French Environment and Energy Management Agency (ADEME):

The long term place of electricity storage in continental France and in Non-Interconnected Zones

OFATE conference : « Storage as a vector of flexibility for energy transition »

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Berlin, September 25th, 2019

Summary

Part 1 : electricity storage in continental France, current situation and prospects

1. Electricity power generation mix : current situation
2. Mix modelling up to 2050
3. Long term place of electricity storage : focus on battery storage

Part 2 : electricity storage in French Non-Interconnected Zones, overview of a prospective study

1. Introduction to the study : objectives, methodology and hypothesis
2. Main results : Réunion, Guadeloupe et Martinique
3. Focus on storage

Part 1 : electricity storage in continental France, current situation and prospects

Main approaches of electric storage

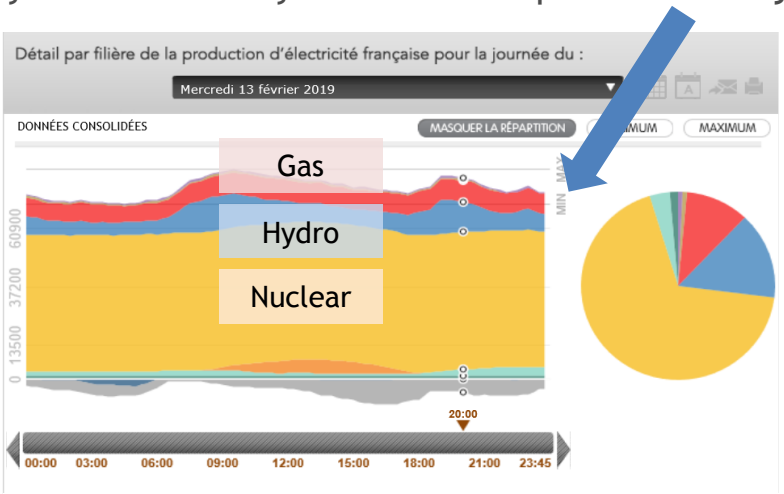
- Means of storage to meet the needs of electric power systems ?
- Which kinds of synergy between the different energy networks (gas, electricity, heat) ?
- Medium term prospects of storage deployment ?
- Links between variable renewables and storage, in the case of the interconnected european network ?
- Particular issues : recycling ? System services ? « Vehicle to grid » ? etc

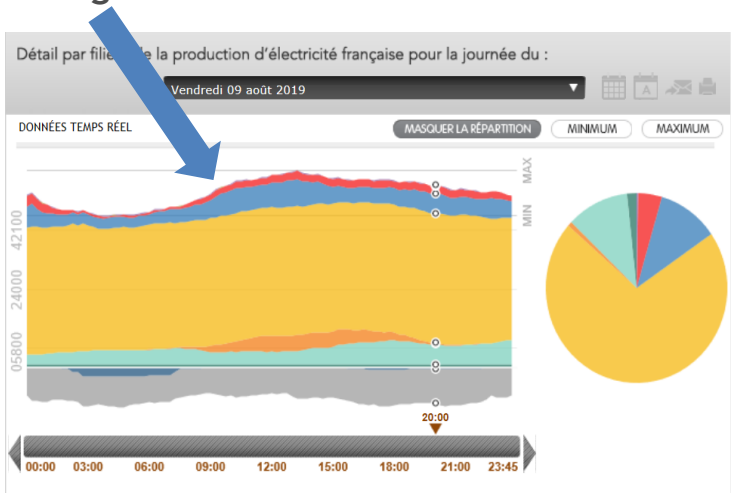
Electricity storage in continental France
1. Current situation

Hourly balance between supply and demand in France, 2019

- The only storage in operation : Pumped Storage Hydroelectricity : 4GW at present, +1,5 GW up to 2035 according to the nation's energy policy for the coming years (PPE)

- Supply/demand hourly balance example in **february** and **august** of 2019





- Conclusion (extract from the PPE) :

« *The electric system flexibility means (demande controlling, load shaving, storage, interconnections) are not immediatly essential but have to be developped in the medium term (…)* »

Introduction

- Etude « Trajectories for the evolution in electricity mix 2020-2060 », (2018/2019)
  https://www.ademe.fr/trajectoires-devolution-mix-electrique-a-horizon-2020-2060
- Trajectory = nature of the mix and network from 2020 up to 2060, in 5 years increments
- Trajectories elaboration based on economic optimisation:
  → To minimise the updated sum total of production system and network
  → Under several constraints (balance between supply and demand, merit order logic…)

