



Flexibility enhancement to ensure European islands decarbonisation

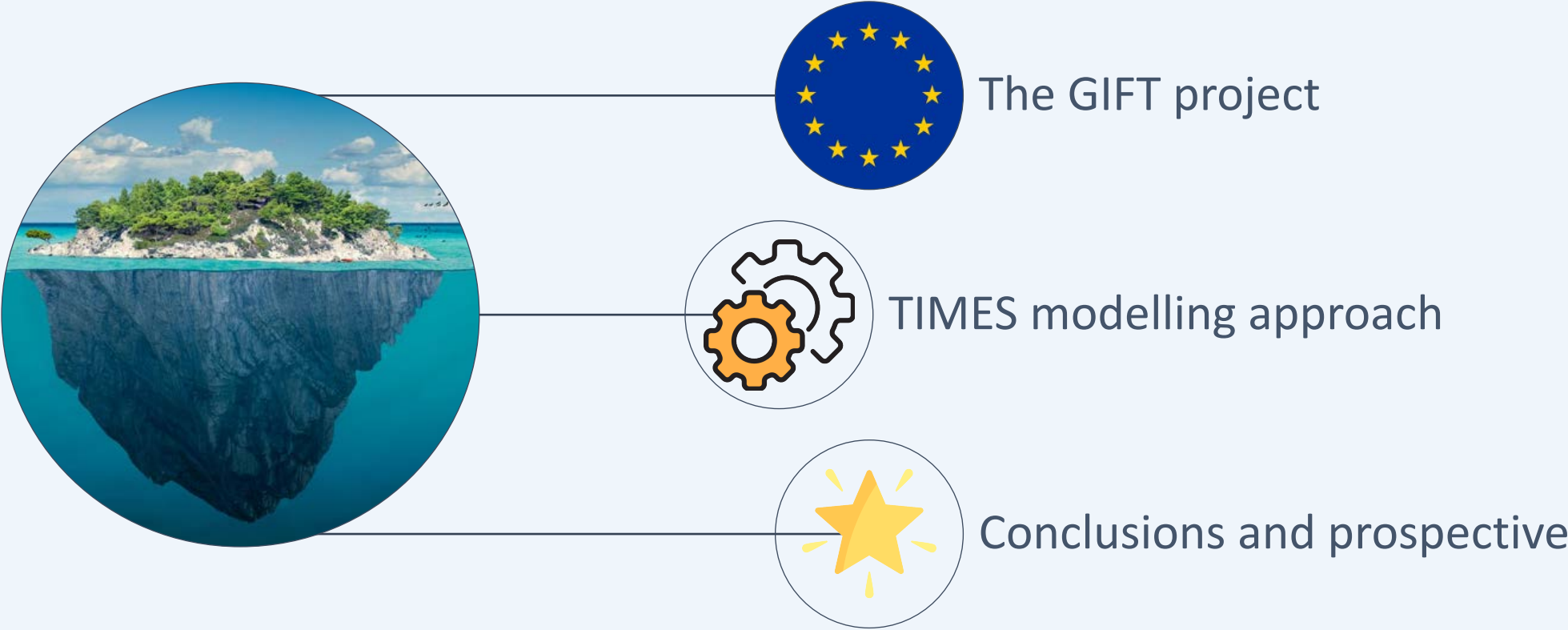


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Summary



New challenges for the electric grid

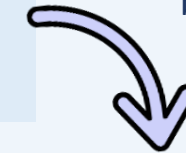


Electricity production limiting GHG emissions

BUT

Intermittent energy sources

Ensure the balance between demand and supply at all time



Grid flexibility

*Ability of a power system to **reliably and cost-effectively** manage the **variability and uncertainty of demand and supply** across **all relevant timescales***

Flexibility needs for the electric grid



Additional limits:

- **Limited energy production possibilities**
- **Space constraints**
- **Limited interconnection** with mainland



have to **rely more on flexibility options** to ensure the secure and cost-efficient operation of their energy system

The GIFT project (H2020)



Decarbonise the energy mix of the **European islands**

-50% fossil fuels use
+100% renewable energy penetration



Development of **innovative solutions** for the integration of large amounts of renewable energy



Two islands:



HINNØYA



PROCIDA



17 partners ...



