PowerHub®

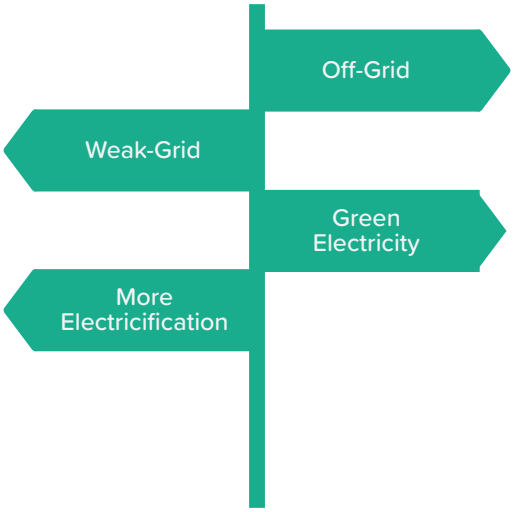
For Hybrid Power & Smart Microgrid

Product Series
50kW~5000kW
& Bespoke

HybridPower

CAIGATETEX
ENERGY SOLUTIONS

Reality and future of global electricity supply

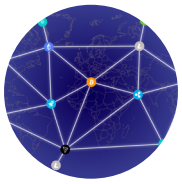


The current situation

- 1.2 billion people, an estimated 16 percent of the world's population, have little or no access to electricity. (WWF)
- Global electricity demand will reach around 38,700 terawatt-hours by 2020 from 25,000 terawatt-hours in 2017, and increases by 57% by 2050. (Bloomberg NEF)
- The share of renewable energy in the power sector would increase form 25% in 2017 to 85% by 2050, mostly through growth in solar and wind power generation. (IREA)
- By 2050 the share of electricity compared to total energy consumption will increase from 19%(2018) to about 44%, with electricity taking on an increasing role in transport and construction industries. (IREA)

Green Energy

Decentralized



Digitalized

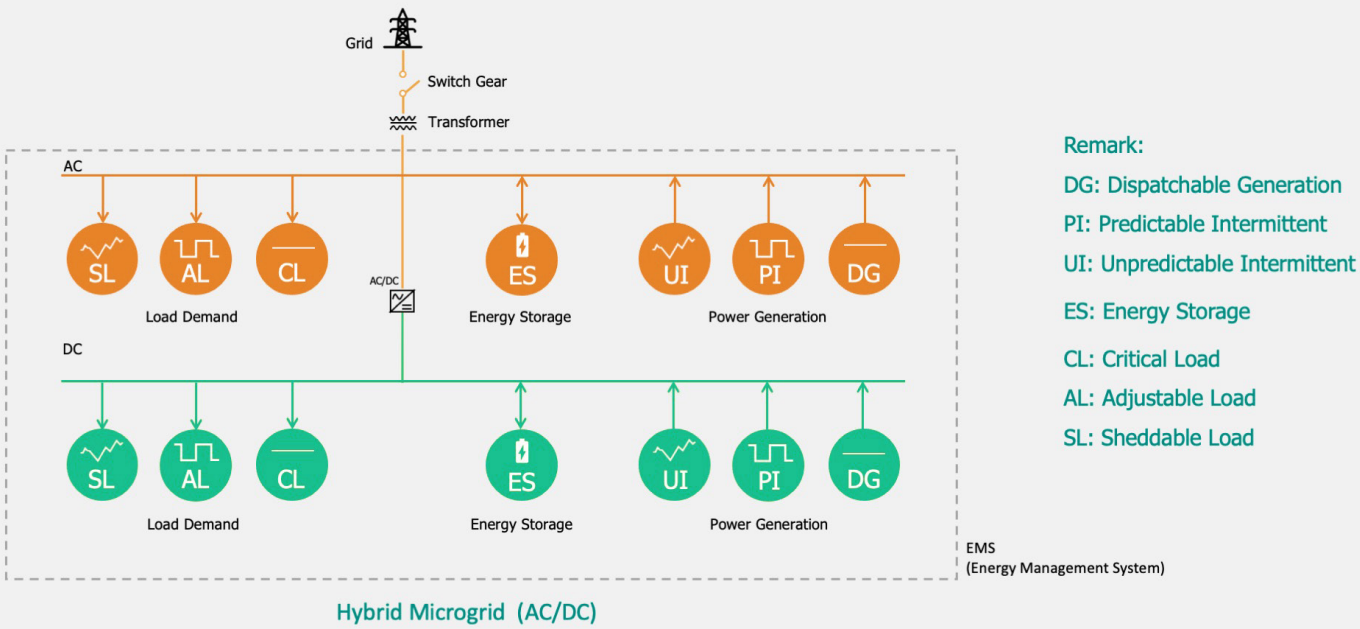
Megatrends in the golbal energy transition

- The end of the fossil era has begun
- The energy future has already begun
- The energy future is **renewable**
- The energy future is **decentralized**
- The energy future is **digital**

Hybrid microgrid to meet the needs of the world

What is a Hybrid Microgrid?

