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Autorità di Regolazione per Energia Reti e Ambiente

Energy Storage Systems (ESS): regulatory framework in Italy

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Member of **CEER** DS (distribution system) WG
Member of **ACER** INF (elecricity infrastructure) TF

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Ethical code of ARERA, 10(2)

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AGENDA

1. **Ordinary regulation: storage as a market player**
   Definitions and regulatory treatment for storage
   Participation to Ancillary Service Market

2. **Derogations: storage owned and operated by the TSO**
   «Energy-intensive» pilot projects (in order to avoid wind curtailment)
   «Power-intensive» pilot projects (storage lab in major islands)

3. **Derogations: storage owned and operated by DSOs**
   Smart grid pilot projects including storage
   CBA methodology for exceptional cases

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Ordinary regulation of storage: ARERA decision 574/2014

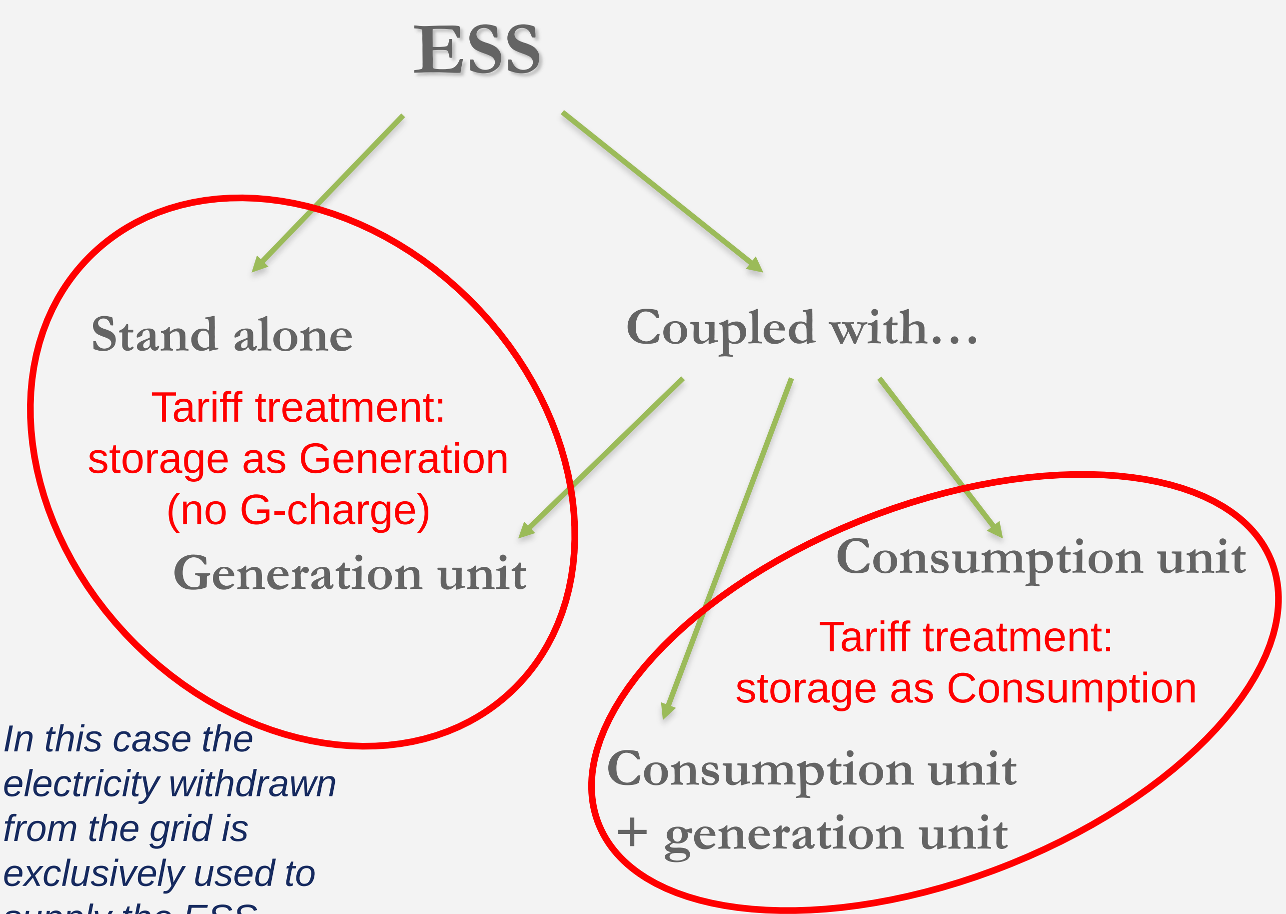
At the end of 2014 the Italian Regulator published the decision 574/2014/R/eel, defining regulation concerning Energy Storage Systems (ESS). According to that decision:

- ESS is "*a set of devices, equipment and control logics, functional to withdraw electricity from or inject it into the grid, planned to operate continuously in parallel with the public network*"
- The storage system "*may or may not be integrated with a generation unit*" (if a generation unit is present on site).

