Energy Storage Report: Applications and market potential for energy storage in Italy

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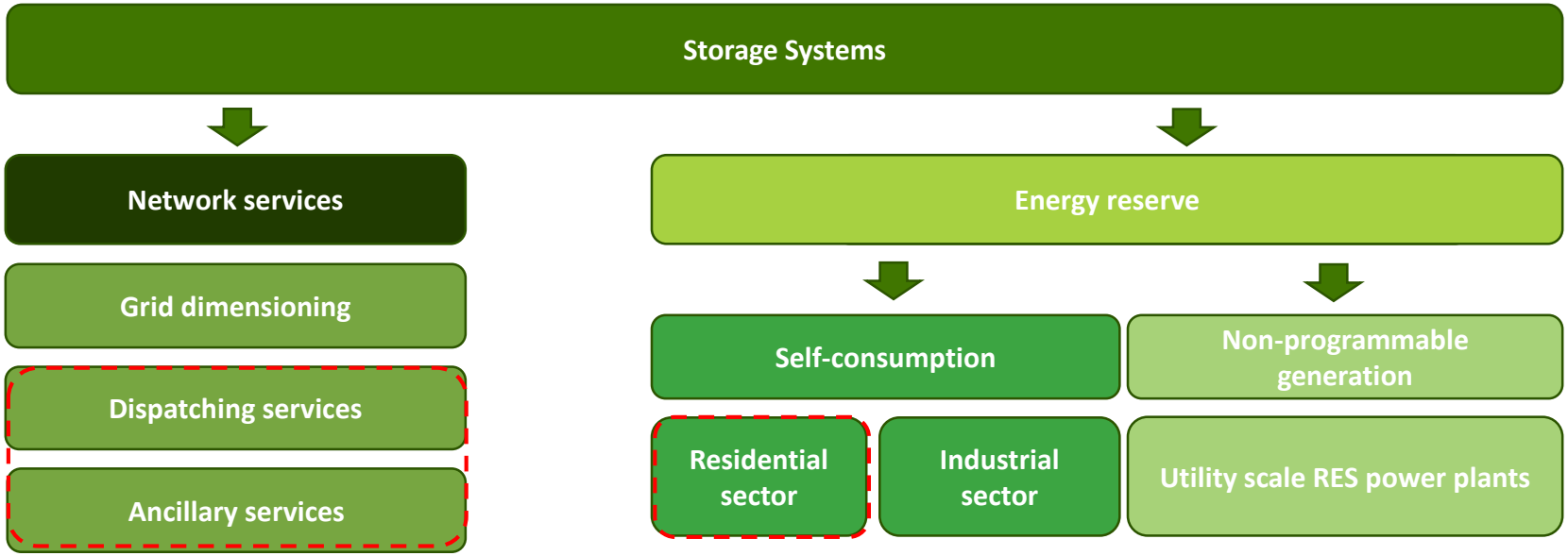
Agenda

1. Definition and analysis area
2. Storage systems as “energy reserve”
3. Storage systems for “ancillary services”
4. Storage systems’ potential in Italy

