Italian Electricity Market Scenario

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REF4E SCENARI

MBS
A Cerved Company

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1 Frame of Reference

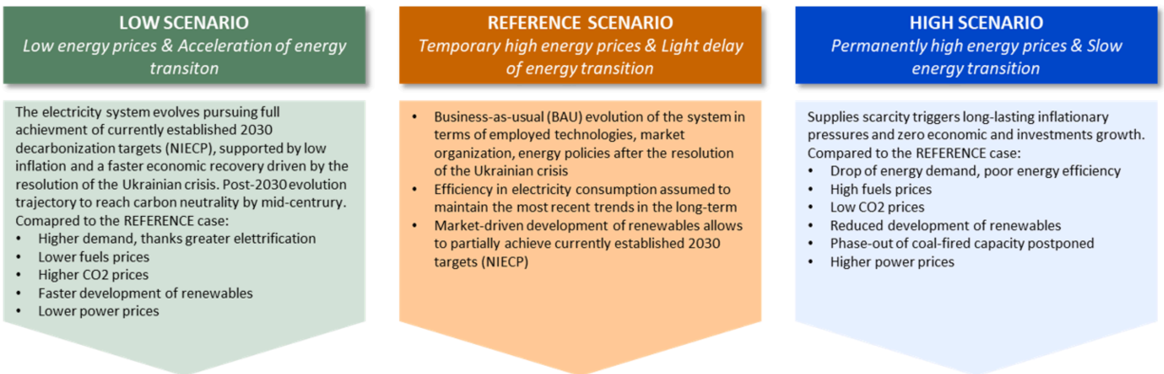
REF-E scenarios over the time horizon 2024-2050 (with projections up to 2060) are elaborated by MBS Consulting experts on the base of proprietary suites and market knowledge. Econometric and structural models, as well as our expert sensitiveness, detailed knowledge of regulation, and accurate monitoring of market outcomes underlie our elaborations.

Gas and electricity forecasts consider the diverse geopolitical and economic hypothesis deriving from the regulatory, financial and fundamentals adjustments to the disruption generated both from the pandemic and the Ukrainian war, which are seen as key determinants of the future equilibrium of the energy markets.

Current scenario update incorporates an evolution of climate variables in line with the historical average trend.

In this perspective, we defined three scenarios:

- The **High Case scenario** is characterized by permanently high fuels and power prices amid negative or zero economic growth depressing investments and weighing on the energy transition process.
- In the **Reference scenario**, is characterized by the energy transition process progress leading to a diversification of energy sources supported by the existing policies. This, combined with efficiency maintains the energy market on a transformation path. The economic growth slowly recovers over the next two years.
- The **Low Case scenario** would materialize in the event of favorable weather conditions and a fast energy transition, supported by low inflation and a faster economic recovery, reducing power and fossil fuels demand over the next few years. This would limit energy prices upside potential and then fuel a downward acceleration.



1.1 Without reforms, how far could the Italian market advance in decarbonization?

Key Insights

The 2021-2023 period put a lot of pressure on the energy markets in Italy and Europe, underpinning the urgency to ensure diversification and efficiency of energy supplies. More than ever, decarbonization of the electricity sector by increasing the share of renewable and other low-carbon sources in the energy mix is at the heart of the energy policies applied across Europe and requires substantial overhaul of the energy systems. The transformation is already taking place guided by favorable market conditions driving new investments. Renewables and energy storage solutions are gaining traction in most of the European markets, including Italy.

Italy aims to embrace ambitious decarbonization goals for 2030, indicating a nearly twofold increase in the current share of renewables in electricity demand. The surge is foreseen due to expected rapid electrification trends and will necessitate concurrent technological and infrastructural development. One question remains: is the Italian market prepared to fully embrace the transition? Can it facilitate the growth and integration of renewable source at reduced costs for consumers and investors? Which is the role of the regulatory framework and how far the system could advance without reforms?

MBS delves into these critical topics in its latest market scenario report for Italy. Starting from eased short-term gas market dynamics and favourable renewable electricity production that contributed to keeping power prices across Europe on a downward trend since the beginning of 2024, the report explores the range of risks and opportunities expected in the long run on pure merchant basis. The analysis addresses the discrepancies between the expected market trends and national decarbonization objectives, outlining the gaps that must be bridged moving forward.

Short-term GDP growth continues to be modest, supported by a gradual rebound in industrial production driven by wage trends and anticipated monetary policy adjustments. In the Reference scenario GDP growth is expected to near 0.4% year-on-year in 2024, followed by a more robust increase of 1% in 2025, driven by an anticipated easing of financial conditions. A relatively weak industrial sector and restrained investment weigh on 2024 performance. However, a gradual easing of monetary policies in the second half of the year, coupled with positive wage dynamics, should bolster growth in 2025. In High case scenario in which the inflationary pressures persist, GDP could decline by 0.1% year-on-year in 2024, recovering slightly in 2025 (+0.3%). The Low case scenario is characterized by accelerated disinflation and rebound in investments, GDP growth could reach 1.2% in 2024 and 1.6% in 2025. In the longer-term growth will rely mainly on factors such as the path of disinflation, improved financing conditions, and the successful implementation of the NRRP. In both Reference and Low scenarios, economic growth is assumed to be supported by the successful execution of NRRP initiatives, global economic recovery, and expedited green transition reforms. In the High scenario, pressure from fiscal policies and shortcomings in NRRP implementation would likely keep economic growth stagnant, jeopardizing the progress of green transition.

Given the current competition in LNG supplies, as well as the level of European domestic gas reserves and demand, notable surge in gas prices is considered improbable until the upcoming winter season (excluding worsening of the geopolitical context). Nevertheless, the prolonged period of low prices is causing delays in the construction of liquefaction capacity, potentially leading to renewed tensions between supply and demand. Despite this, the possibility of a new bullish cycle cannot be overlooked, particularly starting from the winter of 2025-2026. From 2026 on, LNG demand growth is expected to slow down, settling below 5% annually as a result of rise in renewable energy production and energy efficiency measures. A new wave of liquefaction capacity is expected to commence operation by 2026, mostly led by the United States and Qatar. The capacity expansion is expected to significantly mitigate the risk of market scarcity.

Geopolitical tensions have not yet impacted the gas market in this scenario, hence they are not factored into current pricing. However, any further escalation in geopolitical tensions remains a significant risk factor that could disrupt the short-term equilibrium. Low gas demand throughout Europe in 2023 left storages well above historical averages, causing gas prices to decline. Without resurgence in electricity demand resulting in higher thermoelectric gas demand, the 2024 storage injection demand is unlikely to affect gas prices in the coming months. The Italian gas price remains closely linked to the European hub, particularly the TTF. However, the temporary shutdown of the OLT facility has disrupted Italian imports thus leading near-term forecasts to suggest broader deviations from the TTF.

In our Reference scenario, the yearly averages for both PSV and TTF in 2024 stay below 40 €/MWh, reflecting the effects of limited gas demand recovery, shift towards savings and efficiency reduces pressure on distribution networks. Additionally, subdued growth in the energy-intensive sector limits industrial demand, resulting in lower-than-average thermoelectric gas demand. Delays in commissioning of Ravenna FSRU have dampened expectations for gas demand recovery. if tensions reemerge on LNG and TTF prices during winter of 2025-2026, PSV is projected to reach 33 €/MWh. In Low scenario gas prices remain close to 25 €/MWh in 2024, assuming faster energy transition and reduction of global gas demand, the price will settle at near 15 €/MWh by 2026. Under the High case scenario, gas prices are forecasted to average 50 €/MWh due to the compounding effects of economic stagnation, decreased investments, and an unstable geopolitical environment. The PSV is expected to align with the mid-term normalization of European gas prices towards 30 €/MWh by 2030, reflecting a gradual rebalancing of global gas demand-supply dynamics amid the anticipated acceleration of the energy transition. In the very long-term PSV price should converge to an equilibrium of 25 €/MWh in the Reference scenario and 10 €/MWh in the Low case, while it should settle above 40 €/MWh in the High scenario. The enhancement into law of the ETS system reform confirms its pivotal role in sustaining the decarbonization process. Introduction of new measures occurs amidst weakened macroeconomic fundamentals, extended period of low demand and bearish trends of CO2 prices since Q2-23. A range of factors are estimated to have contributed to the decrease in demand such as diminished levels of industrial production (notably in energy-intensive sectors), increased energy costs from the previous year prompting greater savings, higher inflation rates, and a restrictive monetary policy that impacted economic growth adversely. In our Reference scenario, the 2024 average CO2 price is projected to approach 65 €/ton, driven by the gradual implementation of the ETS system reform. The phasing out of free allowances for the aviation sector, accounting for 50% of the total by 2025, and the scheduled removal of 90 million permits from the market in 2024, are expected to push allowances prices upward as supply reduces. Additionally, the gradual inclusion of the maritime transport sector starting from 2025, will further increase overall demand and prices are expected to reach 107 €/ton in 2030. Main concerns regard demand recovery, expected to be limited in the next couple of years due to slow economic growth. The Low case scenario incorporate a swift economic recover coupled with challenges in decarbonizing hard-to-abate sectors like aviation and maritime transport. These factors lead to a substantial increase in demand volume, pushing the CO2 price to surpass 130 €/ton before 2030. If further demand disruptions arise due to elevated energy costs, reduced industrial output, and delays in implementing new regulations, the High case scenario might materialize: ETS price that fails to rebound, staying under 50 €/ton in the short term and under 75 €/ton until 2030. The effectiveness of the ETS System plays a crucial role in reaching the long-term emission reduction targets, with the CO2 price projected to surpass 120 €/ton in the Reference scenario by 2040 and potentially rise to just under 150 €/ton in the Low scenario or near 90 €/ton in High scenario.

