



Leading the energy revolution, together

Smart Power solutions for Microgrids

ABB ELSP Microgrid Solutions Team



What is the world looking for?

Resiliency, sustainability and digitalization

- **Resiliency**

24/7 power availability is very sensitive for critical power facilities like hospitals, banks, datacenters and process industries.

For a data center the average cost of power outage is \$8k per minute, \$600k per shutdown event

- **Sustainability**

7.6% annual reduction of greenhouse gas emissions to reach the global target of reducing the average temperature of the atmosphere of 1.5°C by 2030

1MW of renewable solar power save CO2 k0.5ton equivalent yearly in a manufacturing industrial plant or to supply for 1 year 130 electrical vehicles

- **Digitalization**

Analytics models based on data availability drive decisions in any organization, from shopping malls to Country governments

Investment in utility distribution level networking is expected to grow steadily from \$1.8bn in 2019 to \$2.8bn in 2025



*« Intelligence is the ability to adapt to change »
Stephen Hawking, Professor
at University of Cambridge*

How to have resilient, sustainable and digital power?

DER, Microgrids and VPPs

- **Distributed Energy Resources (DER)**

Energy active assets like renewables or storage systems connected to the grid at distribution level or on the customer's side of the meter

- **Microgrids**

A Microgrid is a group with clearly defined electrical boundaries of low voltage Distributed Energy Resources (DER) and loads that can be operated in a controlled, coordinated way, either connected to the main power network or in islanded mode

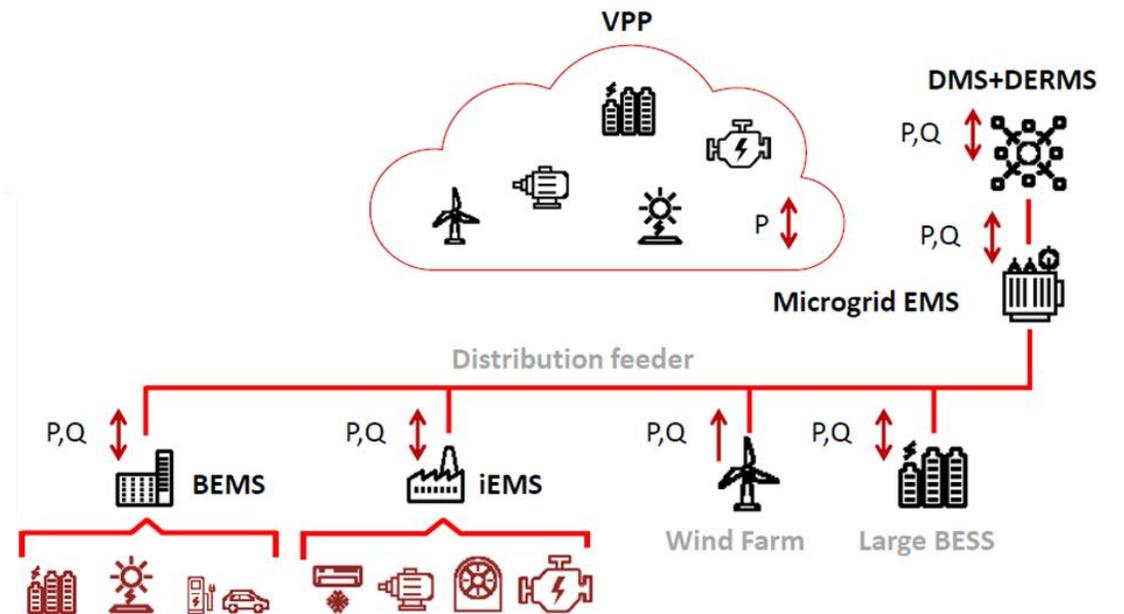
Any Microgrid is ready to become a Virtual Power Plant (VPP)

- **Virtual Power Plants**

A Virtual Power Plant is an aggregated system of energy assets remotely and automatically optimized by a software-based platform

One of the most valuable services offered by a VPP is the Demand Response

*«Power has to be produced where it is used»
Peter Lilienthal, CEO of HOMER Energy*

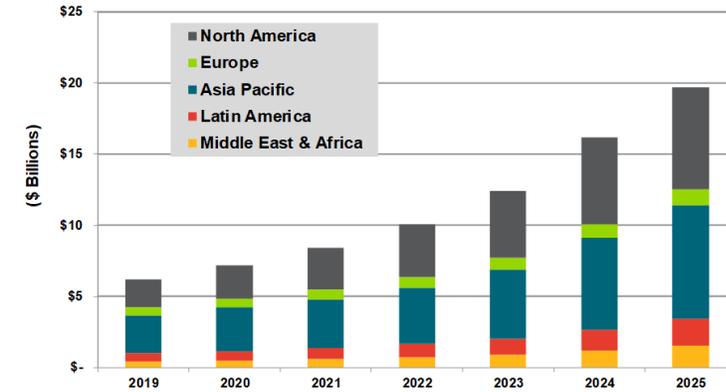


Where is microgrid and VPP market?