A hybrid microgrid is a local energy system which incorporates three key components; Generation, Storage and Demand all within a bounded and controlled network. It may or may not be connected to the grid.



Hybrid Microgrid (AC/DC)

4 core challenges of Hybrid Microgrids

1

Economy

Hybrid microgrids deliver improved energy efficiency, make full use of renewable energy, and reduce operating costs compared to traditional power station.

2

Reliability

The reliability of power supply capacity, power quality stability, and the security of its microgrid system are vital to users.

3

Flexibility

Perform efficient and optimisemanagement and control between different energy storage resources and loads, this is a difficult task.

4

Ease of installation

This is also a technical challenge for all participants, to perform equipment delivery, transportation, installation, commissioning, and enable smooth management of operation.

Our solution for hybrid microgrid

— Efficient, Greener, Smarter

Multiple Function

7 operating modes are available

Off-grid
Suitable for islands. Remote mines and military temporary camps without national grid.

Peak support
Can be used as a peak power source for short-term situations where the power supply is insufficient or the usage load varies greatly.

Standby power
Automatic switching to backup power source in the event of a grid failure or lack of power.

Power quality improvement
Due to fast charging or discharging of super capacitors and integration of optimized power electronics into optimised system stable power quality is provided.

Blackstart
As required to restart large-scale power generators such as coalfired and gas turbine power stations.

Uninterruptible Power Supply (UPS)
The system is composed of energy storage, power electronics and energy management components that seamlessly switch to ensure the safety of your most important equipment.

Arbitrage
Buy and sell power to external grid upon price and internal microgrid generation costs.

Fast Deployment

5 ways to make deployment easy anywhere and anytime

Mobile
Can be moved according to the demand, applicable to off-grid, weak-grid, and grid-tied.

Modular
Compact module designs is ideal for both small and large installations.

Scalable
As our products can be adapted building upon standardized and modular design, this provides great convenience and the ability to increased and decrease capacity on-site.

Plug & Play
Optimal design and in-house manufacturing allows easy installation with reduced costs and instillation times.

Cloud
Cloud-base digital management, allowing device managers to renew the device statue anytime anywhere.

Excellent Performance

4 way to improve Microgrid power quality

Smart management
Industry leading software and communication design model to ensure optimal interaction between various power generation equipment, energy storage and loads.

Stable operation
Factors such as voltage, frequency, harmonics, active and reactive power are fully considered in the system to ensure the stability of power grid.

Intelligent monitor
Every port of the entire system is under strict supervision, user can see date display and analysis of load at remote sites with an alarm function

Maximum efficiency
Intelligent software can help the system maximize the use of renewable energy and minimize fossil fuels thereby reducing system operating costs.

Green & Saving

4 steps to reduce cost of operating and minimium emission

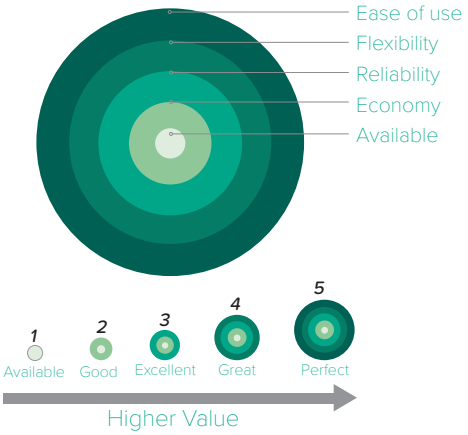
Save fuel
Significant fuel savings through intelligent software, energy storage and optimized generator set efficiency.

Savings in investment
From product portfolio efficiency and economical optimization, standardization of instillation and deployment to facilitation of operation and management, we can bring customers savings in investment costs.

Save O&M cost
Highly efficient fossil power generation equipment, used for the minimum number of hours required per year, reducing equipment cost, maintenance and spare parts.

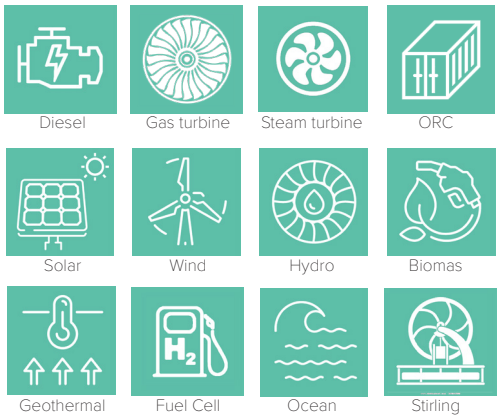
Reduce emission
Improve the combination of fossil power generation efficiency, energy storage and renewable energy, is very effective in reducing CO2 emissions and beneficial to the global environment.