In 2023, electricity consumption dropped to 306 TWh, reflecting a 3% decline from 2022 . A slight recovery of 2024 macroeconomic outlook, combined with improved end-use consumption electrification, is expected to increase consumption to 312 TWh in the Reference scenario. A more optimistic economic view could bring to 314 TWh as in the Low case scenario, while a more pessimistic view and delay in final use electrification is foreseen in the High scenario, 310 TWh. In the coming years supportive economic measure driven NRRP and unfold of electrification potential could determine a possible fork between 327 TWh in scenario High and 358 TWh in Low case, containment in efficiency and moderate economic growth are expected in Reference case with an electricity demand of 339 TWh in 2030. In the very long-term a successful electrification trajectory and stable economic outlook could see consumption reach 377 TWh in 2040 in Low scenario, a partial upside of this trend is foreseen in Reference scenario with 364 TWh, while the structural delay in High scenario result in an electricity demand of 340 TWh.

General contraction of electricity demand in European countries, recovery in hydro generation after the severe drought of 2022 and the first half of 2023 and enhanced availability of France nuclear plants favored an increase in net import flow in 2023, +15 % y/y reaching 53 TWh. In the coming years still contained electricity demand, increase in electricity import capacity at the Northern border support by the commissioning of the new 1,200 MW HVDC connecting the Piossasco (Italy) and Grand-Ile (France) electrical substations, operational since August 2023, will further contribute to supporting power flows from France to Italy. Furthermore, high electricity imports to Italy are also favoured by the PUN seen as stabilizing well above other European electricity prices (particularly the French and the Swiss ones). In fact, the average spread between the Italian power price and those of northern borders nearly doubled over the last five years. Moving toward 2030 partial achievements of decarbonization targets in European countries, gradual phase-out of coal-fired generation in continental Europe and reduction in availability of France nuclear fleet are going to reshape import flows toward Italy, defining a declining trend expected to reach 32 TWh in 2030 and 13 TWh in 2040, if investments are not made in new nuclear generation capacity.

During 2023, a notable increase in renewable installation rate (+5.7 GW compared to 1.5 GW/y during the last 5 years), driven by solar technologies, marks a further step towards the net zero path in the long run. 2023 momentum is expected to enhance over the coming years with a yearly increase up to 6 GW (4.5 GW of solar and 1.5 GW of wind) in the Low scenario and 3 GW (2 GW of solar and 1 GW of wind) in the Reference case, still below the NIECP average annual target of 8 GW necessary to reach the 2030 targets. Improved regulation, gradual reduction in investment costs and ETS price signals should support the market parity conditions in the long run. A draft decree, the so called FER X, proposes contracts for differences that target the 2030 objectives, limiting the space for market initiatives, with a quota of almost 70 GW (45 GW solar and 16 GW wind) to be allocated between 2024 and 2028. The decree now under review by the European Commission, aligns with the objectives for 2030 of NIECP, future update are going to integrate this evaluation when defined.

Renewable generation has seen a recovery during 2023 mainly driven by hydro production +36% y/y, while wind and solar production increase by 15% and 10% respectively. Despite recover in hydro generation the evolution of climate dynamic are expecting to affect production, aligning yearly results with recent years average, around 45 TWh. In the coming years the expectation of a slow recovery in electricity demand, below 2019 level until 2026, and a sustained pace of renewable installations are going to increase RES quota in the generation mix, reaching in 2030 almost 50% in Reference scenario and 60% in Low case respectively, while it should remain close to 40% in the High case. In our scenario zonal distribution of the new capacity follow the patterns revealed by Terna's connection request database, and new utility scale projects are expected to be concentrated mostly in the Southern macrozone and the two islands. Growth of small-scale distributed renewables for self-consumption should be concentrated in the Norther area following the historical path with 6% annual increase.

Grid expansion reflect Terna's 2023 Development Plan indications. In the Reference case reinforcements are assumed operational already in the 2020s but the main improvements to resolve zonal congestions are expected to be completed in the 2030s – Tyrrhenian link and Adriatic link as well as first portions of the Hypergrid. Faster penetration of renewable energy in the Low case would require the realization of the main projects even before 2030, while the slower system transition in the High case postpone the key investments to the middle of the 2030s.

By 2030, significant overgeneration and curtailment risks are expected to arise in the Southern zone and the Islands, which will prompt a surge in new electrochemical storage projects. Depending on the alternative scenarios of RES and grid development trajectories, these dynamics may be accelerated or delayed, with expected 16 GW of storage capacity in Reference scenario and 23 GW in Low case. Long-term development of batteries should follow the opportunities for time-shifting applications on the day-ahead market, with investments in power intensive electrochemical batteries can be in-the-money in the medium-term, with revenue streams deriving mainly from the participation in the balancing phase of the Ancillary Services Market and a long-term capacity remuneration through specific projects. Investments in merchant energy intensive storage batteries are likely to be attractive only in the long-term when time-shifting applications on the DAM could become economically sustainable thanks to increasing price spread volatility and the presence of overgeneration. In 2040, up to 28 GW of energy intensive batteries are expected to be developed in our Reference scenario and 30 GW in Low case. Regulatory framework is evolving creating new opportunities for batterie, with MACSE a regulated remuneration mechanism designed only for storage systems, Terna pays a fixed remuneration (€/MWh/year) for the operator to provide capacity and 5% of revenues from balancing activities to support storage development, auctions are scheduled for the end of 2024.

The need to boost energy independence in the decarbonization process at European level has placed green hydrogen at the forefront of the European energy strategy (REPowerEU). It is expected to determine the allocation of substantial funding – way more than the amount currently earmarked – to accelerate the development of a European hydrogen supply chain, improving current cost perspectives of green solutions. But accelerating renewables development poses the risk of structural overgeneration if the development of BESS does not advance concurrently, especially in less interconnected regions and have a high intensity of renewables relative to demand, such as Sardinia and Sicily where economically viable opportunities for competitive green hydrogen consolidate starting from 2035.

During 2023 electricity prices drastically reduce after 2022 peak, -58% averaging 127 €/MWh, the decreasing trend follow gas dynamics, emphasizing electricity price dependency. The relaxation of short-term gas market and increase in renewable electricity production have contributed to maintaining downward pressure on power prices across Europe since the beginning of the year. This trend will continue into 2024 due to improved conditions in the Italian gas market and further expansion of renewable generation, with the 2024 average PUN is expected to approach €100/MWh in Reference scenario and 96 €/MWh in Low case. However, the recovery of CO2 prices in 2025, bolstered by the EU ETS reform potentially coupled with renewed tensions in global gas market supply-demand dynamics depending on delays in LNG liquefaction capacity development, could result in higher electricity prices in 2025 and 2026, with the PUN projected to average close to €110/MWh, in Low scenario reduction in demand and faster transition push prices to 90 €/MWh. Moving toward 2030 integration of renewables technologies in the energy, further reduction in commodities levels and gradual grid improvements push prices at 74 €/MWh Low case, in Reference case a partial delay in decarbonization trajectory and higher PSV determine an average price of 106 €/MWh. In the mid-term renewables penetration, led by solar energy, is expected to strongly affect peak/off-peak dynamics after 2030, when the inversion of price spreads between time slots is expected to occur. With the expected slow electricity demand recovery, the differences in zonal prices will be limited due to reduced transit between market zones. Additionally, abundant electricity imports from the northern borders will further alleviate congestion. Average zonal spread are expected to remain below €1/MWh in the short term, with southern market zones experiencing a higher differential with the PUN. However, after 2026, zonal spreads are anticipated to widen as a result of increasing electricity consumption, combined with accelerated development of renewable energy and a gradual decrease in electricity imports. Over the long term, the significant development of renewable energy sources in the southern macro-zone is expected to drive prices down through the cannibalization of solar technologies. Despite grid improvements, bottlenecks are still expected between the northern and southern zones, resulting in differing price levels in the 2030s. From 2035 onwards, further grid reinforcements are assumed to occur, resulting in a reduction of inter-zonal congestion issues on the mainland. However, criticalities are likely to remain evident in the islands.