North America, Asia, Europe

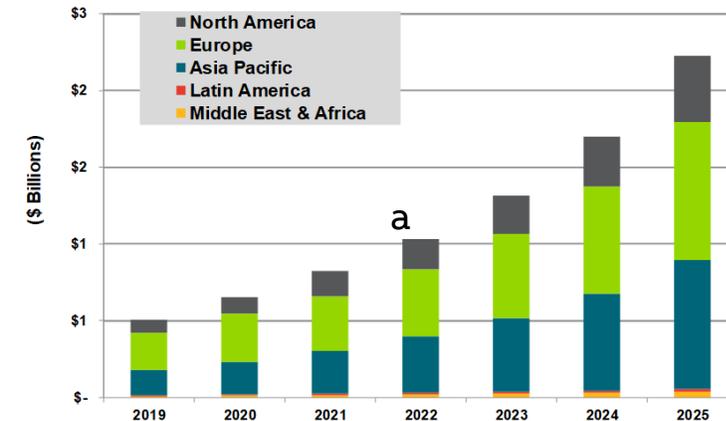
- According to Navigant Research, the annual spending on microgrid implementation is projected to reach \$19.7bn by 2025 at a 21.4% CAGR

North America and **Asia** together account for about 76% of spend over the next 5 years - a total of \$15.2bn



- Global implementation spending on virtual power plants is expected to grow from \$508.7M in 2019 to more than \$2.2bn in 2025 (27.9% CAGR)

Europe is the leading region, with an annual market of \$897.8M in 2025, closely followed by the Asian region with \$839.3M in annual spending



Where is microgrid and VPP market?

Most important segments

- **Commercial**

Offices, hotels, shopping malls, banks



- **Campus/Institution**

Campus, universities, institutions, hospitals, schools, fire stations, police stations



- **Remote**

Rural villages, off-grid mining/resorts



- **Industrial**

Waste&water, food&beverage, automotive, manufacturing, mining, datacenters



- **Military/Marine**

Light vessels, defense stationary basis



- **Community/Utility**

Smart districts, residential communities



Segment	2019	2025	CAGR
Campus/Institutional	M\$ 401	M\$ 970	15,9%
Commercial	M\$ 201	M\$ 1.404	38,3%
Industrial	M\$ 600	M\$ 2.615	27,8%
Community	M\$ 572	M\$ 1.937	22,6%
Remote	M\$ 2.784	M\$ 7.306	17,4%
Utility Distribution	M\$ 1.149	M\$ 3.952	22,9%
Stationary Military Base	M\$ 461	M\$ 1.527	22,1%
Total	M\$ 6.169	M\$ 19.712	21,4%

Why microgrid market is booming?

Lower costs, modularity, cloud and VOR

- **Declining DER costs**

Solar has already reached grid par level, while lithium-ion batteries will reach \$ 500 / kWh by 2025, 30% less than today. In parallel, electric mobility and V2G (Vehicle to Grid) applications will increase the availability of stored energy

- **Standardization**

Microgrid component suppliers are moving from “cookie-cut” configurations to “plug & play” modules, thanks to the global definition of application standards in AC and DC electrical architectures

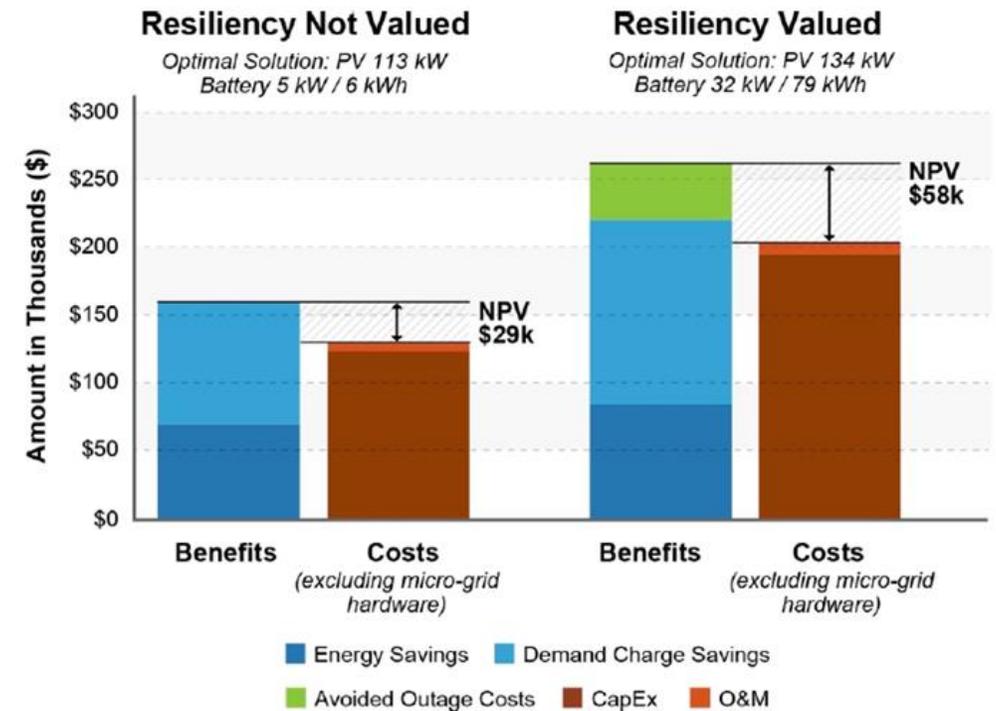
- **Cloud and edge computing**

The ideal configuration is to have control devices that independently regulate frequency and voltage, while a higher level of tertiary controls overlooks a longer decision-making horizon, forecasting weather, loads and market prices

- **Value Of Resiliency**

According to NREL, at the same capital expenditure cost of a plant based on 2.5MW diesel backup genset, a microgrid with 2MW of solar and 500kWh of BESS grants 80% more time of power autonomy

- Example about how Resiliency improves a Microgrid investment KPI like the Net Present Value (NPV)



Focus on microgrids during emergencies

No more blackouts

Everything works unless there is electricity but:

- **Storms**

In the Gulf Coast every year 1.3 million people go out of power due to seasonal storms

- **Wildfires**

In December 2017, a Thomas fire due to powerlines burned 281,893 acres impacting more than 1000 structures in California

- **Earthquakes**

In February 2011, a 6.3-magnitude earthquake struck New Zealand. In Christchurch, over 80 percent of the city (approximately 160,000 customers) lost power

What happens if a hurricane comes during pandemic?