Focus on Procida

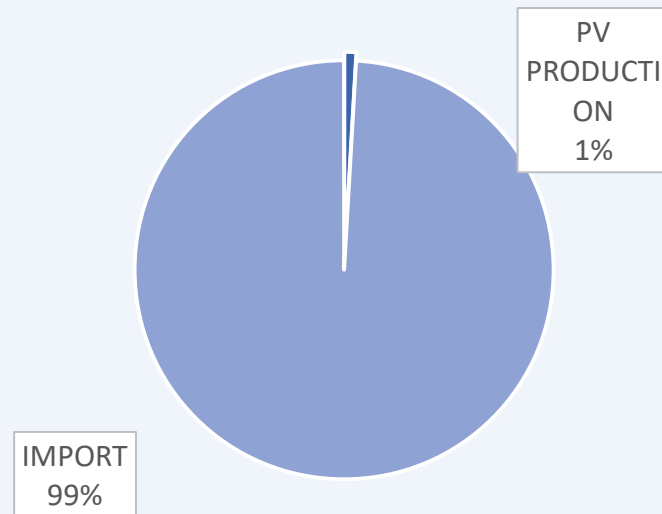


Small island in the Gulf of Naples

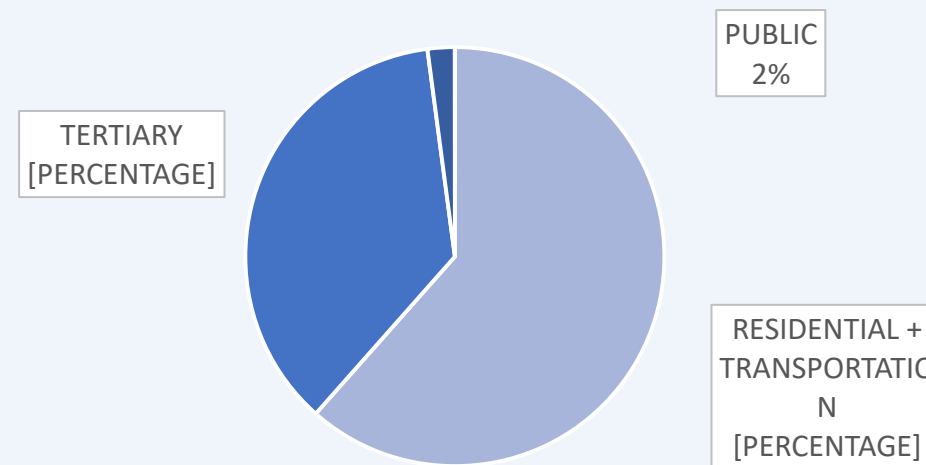
- *European island with the highest population density*
- *Connected to a close island (Ischia) by a 30 kV submarine cable*
- *Limited energy production possibilities: energy supply mostly provided by import (99%)*
- *Popular turistic location during summer*
- *Important share of electric bikes on the island*

In 2018:

ELECTRICITY SUPPLY

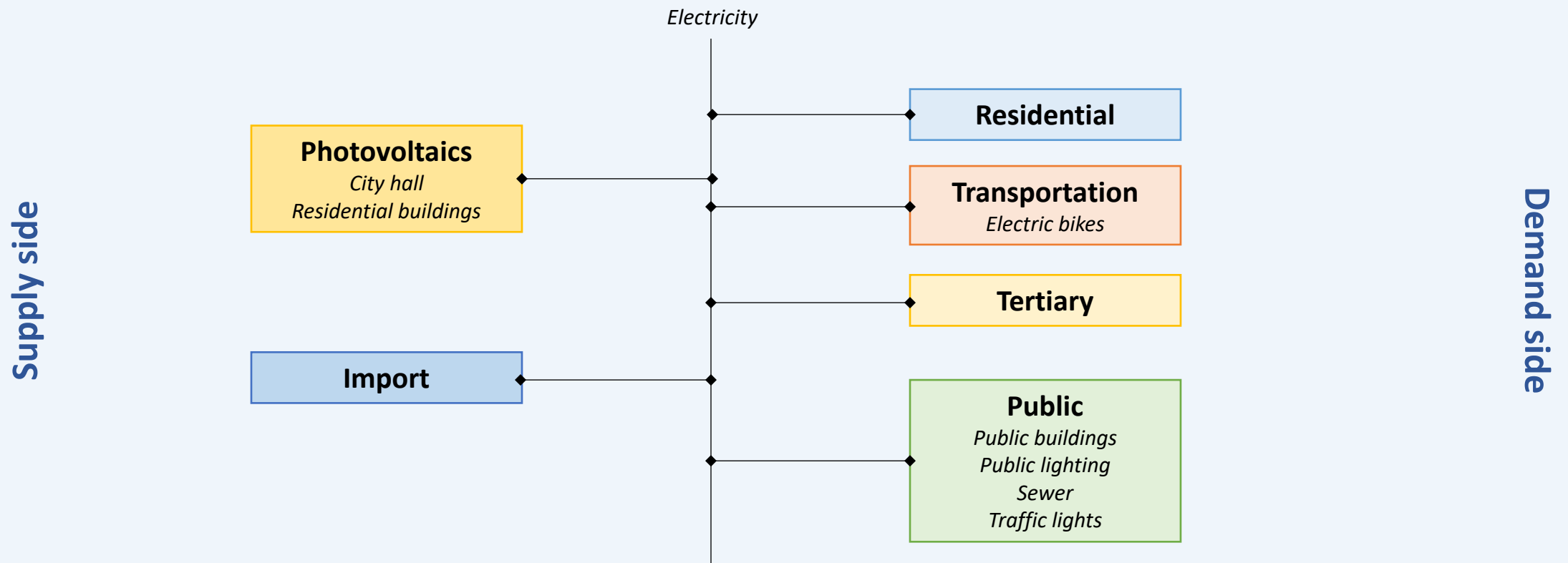


ELECTRICITY CONSUMPTION



Simplified model structure

At the reference year (2018):

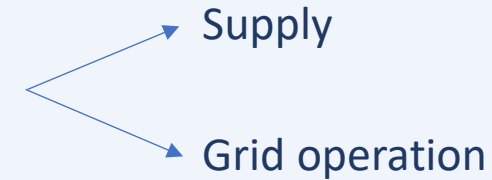


Flexibility assessment in TIMES

VREs share increases
(variability of production increases)