The Law 11/2024, known as DL Energia, mandates that starting from January 1st, 2025, final customers will transition to paying zonal prices based on wholesale market price trends, departing from PUN. The reform is driven by the necessity to implement Capacity Allocation & Congestion Management (CACM) rules, which aim to establish a unified European market by simplifying algorithms, and to create locational signals for both demand and supply. Many aspects still require clarification, particularly the methodologies for implementation, which will play a crucial role in defining the market impact of the reform.

In recent past, prices for renewable technologies have mirrored the fluctuations in commodities markets, benefiting from bullish trends. However, in 2023, prices began to gradually decrease, realigning the zonal differently affected by energy mixes, in particularly the reduction in coal generation in southern zones, that determine lower prices compared to the northern zone. In the short term, differentials are expected to remain consistent with last year's results, with a general alignment between zones. Looking ahead to 2030, the ongoing integration of RES into the energy mix is expected to amplify this disparity, leading to greater price differentials in the southern zones. The market parity for renewables should be sustained by commodity prices higher than in the past, which bolster quotations. After 2030, the decrease in CAPEX and the high CO2 levels support the IRR, but increase the impact of overgeneration risk, especially for projects in southern and island areas. In the coming years contraction in electricity demand and increase in import affect gas plants market competitiveness reducing their marginality compared to recent years peak, favored by high commodities prices. Capture CSS for the average CCGT 53% efficiency should align to 2023 results, around 10 €/MWh. After 2025 despite the entrance of new thermal capacity through the CM, marginality should remain stable around 10-15 €/MWh as electrification in final consumption continue and import flows gradually reduce. In the Reference scenario gas-fired generation is expected to remain at the backbone of the national energy mix even after renewables become the first production source through the next decades, until 2031 when RES become the main resource in the mix. Its share in the generation mix should decrease progressively but stay close to 30% of the national electricity needs until 2040. Mutated market conditions, triggered by the geopolitical tensions and contingent factors witnessed during the last year two years, combined with implications of market design and regulation evolution (XBID and Terna’s Incentive scheme) unveil a changed market landscape context that is expected to permanently change the structure of revenue flows for gas-fired power plants. As observed in the last two years operativity for CCGTs is expected to be concentrated for over 80% of total production on the DAM as ASM, in particular the ex-ante phase, contracted significantly (-85% compared to 2021 ASM ex-ante volumes). Operativity has shifted toward the balancing phase, which remain stable despite Terna’s intervention, in the coming years as the presence of RES in the generation increase BM might provide further support for thermal units marginality. Implementation of TIDE in 2025 may sustain market revenues for CCGTs, through new service remuneration that are current mandatory as “Riserva Primaria” and possible relaxation of operativity constraints depending on XBID participation. Evolution of market regulation and generation mix structure may favour potential upside for thermal units on ASM supporting their revenues, furthermore greater balancing needs brought by the integration of RES in the energy mix are expected to boost operativity on ASM for some specific nodal needs, mainly in southern zone as long as flexible capacity development lack behind.

The scenario analysis is complemented by an assessment of the economic viability of the current thermal generation fleet given the expected market scenario. The evaluation is aimed to highlighting potential financial viability challenges that may arise, emphasizing the need to consider extending a Capacity Remuneration Mechanism solely for existing capacity or substituting unfinished projects. As highlighted by Terna in the latest adequacy report, over the past three years, despite the operational capacity market, system adequacy has still been at risk in the face of extreme weather conditions such as those experienced in the summer of 2022. the significant reduction in hydroelectric production compounded with increased unavailability of water-cooled thermal power plants and limited imported energy due to French nuclear unavailability. The proposed changes are intended for auctions related to the years 2025-2027, scheduled for the summer of 2024, with recent DCO 102/2024 published by ARERA the new capacity market premium cap should be fixed at an higher cap than the previous auctions to take into consideration the revaluation of inflation index by ECB.

The new long-term scenario analysis of MBS takes into consideration the latest trends of the Italian system evolution, it peers itself with the Fit-for-55 targets in 2030 and discusses the possible paths towards 2050. Market simulations are extended beyond 2040 by explicitly modelling the market fundamentals through deterministic techniques and by assuming an inertial evolution, in line with the average 2030 – 2040 trajectory, for renewables installation sustained by BESS technologies, reduction in gas generation quota in the energy mix, electrification of consumptions and a proportional gird development on top of Terna development plan. All the elaborations are done considering the market structure and rules as known of today.

The resulting trajectory lacks behind the Net Zero targets: by 2050, only 85% of Italian electricity demand is expected to be met by renewable generation, while the residual demand would be covered by flexible and efficient gas generation, still needed by the system for adequacy reasons. Further contraction in operating hours (morning and evening peaks) impose the need of an explicit remuneration mechanism to support their economic viability. Renewables are expected to become the predominant marginal technology and market prices are expected to become less dependent on gas generation costs and more related to LCOE of renewable technologies as their marginal quota reach 40% of the yearly hours

For evaluating price dynamics beyond 2050 (2050-2060 horizon),we assume an extension of 2050 results taking into account the uncertainty of available information for an explicit evaluation of the very long-term. 2040-2060 scenarios will be carefully evaluated in future updates in order to discuss the economic sustainability of policy scenarios implementing the net zero target.

Key market trends in Italy

		mid-2021 - 2022	2024 - 2025	2026 - 2030	2030 - 2040	2040 - 2050
Main market drivers	Demand	↑	↑	↑	↑	↑
	Coal share	↑	↓	↓	↓	↓
	Import	⇆	↑	↓	↓ ↓	⇆
	RES-E	↑	↑	↑	↑ ↑	↑ ↑
	New CCGT	↑	↑	⇆	⇆	⇆
Main market trends	DAM	High price volatility and low hydro availability supported the DAM results despite coal/oil competition	Competitive conditions persist driven by market tensions and demand reduction	Load factors improve slightly with coal phase-out	Despite the RES-E acceleration, operation of gas-fired plants maintains its share supported by reduction of import from the Northern border	RES quota in the energy mix overcome 80%, only the most efficient CCGTs remain active, with operativity condensed during peak demand hours
	ASM	Reduced ex-ante volumes caused a drop of profits from ancillary services sales and energy shifted to the day-ahead session	Opportunities for gas-fired capacity remain limited as overall volumes remain low and new flexible assets (new CCGTs and BESS) join the market			
	CRM	2022 as the first year of operation for the CRM	2023-2024 CRM premium should partially compensate limited revenues on the spot market	Missing money issues arise for part of the existing fleet, new CM auction needed to mitigate the risk of an inadequate system		Reduced participation in the energy market drastically affect plants marginality, CRM is needed to maintain the units active

2 Key Figures

NET POWER (GW)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
CCGTs	28,2	28,0	23,8	17,7	28,2	28,0	23,8	17,7	28,2	28,0	23,8	17,7
Coal	1,5	0,0	0,0	0,0	1,5	0,0	0,0	0,0	1,7	0,3	0,0	0,0
New CCGTs	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3
Electrochemical BESS - Power Intensive	1,7	2,0	0,0	0,0	7,0	3,4	0,0	0,0	0,8	1,0	0,0	0,0
Electrochemical BESS - Energy Intensive	2,7	13,1	28,5	39,9	3,4	17,0	30,4	43,3	2,0	6,5	10,8	22,2
Hydro	19,0	19,3	20,0	20,6	19,0	19,3	20,0	20,6	19,0	19,3	20,0	20,6
Wind	13,3	16,3	30,1	46,4	14,5	21,6	35,4	46,4	12,5	14,0	19,3	30,1
Geothermal	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8
Biomass	3,9	3,9	3,9	3,9	3,9	3,9	3,9	3,9	3,9	3,9	3,9	3,9
Solar	35,2	49,0	77,7	112,3	39,9	63,0	87,0	112,3	31,6	37,1	47,6	77,7

BALANCE (TWh)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
Demand	315,8	339,3	364,2	390,2	320,9	358,0	377,0	396,0	311,9	327,4	340,2	353,1
Net import	47,4	32,6	13,2	13,3	47,4	32,6	13,2	13,3	47,4	36,4	37,7	37,6
Hydro	45,7	46,7	49,6	52,2	45,8	47,1	49,8	52,2	45,7	46,5	48,9	51,6
Renewables	87,0	114,0	194,6	285,8	105,3	110,8	86,9	60,6	81,4	88,7	111,2	174,9
Natural Gas	109,2	126,3	106,8	66,0	1,2	0,0	0,0	0,0	106,4	131,8	130,1	94,6
Coal	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,9	2,3	0,0	0,0
Overgeneration	-0,2	-0,3	-4,4	-8,3	-0,5	-3,8	-3,9	-8,4	-0,1	0,0	-0,2	-2,5

COMMODITIES	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
PSV (€/MWh)	34,3	30,6	25,1	25,1	21,6	11,1	10,4	10,4	54,8	55,7	44,6	44,6
Coal (€/MWh)	15,6	18,0	8,0	8,0	9,5	9,0	4,0	4,0	18,7	21,9	10,6	10,6
CO2 (€/ton)	86,3	107,3	123,0	139,7	131,1	133,1	147,2	160,5	49,3	72,3	93,8	119,2