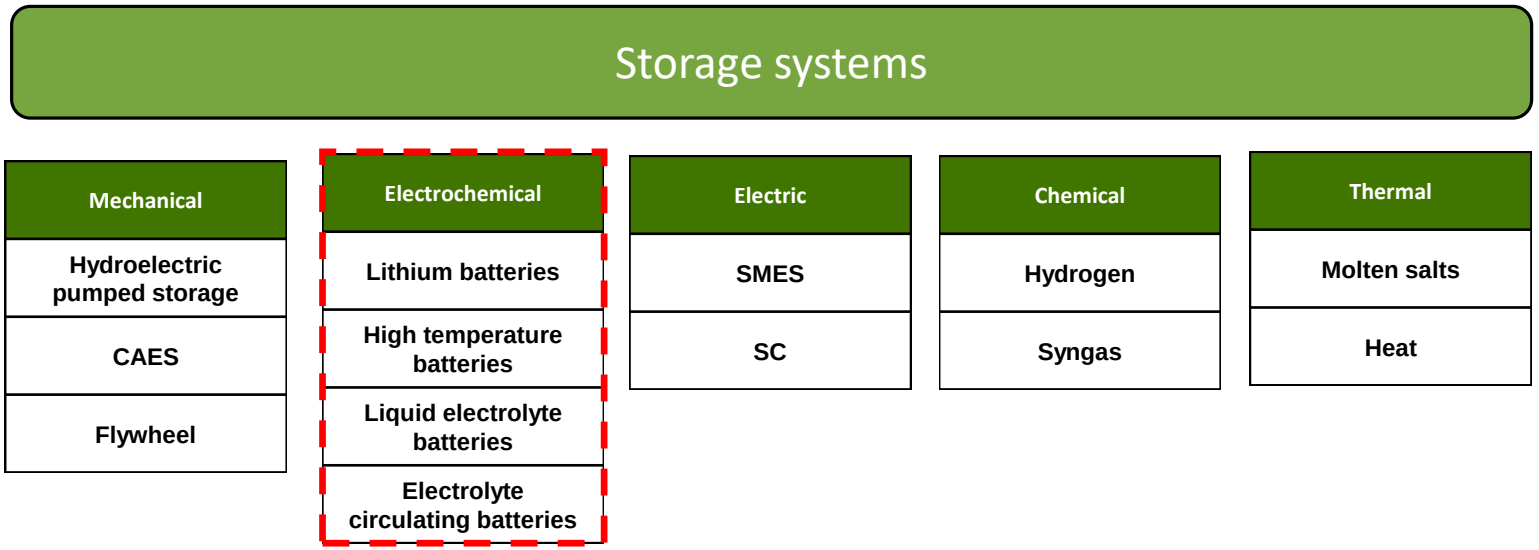
Storage systems' applications

- The following figure shows the **classification between the different applications that has been considered in this Report.**



Technological solutions for storage systems

- **Accounting for more than 90% of the total investments in storage systems**, electrochemical solutions are those which deserve a further detailed study.
- It has been focused on the **electrochemical solutions** because they **are the most suitable for the distributed generation paradigm** which is strongly increasing its presence in the mix generation of the main European countries.



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Storage systems as “energy reserve” in residential sector

- The investment costs for the storage system are presented in the following table

STORAGE SYSTEM			
	Capacity	*Cost (New installation)*	*Cost (Retrofit)*
Lithium-ion battery	**2 kWh**	3.500-4.000	5.000-5.500
	4 kWh	5.000-5.800	6.000-6.500
	6 kWh	7.000-7.500	8.000-8.500

- The difference in cost between **“retrofit” case** and the new one are due to **the PV inverter replacement necessary to host the storage not provided before.**

(*) New-generation inverters have a specific «connection» for the storage system so they already set-up for an integration

Case 1: 2 kWh storage system applied to a new photovoltaic installation

- The following table summarises the results for a **2 kWh** storage system applied to a **new photovoltaic installation** in the residential sector, depending on the user's annual consumption profile.

Consumption profile 4.000 kWh/year	TURNKEY COST*	Selfconsumption	IRR	PBT
North	3.500€ - 4.000€	40% - 50%	(-2,6%) – (-3%)	> Battery's life-cycle
Center				
South				
Consumption profile 5.000 kWh/year	**TURNKEY COST***	**Selfconsumption**	**IRR**	**PBT**
North	3.500€ - 4.000€	40% - 50%	(-1,9%) – (-2%)	> Battery's life-cycle
Center				
South				
Consumption profile 6.000 kWh/year	**TURNKEY COST***	**Selfconsumption**	**IRR**	**PBT**
North	3.500€ - 4.000€	40% - 45%	(-1,85%) – (-1,95%)	> Battery's life-cycle
Center				
South				

*No battery replacement during the PV's life-cycle.

