



Industrial Solutions



Reliability of supply

Wind and photovoltaic are non-dispatchable generators. Production is dictated by weather conditions, not users' demand.

Energy Efficiency

Variability in demand and production by wind and sun can cause energy losses when the generated energy exceeds consumers' needs.

Grid Stability

Integration of renewables can cause difficulties in managing stability of the grid in terms of voltage and frequency.

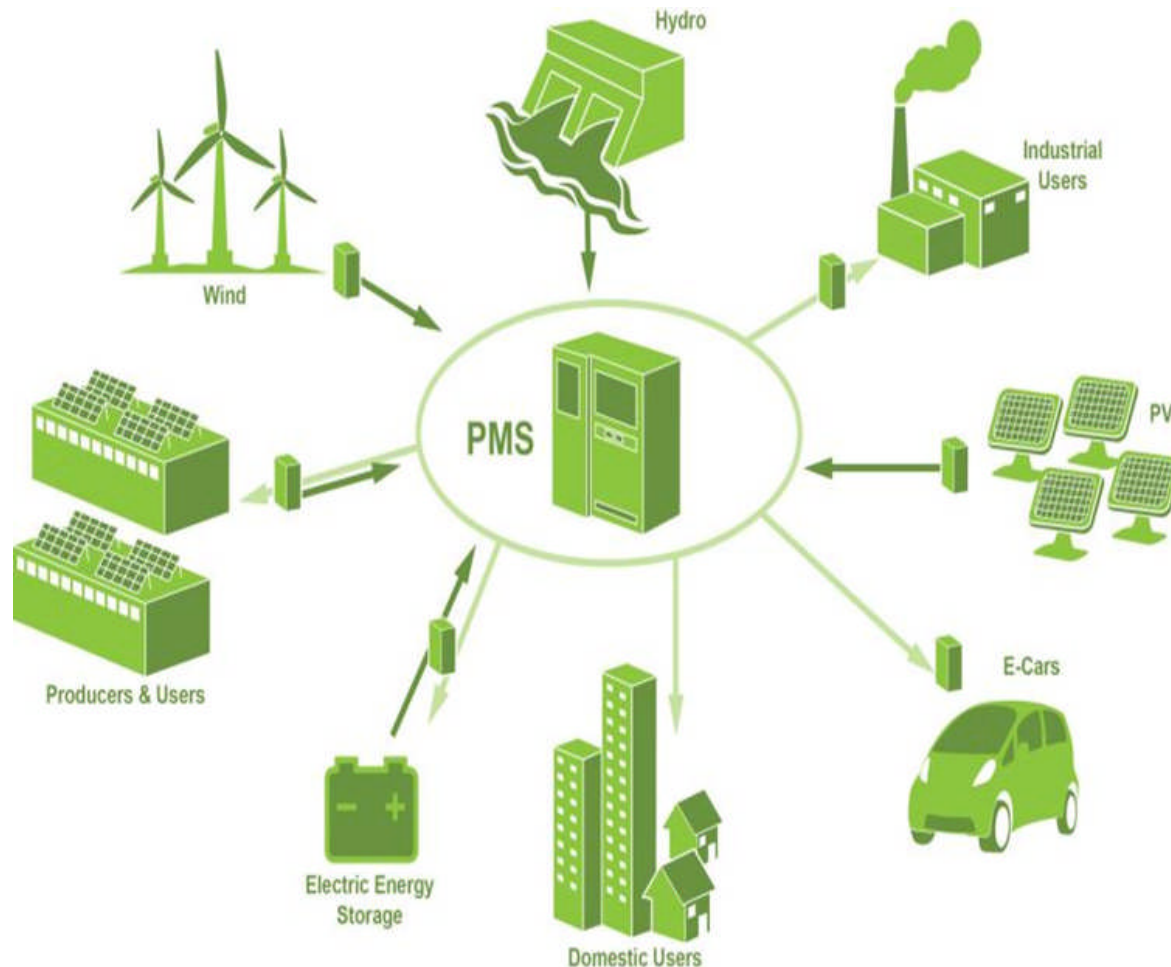
**ENERGY
STORAGE**
(is the)
SOLUTION

We provide turnkey solutions worldwide



Experience

More than 70 MW of microgrid and battery energy storage solutions (BESS) installed worldwide

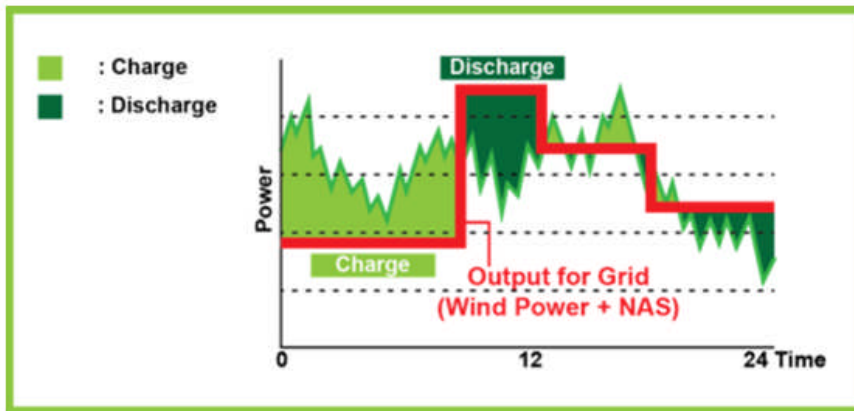


A microgrid is a subset of electric network where distributed generators and loads are connected.

- Integration of different power sources in a SMART system
- Proprietary Power Management System (PMS) managing the microgrid and providing efficient backup/storage
- Best technology selection for Customer's expected consumption profile

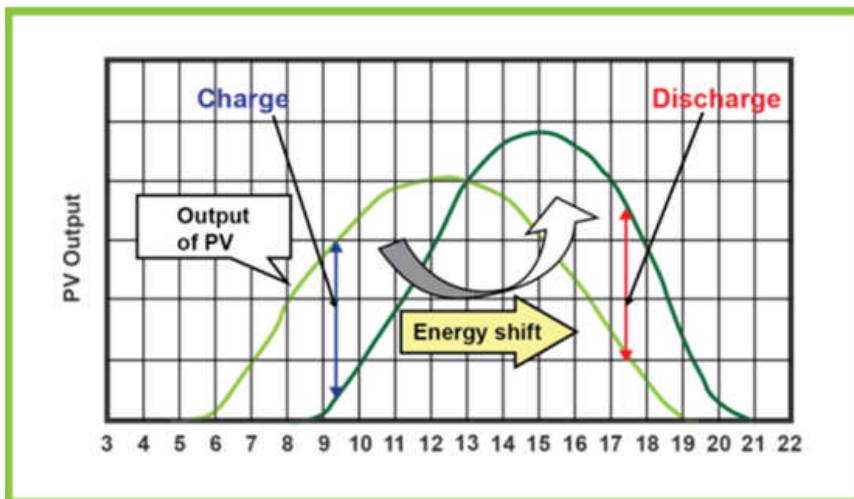
Regardless of whether
connection to the grid is
available

Power Balancing



Power balancing:
compensating the random
production of energy from
wind and sun in real time

Time Shifting



Time shifting / peak shaving:
the system can store the
energy when the load of the
grid is weak and it can inject
energy during the peak hours.