ELECTRICITY PRICES (€/MWh)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
Fuel variable cost - CCGT 53%	71,6	63,8	52,2	52,2	45,0	23,2	21,7	21,7	114,2	116,0	92,9	92,9
Logistic variable cost - CCGT 53%	9,6	3,4	3,4	3,4	9,6	3,4	3,4	3,4	9,6	3,4	3,4	3,4
ETS impact - CCGT 53%	32,5	40,4	46,3	52,6	49,3	50,1	55,4	55,4	18,6	27,2	35,0	35,3
Clean Spark Spread - CCGT 53%	-0,8	-0,6	-1,4	-21,2	-3,2	-2,7	-1,7	-17,2	-2,5	0,4	3,3	-19,8

ZONAL PRICES (€/MWh)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
PUN	112,8	107,0	100,5	87,0	100,7	74,0	78,8	63,3	139,8	147,1	134,6	111,8
North	112,8	107,8	105,4	91,7	101,7	76,6	84,1	67,3	139,7	146,5	136,2	114,1
Centre-North	112,7	106,0	98,3	87,9	101,7	75,2	74,3	62,9	139,7	146,4	136,0	113,3
Centre-South	112,7	105,8	95,0	79,9	98,5	75,2	71,7	56,9	140,0	148,1	131,7	107,7
South	112,1	105,0	94,5	79,7	98,4	61,8	70,5	56,7	139,9	148,1	131,7	107,7
Sicily	112,6	106,9	87,1	77,2	98,5	62,0	70,2	55,0	140,1	148,2	131,6	107,7
Sardinia	112,7	105,8	83,3	70,0	98,4	72,5	68,2	55,4	134,9	147,2	129,0	105,1
Calabria	112,1	105,0	94,5	79,7	98,5	62,0	70,5	56,7	140,1	148,1	131,7	107,7

CAPTURED PRICES PV FIXED TILT (€/MWh)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
North	100,2	91,3	83,2	59,6	89,0	61,5	66,2	46,6	125,4	133,0	119,3	86,4
Centre-North	100,6	85,9	64,0	53,6	89,3	58,5	48,0	40,6	126,1	133,9	119,3	85,0
Centre-South	96,8	83,8	55,8	38,7	77,0	58,7	43,5	28,9	122,7	132,1	110,1	71,5
South	94,8	81,2	54,2	37,9	76,8	38,2	40,8	28,6	122,7	132,0	109,8	70,9
Sicily	94,9	81,6	45,0	34,9	77,1	39,1	40,3	26,3	122,9	132,4	109,6	71,3
Sardinia	96,1	82,9	28,8	20,5	76,3	51,8	32,2	25,6	117,6	130,3	100,4	63,0
Calabria	94,7	80,8	53,5	37,4	76,4	38,4	40,4	28,1	122,6	131,5	109,3	70,2

CAPTURED PRICES PV TRACKER (€/MWh)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
North	101,7	92,9	85,1	61,4	90,3	62,5	67,5	47,8	0	0	0	88,0
Centre-North	102,1	88,0	66,5	55,4	90,7	59,9	49,9	42,0	0	0	0	87,0
Centre-South	99,5	87,1	59,6	41,6	80,4	60,6	46,0	31,0	0	0	0	75,4
South	97,6	84,4	58,0	40,6	80,0	41,2	43,3	30,6	0	0	0	74,6
Sicily	98,2	85,4	48,7	38,1	80,7	42,2	43,2	28,6	0	0	0	75,5
Sardinia	98,4	85,8	32,5	23,3	79,2	53,8	34,7	27,4	0	0	0	67,1
Calabria	97,3	83,7	56,9	39,5	79,3	40,9	42,5	29,6	0	0	0	73,6

CAPTURED PRICES WIND ONSHORE (€/MWh)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
North	115,5	106,9	100,3	85,7	103,9	75,1	80,2	62,9	143,5	146,3	134,3	110,9
Centre-North	115,2	104,7	88,0	74,0	103,3	73,5	61,1	50,6	143,7	147,3	134,0	106,6
Centre-South	110,8	101,3	79,9	57,9	92,2	73,1	55,4	40,6	139,0	144,8	126,0	94,1
South	109,0	99,4	80,6	58,4	92,3	44,2	53,2	40,7	138,4	144,8	126,5	95,4
Sicily	107,9	98,6	64,3	52,7	92,1	44,1	51,8	37,0	137,8	144,2	125,5	94,5
Sardinia	111,0	99,7	63,5	45,0	93,5	63,7	51,6	39,6	126,6	140,2	119,1	89,7
Calabria	109,0	99,4	80,5	58,4	92,2	44,6	53,3	40,8	138,6	144,7	126,4	95,4

CAPTURED PRICES WIND OFFSHORE (€/MWh)	Reference				Low				High			
	2025	2030	2040	2050	2025	2030	2040	2050	2025	2030	2040	2050
North	0,0	107,9	100,9	86,0	0,0	75,7	80,5	62,6	0	0	0	113,0
Centre-North	0,0	107,1	89,5	75,0	0,0	74,8	60,9	50,1	0	0	0	109,1
Centre-South	0,0	104,2	86,3	65,1	0,0	74,0	59,2	45,2	0	0	0	99,7
South	109,7	102,1	84,9	62,9	94,3	47,0	56,0	43,7	0	0	0	99,8
Sicily	0,0	104,2	73,9	63,6	0,0	53,3	60,2	44,9	0	0	0	102,5
Sardinia	0,0	104,5	75,7	59,1	0,0	69,6	60,7	48,0	0	0	0	99,8
Calabria	0,0	0,0	84,9	62,9	0,0	0,0	56,0	43,7	0	0	0	99,8

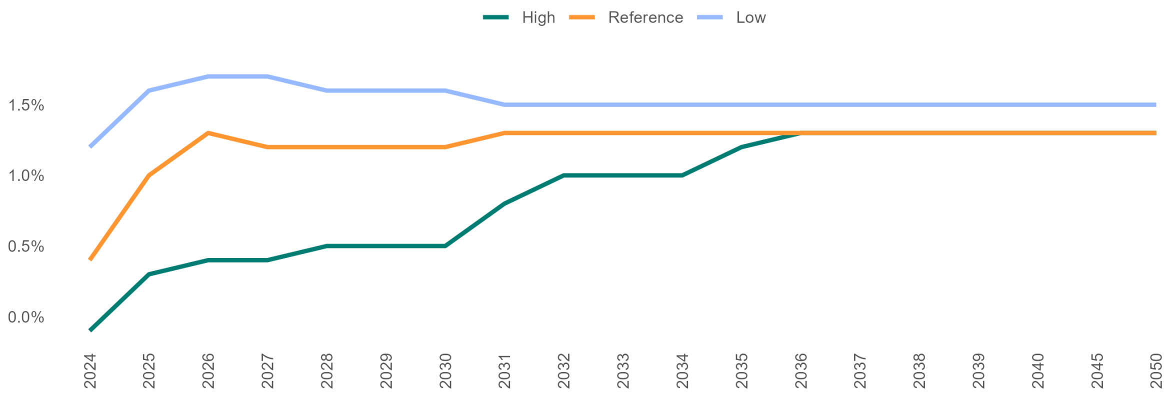
3 Macroeconomic Context

3.1 GDP

GDP GROWTH IN THE SHORT TERM REMAINS SUBDUED, WITH A MODERATE RECOVERY IN INDUSTRIAL PRODUCTION ANTICIPATED, SUPPORTED BY WAGE DYNAMICS AND THE EASING OF MONETARY POLICIES. IN THE MEDIUM AND LONG TERM, GROWTH PROSPECTS ARE PRIMARILY DRIVEN BY THE PATH OF DISINFLATION, EASING FINANCING CONDITIONS, AND THE IMPLEMENTATION OF THE NRRP

