PUMPED HYDRO STORAGE IN ITALY: PRESENT AND FUTURE DEVELOPMENT

Ing.Ezio Baldovin

Chairman Itcold Working Group "Pompaggi idroelettrici in Italia: quale futuro?"

Chairman and Technical Director Geotecna Progetti srl - Milano

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Pumped Hydro Storage (PHS) active in Italy

Currently 21 main PSH plants are operating in Italy, with a maximum capacity of about 6.2 GW in absorption (pumping) and 7.3 GW in production. Of these, the largest 6 exceed a capacity of 500 MW for a total of about 5240 MW.

The overall geographic distribution is of 65.5 % in the North, 23.3 % in the Central and Southern regions and 11.2 % in Sicily and Sardinia.

For the rebalancing of non-programmable renewables, expected to grow strongly in the South, the fact that of these plants only Presenzano (1000 MW), Anapo (500 MW) and Taloro (240 MW) are located in this area of the country represents a critical issue.

The drastic decrease of the pumped production in Italy in the last decade plays as a confirmation of low profitability.

Moreover, the current structure of the electricity market does not make the construction of new pumped hydroelectric plants or storage plants with electric batteries convenient.

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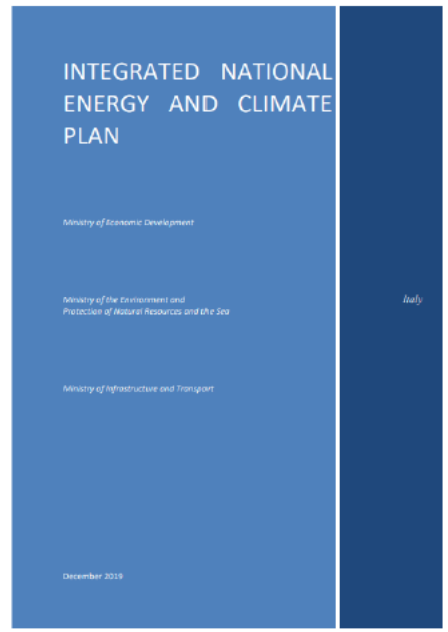
National Integrated Energy and Climate Plan (P.N.I.E.C.)

The European project for the decarbonisation of electricity production, following the 2015 Paris Agreement, in Italy, as in the rest of Europe, finds application in the National Integrated Energy and Climate Plan (PNIEC).

It envisages that the development of storage capacity is gradually, but increasingly aimed at limiting the phenomenon of overgeneration and encouraging the achievement of renewable energy consumption objectives.

In 2019, in addition to the optimal management of existing water storage systems, new storage systems for almost 1000 MW in production, including hydroelectric and electrochemical, were estimated to be necessary already in the medium term (around 2023). For 2030 preliminary estimates indicated a requirement, functional to containing overgeneration from renewables of around 1 TWh, equal to approximately 6000 MW between pumped and electrochemical storage.

The update of the P.N.I.E.C. in 2024 takes into account the effects of the COVID pandemic and the Russia-Ukraine war, as well as the pursuit of the ambitious European objectives of the Fit for 55 Program (FF55).



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Legislative Decree n. 210 - Rules for the internal electricity market

- In this essentially blocked context without specific regulations for pumped hydro systems, on the occasion of the transposition at national level of the European Directive 2019/944, Legislative Decree 210 - "Common rules for the internal electricity market" was launched, containing the basic elements for future developments.
- In particular, the art. 18 of Legislative Decree n. 210 is entitled "Development of storage capacity" and outlines the procedural path for the identification and construction of new plants.
- A long-term procurement system is defined based on competitive, transparent, non-discriminatory auctions, carried out by the National Transmission Network Operator (TERNA) and aimed at minimizing the costs for consumers following the auctions (*paragraph 3*).
- It is also established that the construction and operation of pumped storage hydroelectric plants, the related works and indispensable infrastructures, as well as substantial modifications to the plants themselves, are subject to a single authorization (*paragraph 10*), issued with the effects and according to the procedural methods and conditions provided for by article 12 of Legislative Decree n. 387/2003 .