The ARERA definition does not distinguish according to technology.

NOTE: Systems used in emergency (f.i., UPS that come into operation only at the interruption of the power supply for reasons independent by the subject who manages the storage system) are NOT classified among ESS.

Ordinary regulation of storage: ARERA decision 574/2014



In this case the electricity withdrawn from the grid is exclusively used to supply the ESS

In this case final appliances can be fed by electricity withdrawn from the grid through the ESS

Regulatory treatment:

- Connection: all ESS are treated as generation units; a regulated procedure (specific for G-units) applies, with financial compensations in case of delays
- Network tariff and policy costs: ESS stand alone or coupled with G-units have the same tariff treatment as generators (no G-charge); network tariff and policy costs apply to ESS coupled with consumption unit

What ESSs can do in the market

ESS can be used in order to:

- provide ancillary services through the market (MSD)
- reduce imbalances, especially if coupled with non-programmable RES generation units
- shave peaks of electrical energy withdrawals (benefit because network tariff is cost-reflective and mostly capacity-based)
- maximize self consumption exploiting benefit from reduced payment of volumetric components of both network tariff and "general system charges" (policy costs, mainly RES support).

ESS can therefore contribute in the reduction or in the lower increase in the dispatching cost due to non-programmable renewable units.

For the time being, storage is mainly installed for maximise self-consumption.

How ESSs can participate in the Ancillary Service Market

With decision 300/2017, the Italian Regulator started to open the Italian ancillary services market (MSD) to new players:

- RES and distributed generation systems
- Final customers (active demand)
- Energy storage systems that may have a relevant role in order to provide efficiently ancillary services and to reduce unbalances if coupled to non programmable RES.

Demand, generation and storage can be aggregated by a BSP.

ESS participating in Ancillary Service Market, if coupled with consumption units, may be treated as G-units for the electricity withdrawn from the grid and not used for final consumption (final decision envisaged and still to be taken).

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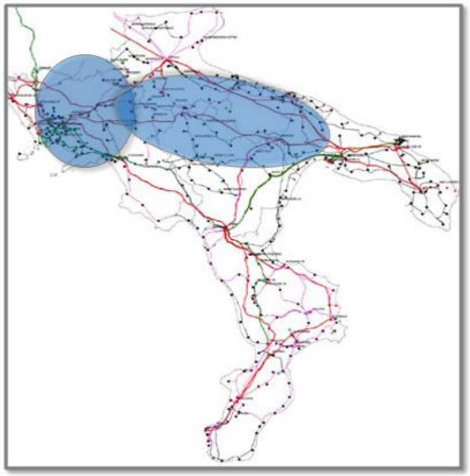
Derogations/TSO: selection of Terna pilot projects



Wind curtailment:
ca. 450 GWh (2012)

3 sites, overall 35 MW - 230 MWh
(time-shift in order to reduce wind curtailment; with Dynamic Thermal Rating embedded)

Benefit/cost ratio
Range **0.20-0.22**

considering only ***time-shift as benefit****, due to specific technology (NaS)*

Avoided energy curtailments to RESs in the area

Charge/discharge efficiency

Price of energy

$$B/C = \frac{Q_{rid\text{-}MPFR} * \eta * P_{en} \text{ (actualised benefits)}}{\text{Total project costs (OPEX+CAPEX) (actualised costs)}}$$

ARERA decision 66/2013

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Derogations/TSO: results of pilot projects

Results of first year of full operations (2016)

Parameter	Value
Technology most suited for time-shift	**NaS** (*)
Capacity [MW] / [MWh]	35 MW / 230 MWh
Investment	≈160 M€ (**)
Wind curtailment avoided	66.8 GWh/y
- due to Storage	17.7 GWh/y
- due to DynamicThermal Rating	49.1 GWh/y
Average availability (including tests)	81.5%
Overall energy efficiency (avg 1 year)	50.7%

(*) operating range of temperature: 305-350 °C (**) DTR investment costs: <1 M€

Full report publicly available (in Italian) for dissemination
https://www.terna.it/it-it/sistemaelettrico/progettipilotadiaccumulo.aspx