Case 2: 2 kWh storage system applied to an existing photovoltaic installation (*retrofit*)

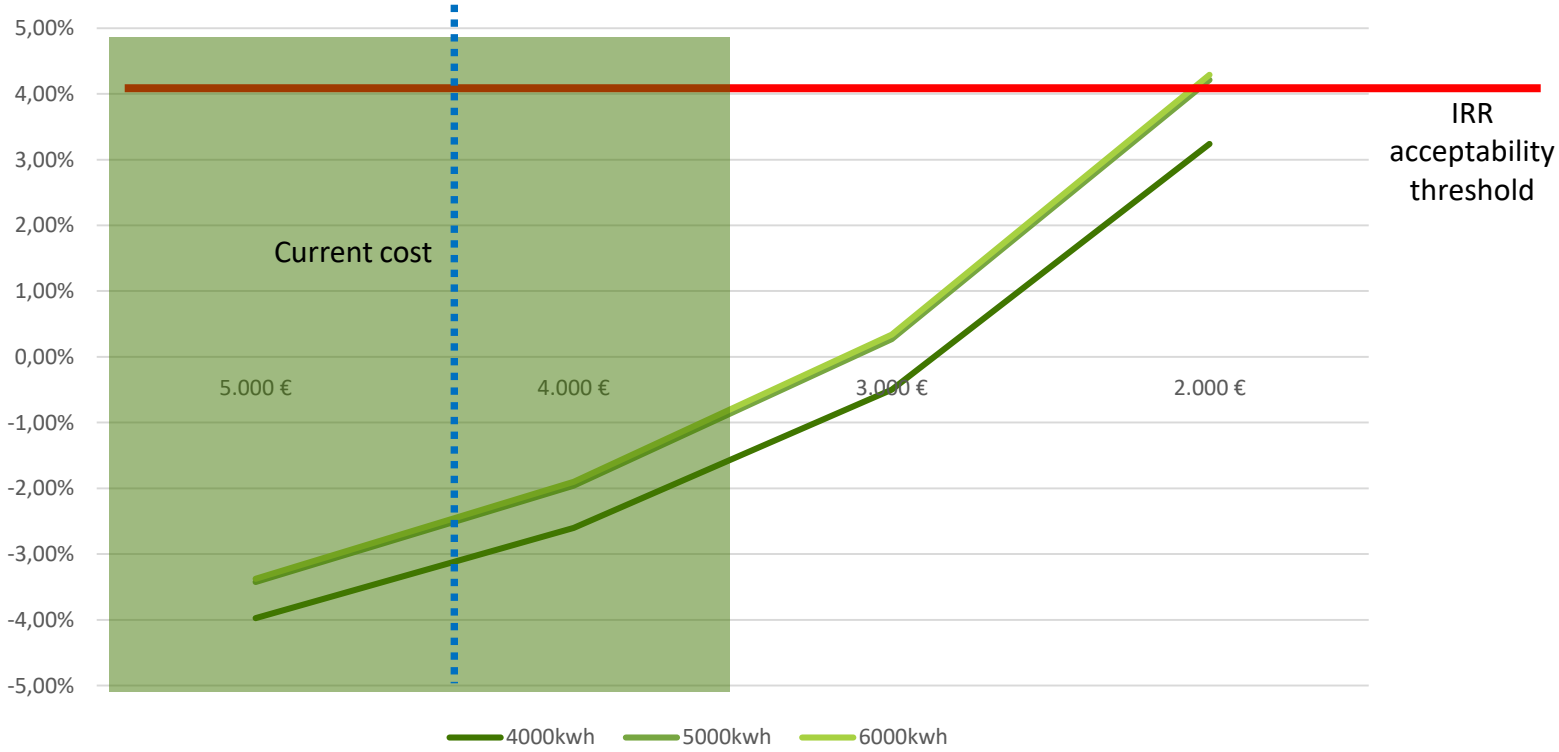
- The following table summarises the results for a **2 kWh** storage system applied to an existing photovoltaic system ***(retrofit)*** in the residential sector, depending on the user's annual consumption profile.