Forward Electrical Storage Capacity Procurement Mechanism (MACSE) highlights

- **26 december 2021** – Entry into force of L.D. n. 210 "Common rules for the internal electricity market"
- **9 august 2022** - "Scenarios Description Document" - TERNA and SNAM
- **23 june 2023** – ARERA Resolution n. 247/23 R/EEL "Operation of the electrical storage supply system"
- **10 october 2024** –MASE Decree n.346 which approves the regulations of the Electrical Storage Capacity Procurement Market (MACSE)
- **31 march 2025** – Date by which TERNA must update the MACSE Regulations for pumped hydroelectric storage
- **Second quarter 2025**–First BESS auction
- **Fourth quarter 2025**–Expected First PSH auction

Forward Electrical Storage Capacity Procurement Mechanism (MACSE)

The mechanism aims to guarantee, at the same time as the growth of non-programmable renewables, an efficient level of "overgeneration" (i.e. in the moments in which electricity production exceeds demand) starting from the planned network developments.

It will allow the system to acquire new storage capacity (primarily BESS and hydroelectric storage) through long-term supply contracts awarded through competitive auctions organized by TERNA, in which operators owning new storage systems can participate.

The subjects selected following the auction have:

- the obligation to build the plant;
- the obligation to make storage capacity available to third-party market operators, for use in the energy market, through a platform managed by GME;
- the obligation to offer this capacity on the MSD;
- the right to receive a fixed annual bonus from TERNA.

The mechanism will incentivize the realization of a total of 9 GW/71 GWh of storage capacity for 10 years, until 31 December 2033, with resources equal to 17.7 billion euros.

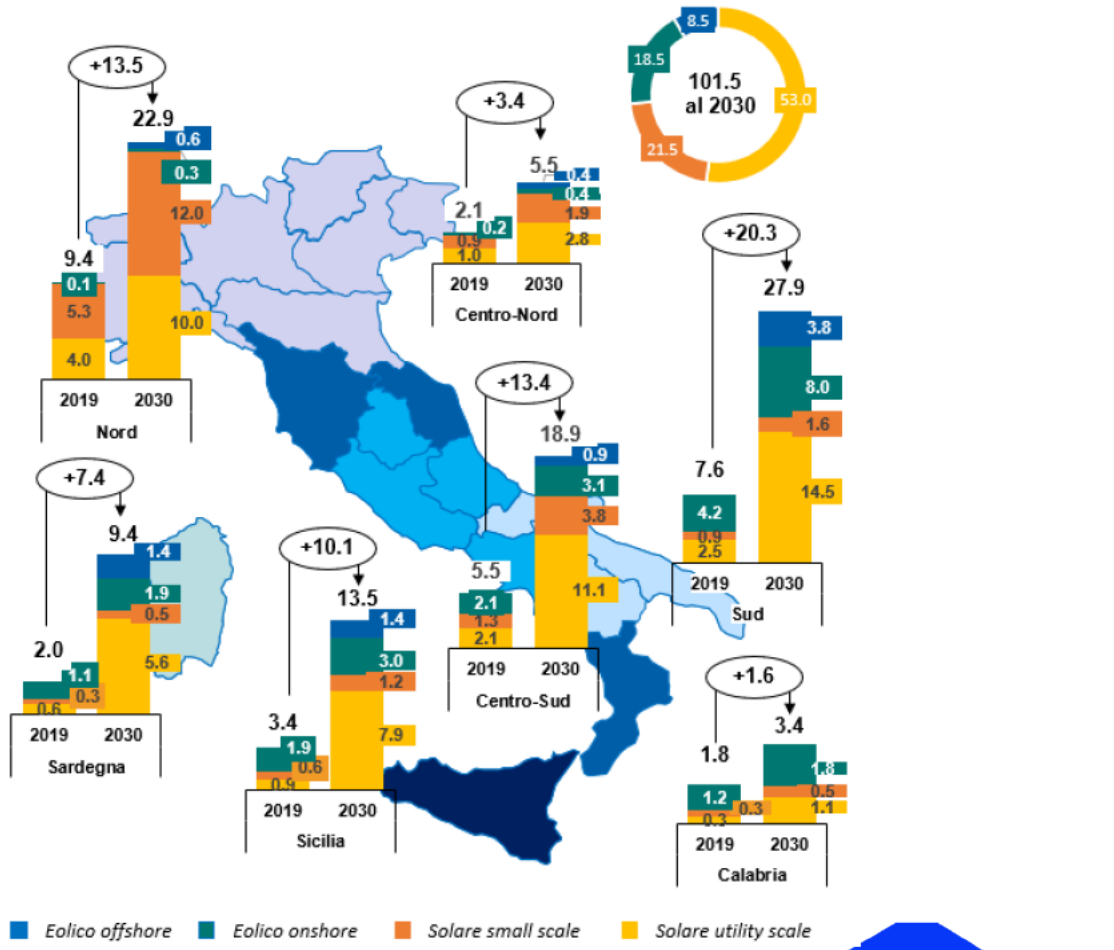
The role of hydropower in the energy transition process

