



STEPHANE LASCAUD
THE HUGE OPPORTUNITIES
OF THE NEW STORAGE SYSTEMS

MASTERING THE INTERMITTENCY
OF RENEWABLE ENERGY



store & forecast

GROUPE **edf**

The huge opportunities of the
new storage systems





Who are we?

We commercialize software solutions for **forecasting, planning and optimal automatic control** of renewable power production and energy storage systems.

By using our solutions, **producers, grid operators and C&I consumers** wishing to invest in storage, optimize both system sizing and real-time operation.

Key figures

2014
Foundation

+70%
Growth

80MW
Storage capacity
in operation

+14
Employees

Our Services

We assist clients from the engineering step to the operational phase through a **global and modular offer**:

ENGINEERING

Upstream engineering study of the system sizing with storage, production forecasting, performance simulations and system's energy balance.

EMS SUPPLY

Design, implementation and commissioning of the Energy Management System, and customization to fit to the clients' needs.

MAINTENANCE

Corrective and evolutive maintenance, remote monitoring of the EMS, and of the global performances of the system.

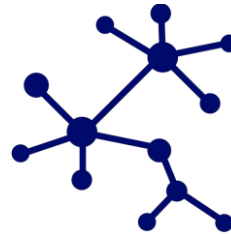
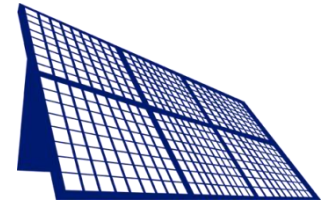
FORECASTS

Day ahead and intraday forecasts for PV and wind production and for electric consumption.





Our vision



Fast decrease of
photovoltaic cost

Fast decrease
of **battery storage**
cost


Introduction of IT
in electric **Smart
Grids**

Public policy-
driven **energy
transition**



Electric system change

from a centralized grid to an energy circulation grid
with storage systems





Energy storage on electric grids



Pump hydro storage station of Grand-Maison
1680 MW



Centralized storage = Pump Hydro energy storage (PHES).

- Thermal storage : 1237 MW
- Lithium ion Batteries: 500 MW
- Compressed air storage : 435 MW
- Sodium Batteries : 340 MW
- Lead acid Batteries : 87 MW
- Nickel Cadmium Batteries : 31 MW
- Super capacitors 21 MW
- Redox flow Batteries 13 MW