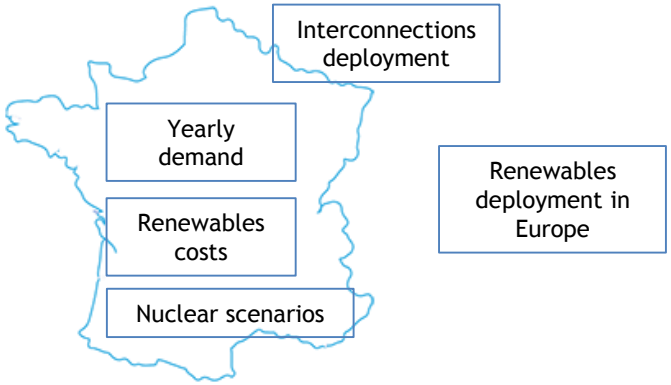
Hypotheses from the « Trajectories » study that are linked to the storage (case of 2050)

- French power consumption : 540 TWh
- French interconnection capacities : about 25 GW (imports) and 30 GW (exports)
- High consumption flexibility, particularly for : electric vehicles consumption (80% flexibility during the same day) and heating (2 « load shavings » by day, limited to 7GW)

Electric storage in continental France

2. Electric power generation mix modelling : the ADEME study called « Trajectories » (2)

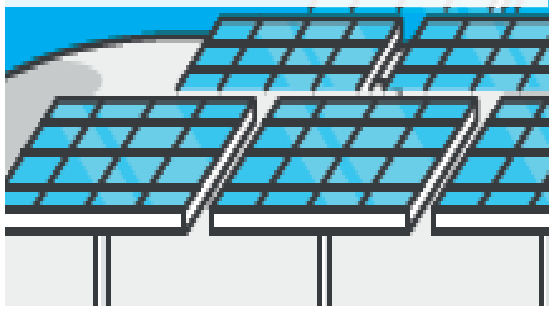
About ten cases, according to different hypotheses variations



Legend : Tested hypothesis

Main results of the « Trajectories » study, horizon 2050

Photovoltaic capacity : between 80 and 90 GW



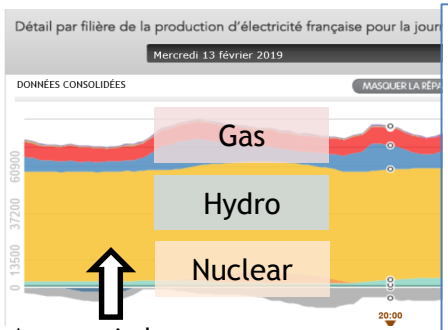
Onshore wind energy capacity : 80 / 90 GW

Extending the life of a part of the historic nuclear power base allows an efficient transition (from a financial and climate point of view)…

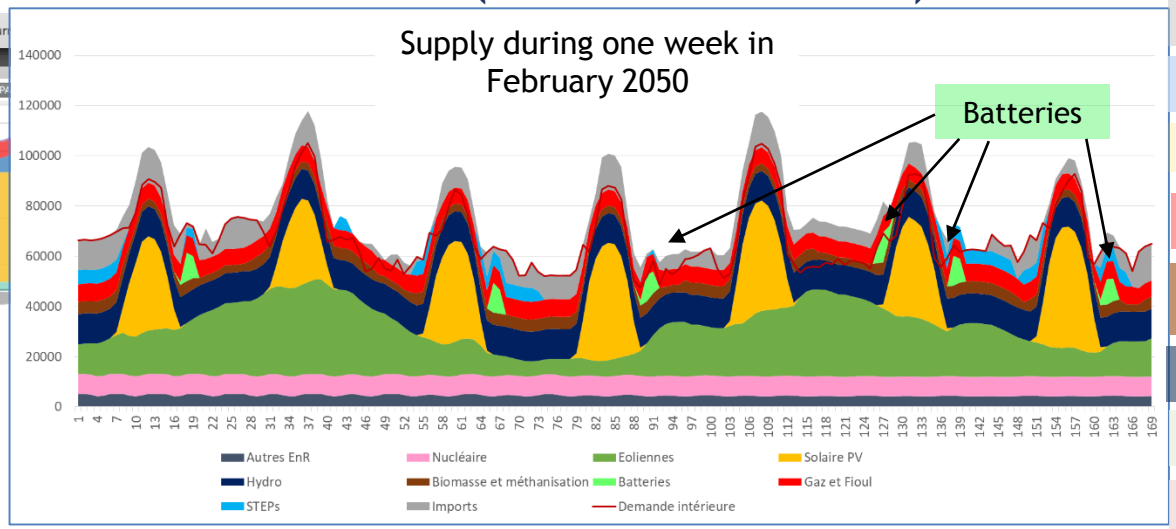
…but developing a new generation nuclear power industry (EPR) is not cost effective