RES capacity evolution to 2030 in the FF55 scenario

Capacità FER al 2030 [GW]	Solare Distribuito	Solare Utility	Eolico onshore	Eolico offshore	Somma FER
Nord	12.0	10.0	0.3	0.6	**22.9**
Centro-Nord	1.9	2.8	0.4	0.4	**5.5**
Centro-Sud	3.8	11.1	3.1	0.9	**18.9**
Sud	1.6	14.5	8.0	3.8	**27.9**
Calabria	0.5	1.1	1.8	0.0	**3.4**
Sicilia	1.2	7.9	3.0	1.4	**13.4**
Sardegna	0.5	5.6	1.9	1.4	**9.4**
Totale	21.5	53.0	18.4	8.5	101.5

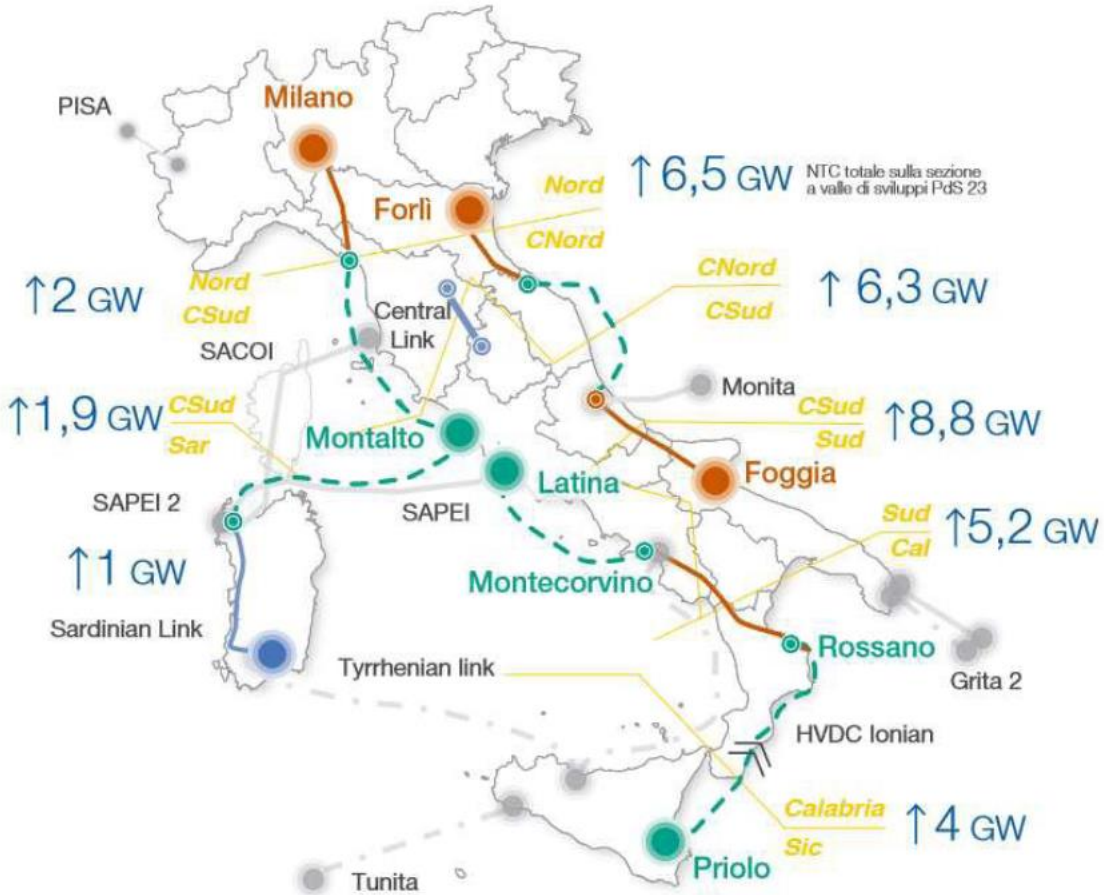
RES increase compared to 2019

Somma FER
13.5
3.5
13.4
20.3
1.7
10.1
7.4
69.8



Source: Scenarios Description Document 2022 (TERNA)