Source DOE Energy storage data base, EPRI, EDF S&F, CNESA

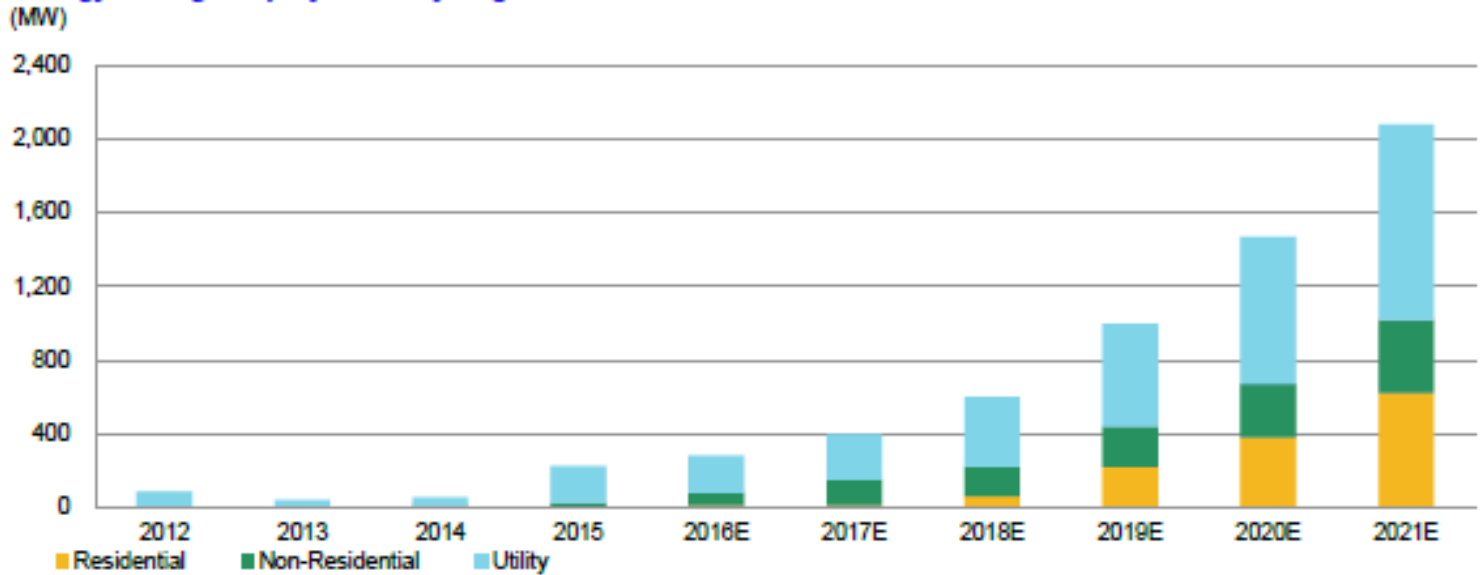


Engine room of an hydroelectric dam



Energy storage market trend

Energy Storage Deployments by Segment

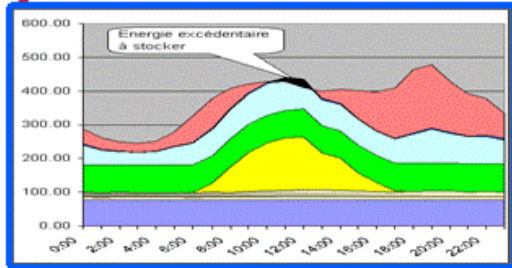


Source: GTM Research

Problems and consequences of a high photovoltaic insertion in electric grids

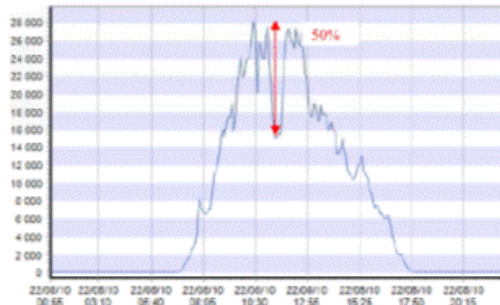


Time scale



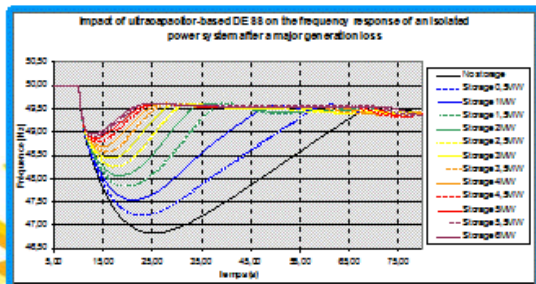
1) Inevitable and hardly forecastable.

Increase stop/start of conventional production plant (increase cost of maintenance) and desoptimize the economic scheduling. Otherwise disconnection of PV (lost energy)



2) Intermittency.

Modulate other means of production (start more production plants, increase of fuel consumption, ageing of the motors)



3) Less inertia to electric system

(increase the risk of black out). If there is a lack of inertia, disconnect PV production once 30% of the photovoltaic rate is reached.