Integrate the system at a higher level



Leading product design standards and vision

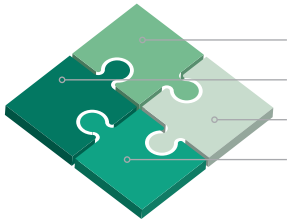
The hybrid microgrid integrates the three areas of power generation, transmissio and distribution, with power consumption into an integrated and innovative total system. Although it is a miniaturized power system, it faces the same technical challenges as a national power system. Creating a balanced hybrid microgrid system is like building a great building, it needs to meet basic requirements and also deliver to higher standards to enable our vision to create better projects. We aim to be more efficient, more environmentally friendly, more reliable and safer, and more user-friendly.



More comprehensive use of various power generation technology advantages

Based on global development and environmental protection, hybrid power or microgrid has become a trend for future global power development. Electric power was historically viewed as a secondary energy source, with early power generation based on fossil fuel resource. This resulted in the steam turbine, internal combustion engine and gas turbine driving the development of power generation technologies. In recent decades however, with the increasingly serious problem of global pollution, the use of renewable energy to generate electricity has become a more mainstream direction. Emerging technologies that use sunlight, wind, biomass, geothermal resources, ocean energy and hydropower have been continuously developed. As these technologies become more mature and are adapted to local conditions, we can develop local renewable resources and produce stable power sources to serve local economic and social activities. Therefore, to create an excellent hybrid microgrid system, it is necessary to fully grasp the operating characteristics of various power generation technologies, and apply the best manufacturing and production components in the world today to complete the integration.

Hybrid Microgrid Solution



Electric & Electronic

IT & Communication

Energy Storage

Power Generation

-Fossil Power
-Renewable Energy:
-Solar, Wind
-Geothermal,
-Biomass,
-Hydro, Ocean, etc

Deeper connection to power generation, PE, ESS and IT/Communication Technologies

How to combine volatility and stable power generation resources in a small-capacity system to meet a series of changing load requirements is a very challenging task that requires in-depth technical research. Today's intelligent digital microgrid technology builds upon the latest developments in modern power electronics technology, various energy storage technologies, and IT and communication-based energy management system software technologies. These technologies bring reliability, economy, ease of use, and flexibility to the hybrid microgrid system. With the continuous reduction in hardware and software costs, distributed hybrid microgrids are bound to be widely used and welcomed by users.

Deeply focused on key technologies

Power Electronic

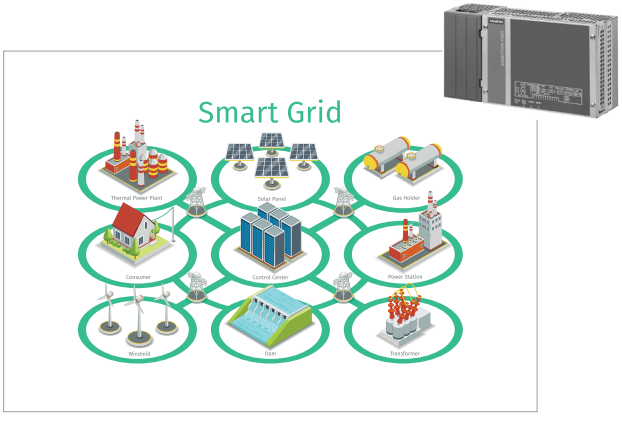
Power electronics is the application of solid-state electronics to the control and conversion of electric power. The first high power electronic devices were mercury-arc valves. In modern systems, the conversion is performed with semiconductor switching devices such as diodes, thyristors, and power transistors such as the power MOSFET and IGBT. In contrast to electronic systems concerned with transmission and processing of signals and data, in power electronics substantial amounts of electrical energy are processed. The power conversion systems can be classified according to the type of the input and output power:

- AC to DC (rectifier)
- DC to AC (inverter)
- DC to DC (DC-to-DC converter)
- AC to AC (AC-to-AC converter)

Active harmonics filter | Voltage control | Peak shaving | Reactive power Control | Frequency stabilization

EMS (IT & Communication)

Energy management system (EMS) is built around IT and communication technology. It is the central command system of intelligent hybrid microgrid. It connects and manages various power generation equipment, transformer units, energy storage systems, and balances load requirements, whether it is an independent isolated network or connected to the grid. Excellent EMS can automatically optimize petrochemical energy efficiency, maximize the use of renewable energy, and reduce the operating costs of microgrid systems. Modern advanced IT and communication technologies provide a channel for people to quickly and easily manage microgrids, and at the same time bring great flexibility to users' comprehensive energy applications and equipment management.