Future developments of the TERNA electric network



The role of hydropower in the energy transition process

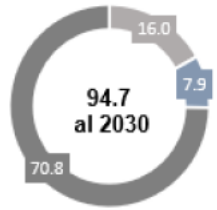
Evolution of total storage capacity by 2030 in FF55 scenario

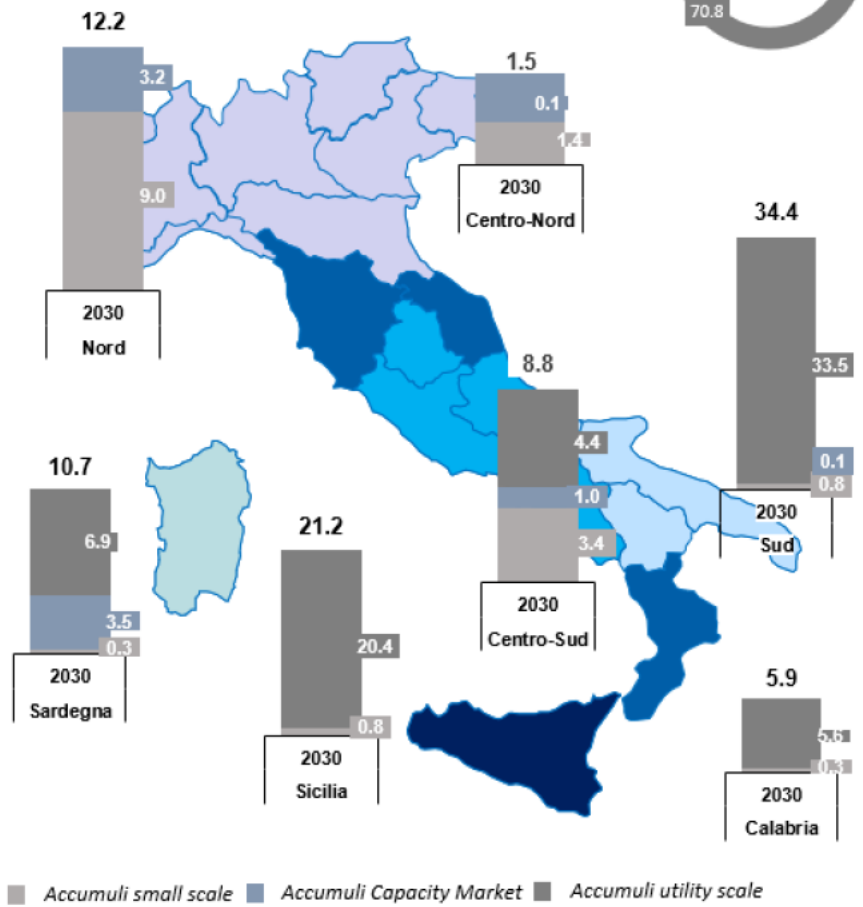
Capacità SdA al 2030 [GWh]	SdA Distribuiti	Utility Aste CM	Utility New E/P=8h	Somma accumuli
Nord	9.0	3.2	0.0	**12.2**
Centro-Nord	1.4	0.1	0.0	**1.5**
Centro-Sud	3.4	1.0	4.4	**8.8**
Sud	0.8	0.1	33.5	**34.4**
Calabria	0.3	0.0	5.6	**5.9**
Sicilia	0.8	0.0	20.4	**21.3**
Sardegna	0.3	3.5	6.9	**10.7**
Totale	16.0	7.9	70.9	**94.8**

