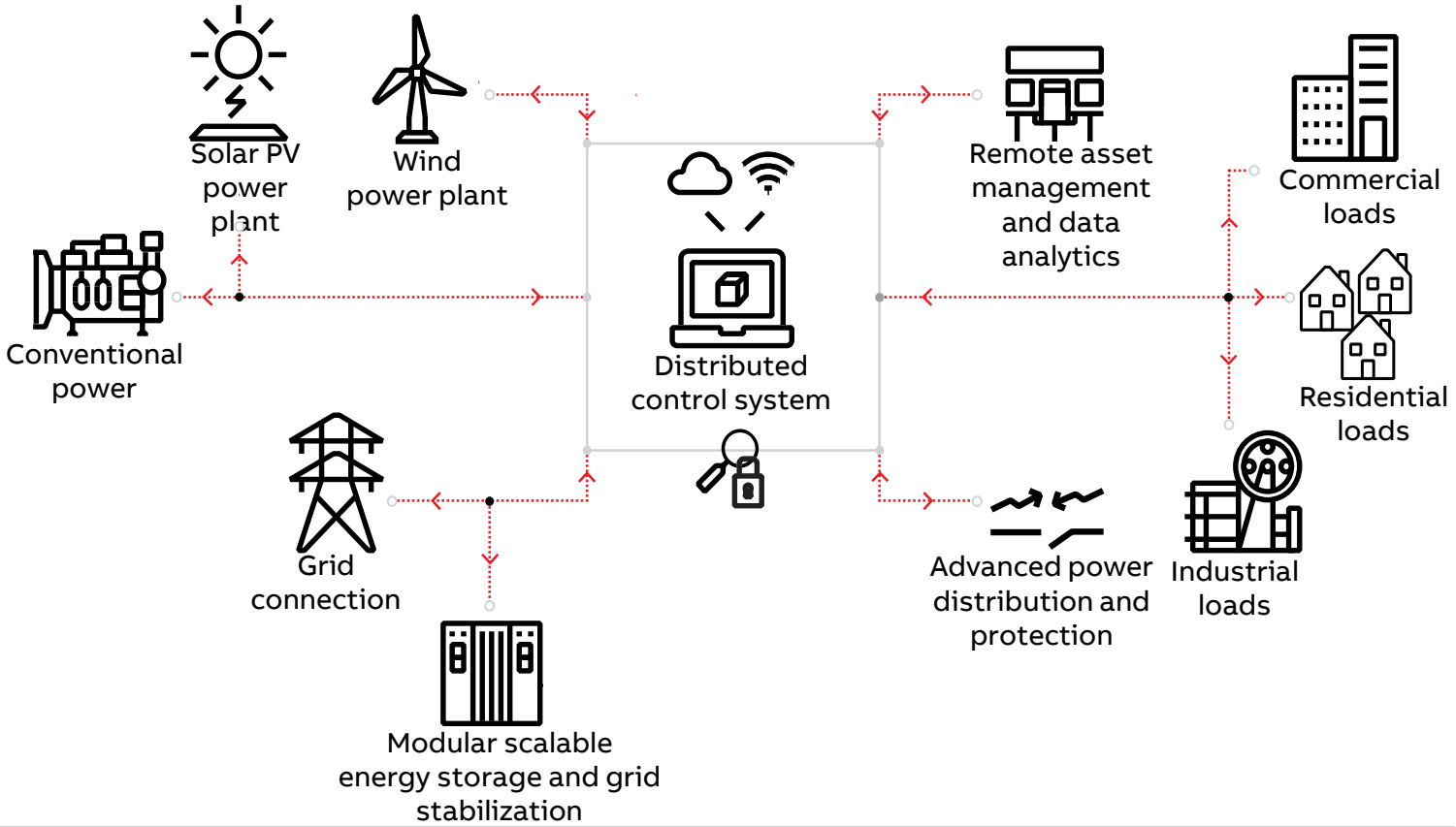
Dedicated Microgrid plus control system delivered pre-programed to meet the application needs

Control System - Microgrid Plus System

Efficient and reliable power flow management

Microgrid Plus Control System

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



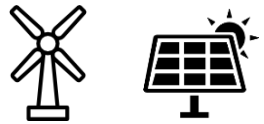
Microgrid operational goals and power system functions drive choice of technology