- Increases self-consumption of renewables
- Provides back-up during sudden outages
- Reduces peak consumption improving grid stability
- Reduces energy bill by using stored energy when the price of electricity is highest

Commercial applications



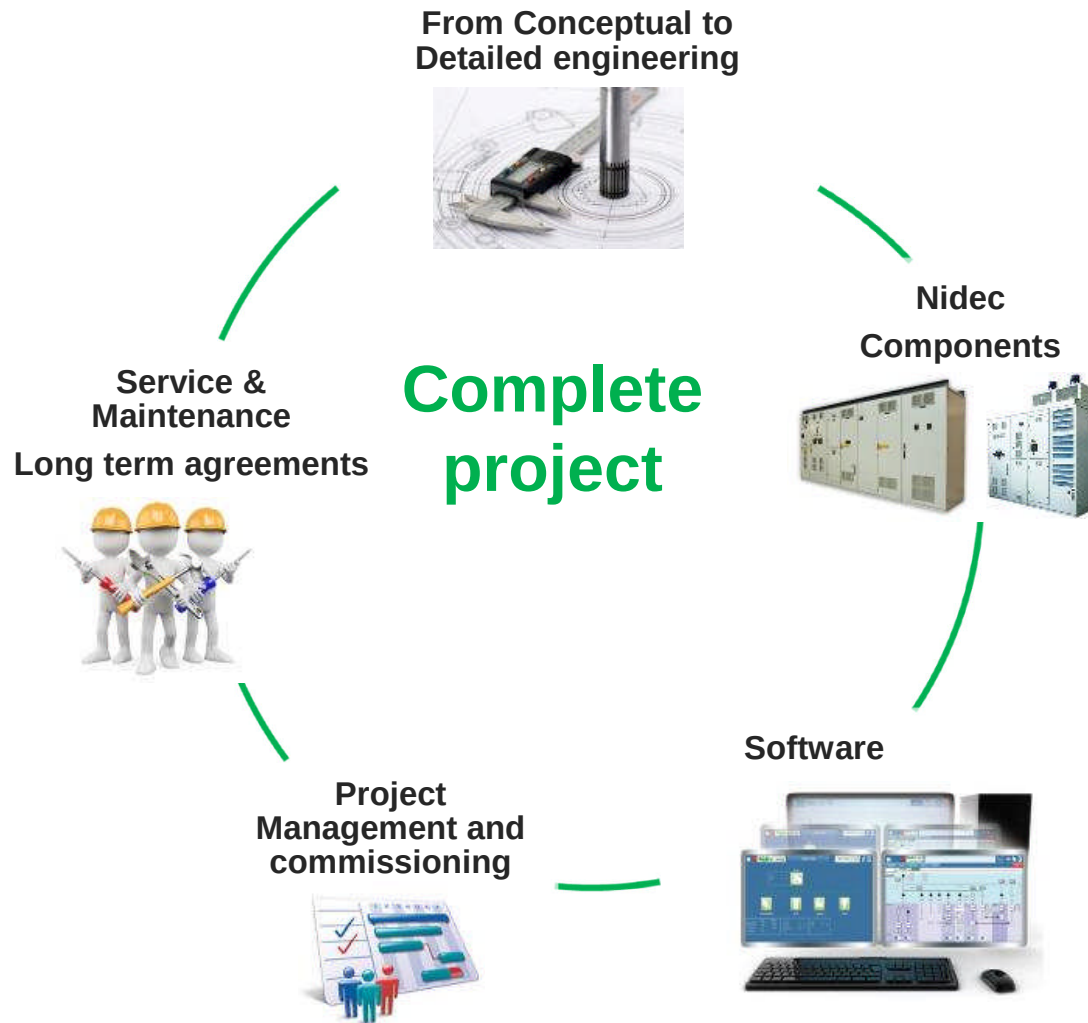
- Permits seamless integration of renewables and time-shifting of production
- Reduces costs for fuel and for fuel delivery
- Reduces CO2 emission
- Reduces duration and number of power outages

Rural & Remote applications



- Stabilizes voltage and frequency of the electricity grid
- Smooths out peaks in energy consumption
- Balances differences between supply and demand in real-time
- Permits sale of energy at the highest price

Grid-tied applications



Greenfield: from integration to complete design of the microgrid

Brownfield: grid stabilization or improved performance

Power Quality: Load analysis and definition of energy strategy

Maximize ROI: we help optimize resources to secure the best return

EPC+

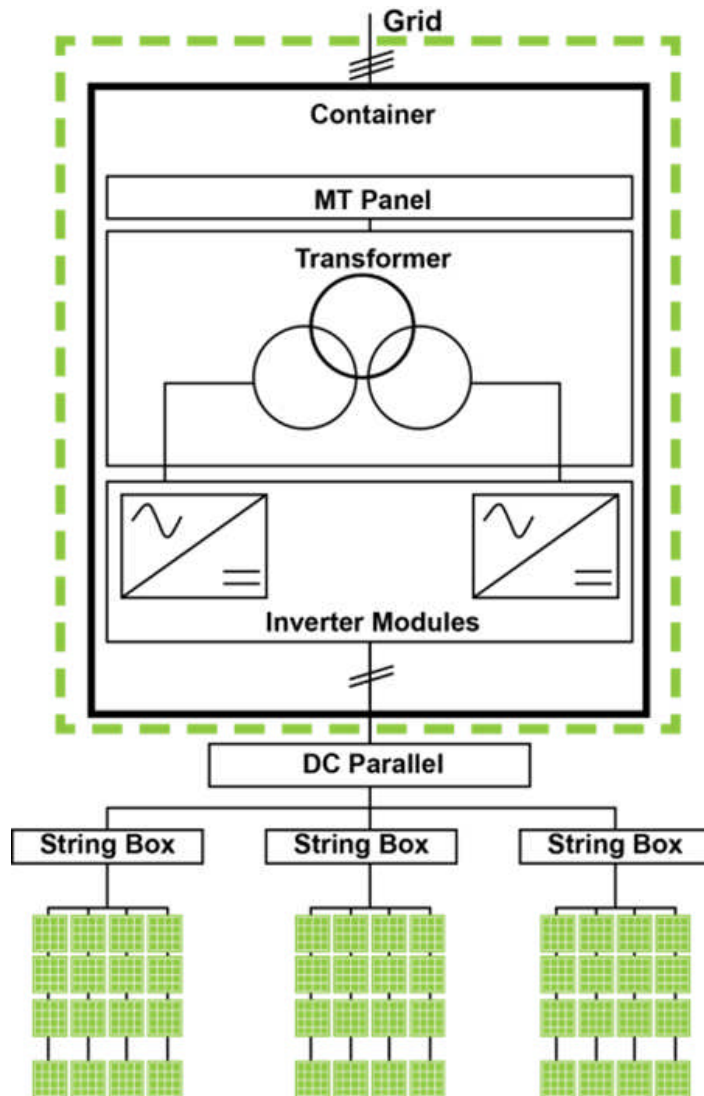
- ✓ Turn-key offer
- ✓ Operation & Maintenance
- ✓ Remote services

BoS

- ✓ Engineering, Procurement & Supervision
- ✓ One Stop Shop for full electrical package, from basic design to installation

Equipment & Software

- ✓ Power Converter equipment
- ✓ PV inverters
- ✓ Power and Energy Management System (PMS+EMS)



Key functions

- Power metering
- Measure and analysis of the electric distribution system
- Real-time control for loads and generators
- Emergency and protection management
- Monitoring and supervision system
- Historical data collection





In our pursuit for excellence we cooperate with a number of world-class battery manufacturers:



- NIDEC ASI produces the **power converter equipment** and the related SCADA systems suitable for managing the energy storage equipment using **any kind of batteries** and at the same time guaranteeing the required compliance to the grid codes of the country.
- The converters are suitable for stand-alone use for substation or in combination with photovoltaic plants and wind farms.

Case studies



Scope Of Supply

Total electrical power: 9 MW

- EPC contractor for solar power plant and Energy Storage System

Project overview

Les Cèdres project enabled the End User, Integrated Organic Fishery & Farm to **offset energy costs** by choosing adequate control strategy.