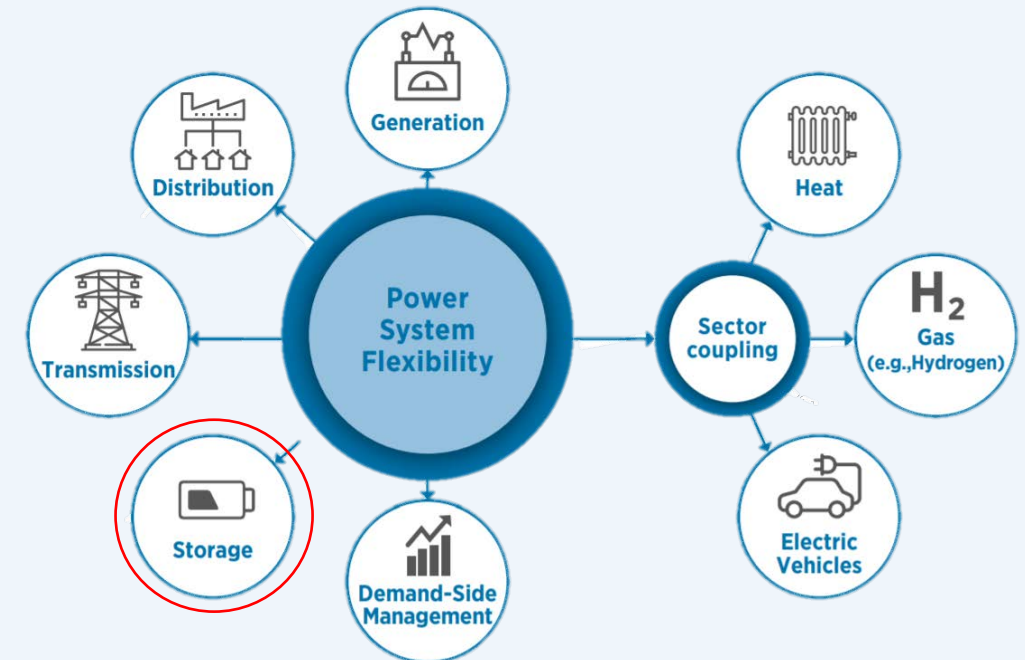
Need to ensure the **security of**



At all timescales

Possible modelling approach to integrate flexibility needs:

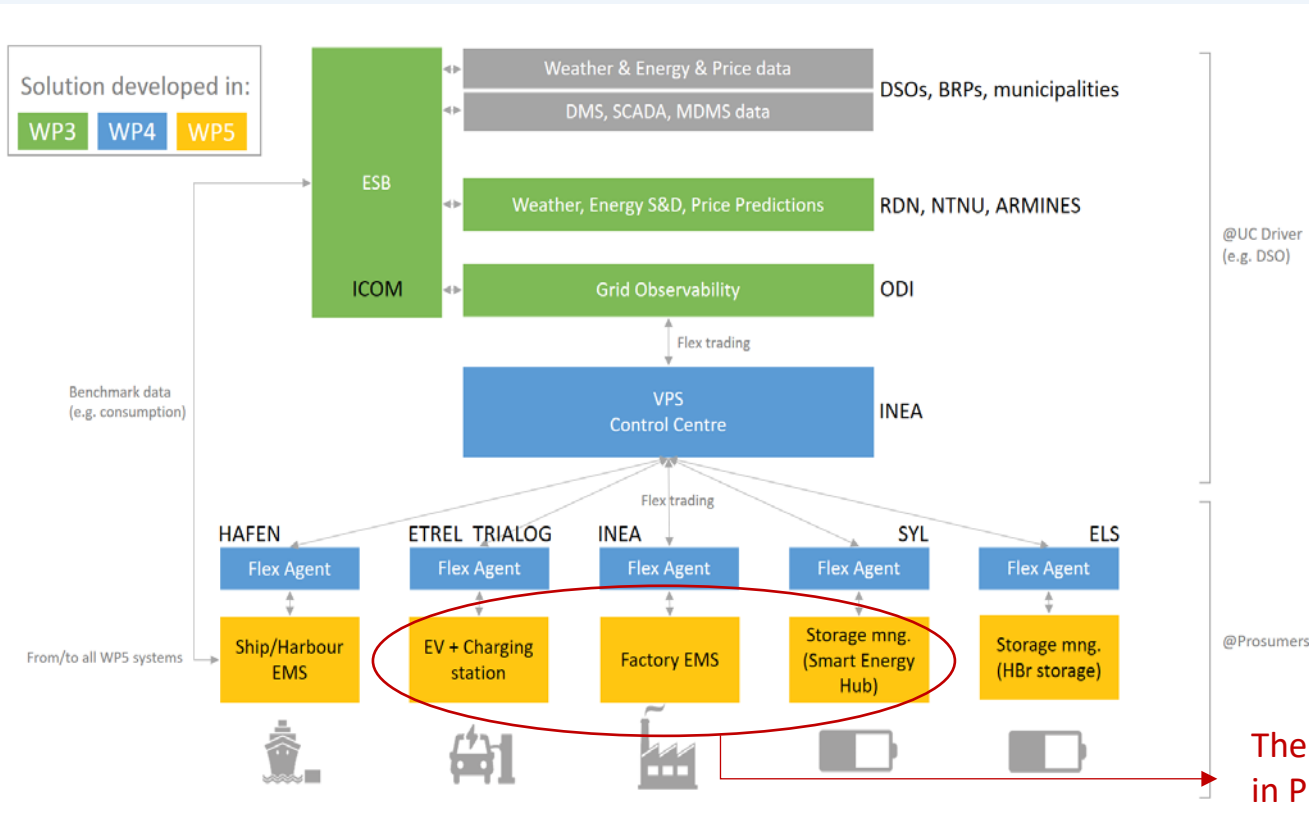
- Integration of **flexibility parameters and constraints** to ensure secure grid operations as variable renewables share increases
 - Definition of capacity margins and inertia needs?
- Possible use of **refined time-slices** to study phenomena at **different timescales**
- Use of **technologies** that increase system flexibility