Consumption profile 4.000 kWh/year	TURNKEY COST*	Selfconsumption	IRR	PBT
North	5.000€ - 5.500€	40% - 50%	(-3,95%) - (-4%)	> Battery's life-cycle
Center				
South				
Consumption profile 5.000 kWh/year	**TURNKEY COST***	**Selfconsumption**	**IRR**	**PBT**
North	5.000€ - 5.500€	40% - 50%	(-3,4%) - (-3,5%)	> Battery's life-cycle
Center				
South				
Consumption profile 6.000 kWh/year	**TURNKEY COST***	**Selfconsumption**	**IRR**	**PBT**
North	5.000€ - 5.500€	40% - 45%	(-3,3%) - (-3,4%)	> Battery's life-cycle
Center				
South				

* No battery replacement during the PV's life-cycle.

2 kWh storage systems: sensitivity analysis

- The graph below shows the sensitivity analysis for the IRR depending on the **2 kWh** storage system's turnkey cost trend, both **«retrofit»** and **«new installation»** scenarios.



Storage systems as “energy reserve” in the residential sector: an overview

- The **cost reductions required** in order to bring the values above the acceptability threshold **seems to be very significant.**

- Therefore it’s clear that **there are just two ways for the market development in the residential sector:**

  - An adoption of storage systems not based on **cost-effectiveness** but on aspects concerning investment’s **technological innovation** or **environmental sustainability**;

  - An adoption based on a **new energy consumption paradigm** which places **distributed generation** and **electricity use** at the centre of the **new residential systems’** design**.**

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Economic sustainability: methodology

- In order to assess the economical sustainability
  - **It was only considered the "Bid-up price" offered on the MSD,** characterised by interesting prices' values.
  - **Three different solutions** were analysed:
    - «**Pure Energy Storager**» which uses electric energy drawn by the grid at the PUN price to charge the batteries ("**reference type" configuration**);
    - **Wind plant*** which adopts a storage system charged using the locally generated energy, at the **LCOE** price – Levelized cost of energy;
    - **Photovoltaic plant*** which adopts a storage system charged using the locally generated energy.
  - The **evaluation criteria** adopted are:
    - **IRR**, internal rate of return (**acceptability threshold set at 10%)**
    - **PBT**, pay-back time (**acceptability threshold set at 6 years**)

*Assuming a growing percentage for the generation used for the battery charging in order to participate in the MSD market.

