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ISES SWC 2023

ISES International Solar Energy Society

ISES Solar World Congress, 30 Oct - 04 Nov 2023 in New Delhi, India

A set of study cases for the massive integration of solar renewables in non-interconnected areas

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Bridging the research gaps to allow massive solar integration, therefore contributing to accelerate the energy transition in La Reunion

A Horizon Europe project using a Twinning approach to widen the European Research Area

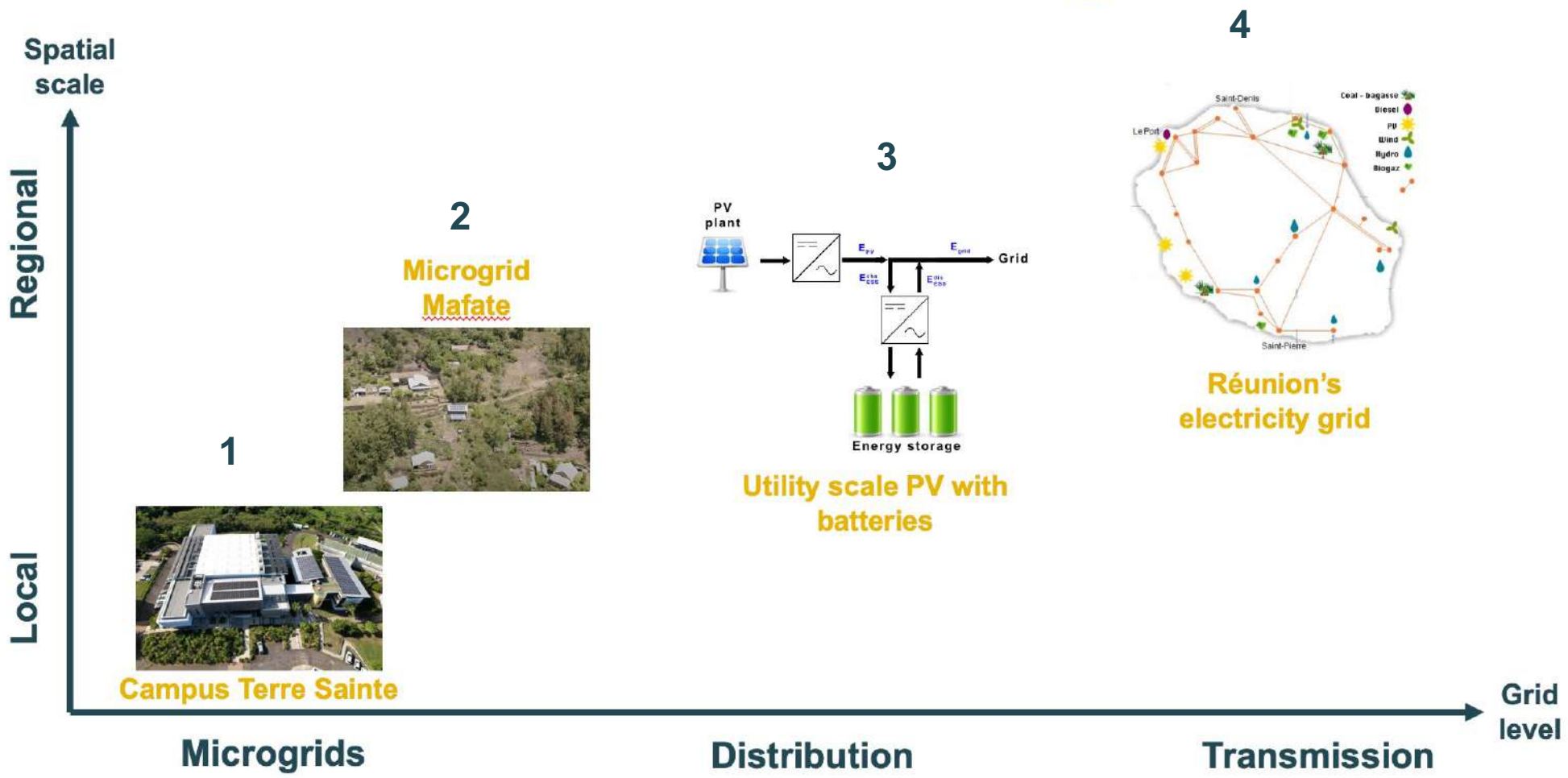
From September 2022 to August 2025

Gathering 5 partners:

- University of La Reunion
- Fraunhofer ISE
- DTU – Technical University of Denmark
- Nexa
- CPMR Islands Commission

https://twinsolar.eu/

Four study cases



1. A grid-connected microgrid

Research part of project TwInSolar

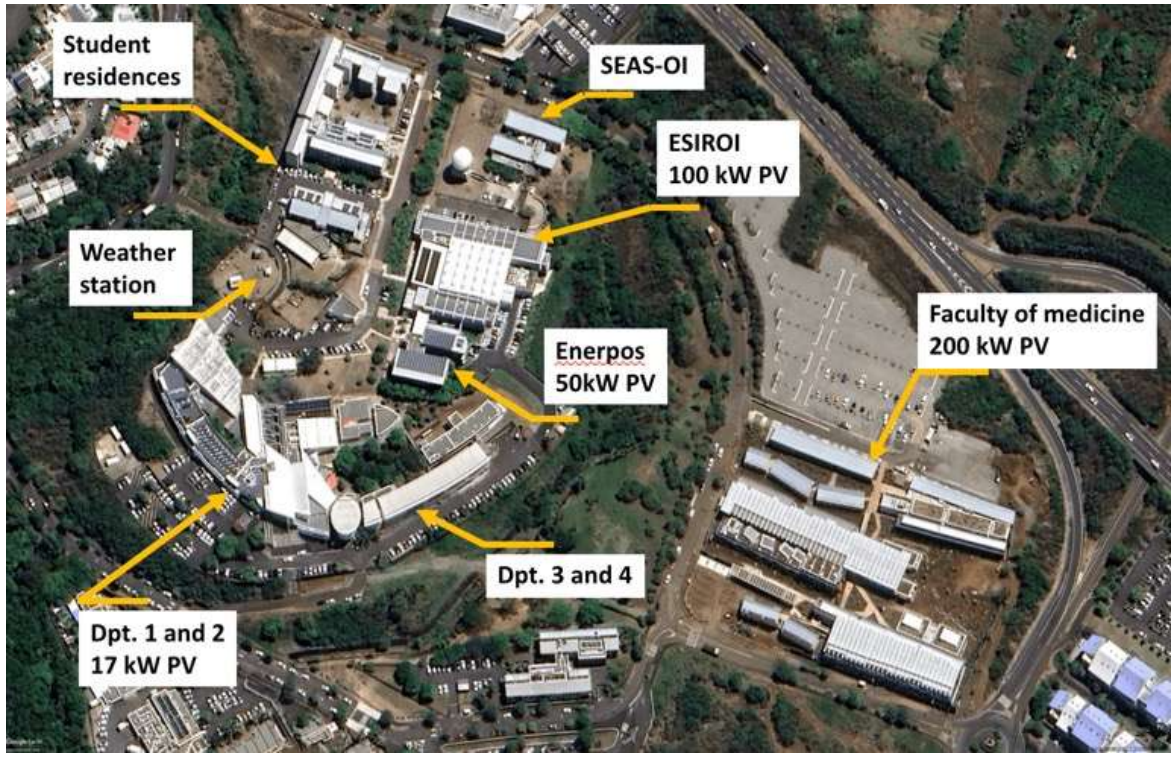
Different generations of buildings

Most recent: Net Zero energy (low-energy design + PV)

Current self-sufficiency: 16%

Challenges

- Design a system to increase the self-sufficient (up to 80%) with a competitive LCOE
- Minimize operation cost with a predictive Energy Management System