A few years ago, a sandstorm cut power to over 8.5 million customers in 21 US states

To cope with the emergency, more than 57,000 teams of workers have been deployed across North America

If a similar event were to repeat during a pandemic period, it would not be easy to manage emergency aids

The recession following the pandemic will reorganize investment priorities, increasing the importance of service continuity, especially for critical power plants such as:

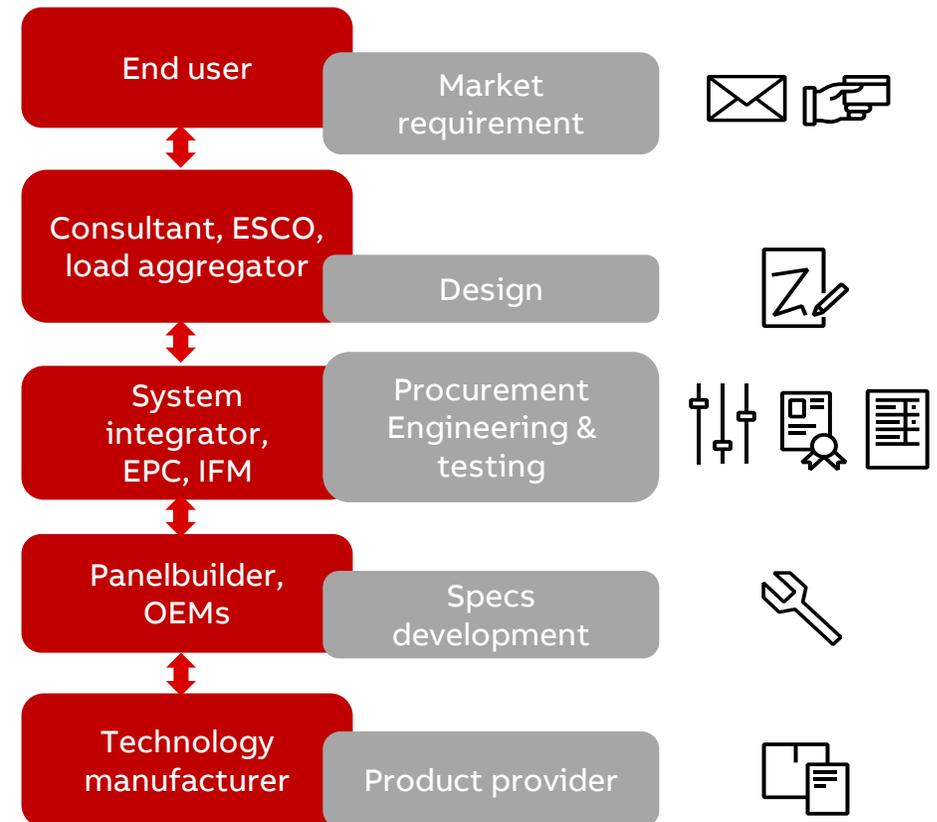
- Hospitals
- Banks
- Data centers

Microgrids take charge working 24/7/365

Who is interested in microgrids?

Complete value chain

- **End users** by main segments involved, like Commercial&Industrial or Utilities
- **Consultants** involved in renewables and e-Mobility business, Energy Services Companies (**ESCO**), **load aggregators** working in demand reponse programs
- **Facility Management** Companies involved in energy efficiency programs
- **System integrators** and **EPCs** working in renewables, BESS, GenSets and e-Mobility
- **OEMs** and **Panelbuilders** to manufacture energy storage systems, solar inverters, ev-chargers, generator controllers and power center switchgears



How ABB supports smart power microgrids?

Providing solution blocks to lead the energy revolution, together

Example: hospital



- Normally grid-connected plant
- Possible multi-point of connections to utility
- Chain with different sizes of existing and new facilities (from 0,5MW in small towns to 10MW in big cities)
- Different assets available in each site (different brands and resources among the chain):
 - Solar rooftops
 - Backup GenSets outside the buildings
 - EV chargers at parking lots
 - Spread loads (heating, ventilation, cooling system, room lights, parking lights, water pumps, air compressors, kitchen ovens, laboratory process equipments, laundry washing machines, plug-in office sockets, surgery process)
 - Energy storage systems (indoor conditioned room or outdoor containers)

Consultant - System integrator needs

- Design the plant with different assets
- Create customized logics with high engineering efforts
- Test the specific study every time
- Identify right products
- Keep margins & competitiveness

End user - Facility manager needs

- Need of 24/7 continuous operation
- Reduce utility bills
- Increase value of the facility
- Reduce operational costs
- Create benchmark for multi-site

Solution pillars

«Lego approach» for system:

- **Scalability** from nano-grid to microgrid depending on hospital size
- **Modularity** based on reference architectures for specific hospital needs
- **Plug&play** system templates granted by ABB, repeatable and share values among the chain



Solution blocks

Protections and regulations to grant power for critical loads even in emergency by redundant layers

Energy optimization and Demand response to reduce energy and power bills, improving self-consumption and joining DR programmes

Energy resource and grid asset monitoring to analyze and make actions on different sites



What is a solution block?