Economic sustainability : methodology

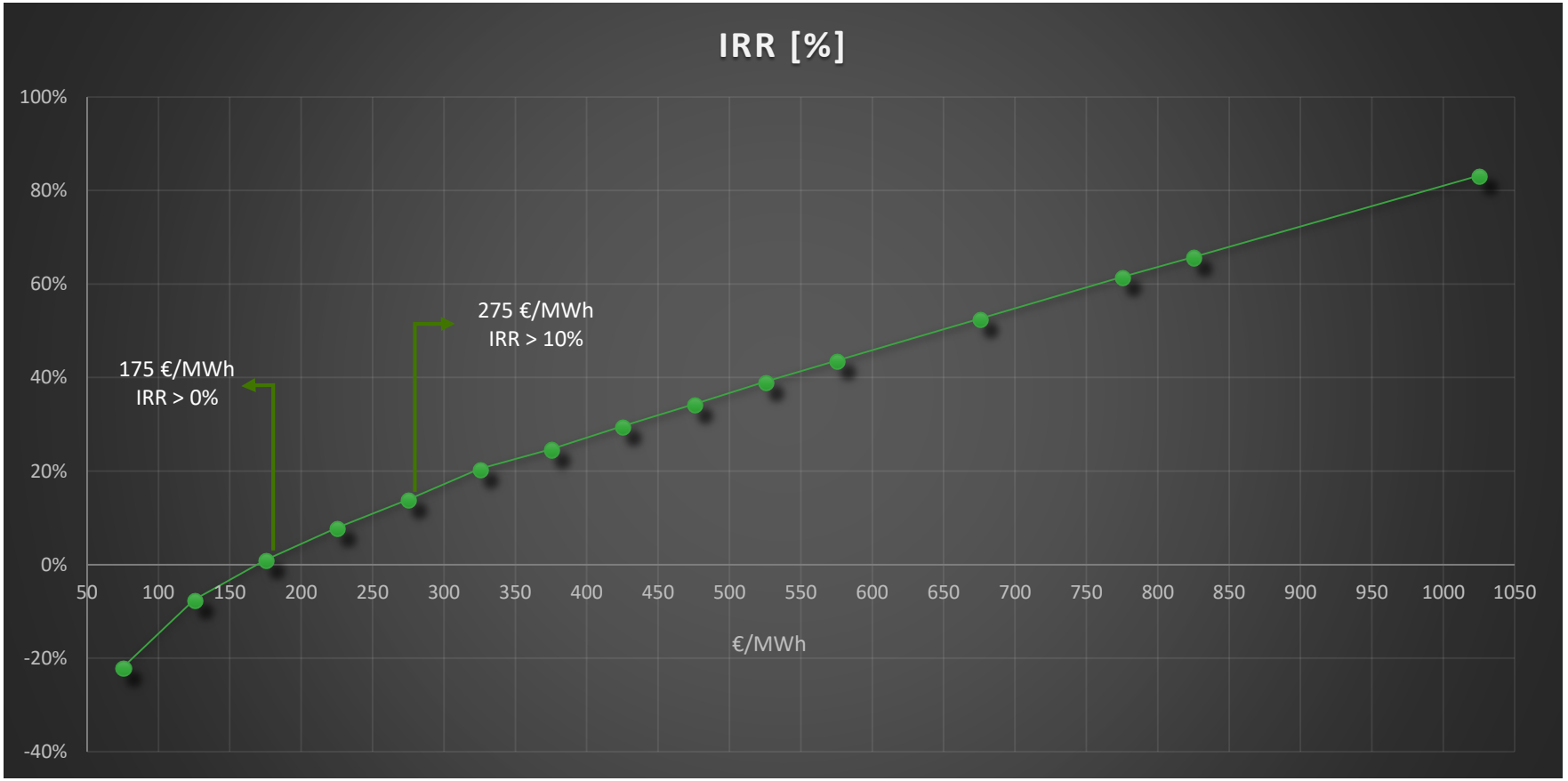
- Finally, the table shows the **assumptions used to define the 'reference case' configuration**.

Storage system	DATA
Technology	Lithium-ion
Power [MW]	10
Capacity [MWh]	20
Cost [€/MWh]	700.000
Charge cost[€/MWh]	40
O&M [€/year]	70.000– (1% of the system cost)
Discount rate	6%
Amortisation	10 years on a straight-line basis
Battery availability (*)	50 charging cycles/month

(*) Number of monthly charging cycles that can guarantee a life-cycle of ten years.

Economic sustainability: IRR

- Considering the **'reference type' configuration** ("**Pure Energy Storager**" which uses electric energy from the grid to recharge the battery), the graph below shows the **profitability of the investment** for **different "increasable reserve" energy price ranges.**



Economic sustainability: PBT

- Similarly, the following graph shows **the PBT trend for the 'reference type' configuration.**