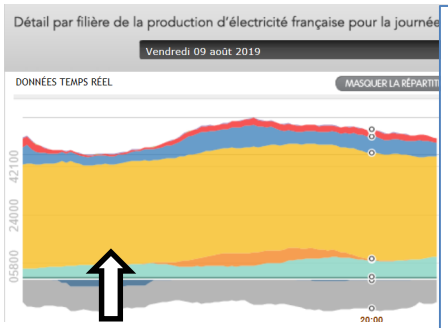
Electric storage in continental France
2. Electric power generation mix modelling : the ADEME study called « Trajectories » (3)

Hourly supply/demand balance in 2050 (continental France)

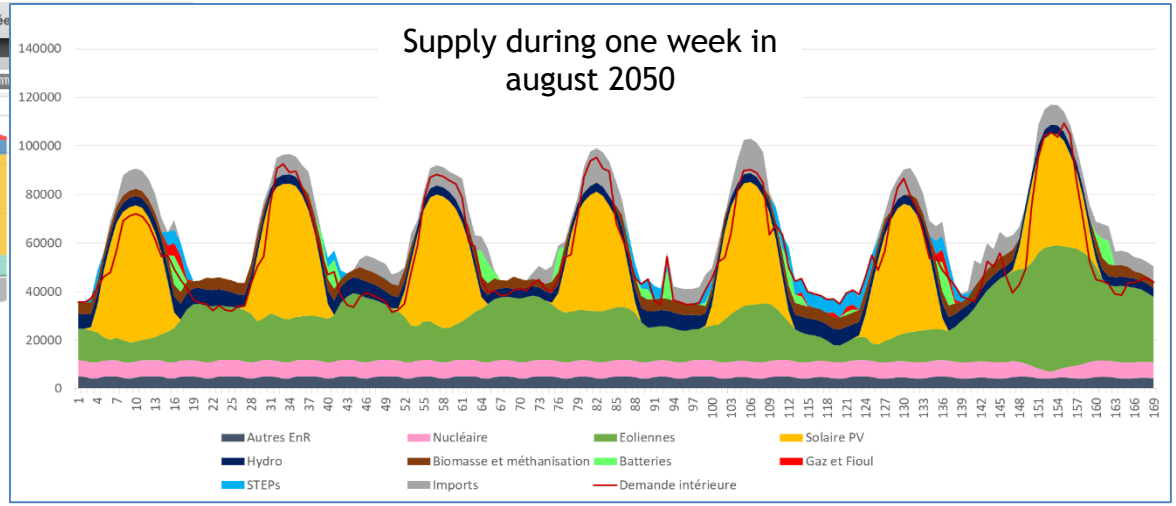


As a reminder :
February 2019





As a reminder :
August 2019



Imports
PSH
Photovoltaic
Gas
Biomass & cogeneration
Hydro
Wind
Nuclear

Electric storage in continental France
3. Long term place of electricity storage : focus on battery (1)

According to the ADEME study, from an economic point of view, the battery storage

- Would not massively develop before 2045
- Would have a 20GW potenitel up to 2060, in the better case
- Would be a daily flexibility mean for a 2 hours injection on average

The demand and the nature of the production system have a strong influence on battery storage

- Trajectories called « 24 GW of third generation nuclear (EPR) in 2050 » and « systematically closing each reactor after 50 years » could cut the storage capacity need by 50% in 2060
- A lower demand (450 TWh instead of 540 TWh) could cut the storage capacity need by several GW

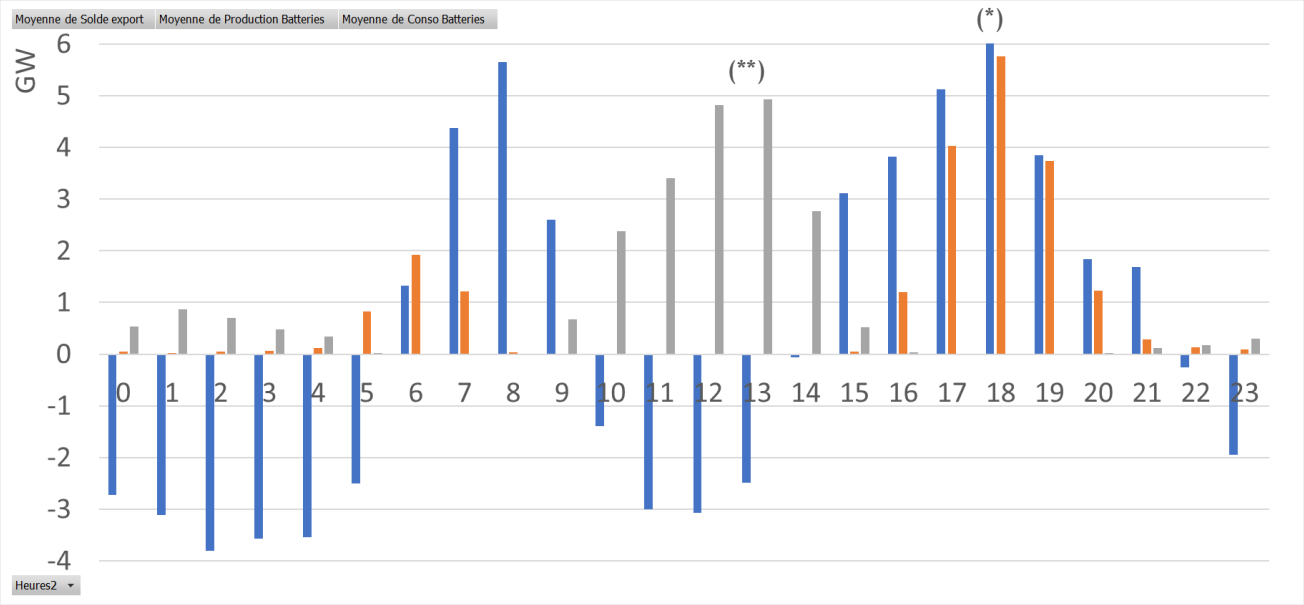
The european context is also essential for the storage development