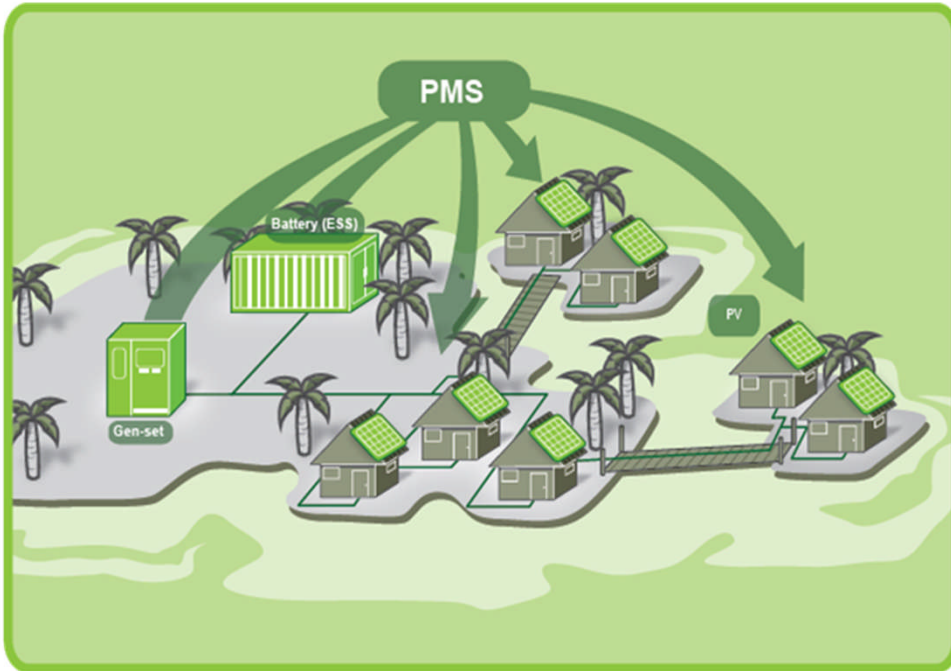
The main goal of the Customer was to **enhance electricity production from renewables** on this French island.

Key elements:

- PV Plant, including solar panel, inverter and transformer
- Energy Storage System (ESS), consisting of batteries, inverter and transformer

Benefits:

- Time shifting of energy production
- Balancing of generation
- Seamless integration of renewables



Scope Of Supply

- Micro grid electrical design and load evaluation (BoS)
- Power Management System - ARTICS Smart Energy
- 1 LV Board
- Water-cooled containerized Power Conversion System (PCS), consisting of:
 - 1 PCS Converter, composed by two parallel cabins
 - 1 PCS Controller

Project overview

The main goal of the project was to maximize energy production from the installed solar capacity, while maintaining **grid stability** and **full electric functionality** at this luxury resort.

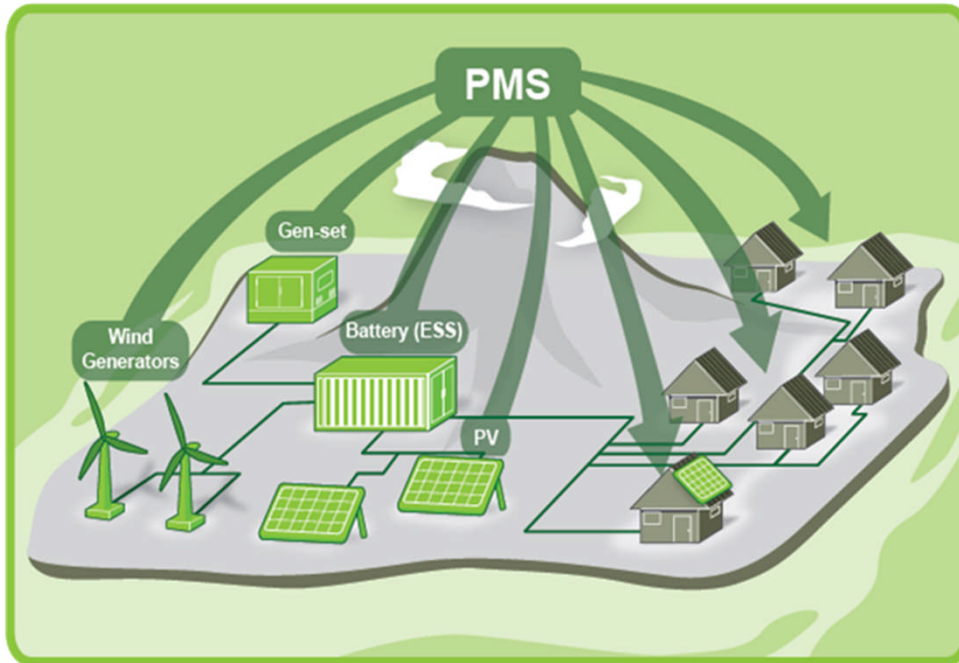
The Client's goal was to ensure the **stability of the electric network**, **reduce energy consumption** and **promote the local generation of energy**.

Key elements:

- 4 diesel generators to start energy production
- Energy Storage System (ESS)
- PV modules installed on the bungalow rooftops

Benefits:

- Maximized energy production from renewables
- Maintained grid stability
- Seamless integration of renewables



Scope Of Supply

- **Power Management System (PMS) - ARTICS Smart Energy**
- **Air-cooled containerized Power Conversion System (PCS), consisting of:**
 - 1 PCS Converter (using a AC/DC converter in AFE (Active Front End) configuration and a DC/DC converter for DC bus control)
 - 1 PCS Controller

Project overview

Goal of the project was to build a hybrid power system able to provide **continuous energy supply** for the Ollagüe, Chilean frontier mining village.

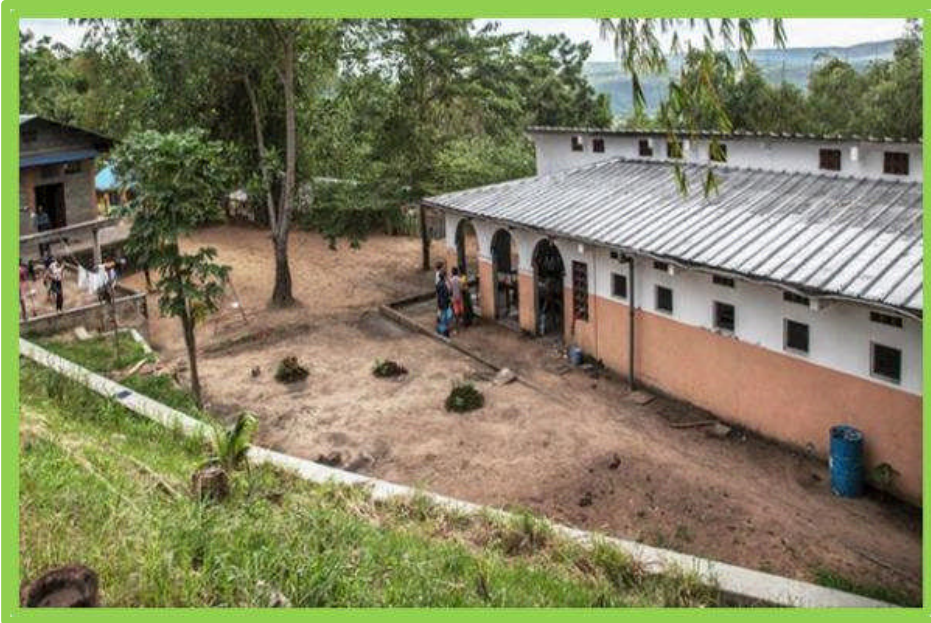
The Customer wanted powerful **Power Management System** to integrate a high number of renewables in a smart microgrid configuration.

Key elements:

- Generation from PV Plant and wind turbines
- Battery Energy Storage System (BESS)
- Diesel generation, for emergency supply

Benefits:

- Stable and independent power supply
- Advanced grid control by means of ARTICS
- Battery charge/discharge management



Scope Of Supply

Total electrical power: 30 kW unbalanced

- **Power Conversion System (PCS) consisting of:**
 - 1 PCS Converter (using a AC/DC converter in AFE (Active Front End) configuration and a DC/DC converter for DC bus control)
 - 1 PCS Controller
 - 1 Transformer

Project overview

The goal of the project was to ensure the **continuity of the power supply** to the Kimbondo Pediatrics, Orphanage and Hospital, located in Congo.

The Customer's goal was to provide **safe environment** for orphans who live in the hospital, using Energy Storage technology for improvement of the **electrical stability**.

Key element:

Nidec ASI has provided the Power Conversion System for smooth integration of 30 kW Energy Storage.