From products to solutions

ABB solution block is based on:

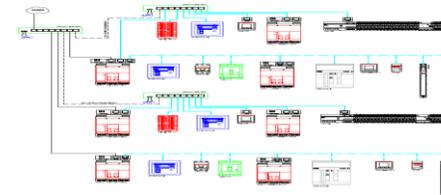
- **Reference architectures** for specific microgrid asset, from grid connection to PV plant
- **Intelligent products** integrated in the architecture and interconnected, to grant unique reliable performances
- **Digital functions** that satisfy specific microgrid requirements, already tested and pre-engineered to speed up the projects
- Supporting **tools** for the selection and configuration, according to personal needs



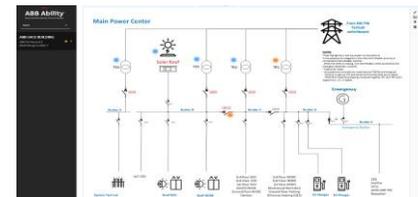
Example: **Energy resource and grid asset monitoring function**
Supervise site assets and energy flows to allow preventive decisions based on real data



No need to start from scratch in the microgrid design



Quick system integration, being already validated



Leverage the maximum of electrical distribution assets

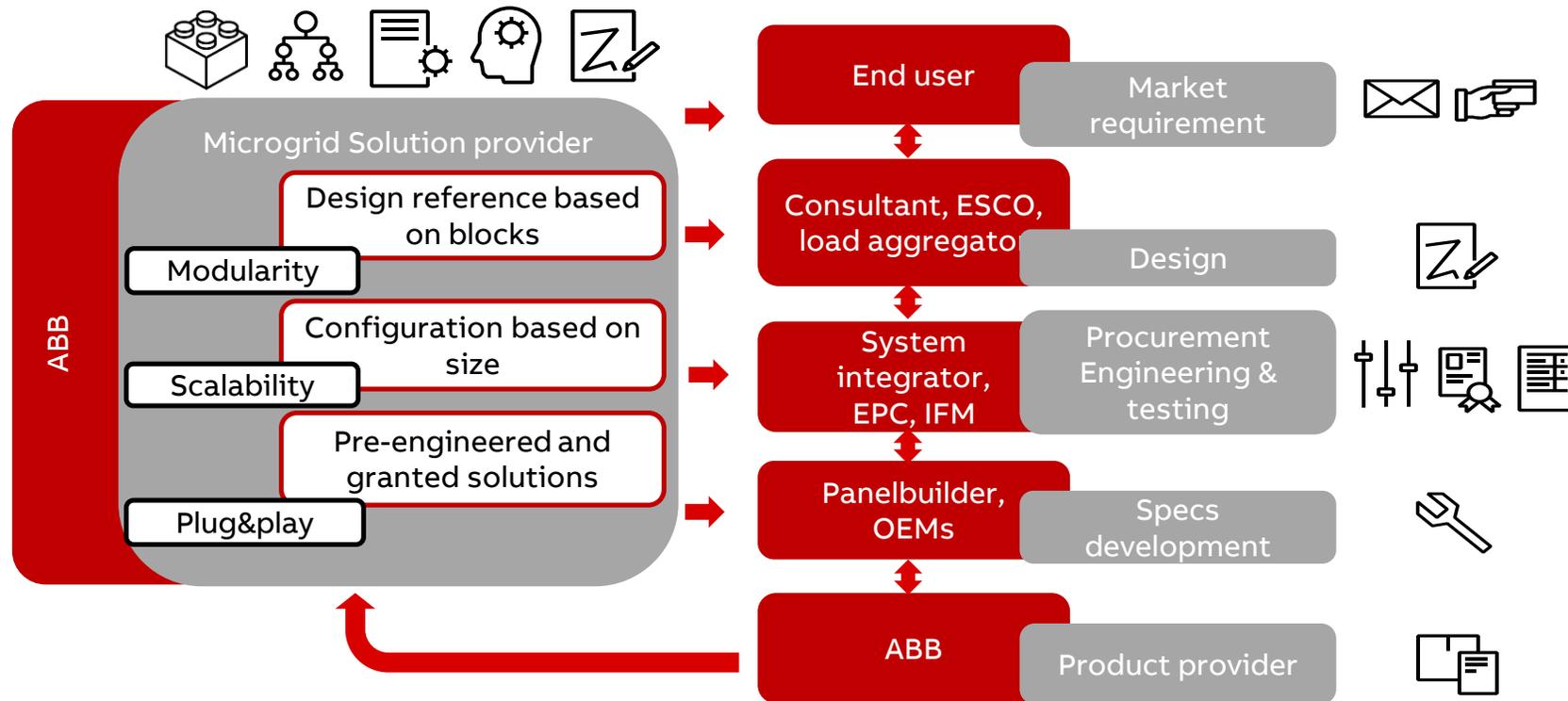


Reduce procurement effort with predefined shopping lists

Product	Product Code	Quantity	Number of poles	Rated current	Distribution	Voltage reference	Frame size current	Breaking
ABB Ability	ABB Ability	1	1	1000A	ABB Ability	10kV	1000A	100kA
ABB Ability	ABB Ability	1	1	1000A	ABB Ability	10kV	1000A	100kA
ABB Ability	ABB Ability	1	1	1000A	ABB Ability	10kV	1000A	100kA

How ABB supports smart power microgrids?

Sharing more values to improve chain profitability



How ABB supports smart power microgrids?

Consolidating a partnerships ecosystem

Inspire



Design

- **Research centers**

ABB has several research centers focused on microgrids across Europe and North America. There are many collaborations with European Universities and national Research Centers operating in microgrid open-innovation

- **Technology providers**

In addition to ABB smart power portfolio, there are strong connections with several other technology manufacturers, within the ABB Group or external partners, to complete the microgrid offering as one ecosystem

- **Service providers**

In addition to its own services, ABB has a network of partners to support system integration and commissioning in more than 50 Countries

Certify



What for a Building microgrid?