- Interconnections development and european production system are concerned.

Electric storage in continental France
3. Long term place of electricity storage : focus on battery (2)

Long term place of battery storage : an economic answer for « rush hour » demand

- Batteries will develop for economic opportunities at the beginning of the day (6 to 8 apm) and at the end of the afternoon.
- The battery production (injection) would strenghten exports and reduce imports (*)
- On the contrary, the battery consumption (charge) would be concomitant to imports (**)

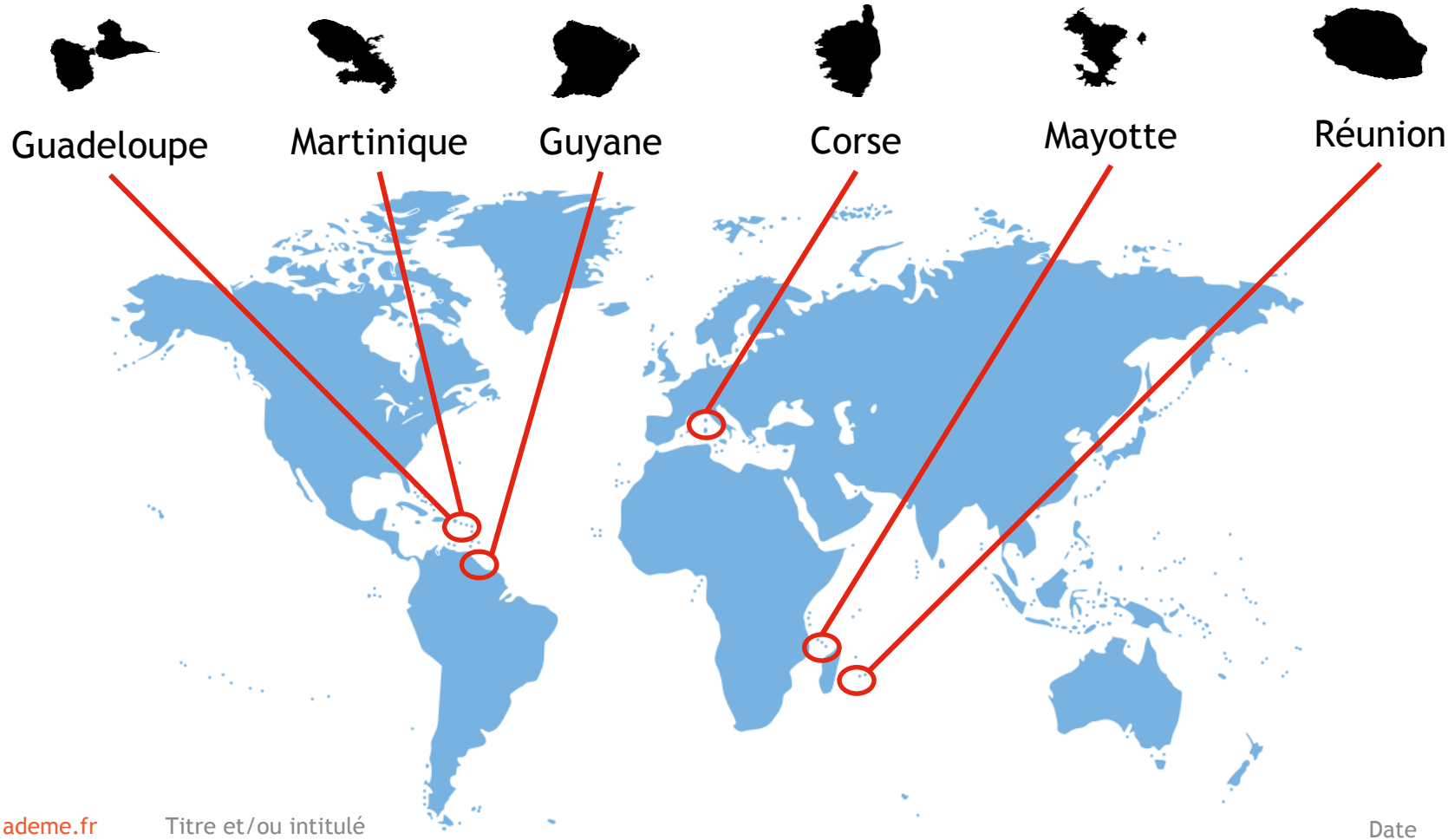


French exports balance, 2050

Battery production, 2050

Battery consumption, 2050

Part 2 :
electricity storage in French Non-Interconnected Zones, overview of a prospective study



Electricity storage in French NIZs
1. Introduction to the study

Objectives

Provide a view of the conditions required to achieve to supply electricity from 100% renewable from a technical, economic and social point of view.

With this work, ADEME has attempted to contribute to answer to the following questions:

- ✓ Will it be possible to supply electricity from 100% renewable sources on island territories in 2030?
- ✓ In this case, what would the optimum production base look like?
- ✓ How are the production resources distributed geographically?
- ✓ How does this impact the cost of electricity production?