Source: IRENA (2018)

Technologies to increase flexibility

GIFT PROJECT SOLUTIONS



ADDITIONAL SOLUTIONS

- ISLAND CHARACTERISTICS
- PROSPECTIVE COSTS DECREASE FOR BATTERIES
- DECARBONISATION TARGETS



- RESIDENTIAL and TERTIARY TRANSPORTATION
 - PV + storage
 - Electric vehicles

SMART ENERGY HUB

For RESIDENTIAL applications



Scenarios



Reference timeline:



Possible scenarios:

CASE	Flexibility	Renewables	Efficiency	Emissions	Imports	
FLEX	With flexibility requirements					Energy system when flexibility constraints are set
TARGETS	With flexibility requirements	Min renewable share	Energy efficiency improvements	Limits on emissions		To achieve national and European goals
IMPLIM	With flexibility requirements	Min renewable share	Energy efficiency improvements	Limits on emissions	Limits on imports	To study the possible energy independence of the island

Conclusions and prospective

PRELIMINARY CONCLUSIONS

- The **integration of flexibility solutions** is essential to ensure the long-term decarbonisation of the island



CURRENT MODEL LIMITATIONS

- The currently available **data** is not detailed enough to properly define the electricity demand in the island
- Need to better define the **flexibility requirements** in the model

PROSPECTIVE

- **Full integration of flexibility** in the long-term assessment of the island
- Estimation of the **contribution of flexible solutions to the island decarbonisation**

Thank you for the attention

Annex

Regulatory framework



2030

-40% greenhouse gas emissions (from 1990 levels)
32% share for renewable energy
+32.5% improvement in energy efficiency



2030

-33% greenhouse gas emissions (from 2005 levels)
+30% renewable energy in end-use consumptions
 (+22% in transportation)

By promoting:

- **self-consumption** in residential and industrial sector
- **electrification** of energy consumptions (mainly in residential and transportation sector)
- **energy efficiency** in all sectors
- **renewable energy** deployment