Benefits:

- Continuous power supply
- Big savings on fuel and maintenance
- Remote access control system via satellite



Scope Of Supply

- 6 Power Conversion Systems (PCS), with power range from 900 up to 1200 kW.

Each PCS included in 40ft container is consisting of:

- 1 PCS Converter (using a AC/DC converter in AFE (Active Front End) configuration and a DC/DC converter for DC bus control)
- 1 PCS Controller
- 1 MV/LV Transformer
- 1 MV switchgear
- 1 Water cooling system

Industrial Solutions

Project overview

The goal of the project was to overcome the **grid stability** problems generated by unpredictable renewable sources.

The Storage Lab is a project created by Terna for **increasing the security of electricity systems** in Sicily and Sardinia with the installation of storage systems for a total 40 MW capacity.

Key element:

One of the newest methods to improve reliability of the grid is through the use of **electrochemical batteries** which **accumulate energy** that can be used when needed, rather than dissipate excess energy.

Benefits:

- Safe management of the electricity grid
- Regulation of peaks in energy consumption
- Reduced energy losses

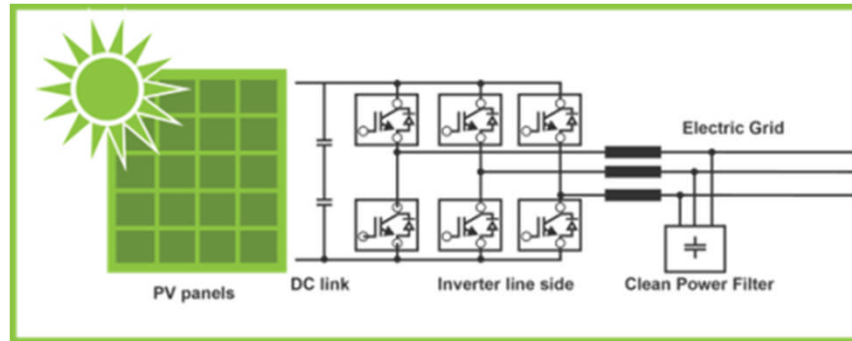
Nidec ASI

- Recognized Power Conversion leader with 150+ years history and more than 2500 units installed across the globe (power, O&G, metals ...)
- Global Project management
- Retrofitting
- Power Quality and Power Supply references
- Network of 25 worldwide service shops

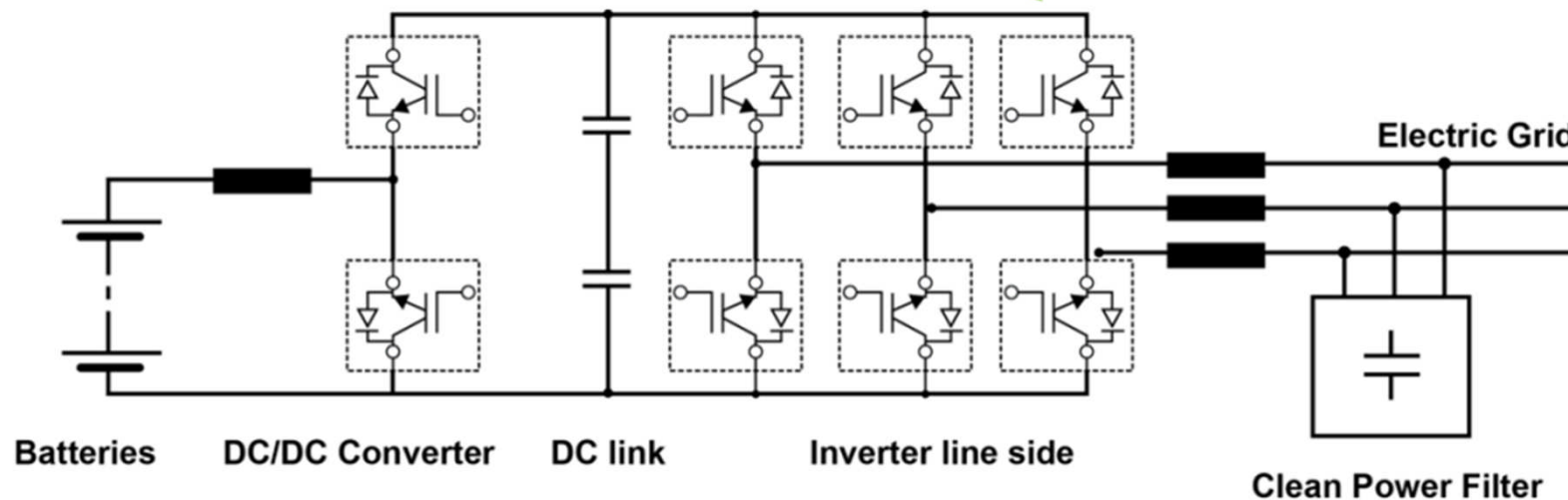
BESS/Microgrids Capabilities

- Evaluation of loads and project design to increase energy efficiency
- EPC of the whole system
- ARTICS EMS for improved grid stability
- Primary regulation through AFE built-in features in the PCS
- Seamless integration of PV and BEES on DC bus through Nidec chopper/inverter
- Reduction of fuel costs by means of renewable energy usage optimization
- Procurement, erection, testing and commissioning and after-sales support
- Cost-benefit analysis for Return on Investment (ROI) calculation

BACK UP

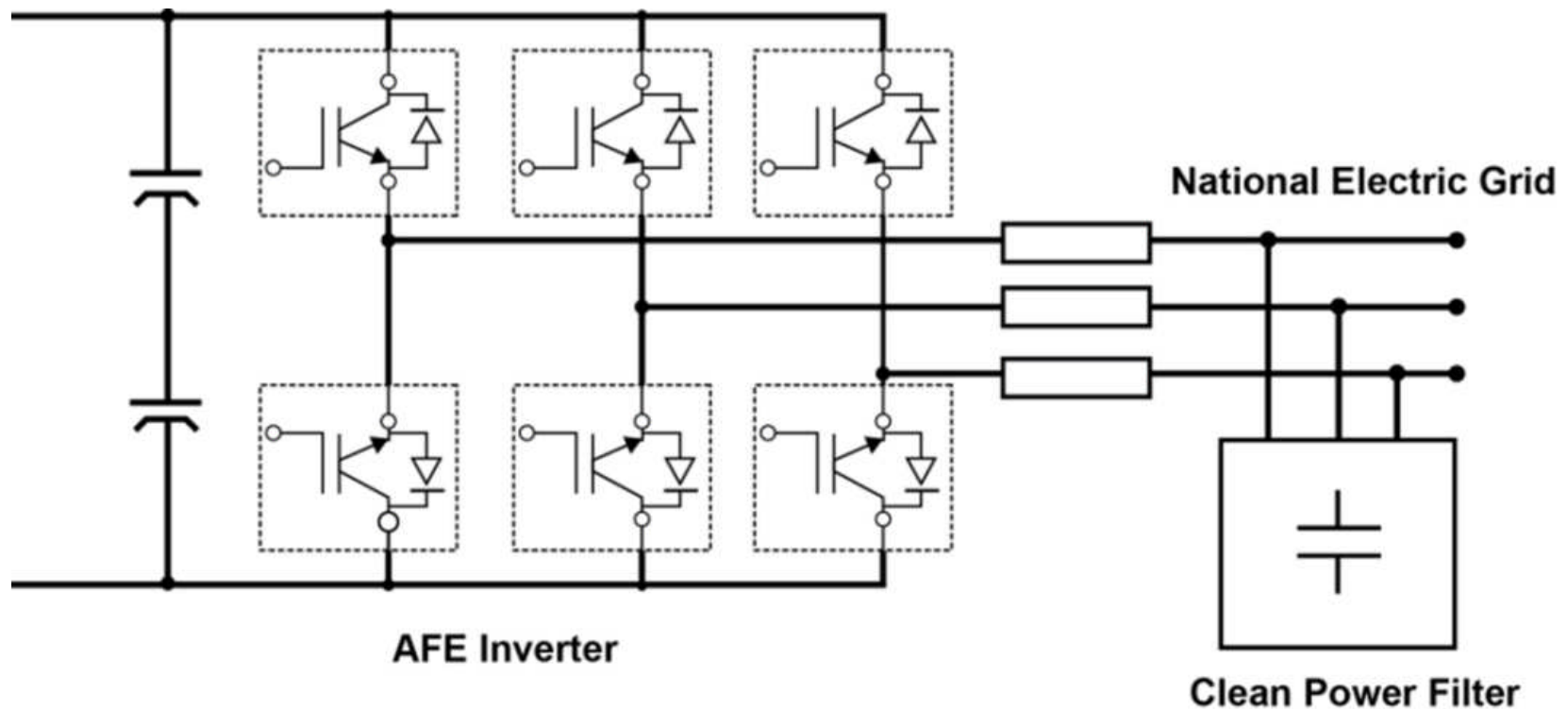


- The batteries are connected to a grid by means of an “AFE” inverter, a solution like the one used in PV or wind plants.
- The charge and discharge of a group of batteries is controlled by a DC/DC converter.