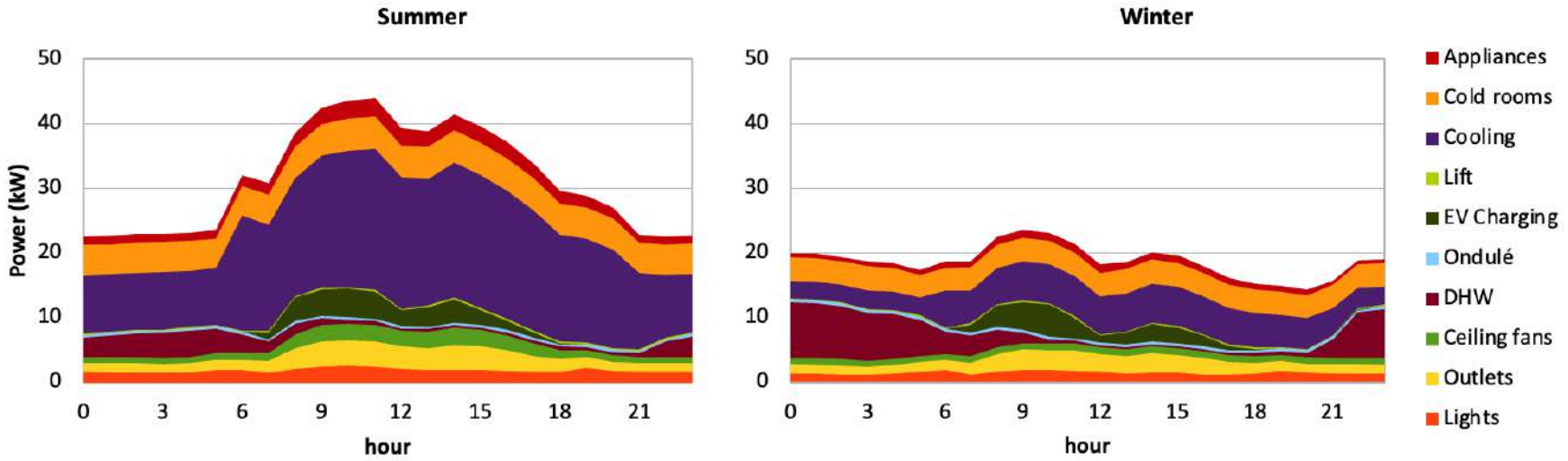


Overview of the university Campus of Terre Sainte in La Reunion

1. A grid-connected microgrid

Available data

- Weather station with advanced irradiation sensors (GHI, DNI, DHI, IR)
- PV generation monitoring
- Electricity demand by building and type of use
- 10–min time step, 2021 – 2022 (consolidated data)



Average daily profile of electricity demand by type of use of the ESIROI building for summer (Nov. to Apr.) and winter (Apr. to Nov.)

2. A standalone microgrid

Aerial view of the remote microgrid located in the Circus of Mafate in La Reunion

Challenges

- Size PV and batteries to achieve affordable design and LCOE
- Engage the users in the energy management

Available data

- Weather station
- PV generation and batteries state (I, V, SoC)
- 5 energy meters per house
- 1-min time step, 2019 - 2022

3. Utility scale PV with storage

Reduction of the variability and uncertainty of PV production

PV + energy storage mandatory for large-scale plants (> 500 kWp)

Call for tender rules: production schedule one day in advance

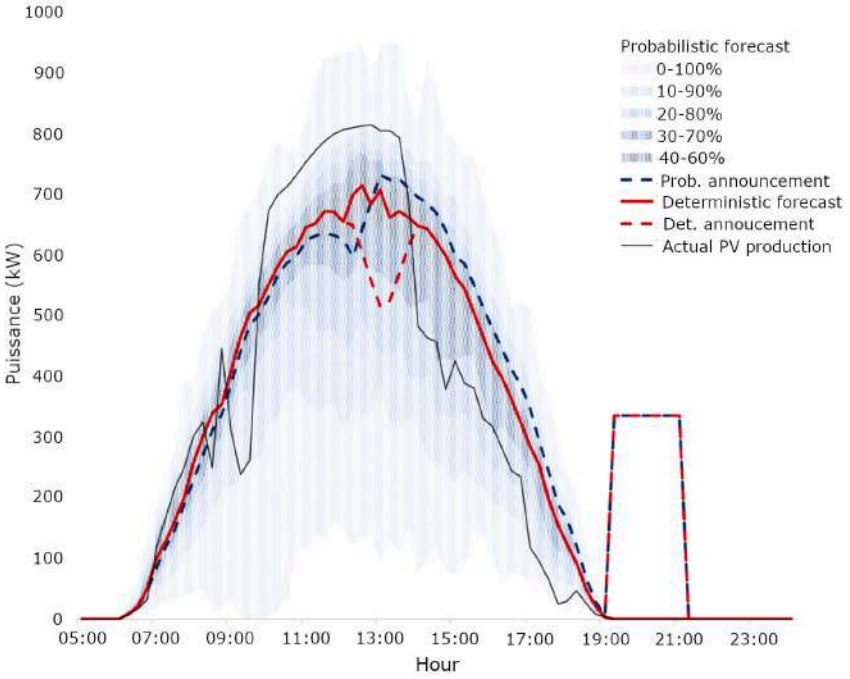
- Trapzium-shaped profile during daytime (2011)
- free power profile during the daytime and constant power during peak hours (i.e., 7:00 p.m. to 9:00 p.m.) with a better selling price (2015, 2017)