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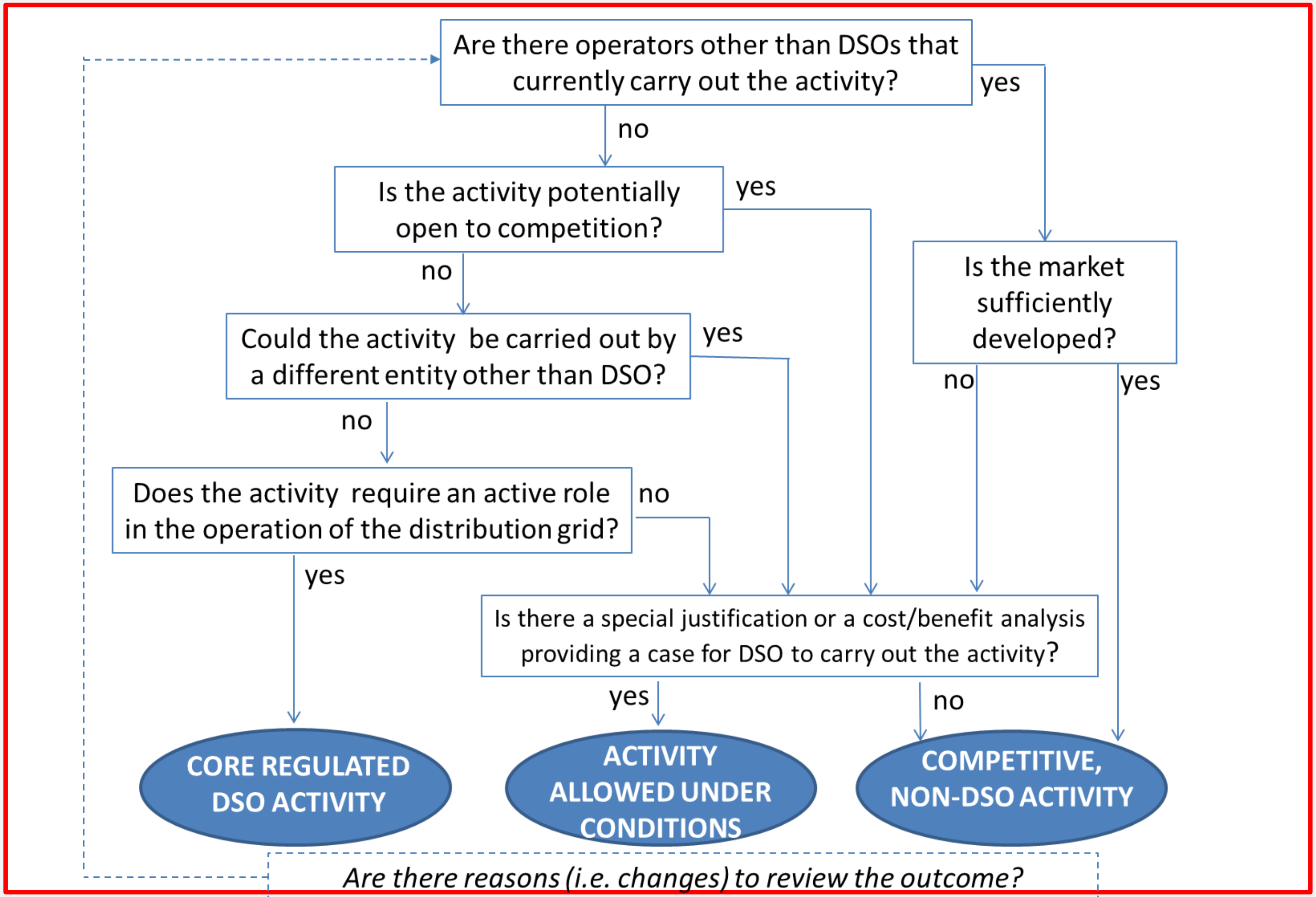
"New role of DSO": a CEER conclusions paper (2015)



Logical Framework applicable for «grey areas»

source: CEER Report C15-DSO-16-03

Derogations/DSO: ARERA work on cost/benefit methodology

ARERA decision 646/15 (regulatory period): DSOs' investments for storage units not to be covered unless DSO provides a cost-benefit analysis demonstrating this is the most cost-effective solution (in line with CEER)

For the time being, no submissions from DSOs; a very limited number of storage units (each < 1MW) have been installed for research/innovation purposes only

ARERA launched a research for a CBA methodology (UniCA, DIEE).