Energy storage

Energy storage introduces many advantages such as balancing generation and demand, power quality improvement, smoothing the renewable resource's intermittency, and enabling ancillary services like frequency and voltage regulation in microgrid operation. Hybrid energy storage systems characterized by coupling of two or more energy storage technologies are emerging as a solution to achieve the desired performance by combining the appropriate features of different technologies. A single ESS technology can not fulfil the desired operation due to its limited capability and potency in terms of lifespan, cost, energy and power density, and dynamic response.

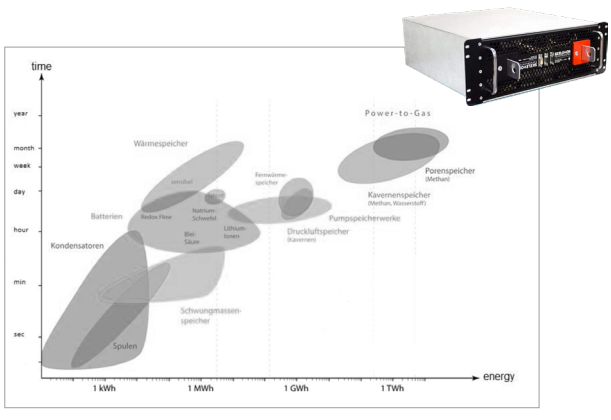
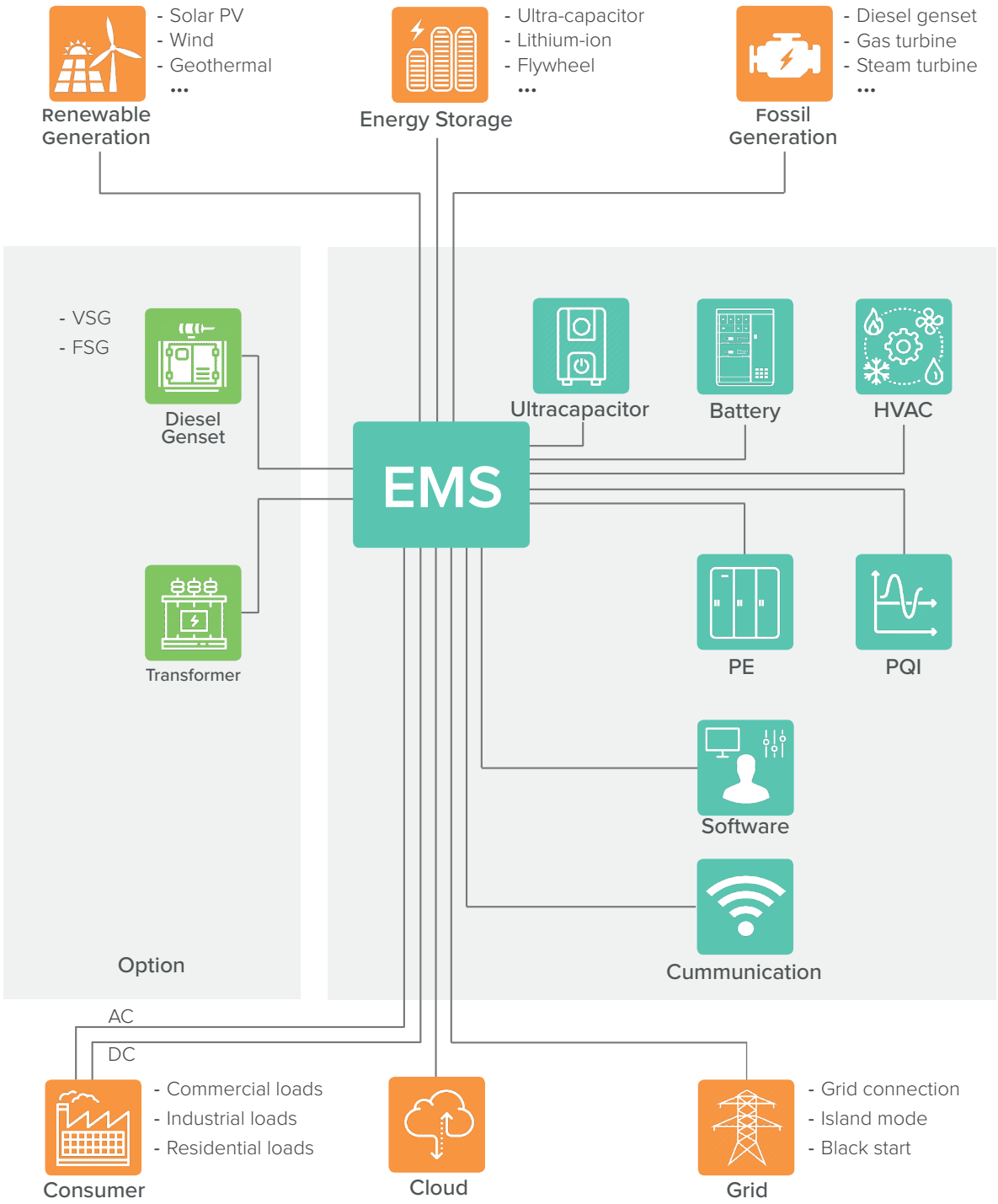