Products, architectures, solutions

Campuses, malls, hospitals, offices

• Energy efficiency

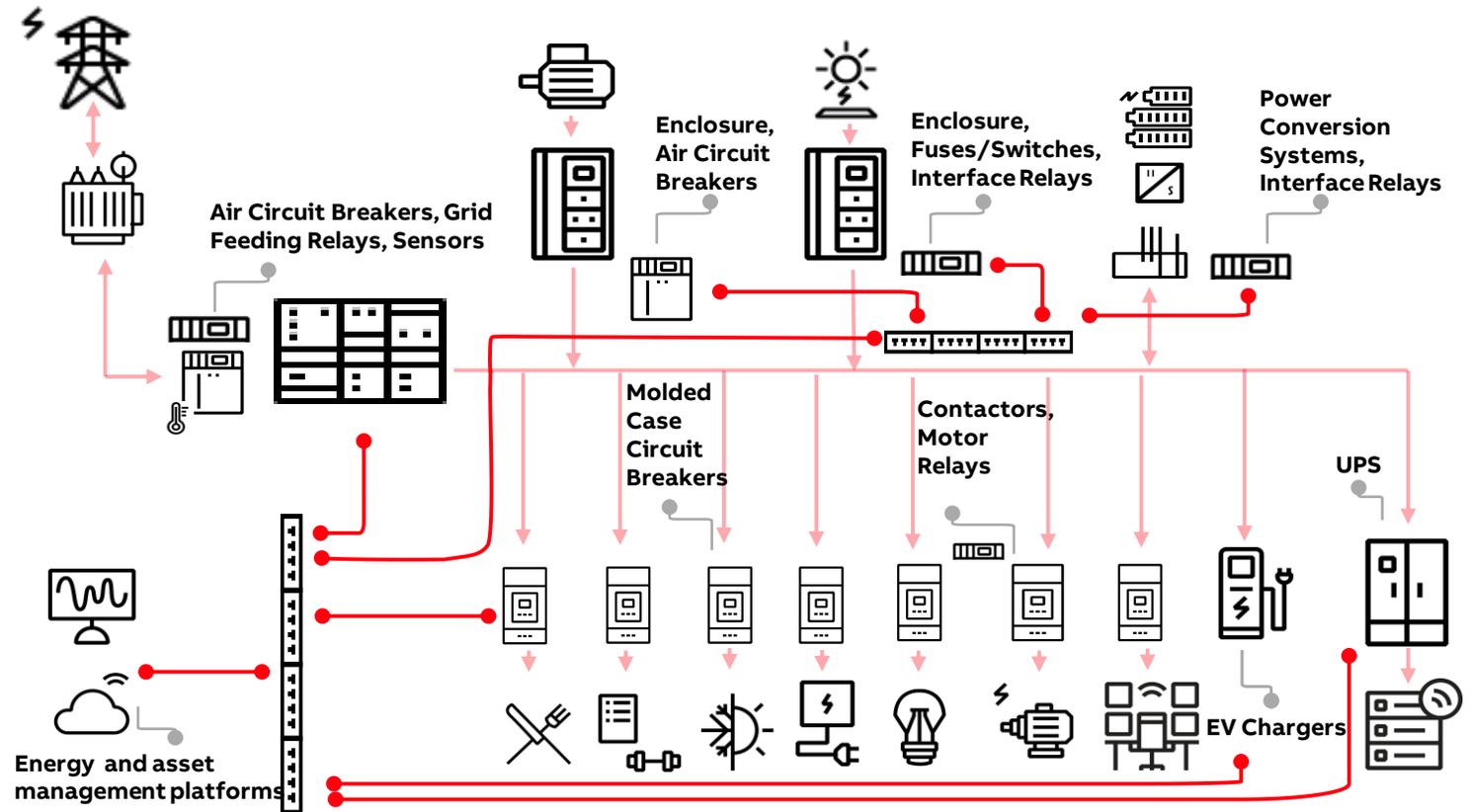
Monitor power flows and assets ensuring data-based improvement actions for energy saving and condition alerting in «green standard» approved energy cloud platforms.

- Peak shaving to save up to 20% in the bill
- Predictive maintenance to reduce 33% of Opex costs

• Continuous operation

Islanding in case of fault on the distribution grid and keep 100% of critical power running.

- Certified interface protections with the grid
- Adaptive protections with full selectivity
- Fast load shedding based on P & F measures
- Transfer switching to backup gensets
- UPS for servers full time supplied
- BESS as virtual generator in island-mode



What for an Industrial microgrid?