excluding existing PHS

Total storage increase compared to 2019

Somma accumuli
11.7
1.5
8.7
34.4
5.9
21.3
10.7
94.1





Source: Scenarios Description Document 2022 (TERNA)

The role of hydropower in the energy transition process

Utility scale pumped hydro systems projects subjected to EIA (M.A.S.E.)

N°	Nome impianto	Regione	Pot. Max Turb. [MW]	Pot. Max Pomp. [MW]	Procedura	Stato procedura
1	Valcimarra II	Marche	19.2	31.5	Val. Impatto Amb.	In corso
2	Provvidenza II	Abruzzo	202.0	194.0	Val. Impatto Amb.	In corso
3	San Giacomo III	Abruzzo		231.2	Val. Impatto Amb.	Sospesa
4	Cucchinadorza	Sardegna	41.5	40.6	Verifica Assogg. a VIA	In corso
5	Pizzone II	Molise	306.0	294.0	Val. Impatto Amb.	Sospesa
6	Guadalami	Sicilia	20.9	20.9	Valutazione prelimin.	In corso
7	Favazzina	Calabria	255.0	325.0	Val. Impatto Amb.	In corso
8	Taccu Sa Pruna	Sardegna	341.4	391.8	Val. Impatto Amb.	In corso
9	Pescopagano	Basilicata	212.0	264.0	Val. Impatto Amb.	Conclusa
10	Villarosa	Sicilia	270.0	285.0	Val. Impatto Amb.	In corso
11	Serra del Corvo	Puglia	300.0	400.0	Val. Impatto Amb.	In corso
12	Orichella	Calabria	152.0	54.0	Verifica Assogg. a VIA	In corso
13	Campolattaro	Campania	572.0	628.0	Val. Impatto Amb.	Conclusa
14	Gravina - Serra del Corvo	Puglia-Basilicata	210.0	210.0	Val. Impatto Amb.	In corso
15	Mandra Moretta	Basilicata	200.0	222.0	Val. Impatto Amb.	Conclusa
		totale	*3029.5*	*3564.3*		

: Ministero dell'Ambiente e della Sicurezza Energetica – Valutazioni e Autorizzazioni Ambientali

The role of hydropower in the energy transition process

Comparison between the Terna FF55 scenario and the producibility of the new utility scale pumped hydro systems in the authorization phase

	DDS 2022 (TERNA)	Impianti sottoposti a V.I.A.	
	Previsione complessiva Scenari [GWh]	Emax turb. [GWh]	Pmax turb. [MW]
Centro-Nord	0.0	0.2	19.2
Centro-Sud	4.4	6.2	774.0
Sud	33.5	8.2	1018.0
Calabria	5.6	2.5	309.0
Sicilia	20.4	2.3	290.9
Sardegna	6.9	3.1	382.9
Totale	**70.8**	**22.5**	

8 hours operation production estimate

Conclusions

The competitive auction mechanism defined by art. 18 of Legislative Decree 210/21 has outlined a method that can allow to emerge from the stagnation of recent years.