Pierrefonds airport, TotalEnergies (2023)
7.7 MWp PV and 10 MWh energy storage
(Picture: TotalEnergies)

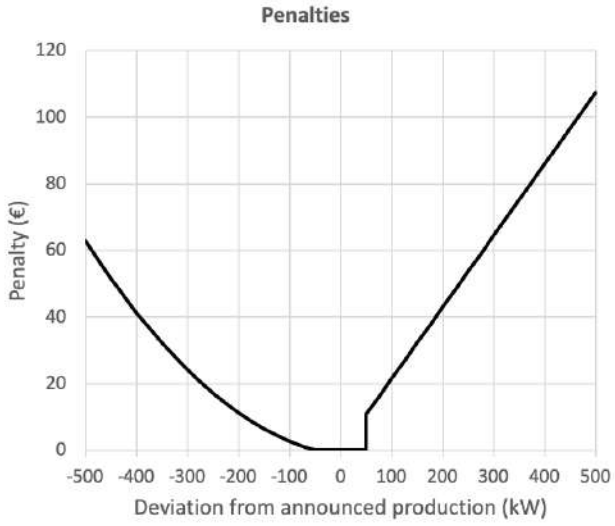
Challenges

- Develop and select high quality short term solar forecasts
- Integrate the forecast (probabilistic) in the Energy Management System (EMS)

3. Utility scale PV with storage



Deterministic (red line) and probabilistic (grey intervals) forecast, announced injection profiles (dashed lines) and actual PV output power (black line)



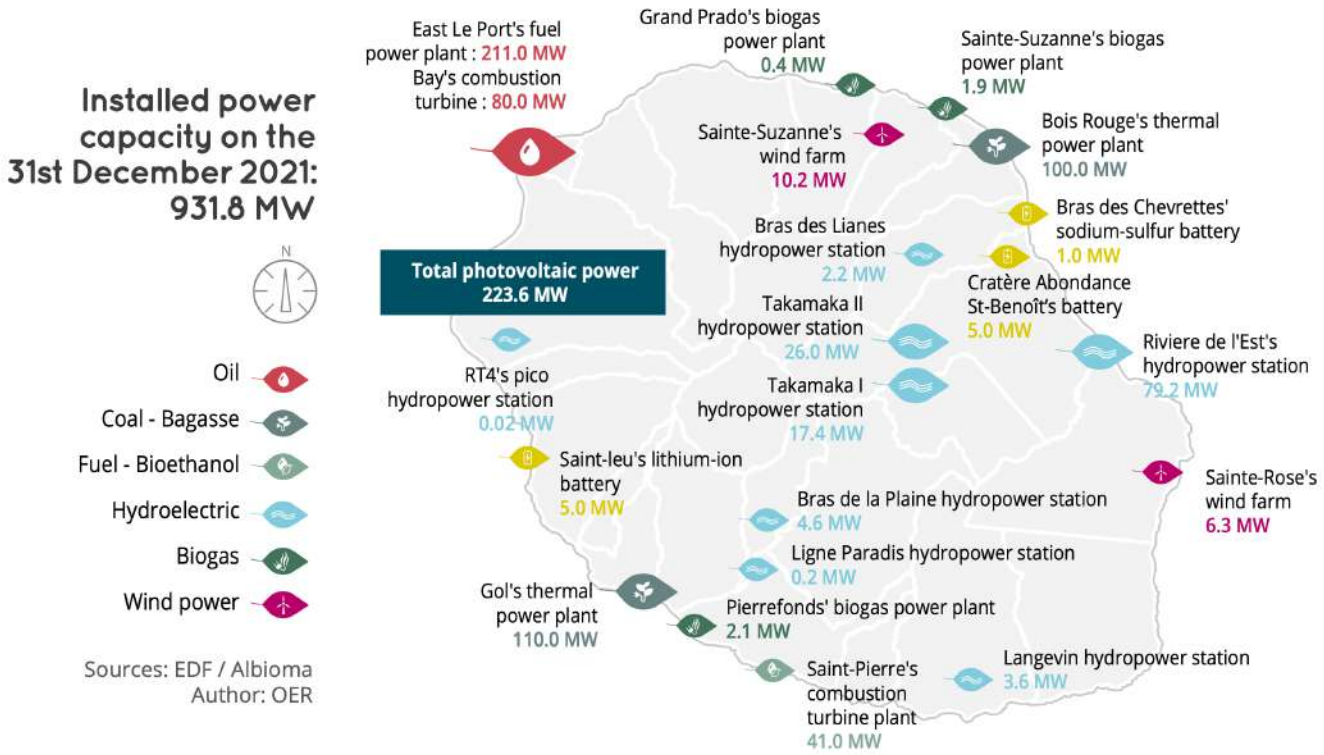
Penalties resulting from deviation from the announced production profile