Operational goals

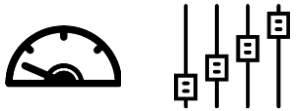
- Access to electricity
- Maximize reliability
- Uninterrupted supply
- Reduce environmental impact
- Maximize renewable energy contribution
- Fuel & energy cost savings
- Fuel independence
- Provide grid services

ABB Microgrid Technology

Renewable power



Microgrid control system



Energy storage and grid stabilization

Power system functions – “8S”

1. Stabilizing
2. Spinning reserve
3. STATCOM (Static reactive power compensation)
4. Seamless transition between islanded and grid-connected states
5. Standalone operation
6. Smoothing
7. Shaving
8. Shifting

Business Case – Commercials & Industries

Business Case for Commercial and Industrial Sector (C&I)

Example: Glass Manufacturing in India

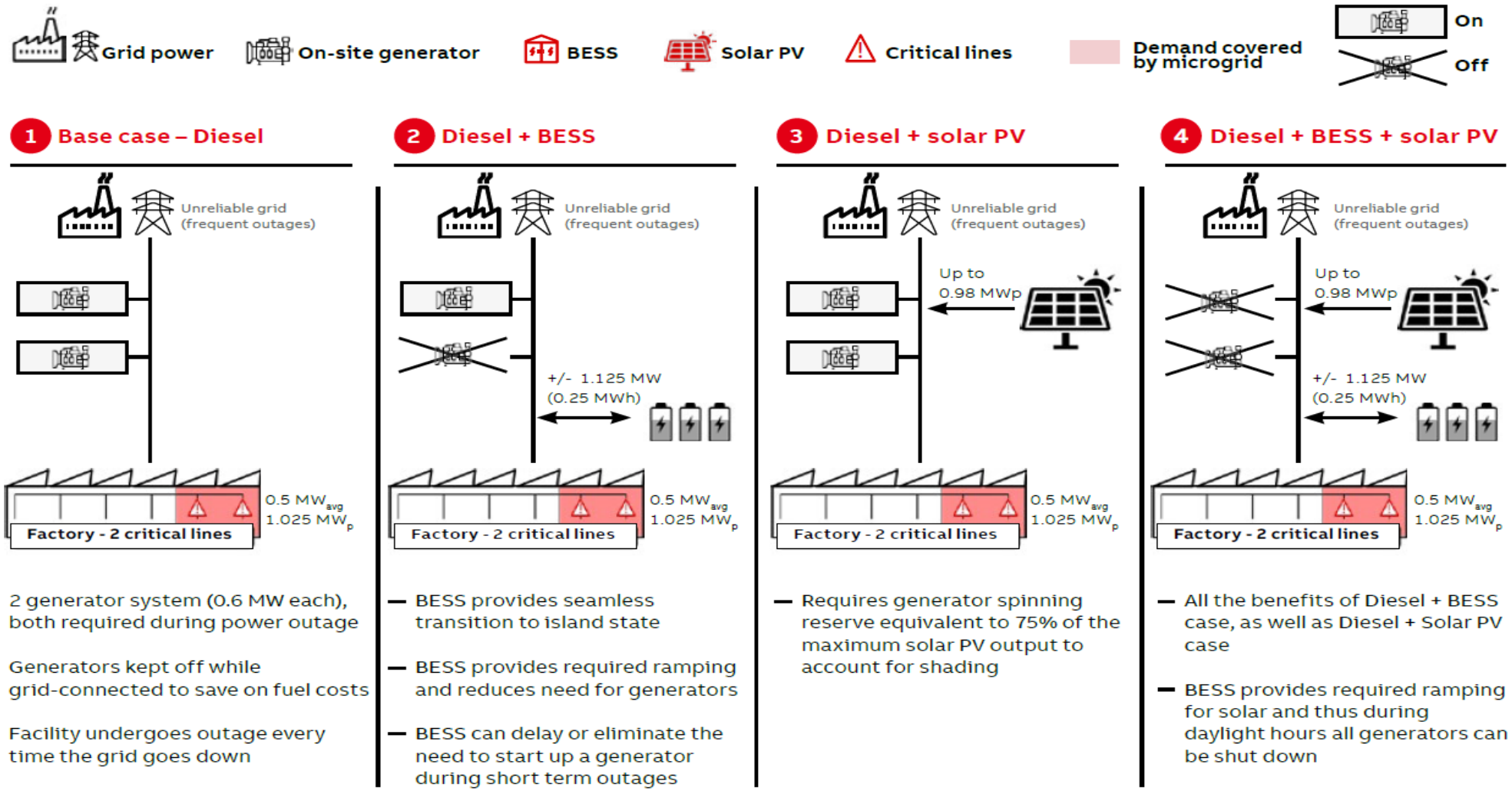
Power system

- 15 MW average load