hours

minutes

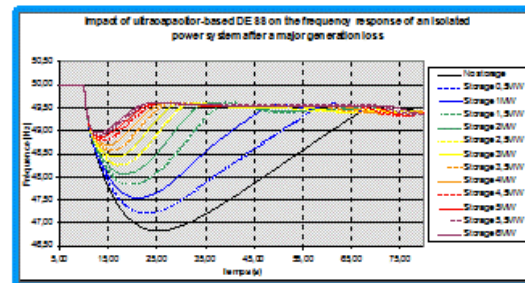
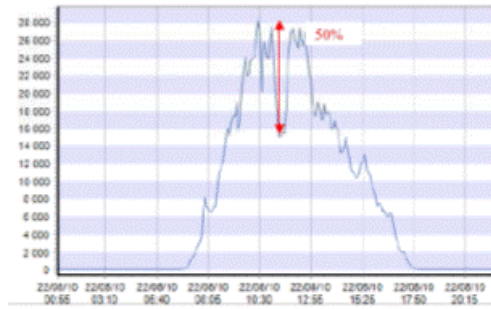
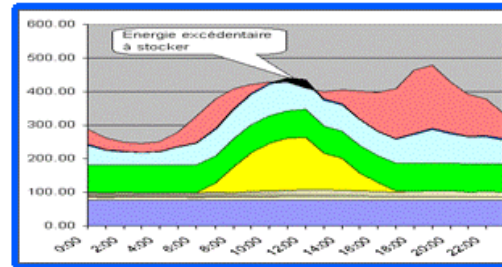
seconds

Advantages of an intelligent storage for PV production

1) **Energy Shifting.** Energy shifting between off-peak and peak hours. Stop/start optimization of the conventional production plants.

2) **Ramp Control.** Avoids using conventional production plants to dynamically balance photovoltaic intermittency. Save fuel/water for thermal/hydro plants.

3) **Ancillary services.** Brings inertia through power electronics. Enable to stabilise frequency. Avoids PV disconnection when reaching the 30% threshold. Bring black start service.