Products, architectures, solutions

Manufacturing, F&B, Water, Datacenters

• Power optimization

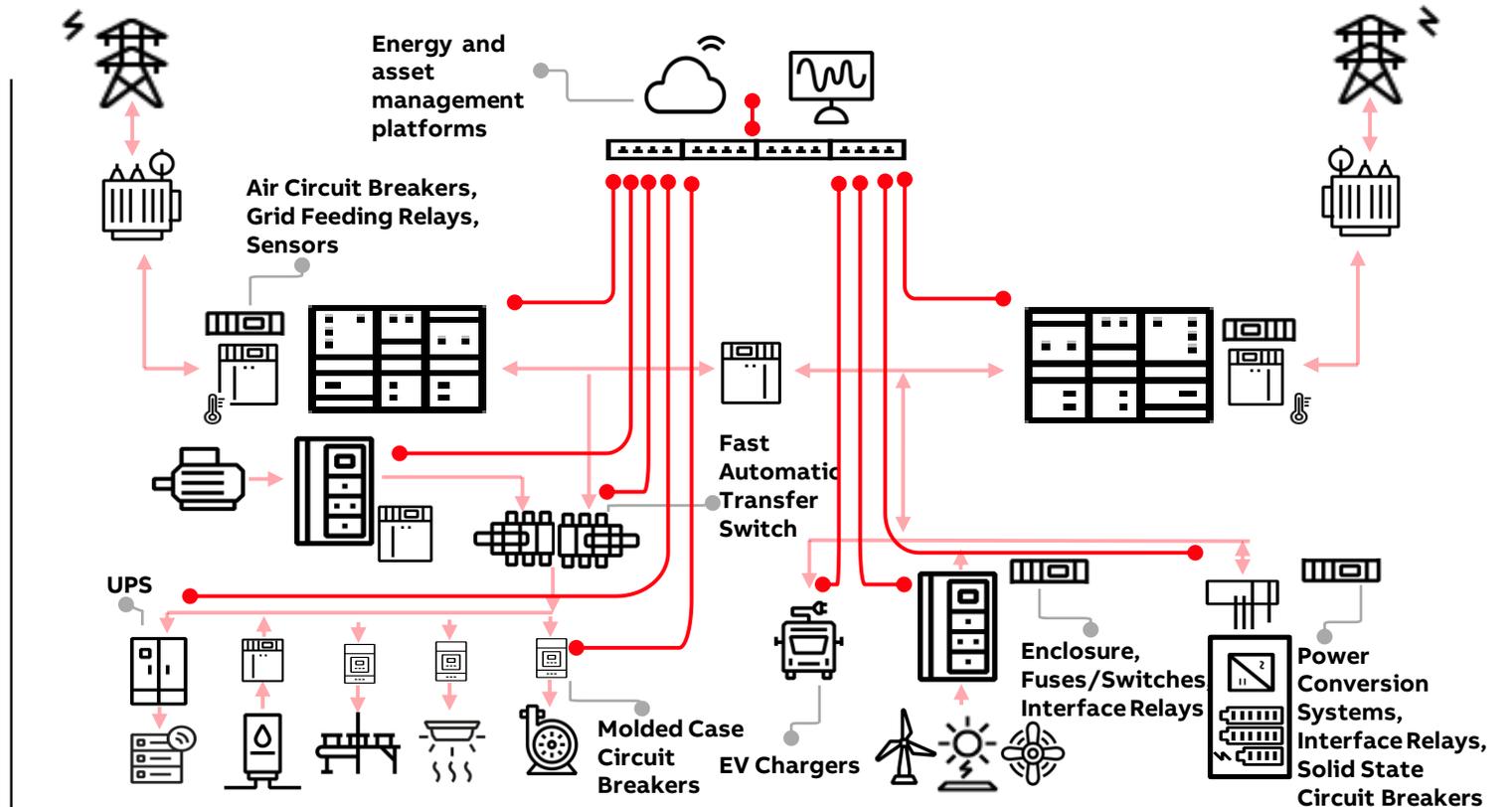
Manage e-mobility charging from renewable power sources and increase power quality KPIs.

- Load management to ensure self-consumption
- Network analyzer to identify areas for compensation switchboards or active filters
- Cost allocation among production lines

• Service enabler

Provide ancillary services to the utility, granting an additional profit center for the plant.

- Demand response with asset connectivity to load aggregator supervision systems
- Frequency fast response from BESS and UPS
- Paralleling of active sources with synchrocheck capability



What for a Community microgrid?

Products, architectures, solutions

Smart districts, Neighborhoods

• Eco-friendly

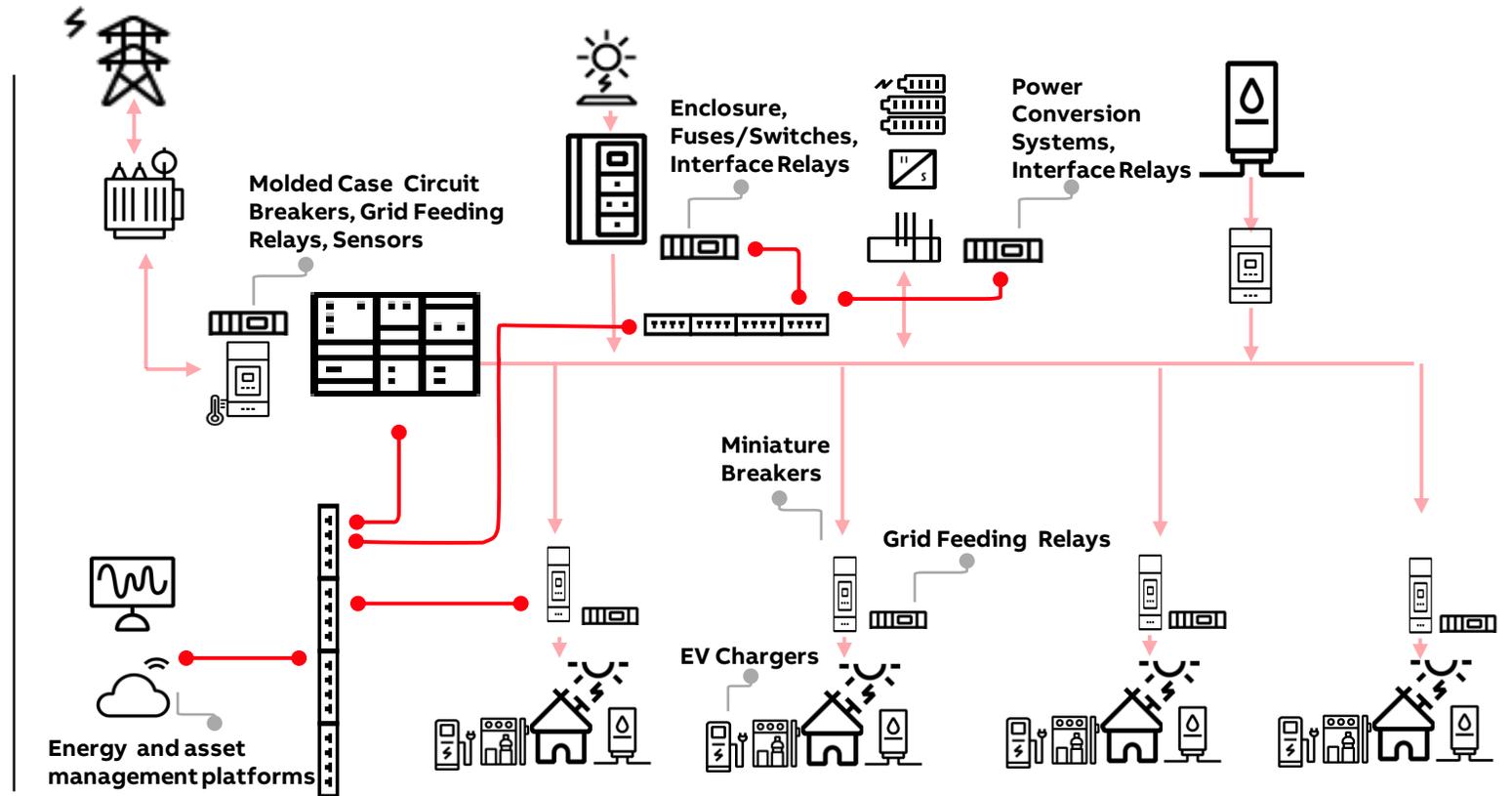
Maximize the prosumer use of sustainable DER sources like solar rooftops, community solar power plant and centralized CHP system.

