

TOWARDS MORE RELIABILITY FOR RENEWABLE ENERGY PRODUCTION

Dynamic battery management and solar forecast in a decentralized system

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INTRODUCTION

EDF is one of the largest utility in the world
 136.2 GWe
 INSTALLED CAPACITY
 CUSTOMERS

 Around 120 researchers work in the department of EDF R&D dealing with optimization

 The development of undispatchable renewable energy plants & improvements in storage technologies have brought some new topics of research





CONTEXT : RELIABLE SUPPLY OF ELECTRICITY IN REMOTE ISLANDS

La Réunion

• **Energy** : +60% of electricity comes from oil and coal

Power : instantaneous production of renewable



A LONG WAY FROM THE ORIGINAL CONCEPT TO REAL-LIFE OPERATIONS



Underlying idea: storage can help lower the impact of variability and forecast uncertainty



WHAT WE DEVELOPPED

A MODULAR CHAIN HAS BEEN DEVELOPPED





A MODULAR CHAIN HAS BEEN DEVELOPPED





TECHNICAL CARACTERISTICS OF THE PRODUCTION SYSTEMS



Photovoltaic production

- 2.5 MWp
- Measures every 5 seconds
- Curtailment allowed



Storage

- Sodium-sulfur technologyAvailable power :
 - 1.2 MW for charge 1 MW for discharge
 - Available energy : 2.5 MWh
 - End-of-day state of charge (25%)

System class	Distributed	Intermediate	Large scale	Large scale
	ESS	ESS	ESS Power	ESS Energy
Applications	Self-storage and back-up residential with PV	Peak shaving, investment deferral substations / smart grids / micro isolated networks	Frequency and voltage regulation Renewable farm integration	Load levelling Energy transfer Renewable farm integration
Typical size	3 kW	100 kW	1 MW	1 MW
	5-10 kWh	300 kWh	500-1000 kWh	4-10 MWh
Technology	Li-ion/Lead-acid	Li-ion/Lead-acid	Li-ion Flywheel/SuperCapacit ors	NaS/ZEBRA Li-ion



FORECASTS OF THE PRODUCTION



Renewable energy production

Storage system

SOLUTION USED FOR THE PROJECT







BIDDING PROCESS



edF

Renewable energy production

Storage system

POWER DELIVERED TO THE GRID

Results from

last optimization



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Renewable energy production

Storage system



WHAT WE LEARNT

SETTING OF PARAMETERS

Level of the penalties can be linked to the level of uncertainty of the forecast



BATTERY MANAGEMENT SYSTEMS NEED SPECIAL PRODUCTION FORECASTS

- A smooth transition between the time scales is important for the optimizer
- The best forecast every 10' (mean error & RMSE) might not be as useful as a stable forecast with lower performances → need for new indicators ?
- Mean forecast scenario with confidence interval
 it is a matter of risk management





CONCLUSION

 Working with a modular chain developped by researchers from different fields has been a challenge

- Management of the data flows
- Optimizer-regulator coordination
- Obvious things » are not the same for everybody
- We have reached a much better understanding of the most important parameters to optimize jointly a storage and renewable power plants in a given set of constraints
- Another call for tender has been published by the French energy regulator in May
 - Writing the specifications for this document is itself a multicriteria optimization problem for a system operator