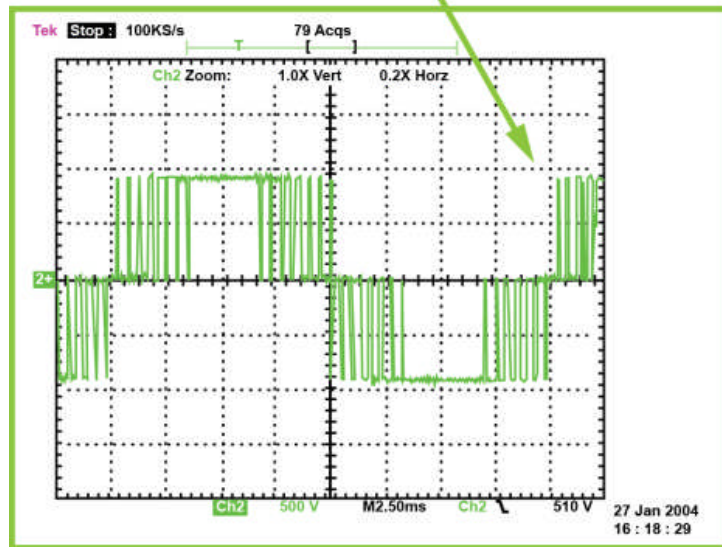


- The grid interface is an AFE inverter with a dedicated control system that allows separate regulation of the active and the reactive power.
- A special line filter cleans out higher frequency harmonics, preventing from being injected into the grid.
- Compliance with the major Grid Code and International Standard
- Primary regulation built-in features