- ✓ What are the needs in terms of network infrastructure?
- ✓ What are the needs in terms of balancing resources and ancillary services?

French version is available on ADEME website
English version will be available soon.

Electricity storage in French NIZs
1. Introduction to the study

1 Building the dataset at the source substation level

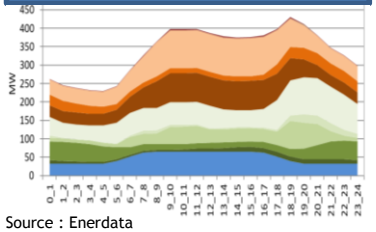
Production ressources

Source : Wikimedia

Grid

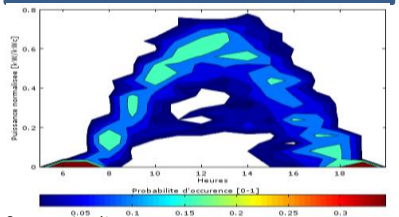
Source : EDF SEI

Characterising demand



Source : Enerdata

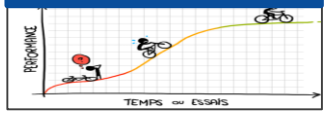
Potential RE



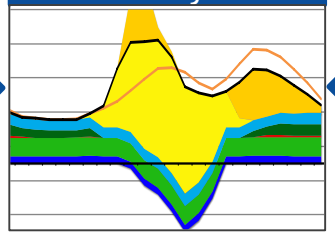
Source : Artelia

2 Elaborating and validating the five scenarios

Optimum trajectory 2015-2030 on typical days

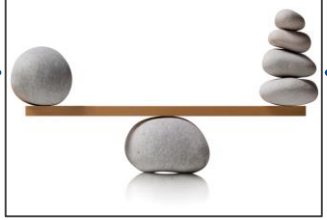


Time dispacthing over a year

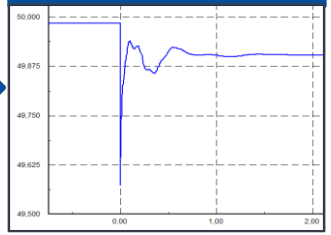


Source : Ordecsys

Static validation



Dynamic validation



3 Analysing economic impacts

- Ditribution grid

Main hypothsesis

- the assessment of the potential for renewable energies is a conservative one.

All of the existing constraints have been retained: Protected natural areas, national parks, coastal protection law, wind energy exclusion areas, conflicts of use, bans on changing land usage and the requirement to return methanisation digestates to the ground as well as a part of green waste.

- Projected costs of RE are delibaretely conservative .