Benefits on DSO side only have bee considered *[and monetized]*

- DSO investment deferral *[avoided CAPEX]*
- Increasing hosting capacity for RES *[price of energy not curtailed]*
- Reducing (or increasing!) energy losses *[price of energy]*
- Improving SAIDI and SAIFI *[value of lost load used by ARERA]*
- Voltage dip mitigation *[cost per event and per contractual power kW]*

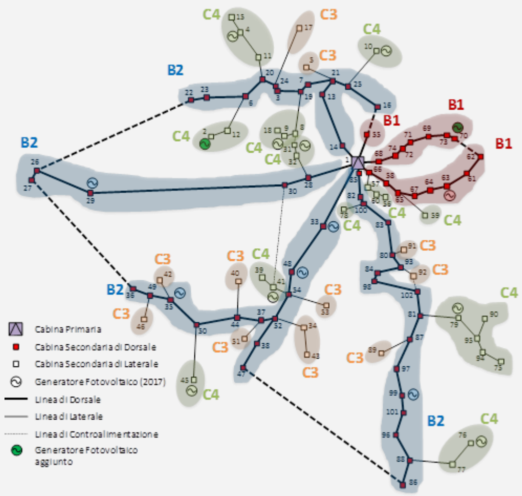
Multi-objective analysis to identify Pareto-optimal solutions on real grids.

Derogations/DSO: ARERA work on cost/benefit methodology

Resarch commited to

Univ. Cagliari, DIEE (Electrical and Electronic Engineering Dep.