Time scale

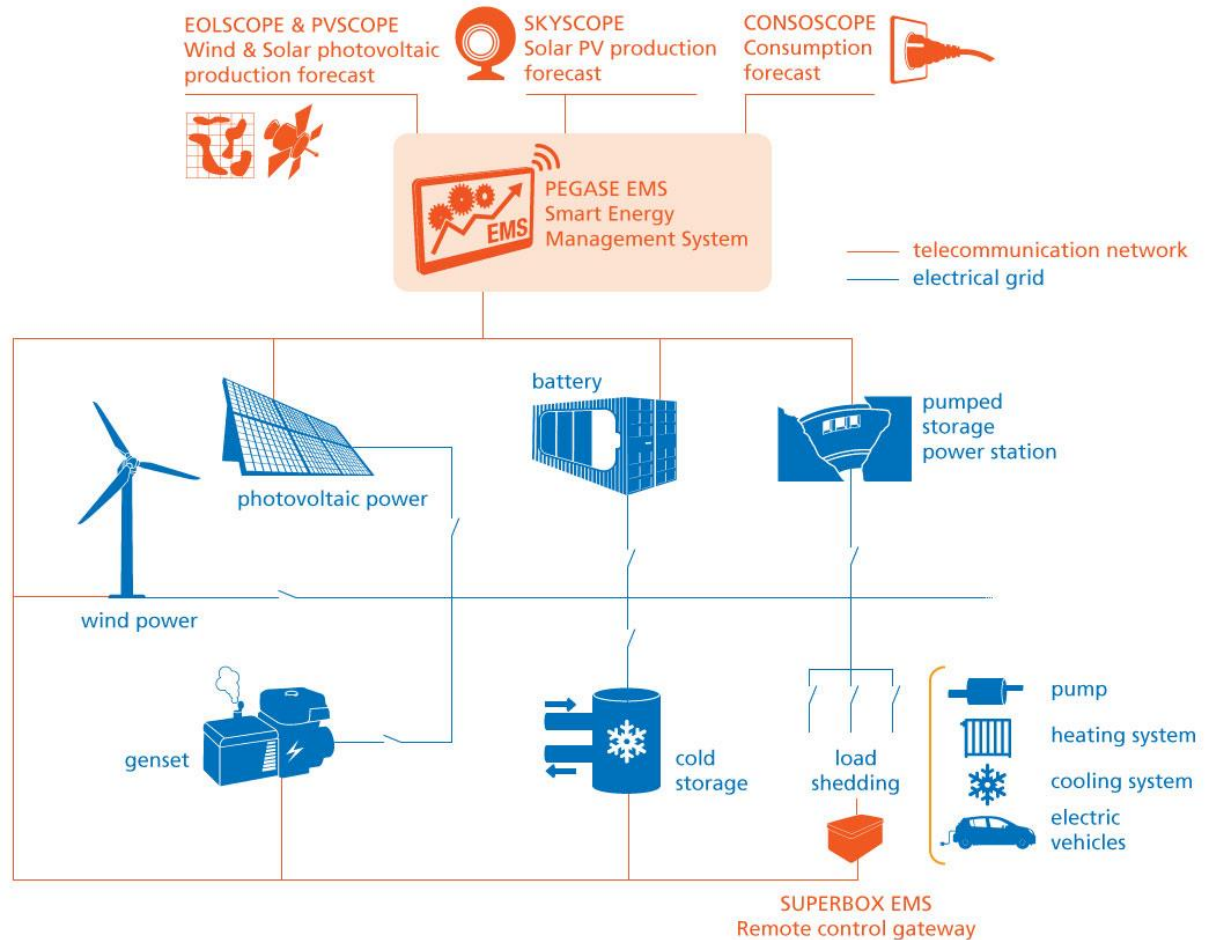
hours

minutes


seconds


Software solution

Our Energy Management System and our forecasts tools optimise projects' performances.



Features

- 
- ✓ Renewable power production forecasts
 - ✓ Smoothing of renewable production / Ramp control
 - ✓ Guaranteed renewable power production
 - ✓ Gensets start and stop
 - ✓ Gensets efficiency optimization
 - ✓ Microgrid supply/demand balance management

- 
- ✓ Consumption forecasts
 - ✓ Peak shaving
 - ✓ Fast Demand Response
 - ✓ Load management



- ✓ Frequency regulation
- ✓ Voltage control



- ✓ Supervisory Control And Data Acquisition



- ✓ Cybersecurity



Applications



Guarantee of intermittent renewable energy production in non interconnected areas

Services to the power system: frequency regulation, voltage control, capacity market

Microgrid supply/demand balance management

Analyze of storage needs for **energy transition masterplan**

Optimization of the energy bill of commercial and industrial sites

Forecasting services of wind and solar PV production



For...