Focus on storage

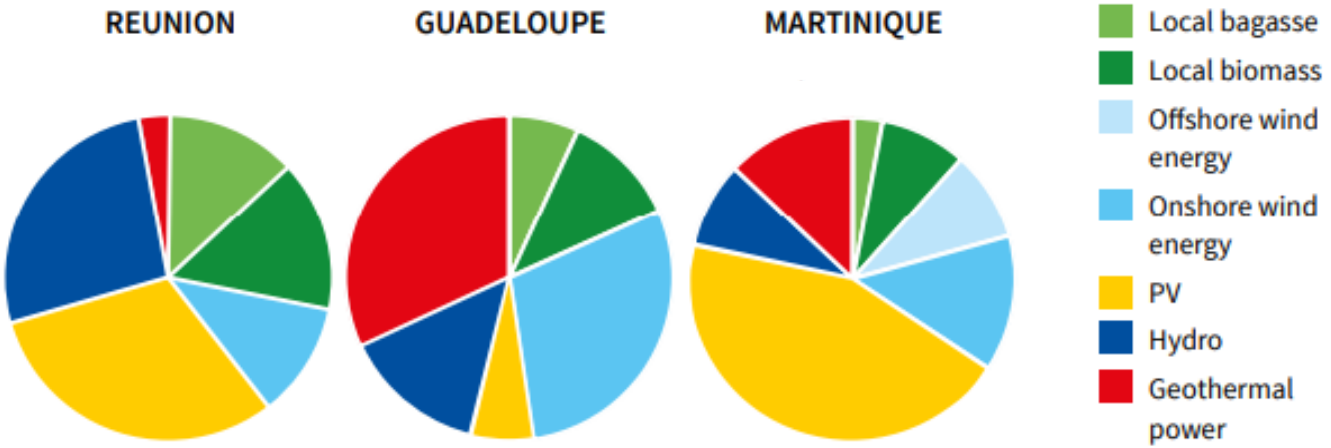
Storage technologies are divided in 3 types depending on their time constant :

- Medium/Long time storage – weekly, seasonal – Primary and secundary reserves
  → Energy sources (hydroelectric dams, biomass) et Pumped storage power station
- Seconds to minutes storage (lissage, aléas et pointe)
  → Li-Ion battery 1MW - 2 MWh
  → Li-Ion battery 1MW - 4 MWh
- Kinetic energy (milliseconds)
  → Flywheel

Electricity storage in French NIZs
2. Main results

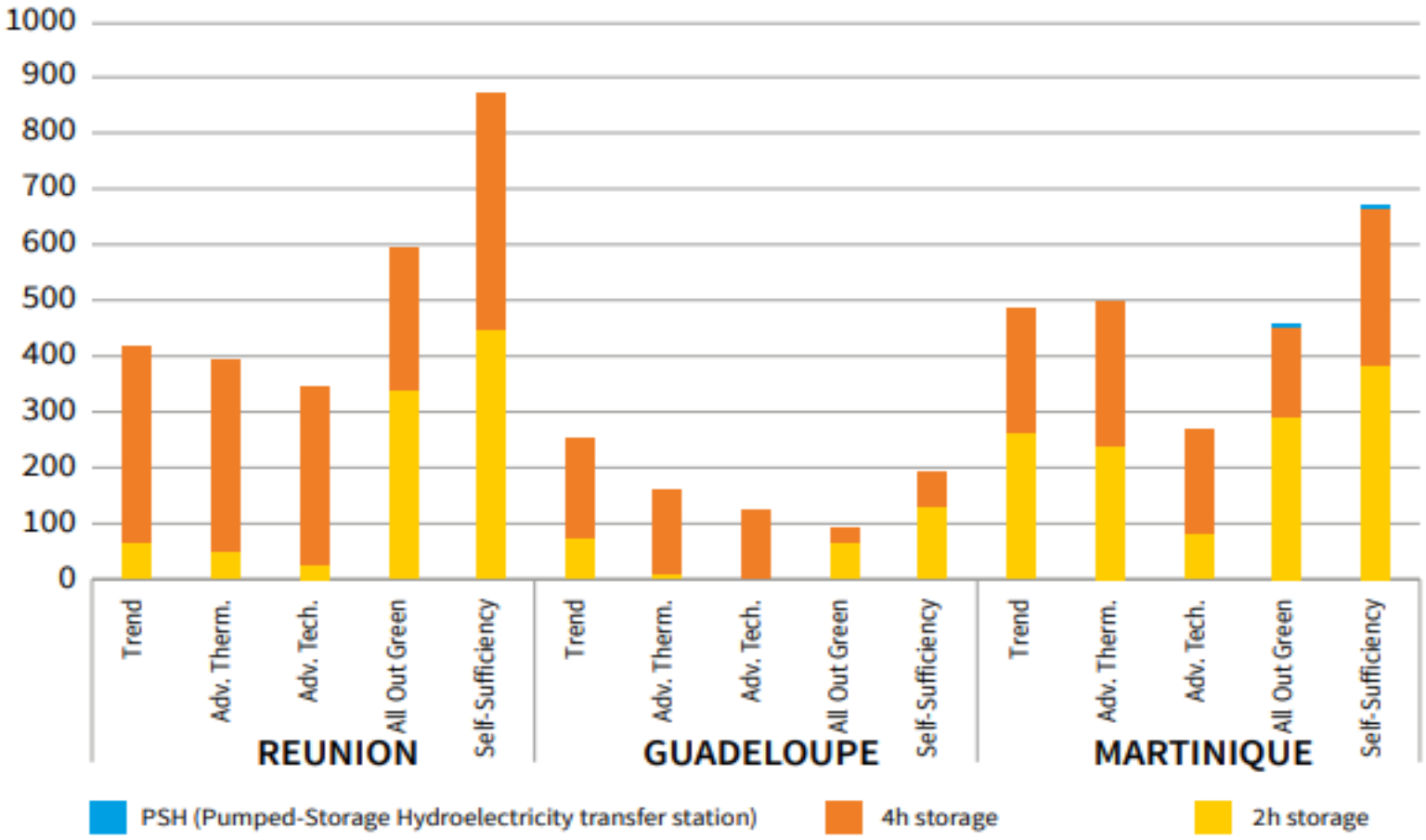
Key figures for the « All Out Green » 100% renewable energy