- Slow and fast e-vehicle charging satisfying all needs
- Real time monitoring of power exchange with the utility grid to allow energy trading for VPPs

• System supporter

Guarantee reserve as an aggregated power plant for balancing system services

- Minute2hour power management up to single load, to answer automatic demand response requirements
- Millisecond2second power change based on frequency



What for a Marine AC microgrid?

Products, architectures, solutions

Light Vessels, Cruises, Fishing ships

• Energy supervision

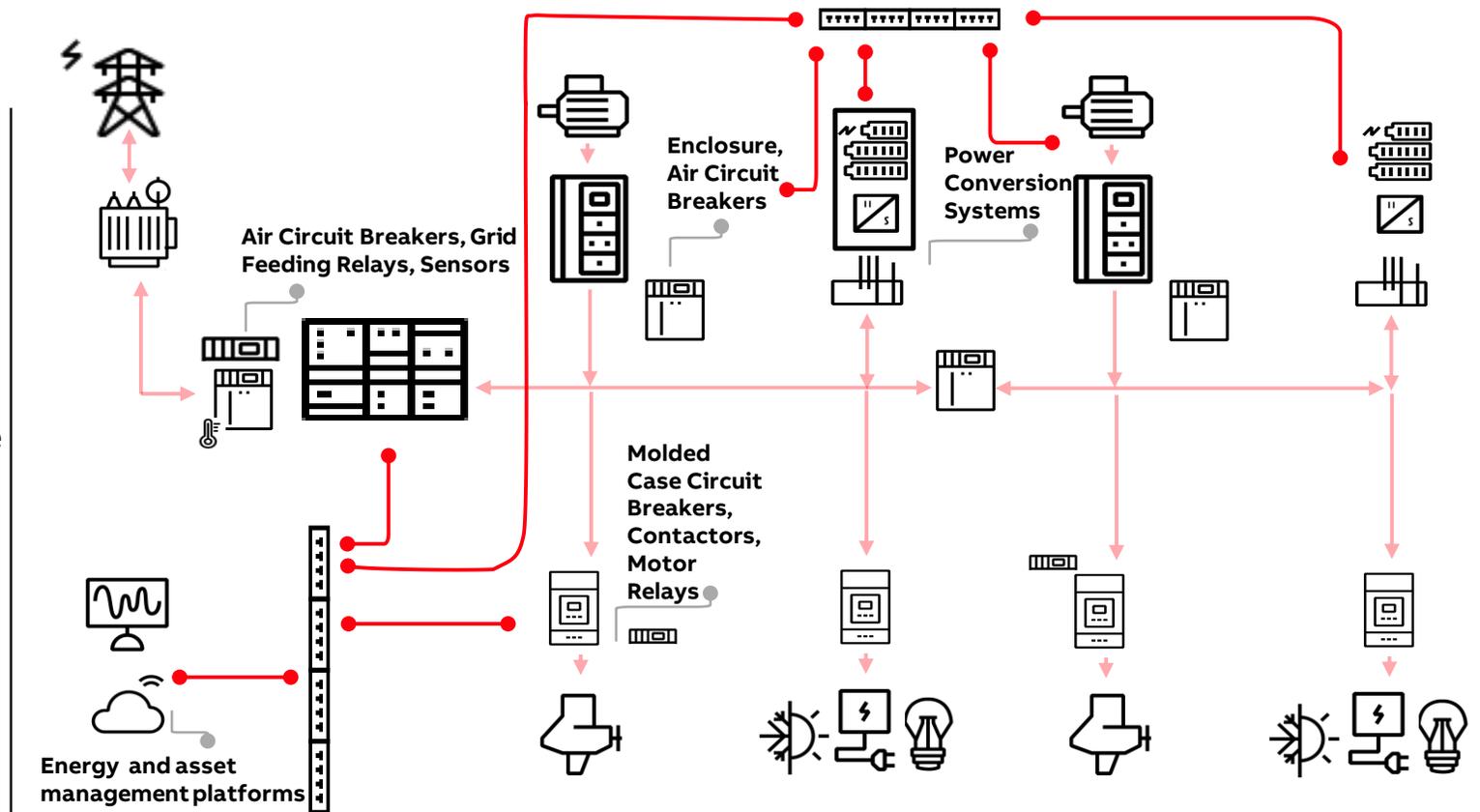
Direct connectivity to marine scada for energy, environmental and asset status information.