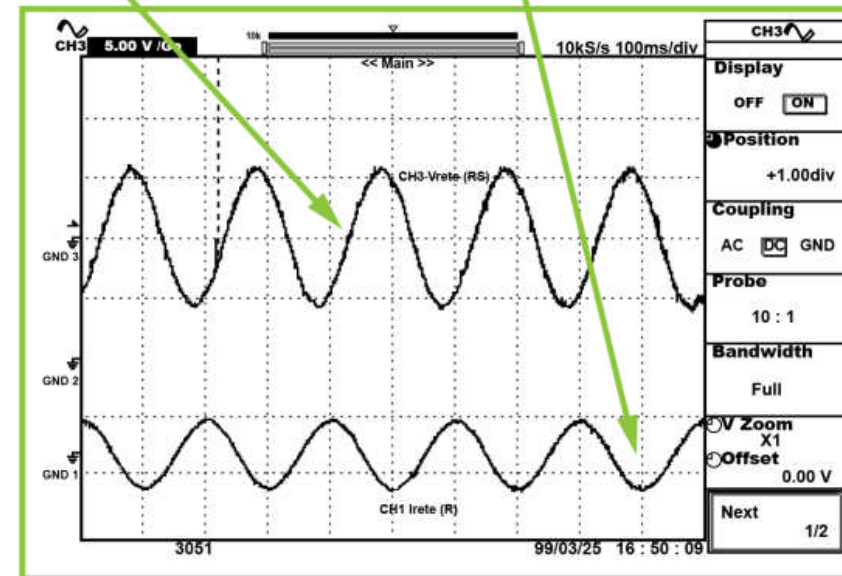
The AFE and the EMC

Voltage waveform
As generated by
The inverter stage

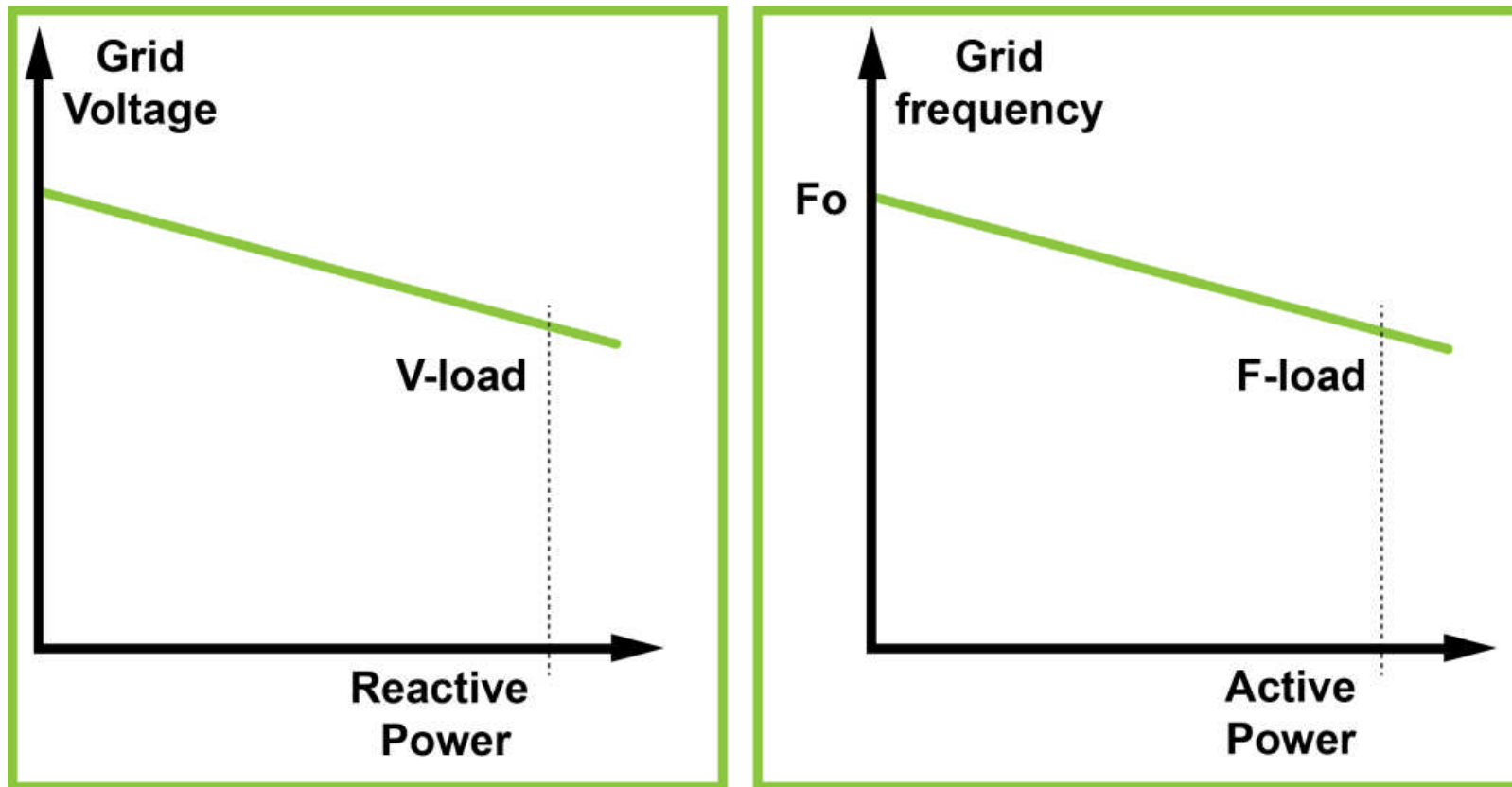


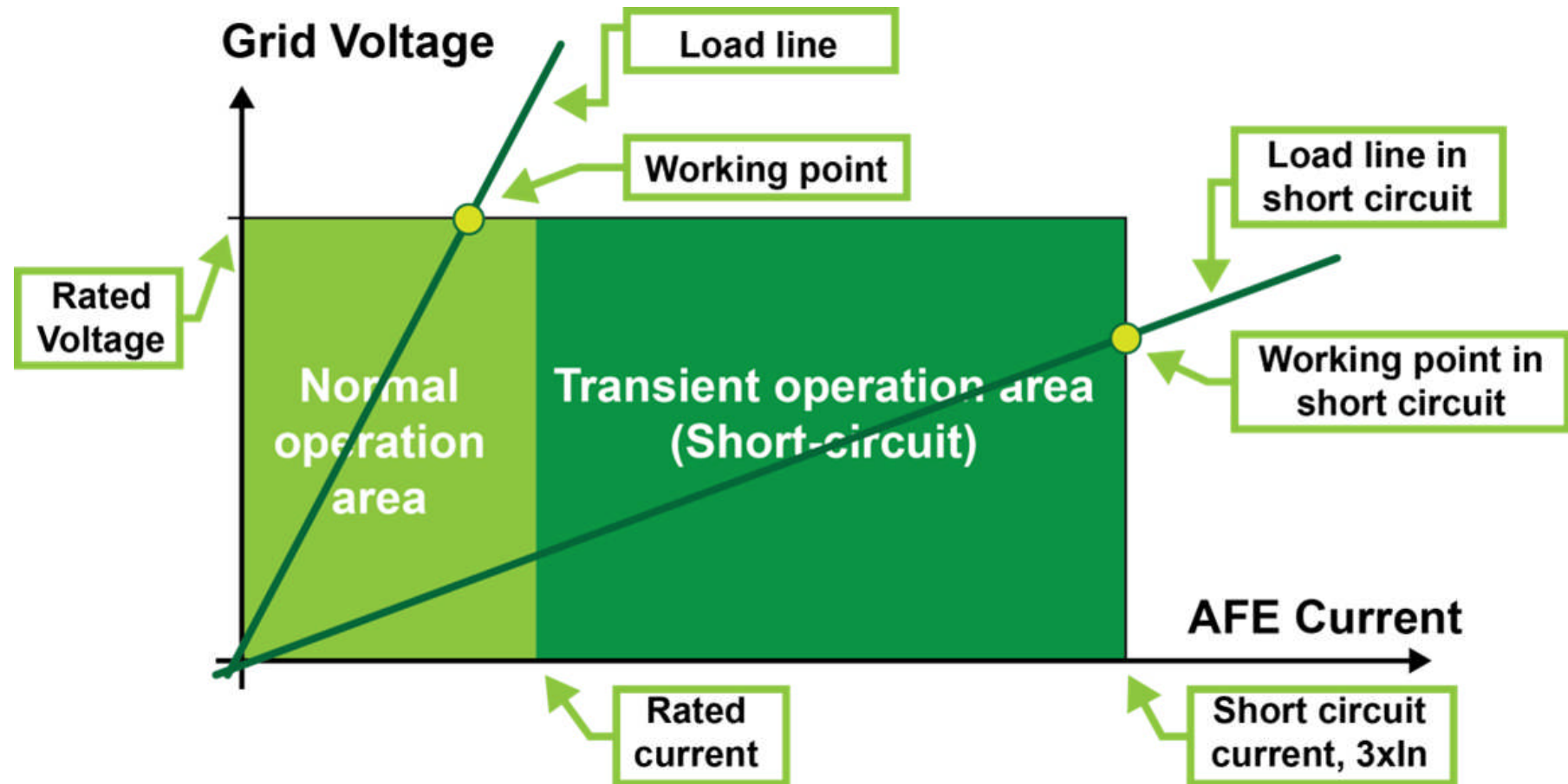
AFE inverter
Output voltage

AFE inverter
Load current

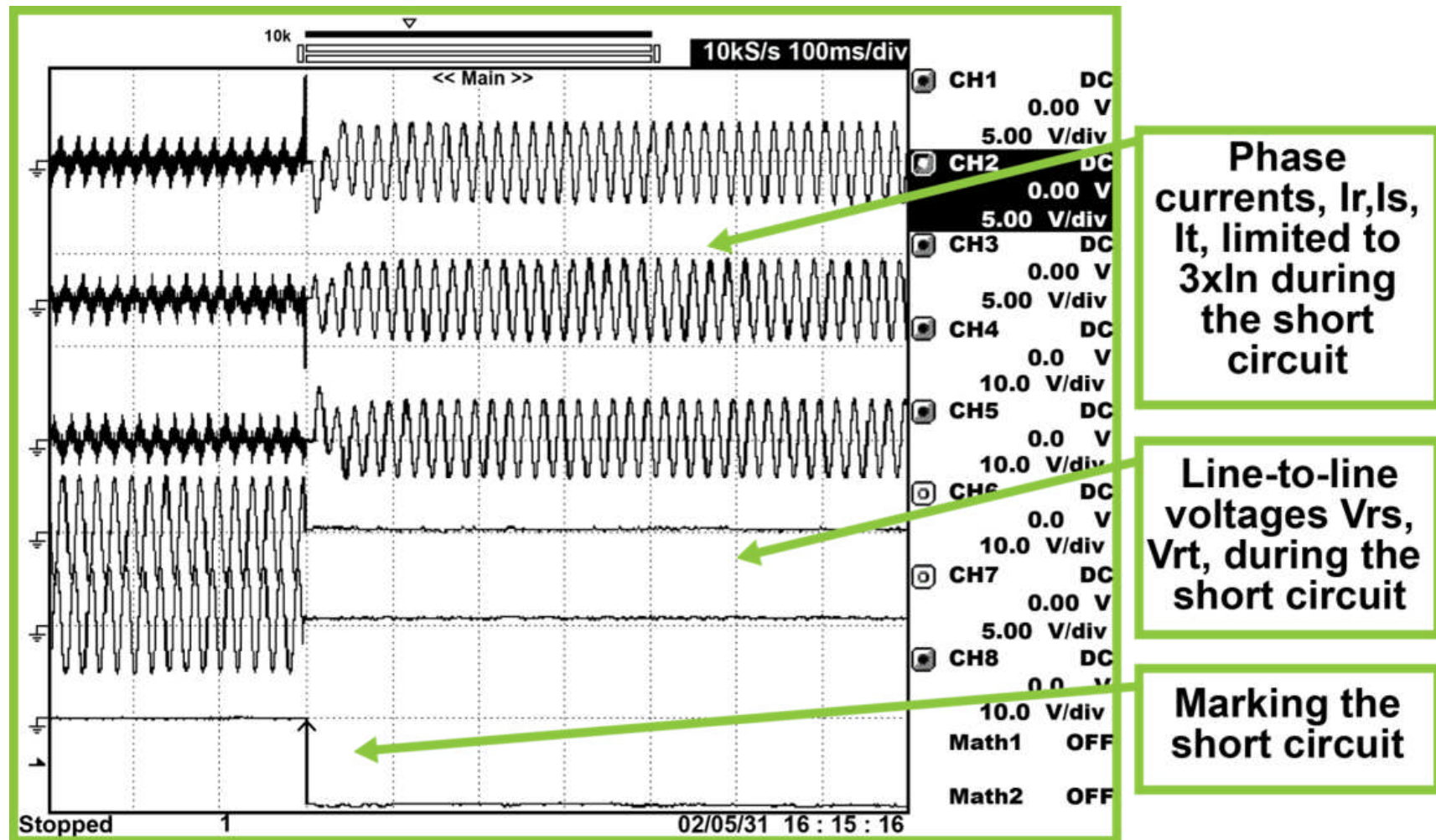


The pwm voltage generated by the inverter is filtered by the “ clean power filter” in order to eliminate the harmonic content and contain the THD within acceptable limits (e.g., less than 2%)