GDP Growth Rate

%

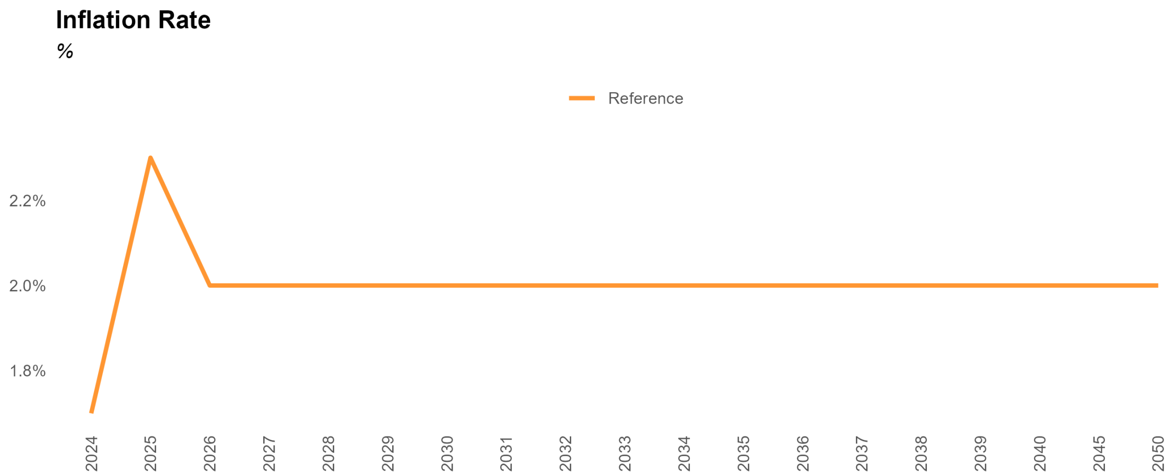


Source: MBS Consulting elaborations

24-25	The reference scenario predicts a 0.4% year-on-year GDP growth in 2024, with a stronger increase of 1% in 2025, driven by an anticipated easing of financial conditions. A gradual easing of monetary policies in the second half of the year, along with positive wage dynamics, should contribute to growth in 2025. In the worst-case scenario, if inflationary pressures persist, GDP is projected to decline by 0.1% year-on-year in 2024 and see a modest increase of 0.3% in 2025. Conversely, the best-case scenario, characterized by accelerated disinflation and a recovery in investments, would result in GDP growth of up to 1.2% in 2024 and 1.6% in 2025.
26-30	In our Reference and Best scenarios, economic growth would gradually realign to the previously projected path, sustained by the effective implementation of the NRRP measures, the recovery of the global economy, and an acceleration of the green transition reforms.
31-50	In the long-term, our Reference and Best-case scenarios remain anchored to the assumption of a stabilization of the yearly GDP growth rate in the 1-2% interval, while in the Worst scenario, GDP growth continues to discount the effects of the failure of key investments.
Main updates	Short-term GDP projections were revised upward, as a faster than expected disinflation and the probable easing of monetary policies combined with positive wage dynamics contribute to GDP growth.

3.2 Inflation rate

THE PERSISTENCE OF THE ENERGY PRICES NORMALIZATION IS DRIVING THE GENERAL PRICE INDEX DECLINE, WITH ITS REDUCTION BEGINNING TRANSMIT ALSO TO THE CORE INDEX. MONETARY POLICY TIGHTENING PROVED TO BE EFFECTIVE IN LIMITING INFLATIONARY PRESSURES AND KEEPING MEDIUM AND LONG TERM EXPECTATIONS UNDER CONTROL



Source: MBS Consulting elaborations

24-25	Inflation is expected to remain close to 2% both in 2024 and 2025, in line with the ongoing disinflation path. In the second half of 2024 monetary policy may revert to easing supporting investments growth. The European Central Bank (ECB) has in fact decided to start a slow path of rate reduction, with an initial cut of 0.25 percentage points from the previous 4.75%. However, geopolitical uncertainty and the risk of pressures, particularly on energy prices, could cause delays in the anticipated lowering of interest rates.
26-30	Still relatively high interest rates are seen as proving effective in guiding inflation back to 2% in the short term. Our scenario foresees a stabilization at 2% in the second part of the decade, even with a gradual easing of monetary policy, although the risk of further pressure on prices due to the expected easing of monetary policy.
31-50	Long-term assumptions envisage the inflation rate to stabilize at around 2%, in line with the ECB's medium term inflation target.
Main updates	Short-term inflation rates remained in line with our previous market update.

4 Commodities

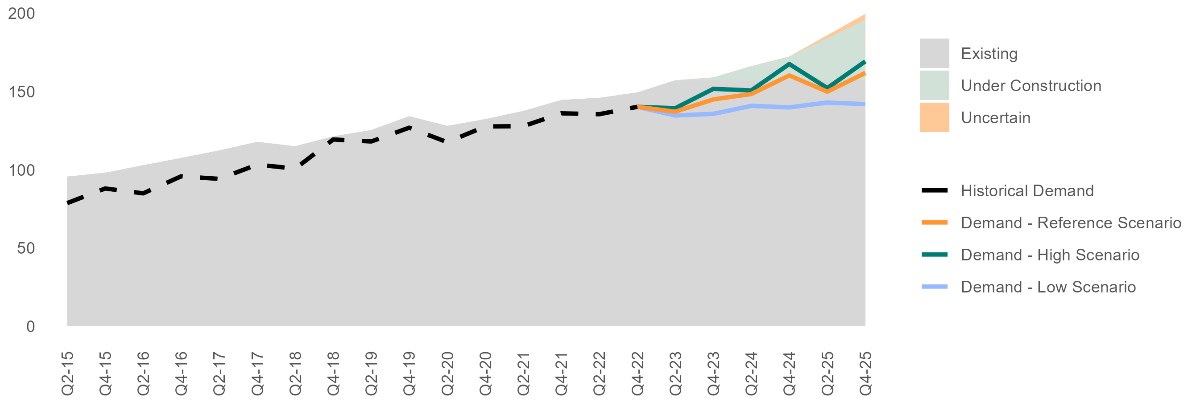
4.1 Natural Gas

4.1.1 LNG

GLOBAL LNG DEMAND IS SEEN AS GROWING STEADY IN THE SHORT TERM, WITH A NOTABLE DISPARITY IN GROWTH RATE SHOWCASED BETWEEN THE ASIAN AND EUROPEAN BLOCS. DELAYS IN THE CONSTRUCTION OF LIQUEFACTION AND REGASIFICATION CAPACITY, INDUCED BY LOW PRICES, COULD TRANSLATE IN RENEWED DEMAND-SUPPLY TENSIONS IN 2025-2026. THERE IS A HIGH PROPABILITY OF AN OVERSUPPLED MARKET POST-2026 LAYING THE GROUNDWORK FOR LNG PRICES NORMALIZING IN THE MEDIUM TO LONG-TERM

World LNG Demand-Supply Balance

Bcm NG/quarter



Source: MBS Consulting elaborations

24-25	Global LNG demand growth is forecasted to grow with an average growth rate close to 5% in both 2024 and 2025. European and Chinese gas demand will primarily drive this uprise, as LNG intake is expected to accelerate in the short-term, in response to expansion of regasification capacity, and to support the transition from coal. Despite 2024 LNG supply growth being limited globally, reduced competition between Europe and Asia, and the expected new capacity entering the market in 2025, are likely to guarantee adequate demand coverage.
26-30	Starting from 2026, LNG demand growth is expected to gradually slowdown, stabilizing just below 5% y/y, consistently with rising renewable energy production and improved energy efficiency measures. Conditional on the lack of further delays, a new wave of liquefaction capacity will enter the market by 2026, driven by US and Qatar, contributing to almost eliminating the risk of market tightness.
31-50	In the long-term, pressure on the LNG market is expected to ease, with new capacity growing and green energy commitments becoming effective.

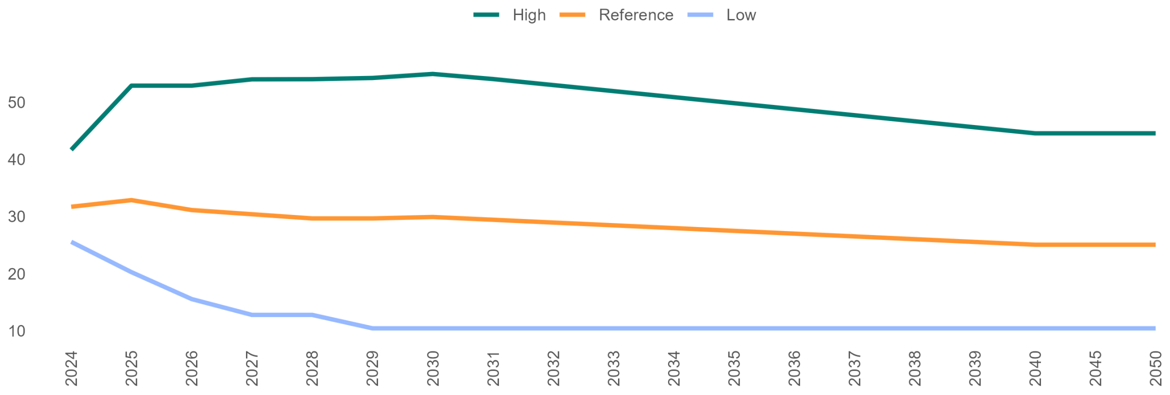
Main updates

Global LNG demand growth remains consistent with our prior market assessment.