- Temperature, vibration, humidity sensing
- Predictive maintenance data with reliability curves, also through APIs

• Service continuity

Coordination among protection devices granted off-shore and during ship2grid connection.

- Digital zone-selectivity logics to enable close ring design and dynamic positioning with up to 3,5% fuel saved
- Adaptive protection settings for loads/generators
- Quick upgrade of installed base, ABB or not
- Power conversion DC/AC unified with UPS features and ATS functions



What for a Marine DC microgrid?

Products, architectures, solutions

Military, passenger ferries, sub-marines

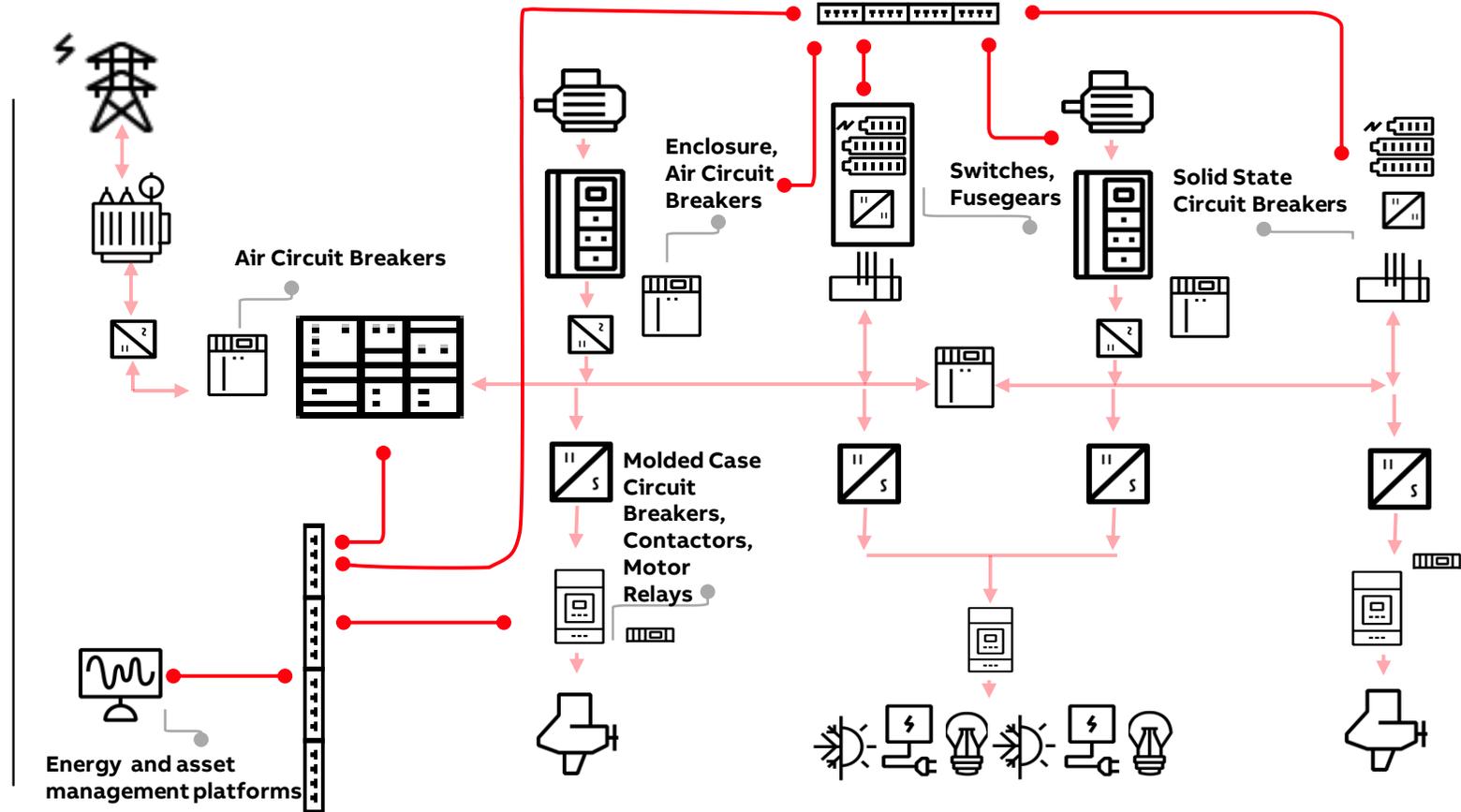
• Safety performances

Architecture for DC electrical distribution on-board the ship with complete coordination logics.

- Failure discrimination among DC and AC feeders by I-t curves
- No need of synchronization with IGBT technology opening and closing electrical circuits in micro-seconds
- Compactness of switchgear thanks to 30% space saved with DC and AC circuit-breakers

• Energy savings

- With SSCB power losses are 70 percent lower than comparable solutions. That means up to \$200k in a cargo or passenger ferry and \$1mln in a cruise over ten-year



ABB