Diagram of an energy management system

Automatic, But everything under your control



Always thinking from a user's perspectives to creat value

—

A Dependable & Cost-effective Solution

Reliable

Providing essential off-grid quality power with blackstart capability.

Affordable

Maximize and make use of local renewable energy resources: including solar, wind, hydro, biomass, ocean, geothermal. Less conventional power, with lower maintenance costs of your projects.

Clean

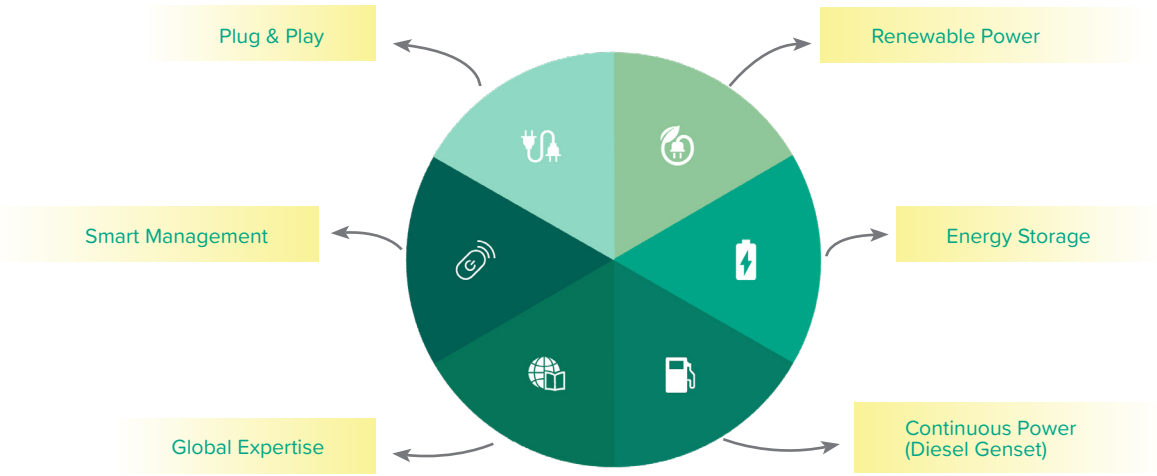
Reducing fuel consumption and associated supply chain risk and CO2 emissions.

Smart

Smart system continuously optimizes the coordination of the Energy Storage, Diesel Genset and Solar power.

Simplicity & Re-usability

Easy transportation, quick set-up, simple management, and everything is reusable globally.



Hybrid Microgrid Solution

Available for any industry and at any location

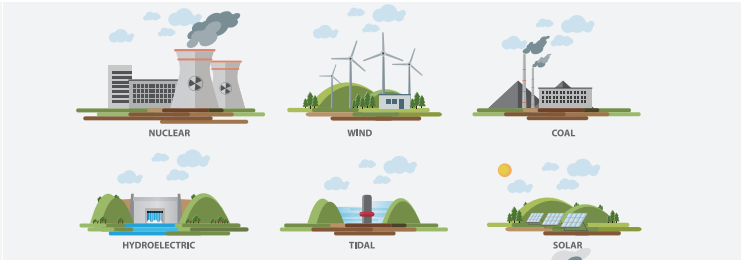
Industries

Smart buildings & Green cities

- Healthcare centre
- Critical process facilities
- Retail & leisure facilities
- Industrial & office building

Power generation

- Renewable generation
- Conventional generation
- Transmission & distribution
- Smart Microgrid