Available data

- Private production systems, data not publicly accessible
- Call for tender rules fully known
- CorRES: long-term time series of historical and forecast weather conditions

Example with the rules of the call for tenders 2015
(PV 1MWp, storage 1MWh, feed-in tariff 215€/MWh)

4. Power grid of La Reunion



Schematic diagram of La Reunion's electricity mix in 2021

Intermediate-size electricity grid (2021):

- 400,000 consumers
- 3,000 GWh/year (28.2% renewable)
- Large variety of production means

PV: 24% of installed capacity

Grid limit: 35% of produced power from solar and wind (variable RES)

100% renewable in 2024 (imported wood pellets)

Autonomy goal for 2030

Challenges

- Achieve a massive integration of solar energy to reach self-sufficiency
- Predictive smart management of energy production, demand and storage

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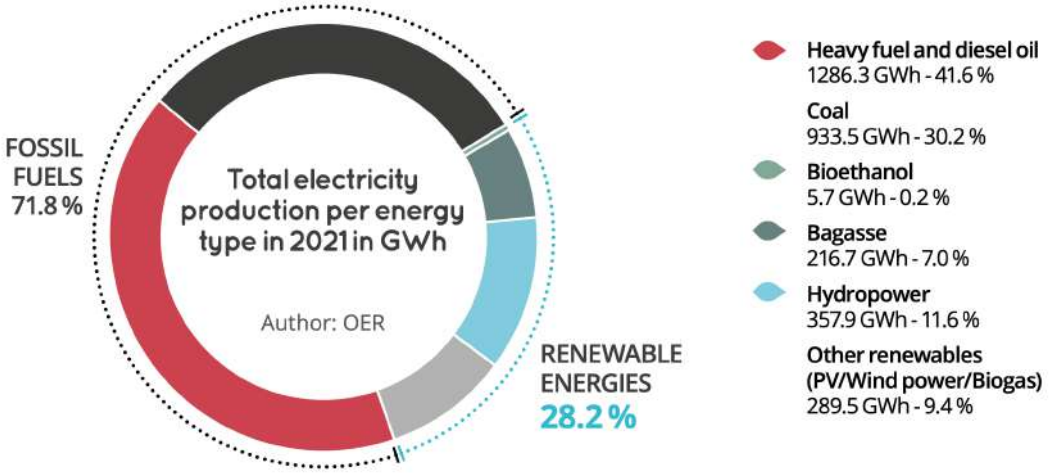
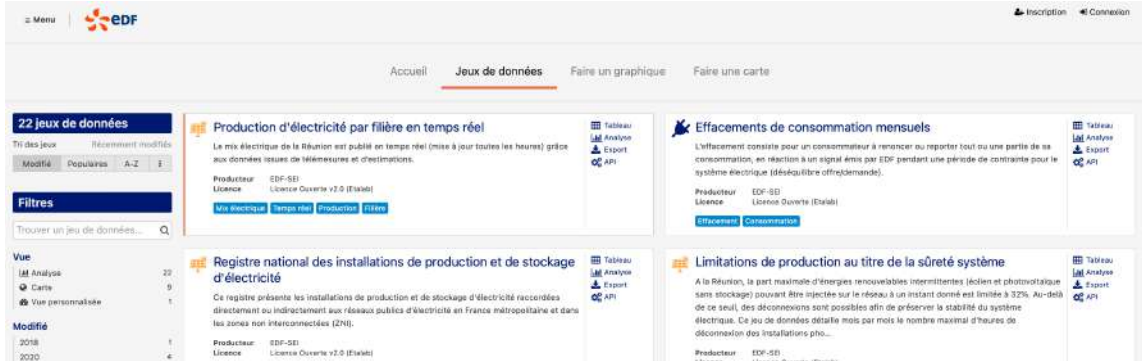
4. Power grid of La Reunion