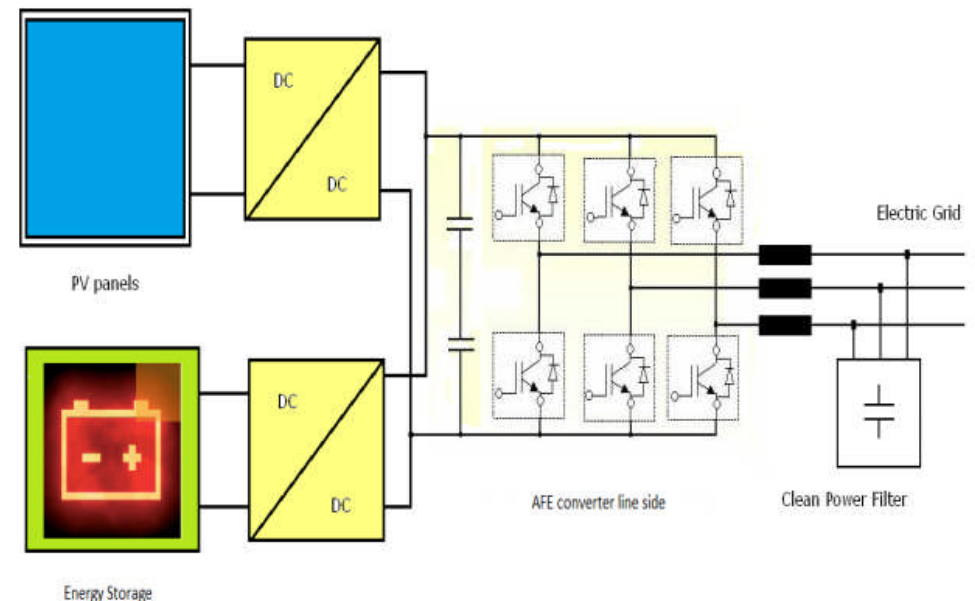
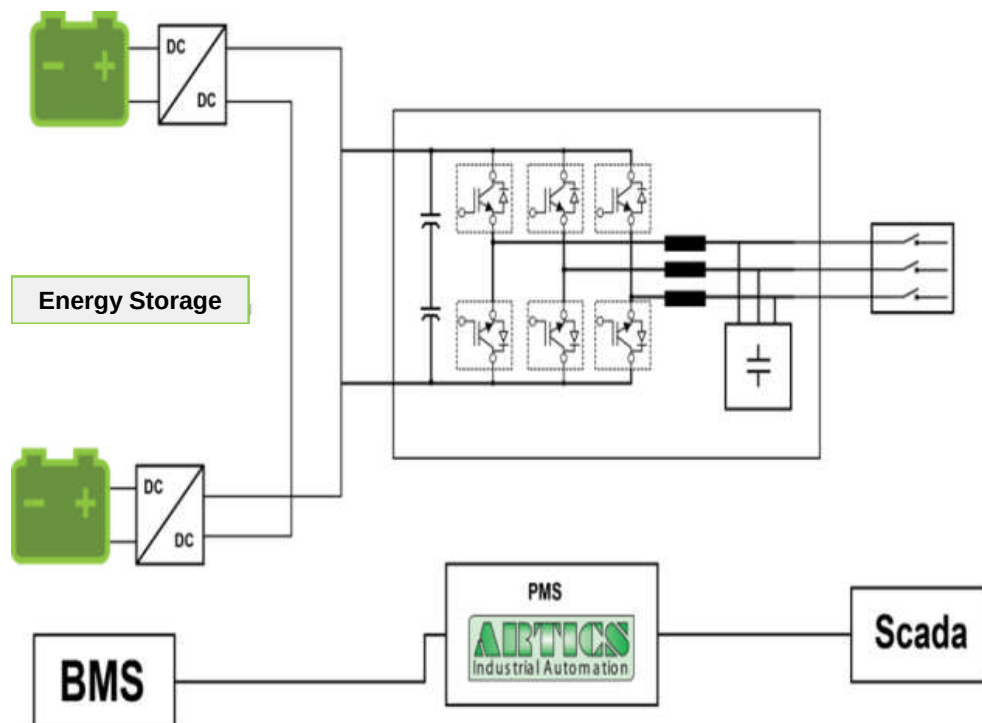




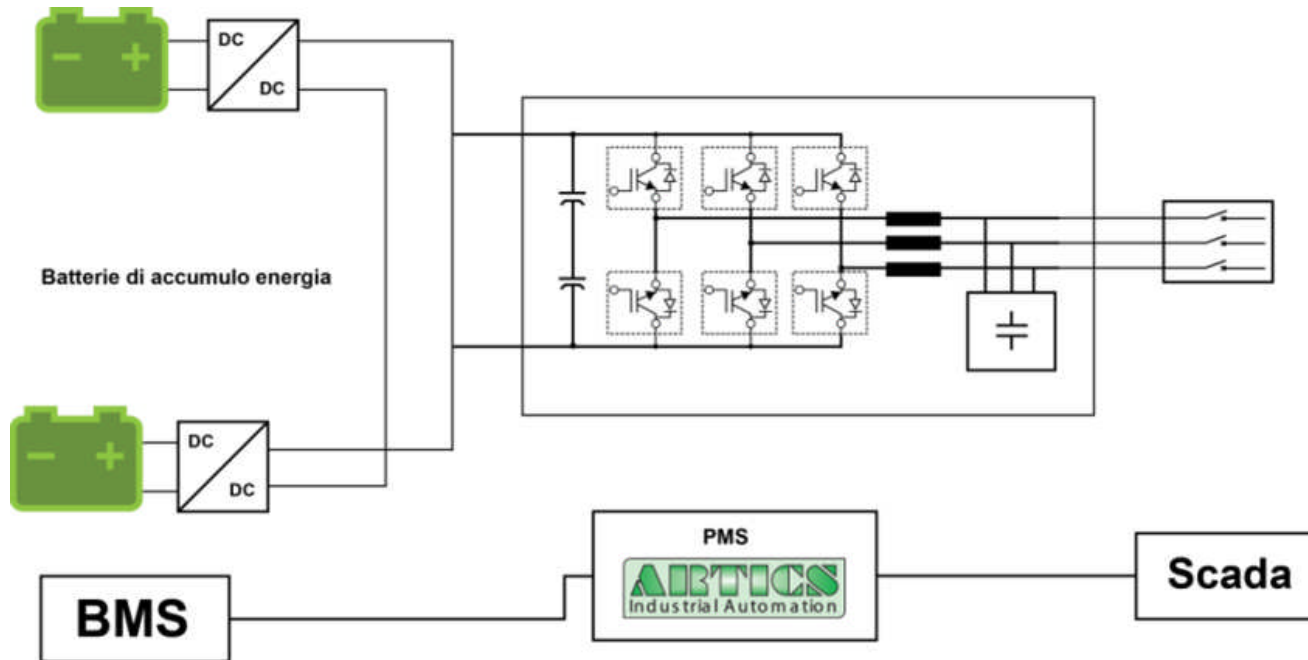
Capability of sustaining the short circuit current in order to let the protection switchgears open.



The charge and discharge of the batteries are controlled by separate dc/dc converters. Each one of them is dedicated to a group of batteries and they work according to the V-I curves provided by the manufacturer of the batteries. Each battery group has its own BMS (battery management system that comes with the battery).