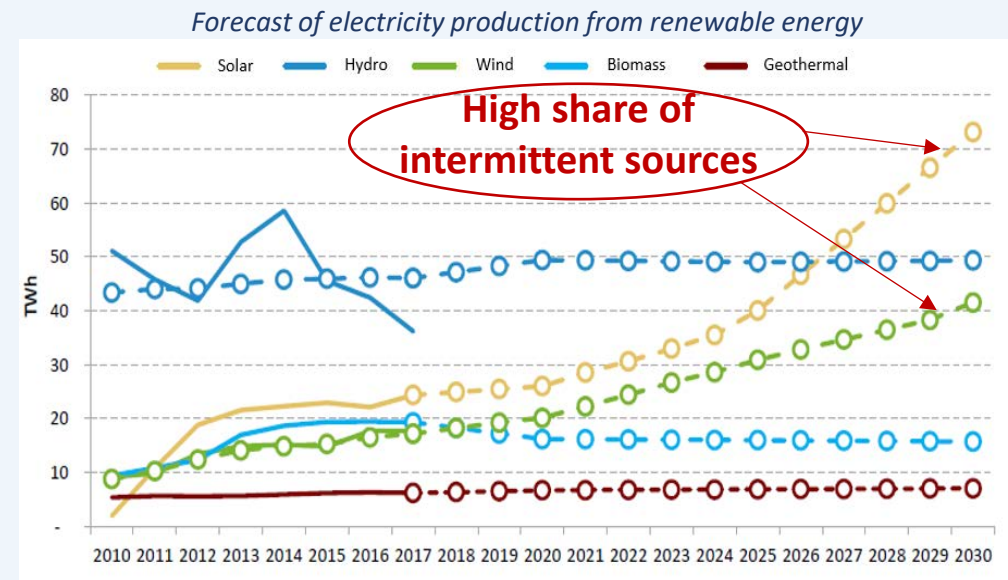
2020

Energy efficiency improvement in public and residential sector
Sustainable mobility plans

(Currently no objectives for 2030)



2050



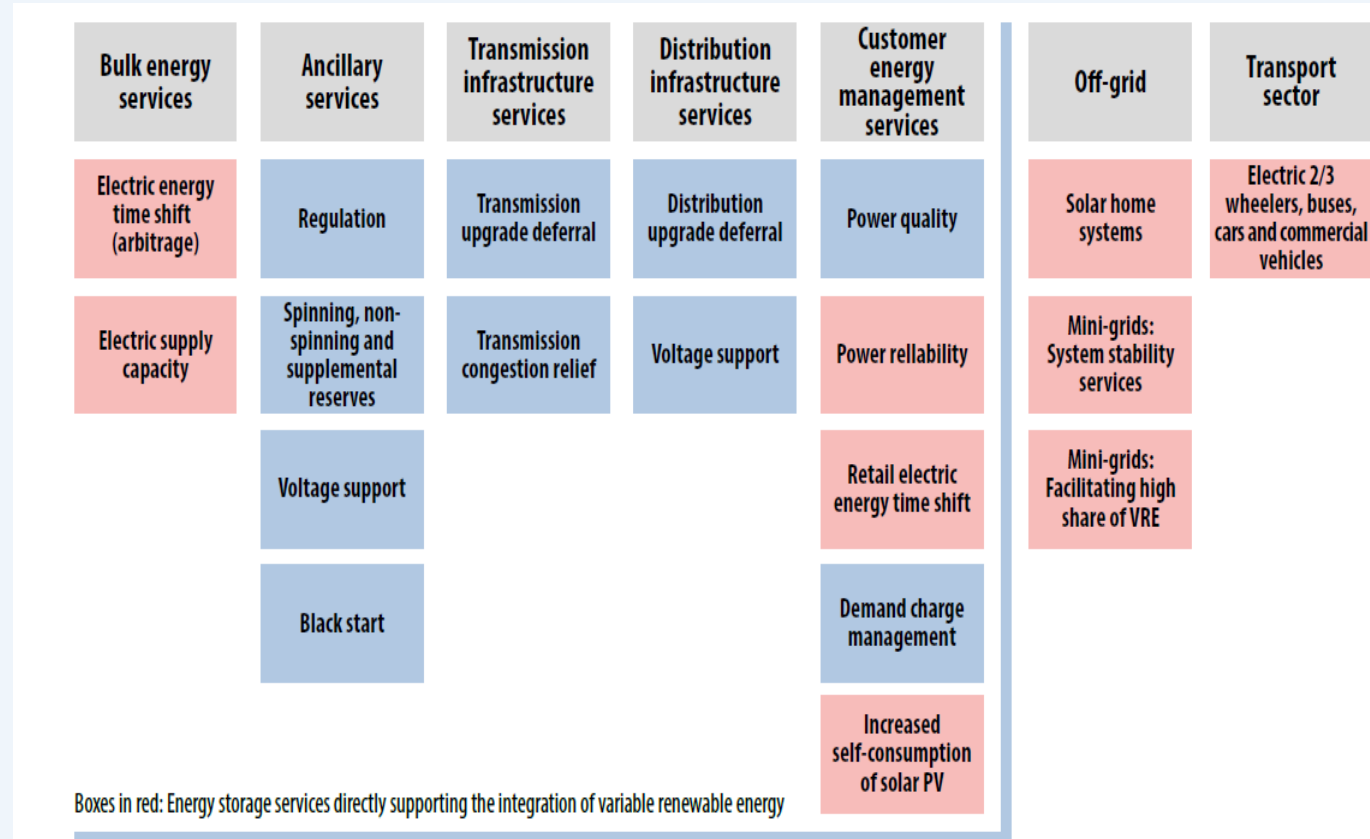
Source: PNIEC – Italy (2020)