Available data

- Open-data website maintained by the DSO (EDF Reunion)
  - Hourly production by type of generation means
  - Cost of production
  - Transportation lines and main transformers
  - …
- Yearly detailed report on the energy production and demand



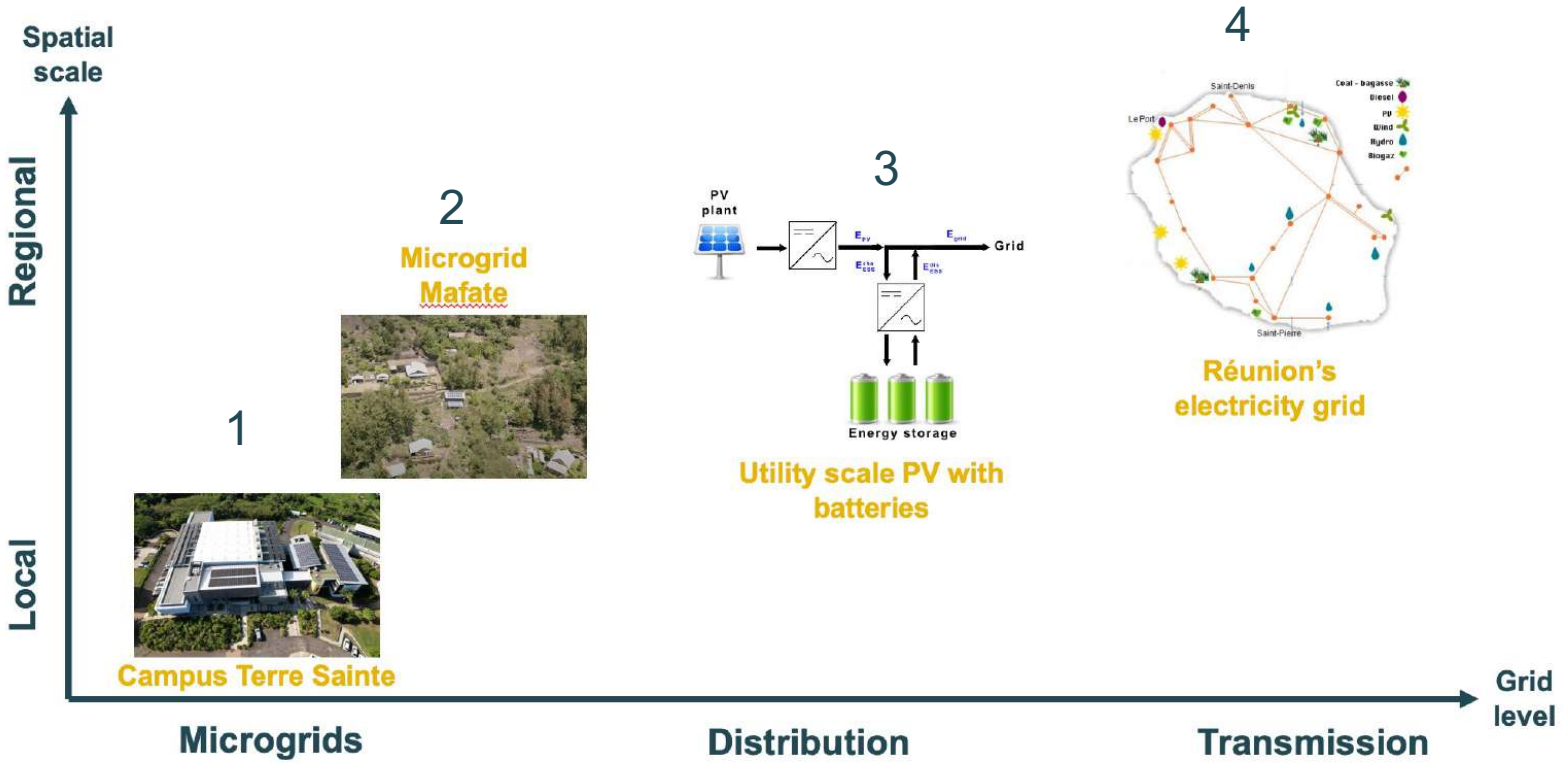
Electricity production mix of La Reunion in 2021 (Reunion Island Energy Observatory (OER), 2022)



Screen shot of the DSO's open-data website (opendata-reunion.edf.fr)

Conclusion

- Study cases representative of different scales and challenges
- Associated data available to the scientific community



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Thanks for you attention

Questions?

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