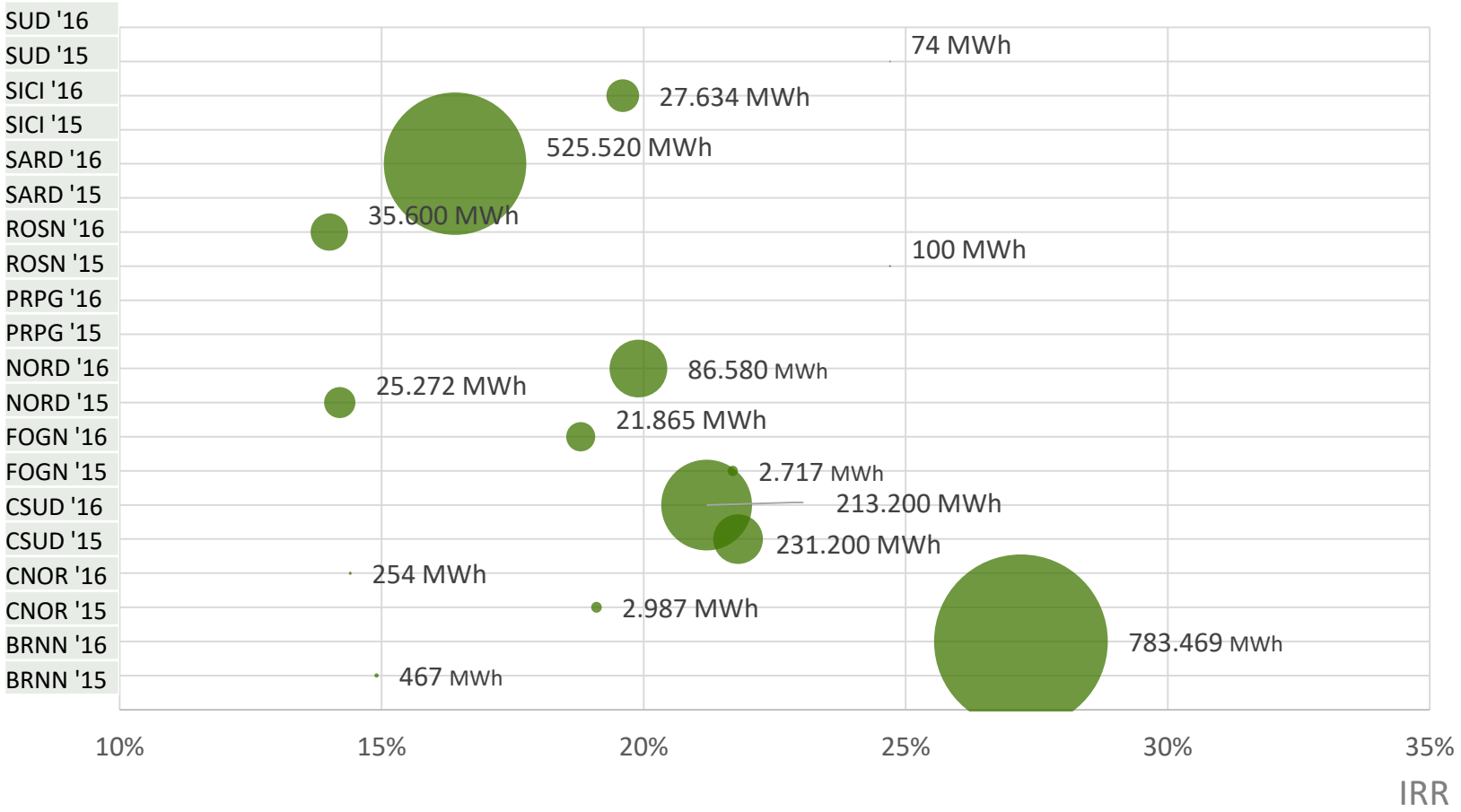
Economic sustainability: methodology

- The table below shows the **10 geographical and virtual zones** in the MSD (Italian Ancillary Services Market)

Acronym	Zone name	Detail	Type
BRNN	**Brindisi**		Limited production zone
CNOR	**Centro Nord**	Toscana, Umbria, Marche	geographical
CSUD	**Centro Sud**	Lazio, Abruzzo, Campania	geographical
FOGN	**Foggia**		Limited production zone
NORD	**Nord**	Val D'Aosta, Piemonte, Liguria, Lombardia, Trentino, Veneto, Friuli Venezia Giulia, Emilia Romagna	geographical
PRGP	**Priolo G.**		Limited production zone
ROSN	**Rossano**		Limited production zone
SARD	**Sardegna**		geographical
SICI	**Sicilia**		geographical
SUD	**Sud**	Puglia, Basilicata, Calabria	geographical

Economic sustainability in the different virtual zones: an overview

- The graph shows the results for each zone, comparing the values in 2015 and 2016. The area of the circle is proportional to the amount of energy (MWh) that can be exchanged in an economically sustainable manner.