4.1.2 TTF Price

THE LIKELIHOOD OF DEMAND RETURNING TO PRE-CRISIS LEVELS WITHIN THE NEXT THREE YEARS IS CONSIDERED LOW, WITH THE SAVINGS PUT IN PLACE IN RESPONSE TO THE RUSSIAN GAS HALT LEADING TO STRUCTURAL CHANGES. IN THE LONG TERM, WE ANTICIPATE FURTHER DEMAND REDUCTION DUE TO EUROPE'S DECARBONIZATION EFFORTS, LEADING TO A LOWER TTF PRICE TRAJECTORY NEARING €25/MWH. PRICE TENSION AND VOLATILITY SPIKES, PARTICULARLY DURING WINTERS, MAY OCCUR OVER THE NEXT FEW YEARS THOUGH

TTF Price
€/MWh GCV



Source: MBS Consulting elaborations

24-25

In our Reference scenario, the 2024 TTF yearly average is projected to stay below 40 €/MWh, with the persistence of subdued demand weighing on prices. Europe LNG import capacity is poised to expand by further 30 Bcm in 2024 enabling additional LNG arrivals, crucial to maintain market equilibrium in the short-term and to structurally adapt to the absence of Russian piped gas.

26-30

From 2026 onwards, a further normalization is anticipated as a result of the significant deployment of new liquefaction capacity. Assuming a progressive growth of global LNG supplies alongside an acceleration of the energy transition, European gas prices are projected to steadily decrease towards 30 €/MWh by 2028.

31-40

The European decarbonization process would keep reducing gas demand, successively pressuring the price action back towards the 25 €/MWh long-term equilibrium. Only in the High scenario, persisting geopolitical and commercial tensions would leave commodities shortages unresolved, leaving prices just below 45 €/MWh in the long-term. Effective green policies supported by economic growth may lead prices significantly lower in the Low scenario, with the TTF averaging near 10 €/MWh in the long-term.

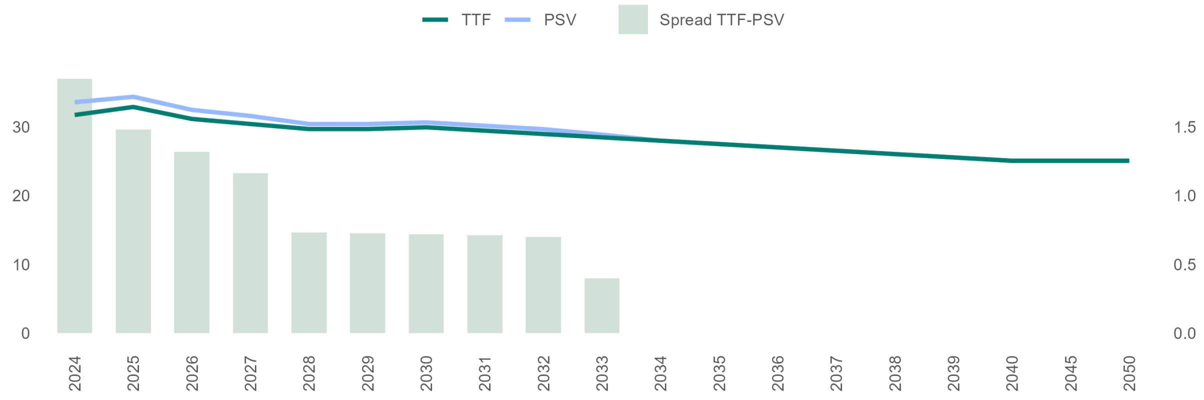
Main updates

TTF gas price projections remain in line with our previous market update. However, lingering geopolitical instability is seen as exerting pressure on global gas prices.

4.1.3 Spread TTF-PSV

IN THE SHORT-TO-MEDIUM TERM THE PSV GAS PRICE IS ANTICIPATED TO MAINTAIN A PREMIUM COMPARED TO THE TTF, FOLLOWING THE NEED FOR NORTHERN EUROPE GAS FLOWS TO COMPENSATE FOR THE INTERRUPTION OF RUSSIAN PIPED GAS SUPPLIES. THE TEMPORARY CLOSURE OF THE OLT LNG REGASIFICATION FACILITY IN ITALY ADDS PRESSURE IN THE VERY NEAR-TERM. IN THE LONG-TERM, THE REBALANCING OF FLOWS IS SEEN AS LEADING TO A PROGRESSIVE NARROWING OF THE SPREAD TOWARDS ZERO

Spread TTF-PSV
€/MWh GCV



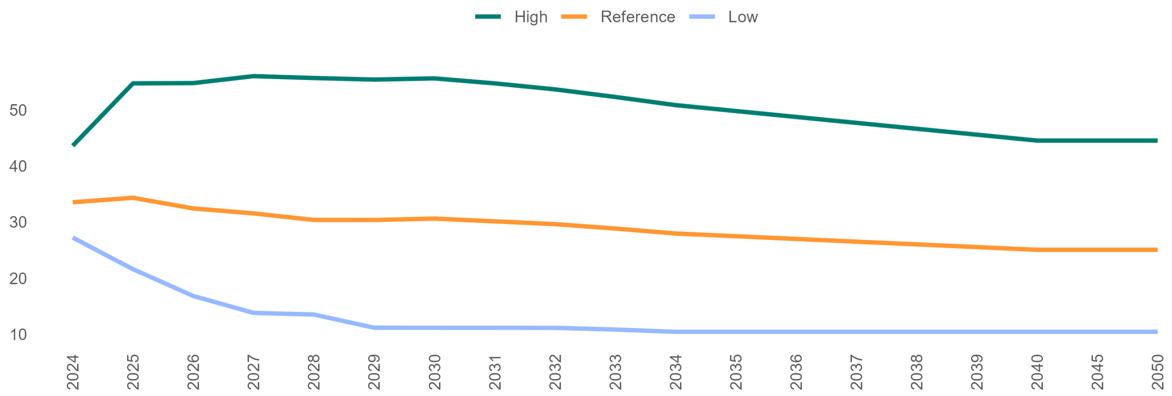
Source: MBS Consulting elaborations

24-25	The PSV-TTF spread is expected to stay just below 3 €/MWh in 2024 following the closure of the OLT LNG regasification facility which increases the Italy's reliance on piped gas flows from Norway via Passo Gries. Fluctuations throughout the year are anticipated to be in line with seasonality.
26-30	Flows from the TAP and Algeria, and LNG arrivals are seen as partially taking over imports from the North in the medium-term, leading to a progressive spread closure to below 1 €/MWh by 2030.
31-50	The PSV-TTF spread is foreseen to reabsorb towards zero in the long-term, with the completion of flows rebalancing from Noth to South and LNG expected to combine with the underlying decarbonization-induced demand reduction.
Main updates	PSV-TTF spread is still expected to remain positive in short and medium term and to reduce progressively towards null in the long-run. A slight increase in the short-term average PSV-TTF spread follows OLT facility temporary halt, coherently with our expectations.

4.1.4 PSV Price

THE ITALIAN GAS PRICE CONTINUES TO BE CLOSELY TIED TO THE EUROPEAN HUB ONE, WITH THE TTF SIGNIFICANTLY AFFECTING PSV TRENDS. HOWEVER, THE TEMPORARY CLOSURE OF OLT LNG FACILITY LEADS TO SHORT-TERM PROJECTIONS SUGGESTING WIDER DEVIATIONS FROM THE TTF. IN THE LONG RUN, WE FORESEE THE PSV TO ALIGN WITH THE EUROPEAN PRICES, TARGETING 30 €/MWH BY 2030

PSV Price
€/MWh GCV



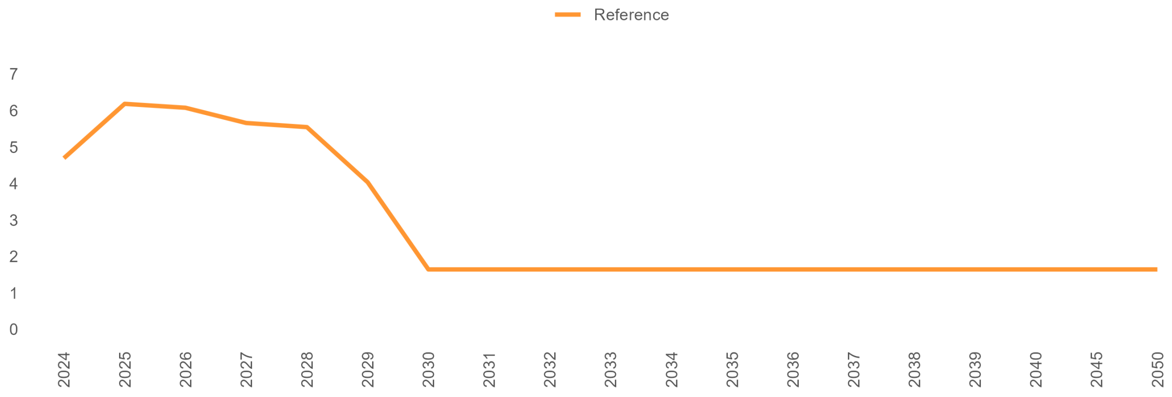
Source: MBS Consulting elaborations

24-25	We anticipate a 2024 PSV yearly average below 40 €/MWh, amid constrained gas demand recovery. The shift towards savings and efficiency weights on distribution network consumption, while subdued growth in the energy-intensive sector limits the industrial demand adding to a lower-than-average thermoelectric gas demand. Delays in the commissioning of the Ravenna FSRU have also hampered gas demand recovery expectations. In the event of renewed tensions on LNG and TTF prices arising in winter 25-26, the PSV would follow.
26-30	The PSV is foreseen to follow the European gas prices mid-term normalization towards 30 €/MWh by year 2030, as a gradual rebalancing of the global gas demand-supply dynamics should follow the expected acceleration of energy transition.
31-40	The PSV Reference price is expected to stabilize, aligning to TTF prices at around 25 €/MWh in the long-term.
Main updates	Our short-term expectations on the European gas hubs prices remain consistent with our prior market update on the back of the persisting relaxation of short-term market fundamentals and the significant slowdown in economic growth in Europe. The risk for renewed tensions in winter 2025-26 and possibly 2026-27 is now seen as not negligible though.