Production mix in 2030

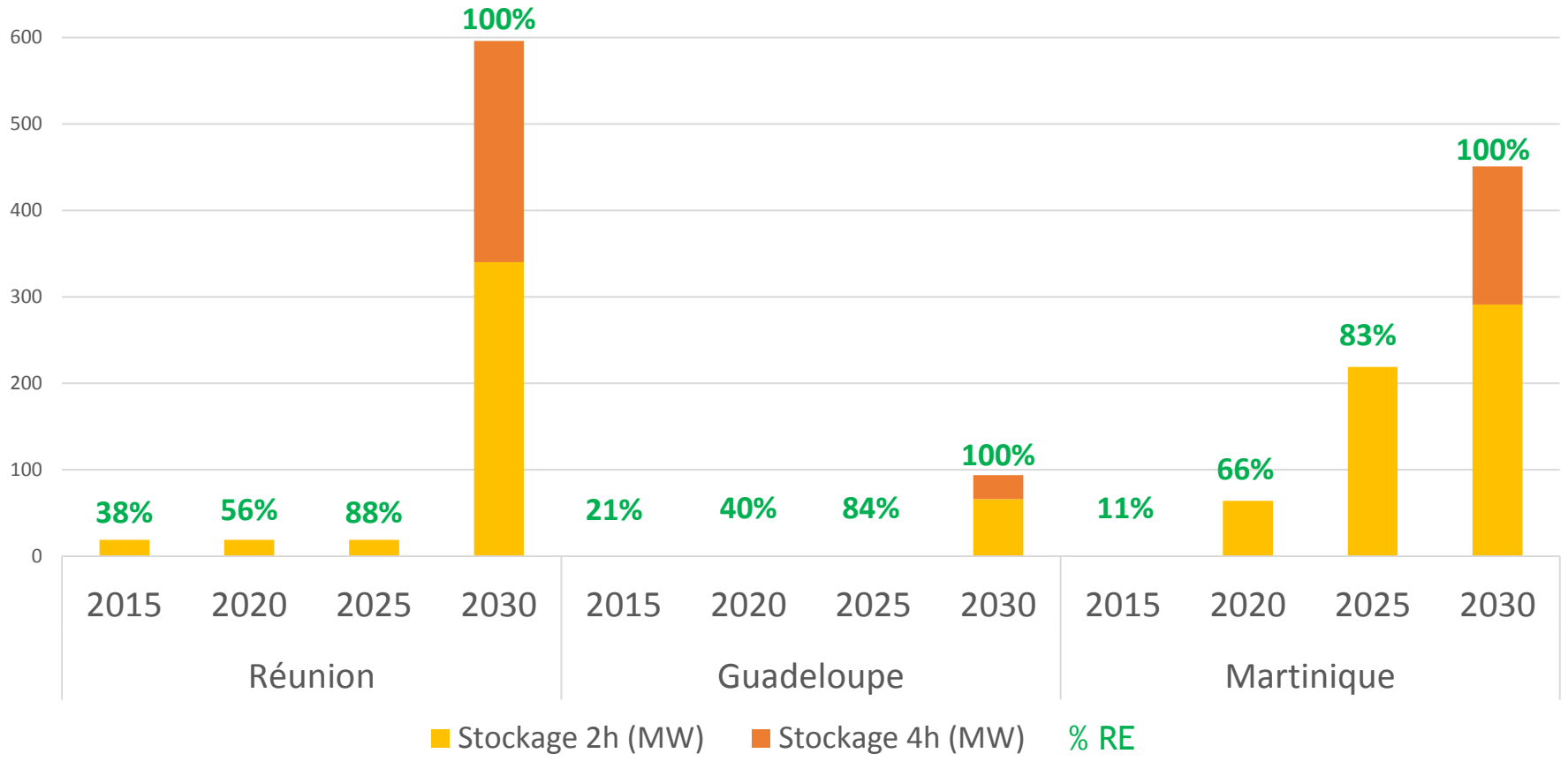


Number of inhabitants in 2030	983,000	370,000	339,000
Electricity production en 2030 (GWh)	3,631	1,907	1,807
Storage capacity in 2030 (MW)	596	94	451
Production cost in 2030 (€/MWh)	99	144	151
Investment over the period 2015-2030 (M€)	2,579	1,109	2,064