Storage technologies

Storage benefits for renewable energy integration

Type	Electricity storage technologies
Electro- chemical	Electro-chemical capacitor Lithium-ion battery Flow battery Vanadium redox flow battery Lead-acid battery Metal air battery Sodium-ion battery
Electro-mechanical	Compressed air storage (CAES) Flywheel
Chemical	Hydrogen storage Liquid air energy storage
Pumped hydro storage	Closed-loop pumped hydroelectricity storage Open-loop pumped hydroelectricity storage
Thermal storage	Chilled water thermal storage Concrete thermal storage Heat thermal storage Ice thermal storage Molten salt thermal storage

Source: based on US DOE, 2017

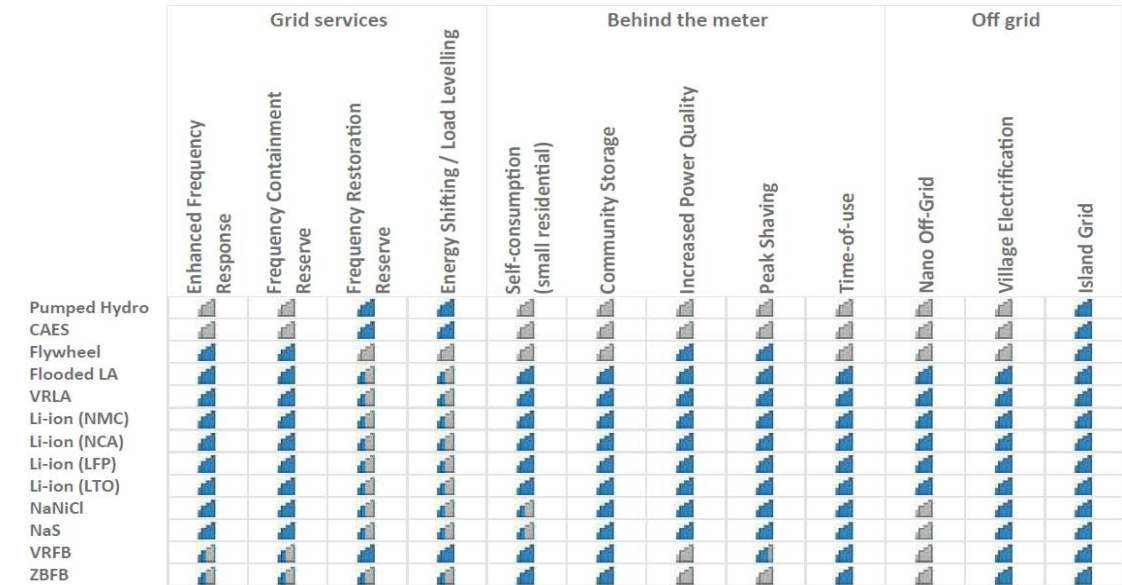


Source: IRENA (2017)