▶ Producers

▶ Producers
Grid operators

▶ Grid operators

▶ Grid operators
Local authorities

▶ C&I consumers

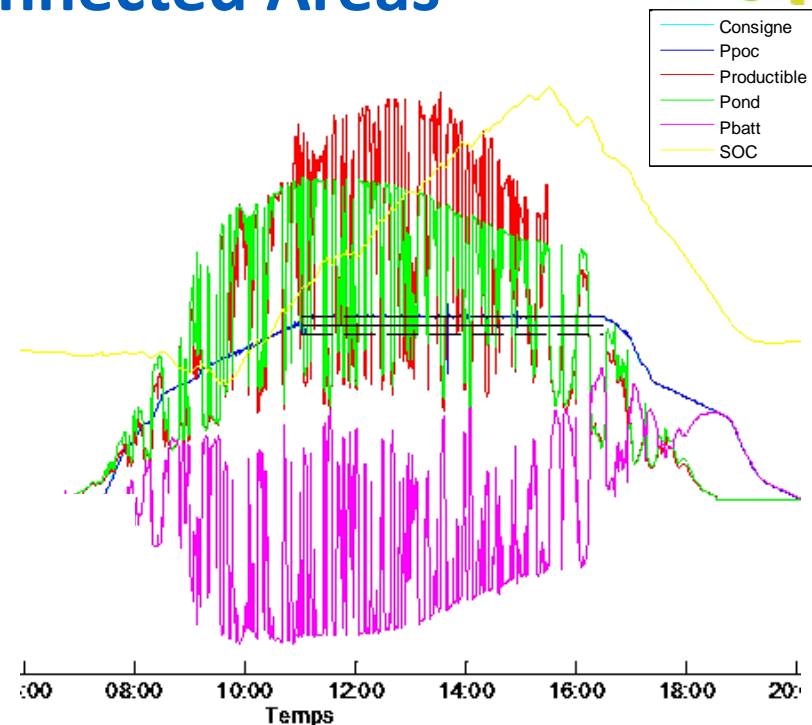
▶ Aggregators

Guarantee of Intermittent Renewable Energy Production in Non Interconnected Areas



Case study: Toucan (Guiana)

- Context** French CRE Call for Tenders in islands
- Target**
 - Controlling the local injected power to maximize the producer's revenues
- Project** PV (5MWp) + Battery (4.5MWh–1.5MW)
Zebra Fiamm & Nidec
- Status** Commissioned in December 2014
- Features**
 - ✓ Smoothing of renewable production
 - ✓ Guaranteed renewable power production



- Services**
 - EMS SUPPLY**
 - Energy Management System supply
 - IT System supply
 - MAINTENANCE**
 - Maintenance and supervision
 - Reporting contract

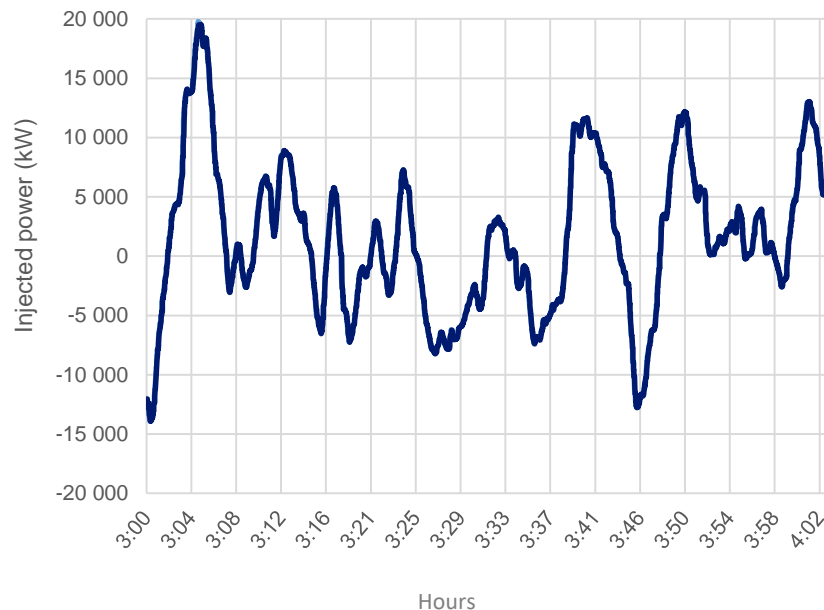




Services to the Power System

Case study: Mc Henry (United States)

- Context** The local US grid manager needs for frequency support and ancillary services
- Target**
- to control the injected power following a reference signal sent by the grid manager and to guarantee optimal compromise between real-time mileage performance and battery lifetime extension
- Project** Storage only (8 MWh – 20 MW of Li-ion battery connected to HTA grid)
- Status** Commissioned in December 2015
- Features** ✓ Frequency regulation