prof. F. Pilo
prof. G. Pisano

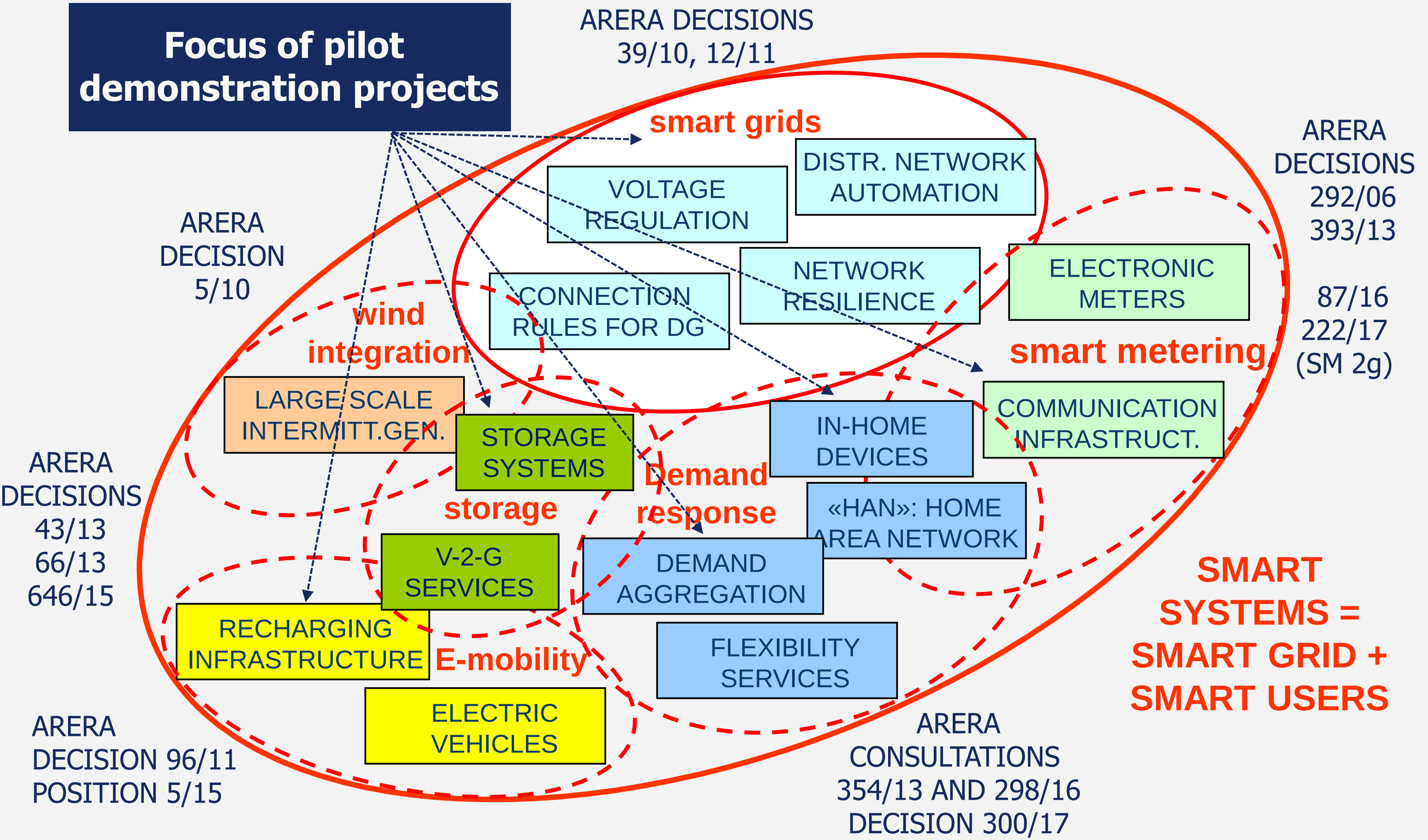


Class ID	Description
A	Trunk feeder, buried cables, including short laterals, with any level of DG
B1	Trunk feeder, overhead lines, including short laterals, with DG ⩽50%
B2	Trunk feeder, overhead lines, including short laterals, with DG >50%
C1	Laterals, overhead lines, with DG ⩽50%, supplied by B1
C2	Laterals, overhead lines, with DG >50%, supplied by B1
C3	Laterals, overhead lines, with DG ⩽50%, supplied by B2
C4	Laterals, overhead lines, with DG >50%, supplied by B2
D	Trunk feeder, buried cables, including laterals (length >150 m) any level of DG
E1	Laterals, overhead lines, with DG ⩽50%, supplied by D
E2	Laterals, overhead lines, with DG >50%, supplied by D

Class ID	ESS rated power [kW]	ESS rated duration [h]
T1	$100 \leq P_{ESS} \leq 500$	$1 \leq d_{ESS} \leq 4$
T2		$5 < d_{ESS} \leq 8$
T3	$500 < P_{ESS} \leq 1000$	$1 \leq d_{ESS} \leq 4$
T4		$5 < d_{ESS} \leq 8$
T5	$1000 < P_{ESS} \leq 1500$	$1 \leq d_{ESS} \leq 4$
T6		$5 < d_{ESS} \leq 8$
T7	$1500 < P_{ESS} \leq 2000$	$1 \leq d_{ESS} \leq 4$
T8		$5 < d_{ESS} \leq 8$
T9	$2000 < P_{ESS} \leq 2500$	$1 \leq d_{ESS} \leq 4$
T10		$5 < d_{ESS} \leq 8$
T11	$2500 < P_{ESS} \leq 3000$	$1 \leq d_{ESS} \leq 4$
T12		$5 < d_{ESS} \leq 8$

MV NETWORK	Classes of ESS position									
	A	*B1*	*B2*	*C1*	*C2*	*C3*	*C4*	*D*	*E1*	*E2*
T1	6%	17%	41%	6%	0%	0%	26%	0%	0%	82%
T2	69%	0%	100%	0%	0%	29%	81%	35%	84%	100%
T3	0%	88%	44%	0%	67%	19%	48%	33%	33%	35%
T4	13%	75%	92%	0%	0%	38%	26%	0%	60%	60%
T5	4%	0%	29%	8%	10%	7%	11%	16%	0%	28%
T6	0%	0%	0%	0%	50%	0%	7%	18%	18%	0%
T7	0%	4%	57%	0%	0%	0%	13%	0%	0%	0%
T8	0%	18%	0%	0%	0%	0%	5%	0%	0%	0%
T9	0%	15%	50%	0%	0%	0%	0%	11%	6%	9%
T10	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
T11	0%	11%	0%	0%	0%	0%	0%	7%	0%	3%
T12	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%

Energy regulators can foster innovation in the power system



Please visit:

www.arera.it

Suggested readings: 3 papers submitted to next AEIT int'l conference (Bari, Oct-18)

On opening of Ancillary Service Market in Italy

A new concept for the Italian dispatching market: regulatory decision n. 300/2017
(A. Galliani ,
M. Pasquadibisceglie)

On TSO storage pilot projects

Pilot projects on battery energy storage systems in the transmission grid: regulatory framework and first results
(L. Lo Schiavo, M. Benini)

On CBA methodology for DSO storage

Assessment of energy storage systems installation in smart distribution networks
(F. Pilo, G. Pisano, L. Lo Schiavo, R. Vailati *et al.*)

Thank you for your attention

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