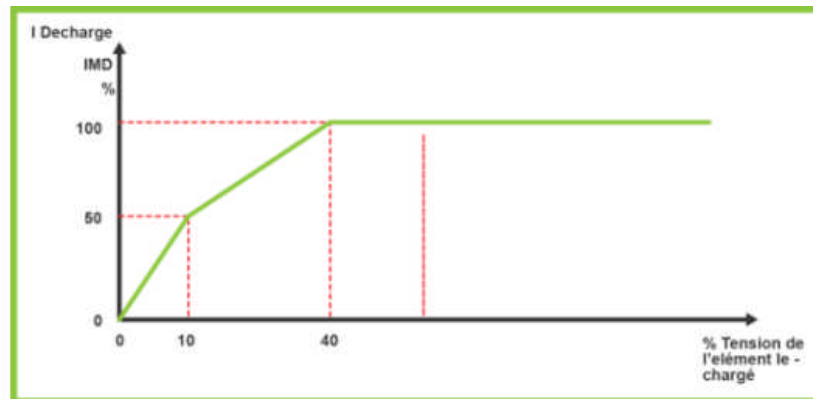
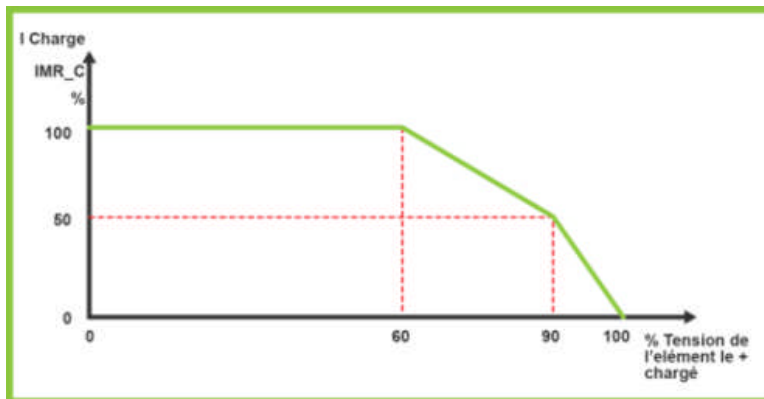
The BMS is linked to Nidec ASI's Scada system
ARTICS Smart Energy.



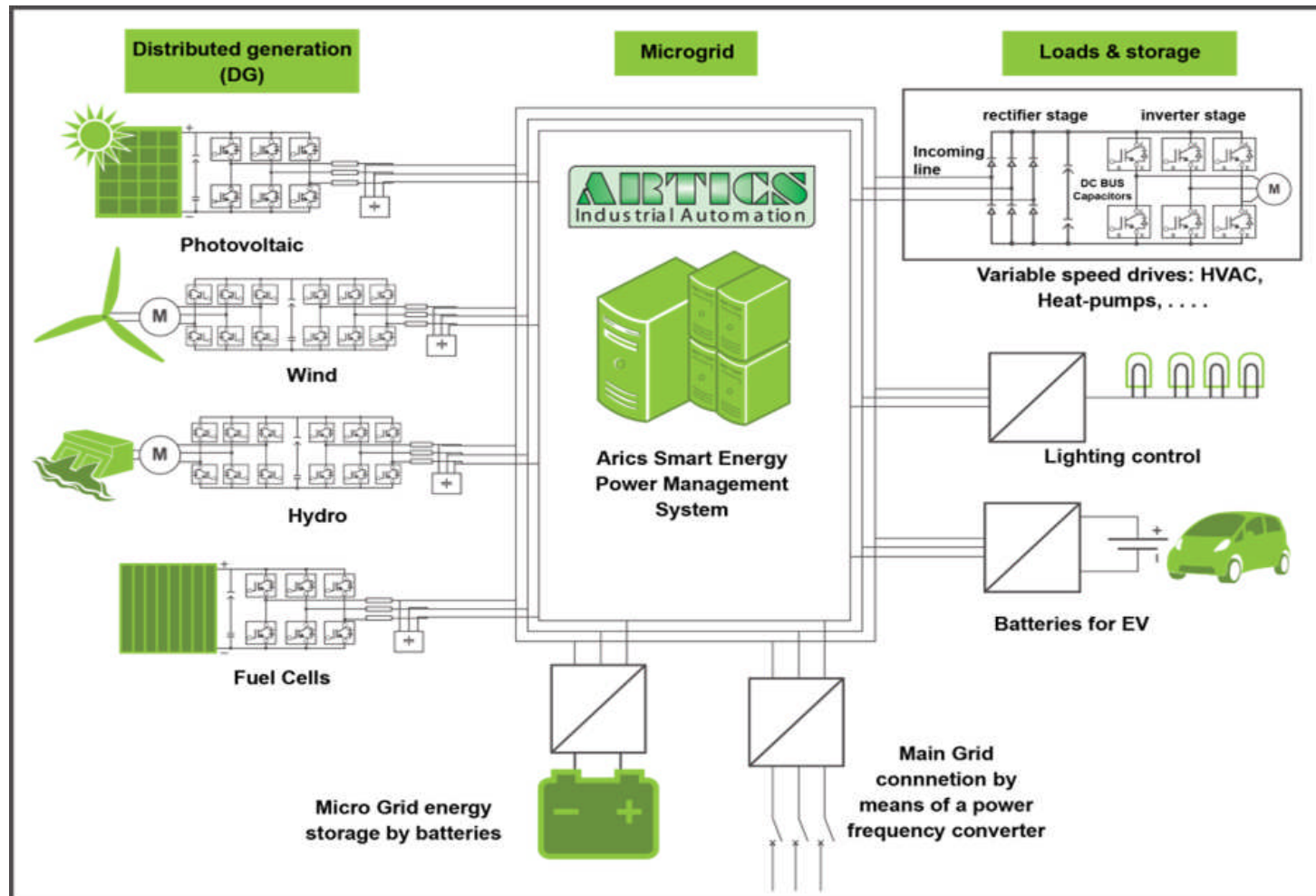
- The usage of a separate dc/dc controller for each battery group allows a better current control and a better system efficiency.
- Each battery group can be charged and discharged with a separate control logic in order to optimize the full exploitation of the batteries. The differences among the various battery groups, due to the unavoidable tolerances, can be compensated.
- Each dc/dc converter is linked to the dc internal bus of the AFE inverter.
- The solution by Nidec ASI offers a redundancy among the battery groups (e.g., each group can be on duty regardless of the behavior of the other groups).

The charge and discharge of the batteries are controlled by separate dc/dc converters. Each one of them is dedicated to a group of batteries and they work according to the V-I curves provided by the manufacturer of the batteries. Each battery group has its own BMS (battery management system that comes with the battery). The BMS is linked to Nidec ASI's Scada system Artics Smart Energy.

Typical battery curves are shown:



The system can interface different kind of batteries, e.g., Li-ion, Sodium based, etc..



ARTICS Smart Energy is the high-performance power and energy management system designed to optimize energy production/consumption and provide the monitoring functions and tools.

Key functions

- Power metering
- Measure and analysis of the electric distribution system
- Real-time control for loads and generators
- Emergency and protection management
- Monitoring and supervision system
- Historical data collection



An electric energy storage equipment can draw power from the grid when there is an excess of production and can inject power when the demand goes over the current production.

The time scale of the charge and discharge function can be of seconds or minutes or hours.

So, different performances can be obtained by the system:

- **Peak shaving / time shifting:** the system can store the energy when the load of the grid is weak and it can inject energy during the peak hours. Typical application in PV and wind plants for maximizing their production.
- **Power balancing:** compensating the random production of energy from wind and sun on a second or minutes time scale.
- **Power quality:** the system is able to provide a control of the reactive power, independently from the active power. Thanks to this feature it can increase the line power factor or it can cancel undesired line harmonics.

- **Voltage regulation:** the reactive power control can be used by the grid operator for the stability of the line voltage.
- **Frequency regulation, primary and secondary reserve:** a dedicated control function links the active power to the line frequency in an automatic mode. The grid operator can use this function in order to make the equipment work as a “reserve” for the frequency regulation.
- **Black start:** the system can also be used as a black start equipment when a portion of the grid has gone out of duty. The batteries through the inverter start to feed the grid after a black out and they allow the grid to restart its full operation.
- **Primary reserve for conventional generating groups:** the equipment works in parallel to the main thermal generators, allowing them to provide their full power, because the necessary “reserve” can be provided on a minutes scale by the energy storage equipment.