Storage structure in 2030, depending on the scenarios (MW)



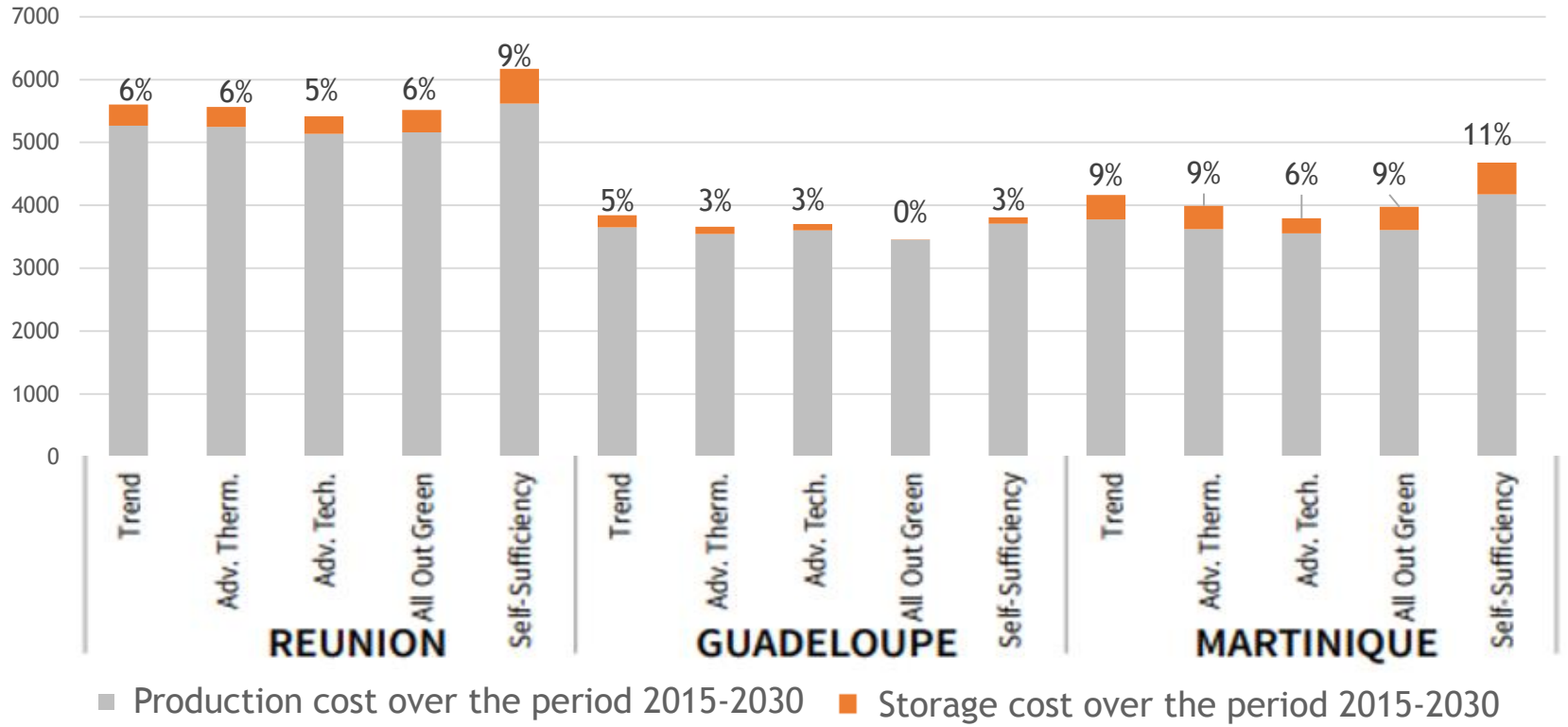
Storage capacity evolution by battery in the « All out Green » scenario (MW) and RE percentage evolution



Electricity storage in French NIZs
3. Focus on storage

Storage cost

Total cost over the period 2015-2030 (M€ discounted)



Cost hypothesis :

- 2h Storage : LCOS decreases from 119 in 2015 to 65 €/MWh in 2030
- 4h Storage : LCOS decreases from 107 in 2015 to 60 €/MWh in 2030

Thank you for your attention

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