4.1.5 Logistics Costs for Italian Gas-Fired Units

** GAS LOGISTIC COSTS ARE EXPECTED TO REMAIN HIGH IN THE SHORT-TERM DUE TO THE INCREASE RELATED TO THE COVERAGE OF STORAGE INJECTIONS ACTIVITY IN PARTICULAR. VARIABLE LOGISTIC GAS COSTS SHOULD START GRADUALLY DECREASING FROM 2028 ONWARDS, FOLLOWING THE EXPECTED GAS PRICES NORMALIZATION **

Logistic Costs for Italian Gas-fired Units
€/MWh GCV



Source: MBS Consulting elaborations

24-27	The 2023 logistic cost for Italian gas-fired units averaged 4 €/MWh amid the increase of the CRVOS (which pays storage injections incentives), CRVBL (which covers the charges associated with the gas system balancing activity) and the CVU (which covers variable charges and it's linked to the gas price trend) components. The variable logistic cost remains around 4 €/MWh short-term due to the essential CRVOS component for storage injection incentives, though thermoelectric producers could request over 60% exemption. The ARERA Resolution 263/2024 temporary fixes the CRVBL component (which covers the charges associated with the gas system balancing activity) equal to zero from January 2025, as a result of the improved natural gas price scenario. As a precautionary measure, we assume a gradual return to historical average levels in the second half of 2025 to account for the volatility of the current transport cost environment, which reverberates on prices consequently.
28-50	A gradual normalization of the average variable logistic costs below 4 €/MWh is only expected beyond 2028, coherently with the foreseen normalization of gas prices and the recovery of the storage-related losses, nearing 1.6 €/MWh on average by 2030.
Main updates	The variable transport charges forecast incorporates the regulator interventions to mitigate the recent commodities surge on bills, compensated by an increase in storages and balancing cost.

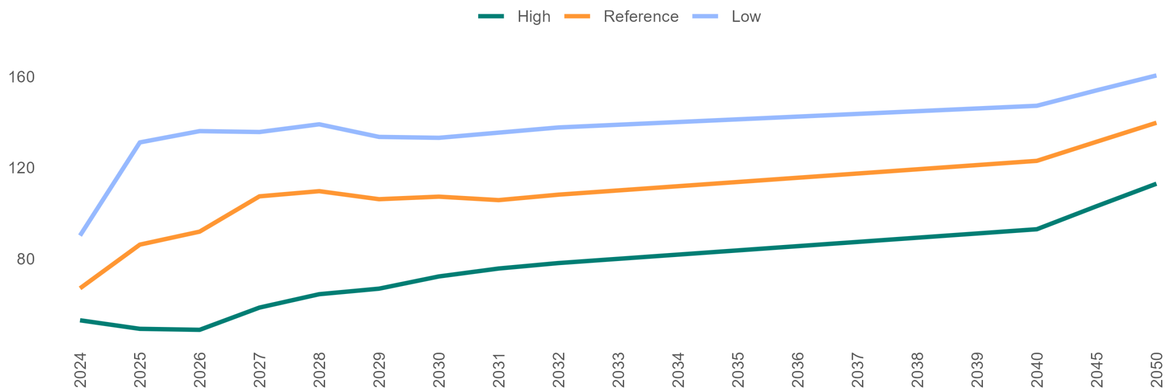
4.2 EU ETS

4.2.1 CO2 Allowances Price

THE ETS REFORM, TO BE INCORPORATED INTO NATIONAL LEGISTLATION OF EU MEMBER STATES BY THE END OF 2024, AIMS AT SUPPORTING A RAISE OF THE CO2 PRICE BY TIGHTENING THE EMISSIONS CERTIFICATES MARKET THROUGH A COMBINATION OF SUPPLY CURTAILMENT AND DEMAND-INCREASING MEASURES. THE INCLUSION OF NEW SECTORS, SUCH AS THE MARITIME, WILL CONTRIBUTE TO SUSTAINING THE ENVISIONED PRICE INCREASES

CO2 Price, EU ETS Mechanism

€/tCO2eq



Source: MBS Consulting elaborations

24-25

In our Reference scenario, the 2024 CO2 price average is projected to stay near 70 €/ton, driven by the gradual implementation of the ETS system reform. The phasing out of free allowances for the aviation sector, reaching 50% of the total in 2025, along with the planned removal of 90 Mln permits from the market in 2024, are expected to begin exerting upward pressure on allowances prices by curtailing supply. From 2025 onwards, the progressive inclusion of the maritime transport sector will further boost overall demand. Concerns remain regarding the underlying demand recovery, which is anticipated to be limited over the next couple of years due to a slow economic growth.

26-30

The widening of the supply-demand gap should become evident starting from 2026, as the maritime sector integrates into the ETS system and the phasing out of free allowances for aviation reaches full implementation. In addition, by 2030, the reinforcement of the Market Stability Reserve and the increase of the Linear Reduction Factor up to 4.4% will contribute to further tightening the market. As a result, the CO2 price is expected to accelerate towards 110 €/ton on average by 2030.

31-50

By 2034 the removal of free allowances for sectors covered by the CBAM will reach full implementation, inducing a further increase in allowances demand. The long-term targets would hinge upon the effective efficiency of the ETS System, with the CO2 price expected to exceed 120 €/ton in the Reference scenario by 2040, and potentially accelerate to just below 150 €/ton in the Low scenario, under the assumption of stricter decarbonization efforts in Europe to accelerate the prices increase.

Main updates

Our CO_2 price targets remain consistent with our prior market update, when we took into account a downward revision in the very short term across all three scenarios, in response to the sharp decline in CO_2 prices in evidence in the second half of 2023 and in the first quarter of 2024. A rebound in allowances demand and, consequently, in average prices in the post-2024 period, is envisaged.

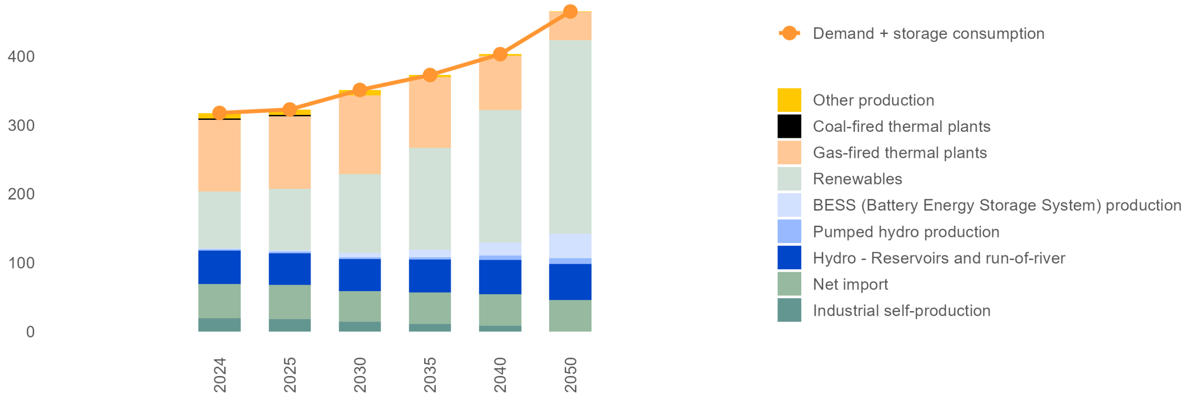
5 Energy Mix

5.1 Day-Ahead Market Energy Balance

5.1.1 Reference Scenario

IN THE SHORT-TERM, SUBDUED DEMAND COVERED BY GROWTH IN RES AND NET IMPORT FLOWS. IN THE MID-TERM, GAS-FIRED GENERATION REMAIN THE BACKBONE OF THE ENERGY MIX AS RES GAIN SHARES. IN THE LONG-TERM, RENEWABLES TAKE THE LEAD AS THE PRIMARY SOURCE OF ELECTRICITY PRODUCTION, SUPPORTED BY GAS-FIRED PRODUCTION