- Critical load: 1 MW peak, 0.5 Average
- 2 x 0.6 MW back up diesel generators
- Grid energy price $ 0.15/kWh

Business Case

- Delivered fuel cost : $ 1 usd/L (all inclusive)
- Solar installed cost : $ 1 usd/Wp
- BESS : 1.125 MW/ 0.25 MWh
- Subsidies :None
- 260 outages per year

HOMER ENERGY



- 2 generator system (0.6 MW each), both required during power outage
- Generators kept off while grid-connected to save on fuel costs
- Facility undergoes outage every time the grid goes down

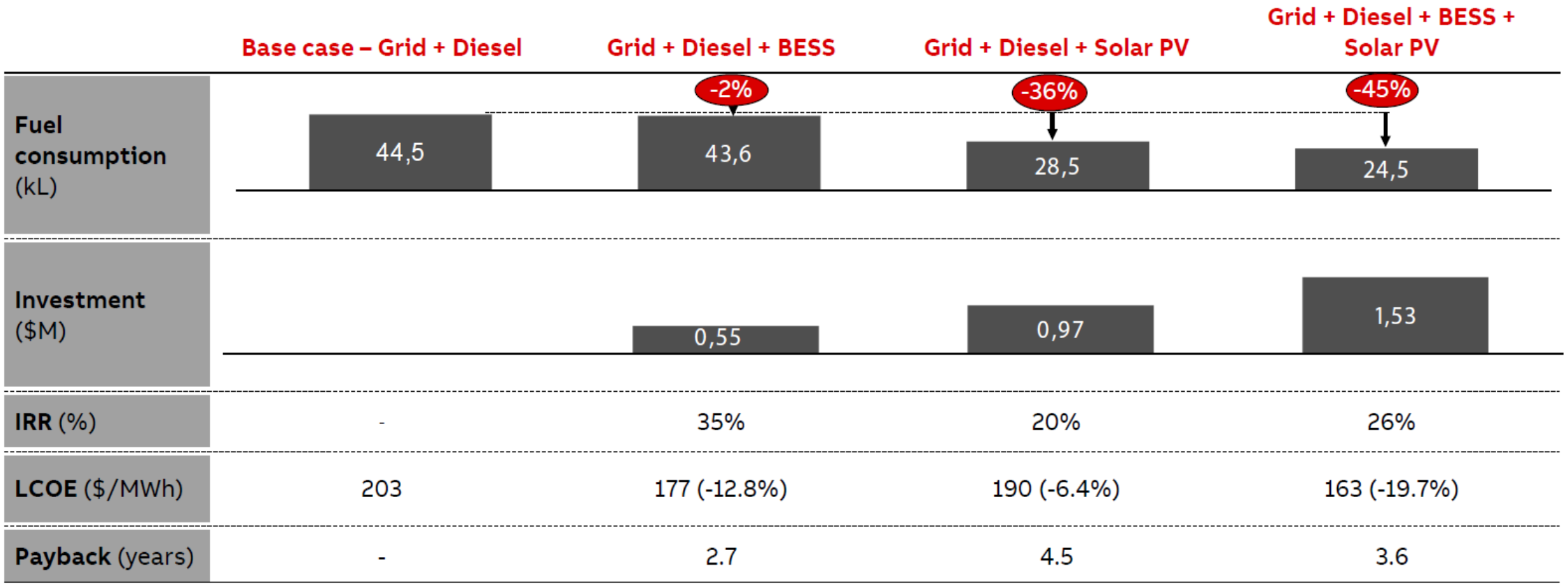
- BESS provides seamless transition to island state
- BESS provides required ramping and reduces need for generators
- BESS can delay or eliminate the need to start up a generator during short term outages

- Requires generator spinning reserve equivalent to 75% of the maximum solar PV output to account for shading