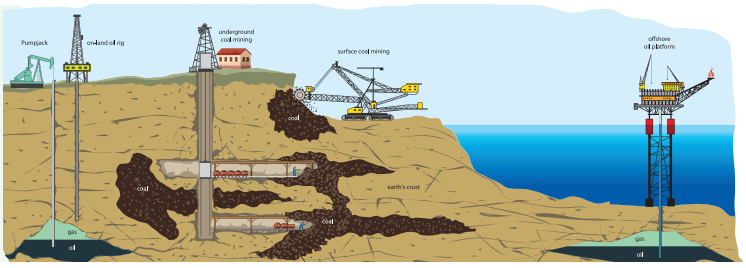


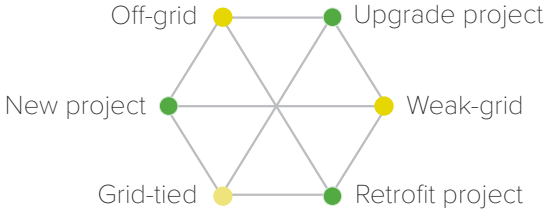
Manufacturing & Municipal engineering

- Manufacturing factory
- Critical process industries
- Transport & Public system
- Water & Sewage treatment

Mining and refining of Raw material

- Various Mining
- Minerals & cement
- Oil & gas
- Steel & metals

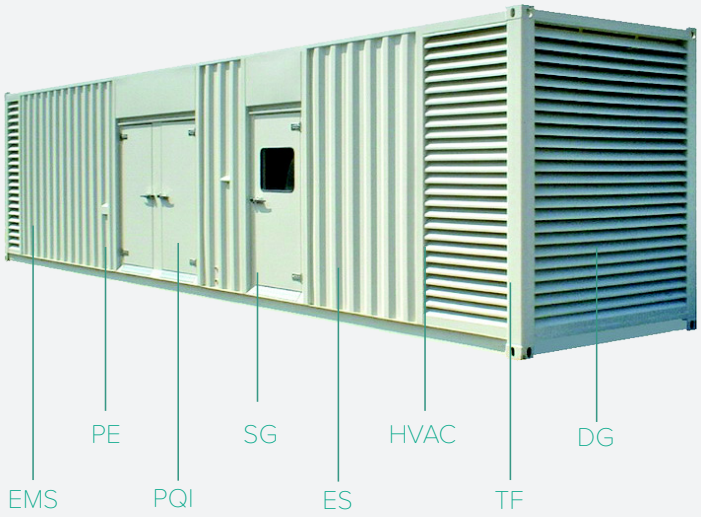




A full range of business opportunities

New system concept

All for one, One for all



EMS

Energy Management System
Hardware and software with communication.

PE

Power Electronic
Multiple-Source converter (DC-DC or AC-AC), recitifiers (AC-DC), inverter (DC-AC).

PQI

Power Quality Improve
Active harmonic filters, voltage stabilization, balance of reactive power, frequency control.

SG

Switch Gear
LV or MV circuit breaker made by European Top Brand Manufacturer.

ES

Energy Storage
Ultracapacitor or Lithium-ion or flywheel and management software.

HVAC

Heating, Ventilation and Air Conditioning
Air conditioning unit, water cooling system, heat exchanger.

TF

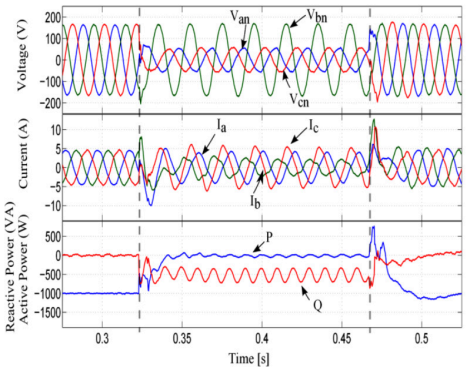
(Option) Transformer
LV to HV
(Max up to 15KV)

DG

(Option) Diesel Genset
FSG (Fixed Speed Genset) or VSG (Variable Speed Genset)

Product function

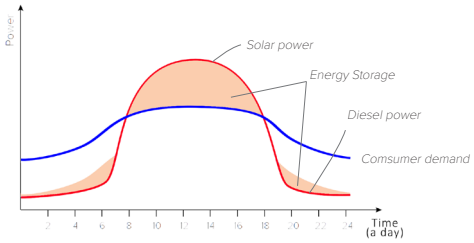
More functions, Easier to use



Stability

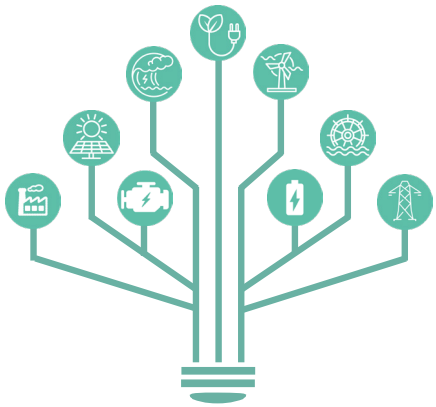
- High dynamic reactive power control to stabilize voltage.
- Providing Firm frequency Response (FFR) to stabilize system frequency.
- Providing STOR (Short Term Operating Reserve) to balance intermittency of renewables.
- System can seamlessly decouple microgrid, moving from tired-grid to island operation mode.
- Tolerant to 100% unbalanced load, designed to handle non-linear loads.
- Automatic balancing of power generation, Energy Storage and variable demands.