Choice of the most suitable storage

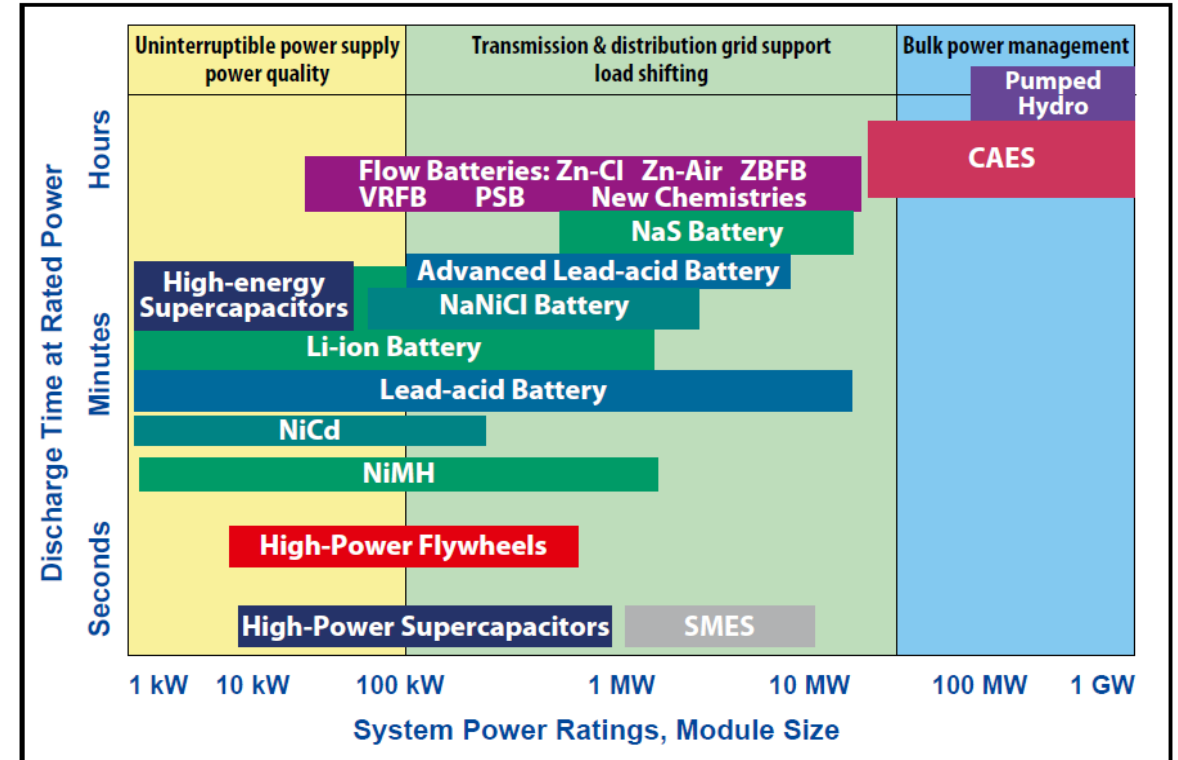
For stationary applications

Figure 13: Suitability of storage technologies for different applications



Source: International Renewable Energy Agency.
 Note: CAES = compressed air energy storage; LA = lead-acid; VRLA = valve-regulated lead-acid; NMC = nickel manganese cobalt oxide; NCA = nickel cobalt aluminium oxide; LFP = lithium iron phosphate; LTO = lithium titanate; NaNiCl = sodium nickel chloride; NaS = sodium sulphur; VRFB = vanadium redox flow battery; ZBFB = zinc bromine flow battery.

Figure 11: Positioning of diverse energy storage technologies per their power rating and discharge times at rated power



Source: US DOE/EPRI, 2015.
 Note: Zn-Cl = zinc chlorine flow battery; Zn-Air = zinc air flow battery; ZBFB = zinc bromine flow battery; VRFB = vanadium redox flow battery; PSB = polysulfide bromine flow battery; NaS = sodium sulphur; NaNiCl = sodium nickel chloride; NiCd = nickel cadmium; NiMH = nickel-metal hydride; SMES = superconducting magnetic energy storage.

Model time structure

Model horizon: 50 years