- All the benefits of Diesel + BESS case, as well as Diesel + Solar PV case
- BESS provides required ramping for solar and thus during daylight hours all generators can be shut down

Microgrid for C&I- Business Case (Homer Pro Software Simulation)

Up to 45% reduction in fuel possible when combining diesel with BESS and Solar PV

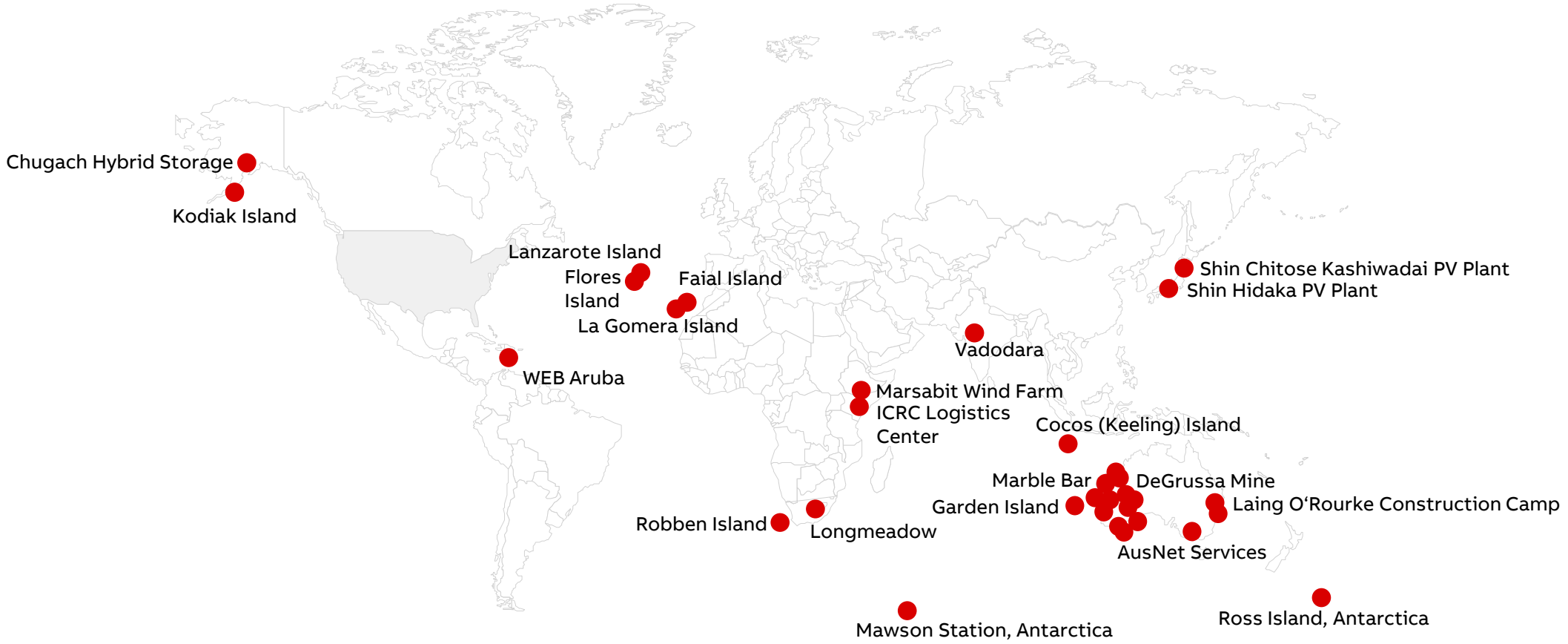


	Base case – Grid + Diesel	Grid + Diesel + BESS	Grid + Diesel + Solar PV	Grid + Diesel + BESS + Solar PV
IRR (%)	-	35%	20%	26%
LCOE ($/MWh)	203	177 (-12.8%)	190 (-6.4%)	163 (-19.7%)
Payback (years)	-	2.7	4.5	3.6

Success Stories & Summary

ABB in Microgrid - Success Stories

Global references with 50+ successfully executed projects



Industrial and commercial sites

Johannesburg, PowerStore/PV/Diesel

LONGMEADOW
Business Estate

Web Story

Project name
Longmeadow
Location
South Africa
Customer
Longmeadow Business Estate
Completion date
2016