Solar Diesel and Energy Storage Hybrid Microgrid



Efficiency

- Shifting peak generation to peak demand by energy storage system.
- Increased renewable penetrations, improved economics, greater flexibility and lower emissions.
- Optimized use of generator in order to reduce fuel and O&M cost.
- All-in-one and ready-to-install, quicks set-up on-site. Reduced installation cost.
- Standardized product design, mobile and modular with ISO container, easy scalable with fast integration.
- Multi-source power converter; parallel operation of several energy sources, with variable speed diesel generator to run only when needed, reduced energy storage investment cost.



Smart

- Maximizes renewable energy generation, manages and minimizes fossil fuel consumption.
- Capability to integrate data into the management system.
- Able to present all data from system with advanced software.
- Technology for providing cloud data service.
- Remote access and control of entire system, convenience of after sales service support, real time monitoring, managed start-up after shutdown.
- Energy arbitrage, trading wholesales power to benefit from price fluctuations.

Service support

Step by step to always meet your needs

1 FEASIBILITY

Caigatex assesses the technical, economic and operational possibilities. We evaluate the technical and commercial return versus investment required. We analyse your exact requirements and identify a 'best fit' solution.

- Application analysis
- Technical, operational and projected performance studies.

Preliminary Documentation

2 F.E.E.D.

During Front-End Engineering & Design, we identify performance requirements to define equipment specifications as well as a programme schedule, with targets and cost estimates, providing you with a preliminary solution and design plan.

- Preliminary planning
- Equipment specification
- Programming schedule
- Budget costing

Preliminary Design

3 DETAILED DESIGN

Caigatex offers definitive, detailed designs with full technical, material and component specifications.

- Mechanical, electrical and system design
- Finalisation of component sourcing and scheduling

Technical Specifications

4 E.P.C.

During the Engineer, Procurement & Construction stage, we finalise all necessary engineering designs and planning. A dedicated project management team will execute the build and manage the documentation process.

- Procurement
- Project execution
- Construction
- Fabrication
- Package
- Testing
- Installation
- Commissioning
- Handover

Equipment delivered, installed and handed over design

5 OPERATION

Certification and handover is not the end of the Caigatex service. Maintenance contracts can be established and operational staff can be provided training programs to ensure all systems are monitored and continue to operate at maximum efficiency.

- Testing
- Maintenance
- Training
- Management

Product range

Note

FSG: fix speed genset
VSG: variable speed genset

Scale	Small-Scale			Medium-Scale				Large-Scale		
Model	PH50-S	PH100-S	PH250-S	PH500-M	PH1000-M	PH1500-M	PH2000-M	PH3000-L	PH4000-L	PH5000-L
Rated output (KW)	50	100	250	500	1000	1500	2000	3000	4000	5000
Voltage	LV			LV				HV		
Freqency	50Hz / 60Hz			50Hz / 60Hz				50Hz / 60Hz		
Included	EMS / PE / ESS / VSG			EMS / PE / UPS / VSG				EMS / PE / UPS / VSG / TF		
With	PQI / SG / HVAC			PQI / SG / HVAC				PQI / SG / HVAC		
Connecting Available	Renewable			Renewable, ESS or Fossil				Renewable, ESS, Fossil		
Option (Add or Reduce)	-VSG / +FSG			-VSG / +VSG or +FSG				-VSG / +VSG, +FSG / -TF		
Diesel Genset (KW)	50	100	250	500	500^{+}	500^{+}	500^{+}	1000^{+}	1000^{+}	1000^{+}
U-UPS (KW)	50	100	250	500	500^{+}	500^{+}	500^{+}	1000^{+}	1000^{+}	1000^{+}
MAX ESS (KW)	50	100	250	500	1000	1500	2000	3000	4000	5000
MAX Renewable (KW)	50	100	250	500	1000	1500	2000	3000	4000	5000
MAX Ftossil (KW)	50	100	250	500	1000	1500	2000	3000	4000	5000
Package	10ft			20ft				40ft		
Dimension (mm)	10ft: 2991×2438×2591			20ft: 6058×2438×2591				40ft: 12192×2438×2591		