Economic sustainability in the different geographical and virtual zones: an overview

2015			
Useful energy [MWh]	Zone [nr]	IRR min [%]	IRR max [%]
95.168	7 out of 10	North 14,2%	Rossano and South 25%

2016			
Useful energy [MWh]	Zone [nr]	IRR min [%]	IRR max [%]
1.694.122	8 out of 10	Rossano 15%	Brindisi 27%

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The potential market for storage systems as ”energy reserve” by 2025

- **Retrofit**

	SMALL-SCALE BATTERY	MEDIUM-SCALE BATTERY
	3kW – 5 kW PV plant	>6kW PV plant
Number of plants	250.000	50.000
Theoretical market potential	850 – 1.000 mln €	200 – 400 mln €
Expected market potential	40 – 50 mln €	20 – 40 mln €

- **New**

	SMALL-SCALE BATTERY	MEDIUM-SCALE BATTERY
	3kW – 5 kW PV plant	>6kW PV plant
Number of new plants	20.000 year	15.000 year
Theoretical market potential	500 – 700 mln €	75 – 100 mln €
Expected market potential	50 – 70 mln €	11 – 20mln €

The potential market for storage systems as ”energy reserve” by 2025

- Considering the expected market we obtain **150 mln € of global turnover.**

- It is clear that the **development of this market will depend on the ability of the storage systems producers to achieve the expected production costs** and/or on the introduction of incentive schemes able to attract the investments necessary to target the mass market.

The potential market of “network services” for storage systems: conservative scenario

- The table below shows the values set for installed capacity and investments in storage systems in the **conservative scenario** (“Pure Energy Storager” operating on “**Bid-up price**” higher than **275 €/MWh)**

MSD_2015	BRNN	CNOR	CSUD	FOGN	NORD	PRGP	ROSN	SARD	SICI	SUD	TOTALE
New capacity [MW]	0 – 1	1,5 - 3	50 - 60	1 - 2	18 - 22	0	0 - 1	0	0	0 – 1	**70,5 - 89**
«Business volume» [mln €]	0– 1.1	1.6 - 5	55 – 65	1,1 – 2,2	20 - 25	0	0– 1.1	0	0	0– 1.1	**78 – 100**

- **67% of the feasible installations are concentrated in the Central and Southern regions**, and “**Centro Nord” comes second with an additional 25%.**

The potential market of “network services” for storage systems: expansionary scenario

- The values set for installed capacity and investments in storage systems in the **expansionary scenario**(“(“Pure Energy Storager” operating on “**Bid-up price**” higher than **175 €/MWh**) are shown in the table below, divided by the ten MSD zones

MSD_2015(E)	BRNN	CNOR	CSUD	FOGN	NORD	PRGP	ROSN	SARD	SICI	SUD	TOTALE
New capacity [MW]	0,5 – 2	51,5 - 63	120 - 135	11 - 16	148 - 157	0	1 - 2	0	0	3-4	**335 – 379**
«Business volume» [mln €]	0,6 – 2,2	57 - 70	132 – 149	12 – 18	163 - 173	0	1,1 – 2,2	0	0	3,3 – 4,4	**369 – 419**

- In this case **Northern and Central regions take the lead with respect to feasible installations (42% of the total), while “Centro Sud” is just below (35%)**

The potential market for storage systems in Italy by 2025

- **The storage systems' market in our country is at a crossroad**:
  - **Be a niche market**, almost addressed exclusively to **residential customers** and not lead by economic reasons but by end-user's environmental awareness
  - **Become a developed market in the generation system**, involving new companies and **allowing specialized operators to emerge** using storage systems to provide ancillary services. In this second case **the adoption of storage systems will be economically justified also for *utility scale plants.***

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