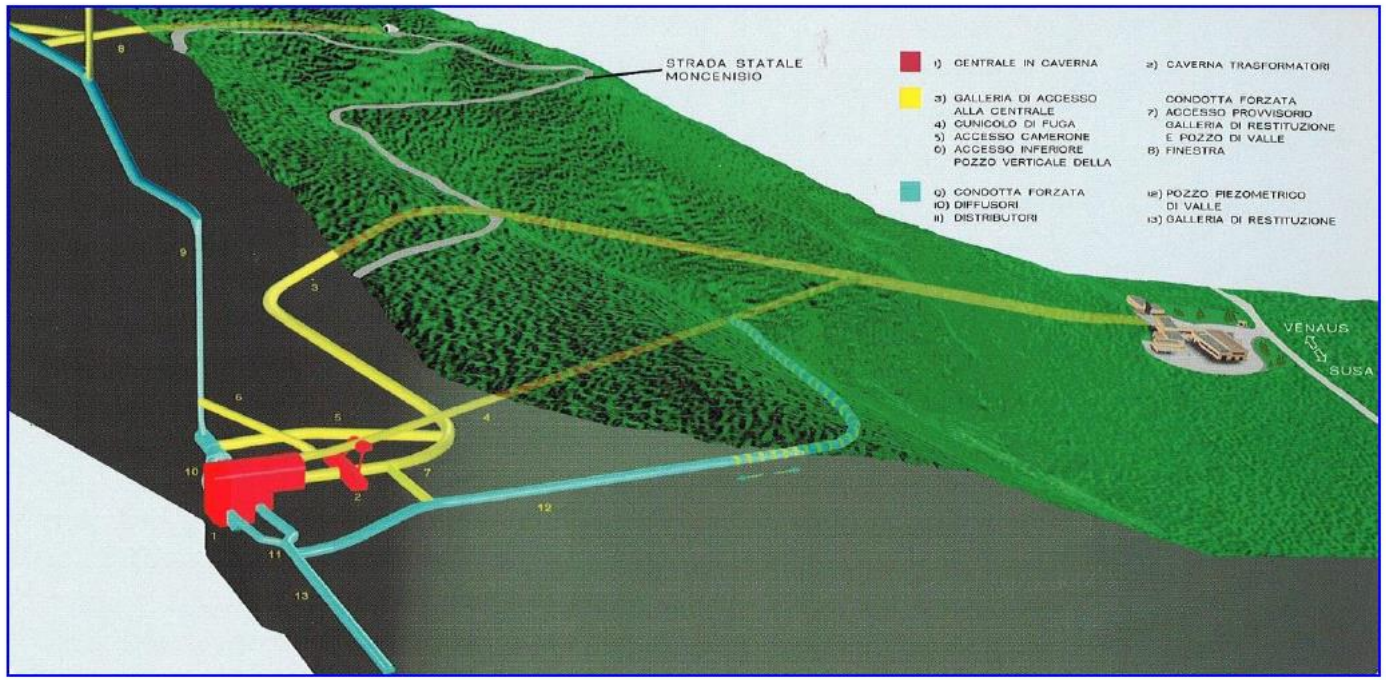
The accumulated delays, being the first auction expected by the 4th quarter of 2025, risk not allowing the pumped hydro storage projects authorization cycle to be completed.

At present only 3 of the mentioned plants (Campolattaro, Pescopagano and Mandra Moretta) have positively concluded the EIA process, whereas Campolattaro is the only one close to obtaining the "Single Authorization", a necessary condition for being able to participate in the auctions.

If not recovered, the existing delay in the authorization process would determine shifting resources towards different technologies.

Finally, it should be noted that this approach ends up delegating to the dynamism of private entities and competitive mechanisms the possibility to improve the conditions of some irrigation reservoirs existing in the South, often not in optimal maintenance status, thanks to the availability of new financial resources for the pumped hydro storage.

The role of hydropower in the energy transition process



Giaglione Underground Powerhouse
(IREN Energia - Pont Ventoux-Susa Pumped Hydroelectric Plant)

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e.baldovin@geotecnaprogetti.com

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