10ft

2991 × 2438 × 2591

20ft

6058 × 2438 × 2591

40ft

12192 × 2438 × 2591

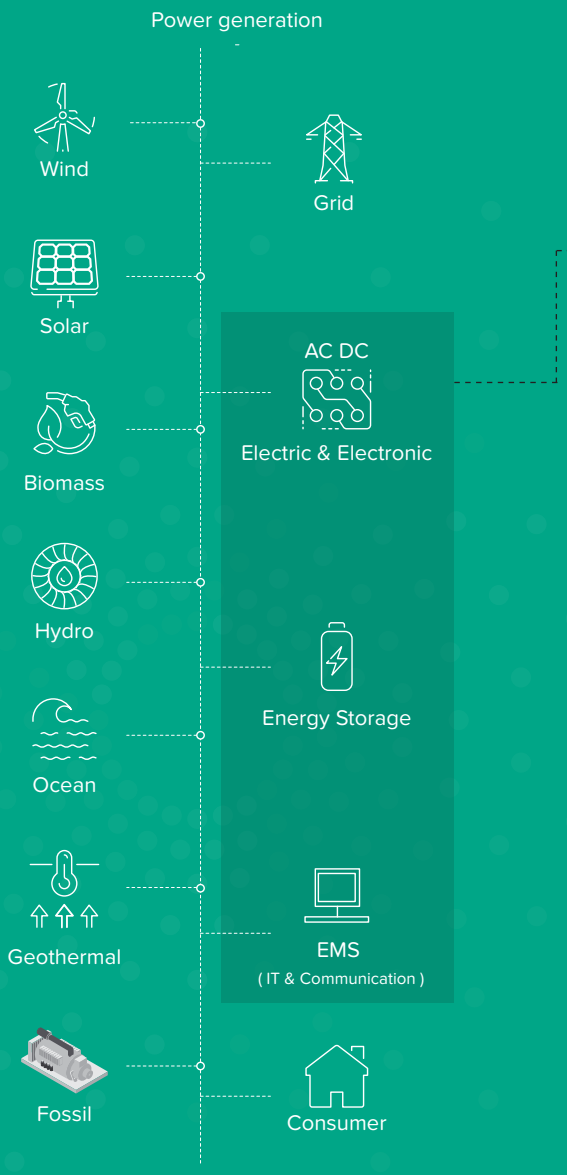
Data sheet

General data MSC converter micro grid consumer side		
Nominal voltage	Option 1	230/400 V AC 3-phase
	Option 2	110/220 V AC 2-phase
	Option 3	110/208 V AC 3-phase
	Option 4	400/690 V AC 3-phase
	Option 5	HV up to 15KV
Frequency		50Hz / 60Hz + / -1%
Nominal power output		50kW...5.0MW
Voltage level		+/-5%
Voltage distortion		<5%
DC output voltage		550 V DC
DC output current		200...1000 A DC
General data MSC Input side		
Wind turbine		Max up to 5.0 MW (Max 15 individual turbines)
Solar PV		Max up to 5.0 MW (Max 50 individual strings)
Diesel Genset		Max up to 5.0 MW (Max 10 different generators)
Other renewable		Max up to 5.0 MW
Public grid	Option	50 KW...5.0MW
Energy storage section		
Super-capacitor		50KW / 15sec...1.0MW / 15sec
Lithium-ion battery		50KW / 50kWh...5 MW / 5 MWh...
Battery Management System		included
Control System		
Controller		Siemens Simotion P320 or similar
Software		TEX Microgrid Controller/Simotion Scout
Internal communication		Profinet
External communication		Ethernet, TCP/IP, analogue 4-20mA
Response time		<20ms
Communication		
Ethernet		100 Mbit
Profinet		RT, IRT
ProfiBus		12 Mbit
CAN		CAN Open
Other Communication Protocols		ModBus TCP, DNP3, IEC61850 and others
Converter		
Principle		IGBT inverter
IGBT type		SKiiP 3640GB17E4-4DUW
IGBT switching frequency		2 ... 4 kHz
Over Temperature Protection		All relevant temperatures are monitored by PLC
Environmental/ambient conditions		
Temperatures	Operation	-40...+45°C
	Storage	-40...+60°C
Max. operation height		2000 m (high altitude with reduced capacity tbd)
Humidity		95% non-condensing
Protection		IP54

Power solutions

Fossil Power. Hybrid Power. Heat Power.

Integrated solution provider for Hybrid Microgrid Solution



PowerHub Service

POWERED BY

FossilPower **Hybrid**Power **Heat**Power

Caigatex is all about providing innovative technology into actual life-changing projects – people cannot live without power! It's about getting the most power out of your system with the least amount of work and cost.

Our mission is simply to "create a cleaner and smarter power solution".

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CAIGATETEX
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