Services

EMS SUPPLY

■ Energy Management System supply

MAINTENANCE

■ Maintenance and supervision
■ Reporting contract



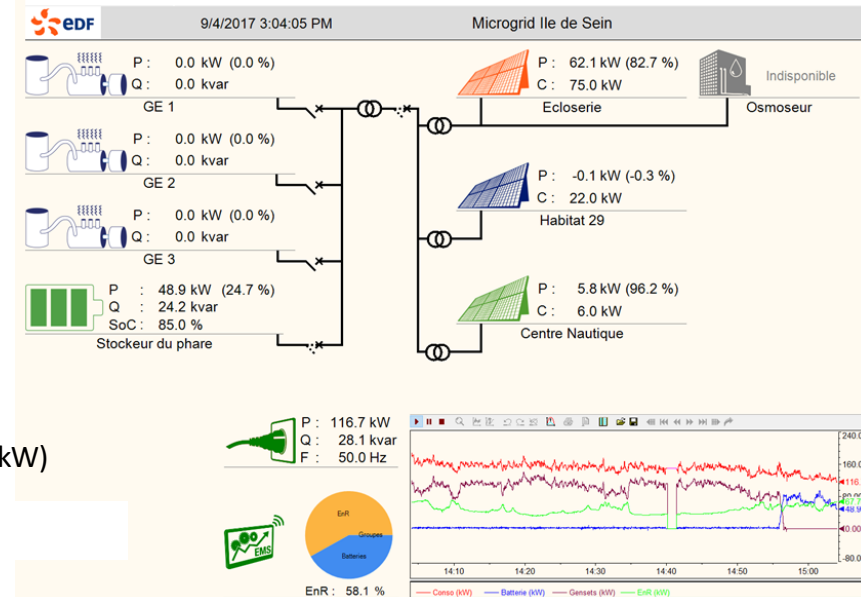


Microgrid Supply/Demand Balance Management



Case study: Ile de Sein (Bretagne)

- Context** A 100% renewable production target on this non interconnected island
- Target**
- Limit the use of genset
 - Compensate intermittency of photovoltaic production
 - ...while ensuring quality and safety of the electric system
- Project** Genset (880kW) + PV (80kW) + storage (100kWh–200kW)
- Status** Commissioned in September 2017
- Features**
- ✓ Microgrid supply/demand balance management
 - ✓ PV ramp control
 - ✓ Gensets start and stop
 - ✓ Gensets efficiency optimization
 - ✓ Supervisory Control And Data Acquisition



Services

EMS SUPPLY

Energy Management System supply

MAINTENANCE

Maintenance and supervision Reporting

Optimization of the Energy Bill of Commercial and Industrial Sites

Case study: Self consumption with PV

Context A 4,000 m² building offering a 100% renewable energy self-consumption (on-site solar panels, battery, and electric vehicles charging stations to be installed).

- Target**
- Reduce energy charge
 - Reduce the power charge
 - Maximize the PV self-consumption rate
 - Smart uninterrupted power supply

Project PV (500kWp) + charging stations + storage

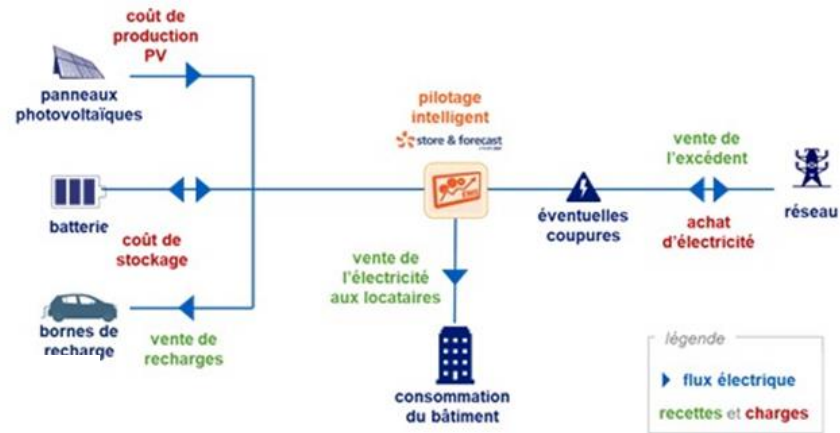
Status Ongoing study

- Features**
- ✓ Smoothing of renewable production / Ramp control
 - ✓ Peak shaving
 - ✓ Fast Demand Response

Services

ENGINEERING

- Assessment of each options and optimization of the global management of the system





Thanks for your attention

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