ABB Solution

The resulting microgrid system consists of:

- PowerStore Battery (1 MW/380 kWh)
- Microgrid Plus Control System
- Remote Monitoring
- Solar PV (1 x 750 kWp)
- Diesel (2 x 600 kW)

Customer Benefits

- ABB 8S application - Standalone, Stabilizing, Seamless
- Reliable and stable power supply
- Optimized renewable energy contribution to the facility
- Ability to island from the grid in case of an outage
- CO_2 reduction: over 1,000 tons/year
- Up to 100% renewable energy penetration

About the Project

The microgrid solution is for the 96,000 sqm facility houses hosting ABB South Africa's headquarters as well as manufacturing facilities with around 1,000 employees.

Industrial and commercial sites

DeGrussa Mine, PowerStore/PV/Diesel

SANDFIRE RESOURCES NL

juwi

Project name
DeGrussa Copper-Gold Mine
Location
Western Australia, Australia
Customer
juwi Renewable Energy
Completion date
2016

ABB Solution

The resulting microgrid system consists of:

- PowerStore Battery (2 x 2 MW/1.4 MWh)
- Microgrid Plus Control System
- Solar PV (10.6 MWp)
- Diesel (22 MW)

Customer Benefits

- ABB 8S application – Stabilizing, Spinning Reserve, STATCOM, Smoothing
- Expected diesel fuel saving is 5 million liters per year - reduction by 20%
- Expected CO2 reduction: 12,000 tons

About the Project

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

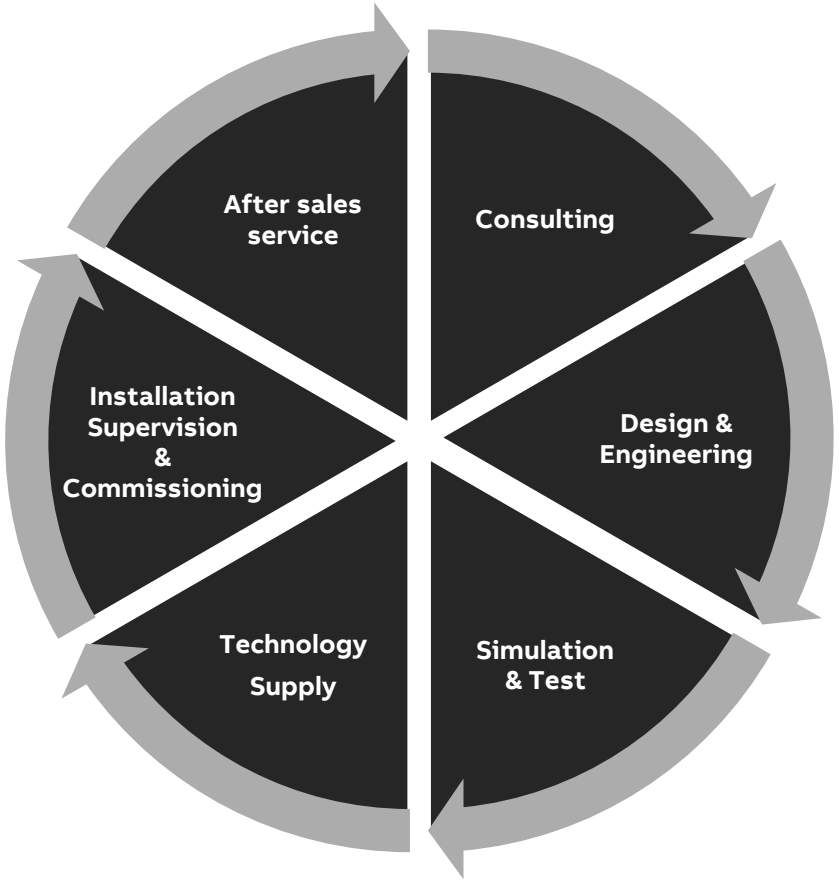
SANDFIRE
RESOURCES NL

DEGRUSSA SOLAR PROJECT

Summary

ABB comprehensive portfolio

- ABB offers a comprehensive portfolio of life cycle management and services throughout the whole project life cycle
- The consulting and service offering is based on extensive process and application know-how as well as one of the largest installed bases in the world
- ABB provides remote monitoring and control of all Microgrid assets



So let’s talk


ABB