DAM Energy Balance, Reference Scenario
TWh



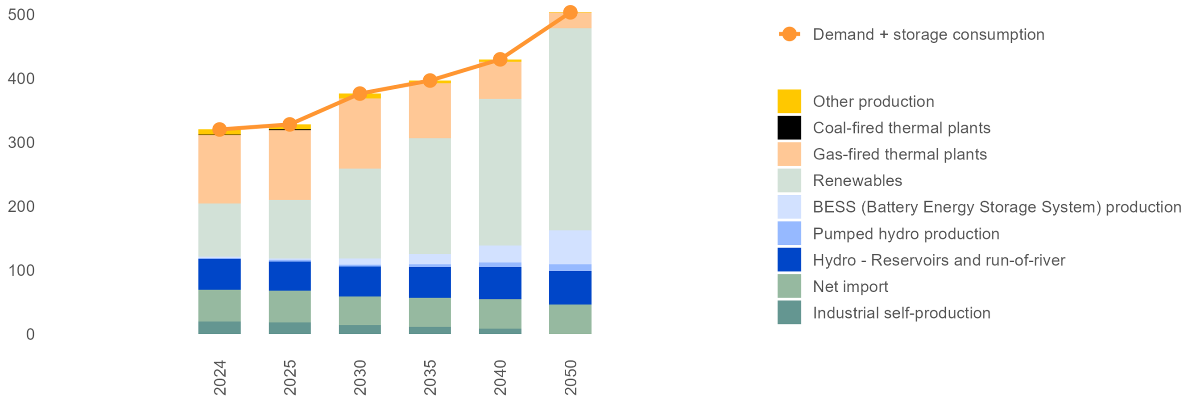
Source: MBS Consulting elaborations

24-25	Electricity demand reduction at European level, nuclear plants capacity recovered from the O&M maintenance of the last two years, and recover in hydro production lead to an increase in the electricity import from the Northern borders. Positive trend of new RES installed capacity in 2023 and first half of 2024 is expected to continue, with gas powered thermal plants remaining the marginal source of the system.
26-30	Coal-fired units are going to phase-out within 2025, with the exception of the Sardinia ones, which remain operative until the completion of the Tyrrhenian Link in 2030 in Reference scenario, 2029 in Low case. Electricity production from renewables will cover almost 50% of demand by 2030.
31-50	Renewables become the main source in the mix with 70% share. Convenient market conditions favoured energy intensive storage.
Main updates	Net import increase in the short-term, aligned with market dyanmics, supported by French nuclear capacity recovery and a general reduction in the electricity demand at European level.

5.1.2 Low Case Scenario

HIGHER COMMITMENT TO DECARBONIZE IN THE EUROPEAN ECONOMY LEADS TO A STRONGER RENWABLES DEVELOPMENT, WHICH COULD SURPASS THE CURRENT 2030 TARGET, REACHING 85% OF THE ELECTRICITY PRODUCTION MIX BY 2050, SUPPORTED BY AN INCREASE IN THE BATTERY STORAGE CAPACITY

DAM Energy Balance, Low Case Scenario
TWh



Source: MBS Consulting elaborations

24-25

A swift rise in decarbonization solutions is supported by an increase in commodities' prices, higher prices in the EU ETS mechanisms, and easier authorization for new renewables projects encourage investments in the energy efficiency. Coal phase-out is expected in 2025 for all units in the peninsula, gas-fired thermal plants production will reach up to 33% of the national electricity demand by 2025, with net import flows over 45 TWh.

26-30

By the end of 2028 coal-fired units are entirely phased-out. Falling renewables costs and a greater effort to reach decarbonizations goals support renewables development. In 2030 the ratio between renewable energy and total electricity consumption reach 59%. Improvements in the electricity grid will facilitate the reduction of electricity imported from neighborhood countries.

31-50

In the long-term, gas-fired thermal plants will be operative to guarantee system security and adequacy, even though the increase in storage system will down their share to 15% by 2050. Despite storage and network reinforcements the integration of renewables in the energy mix will only be partial reached as congestion and overgeneration problems are going to manifest, generating signals for ectrolysis capacty.

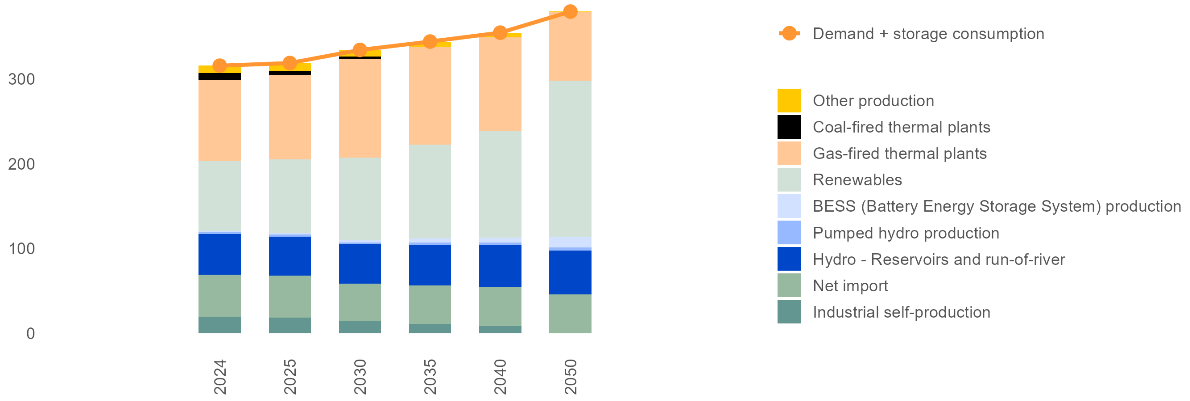
Main updates

Changes in the production mix reflect updated commodities in the short-term. In the long term, new renewables installed capacity will be supported by thermoelectric and storage to maintain system adequacy.

5.1.3 High Case Scenario

SLOWER ECONOMIC RECOVERY IS REFLECTED IN A LOWER ELECTRICITY DEMAND AND LOWER AMOUNT OF INVESTMENT IN DECARBONIZATION. THE ENTRANCE OF THE MAIN GRID INFRASTRUCTURE PROJECTS ALLOWS THE PHASE-OUT OF COAL UNITS BY 2034. RENEWABLES AND BESS GRADUALLY INCREASE THEIR SHARES IN THE GENEATION MIX

DAM Energy Balance, High Case Scenario
TWh



Source: MBS Consulting elaborations

24-25

Coal-fired thermal plants are still an important source of power, even though the reduction in the gas prices will increase the share of the gas-fired thermal plant, covering 35% of the demand. The increase in net import up to 47 TWh in 2025 reduce the need of coal genration to 5 TWh.

26-30

CM-led investments come online but the phase-out of coal-fired capacity is postponed, so as the realization of great network investments. Net imports will reduce to 36 TWh within 2030, and gas-fired production maintains a 40% quota of total electricity needs, as hydro production normalize aroung 46.5 TWh/y and renewable energy sources gradually increase thier share in the mix.

31-50

Increase in CO2 price reduce coal generation competitiveness until 2035, when the entrance of the Tyrrhenian Link determine the phase-out of all coal units. Gas-fired production increases its share in the national energy mix to around 38%. Volatile DAM dynamics and RES development sustain the entrance of 10GW of energy intensive storage in the long-term.

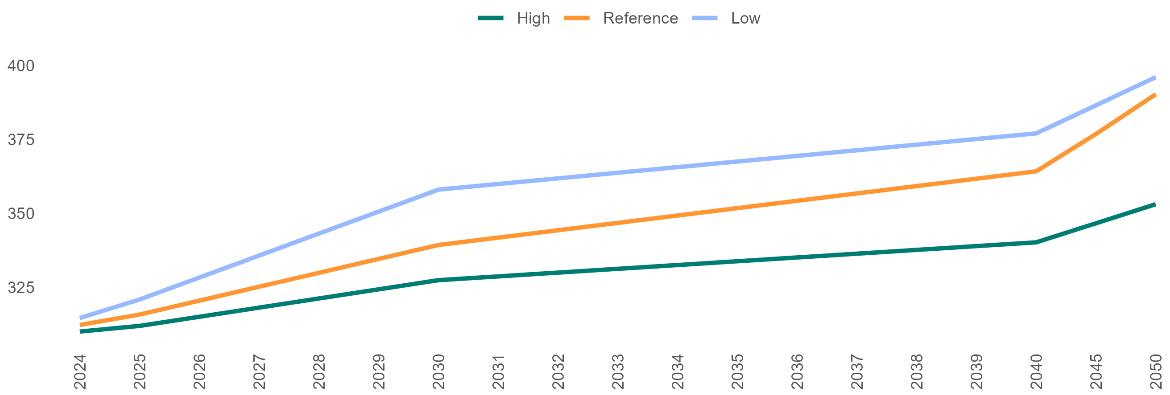
Main updates

Changes in the production mix reflect updated commodities in the short-term.

5.2 Electricity Demand

THE REDUCTION OF ELECTRICITY DEMAND AT EUROPEAN LEVEL IS REFLECTED IN THE ITALIAN SCENARIO, STILL TO EVALUATE WHETHER THE TREND IS GOING TO BE STRUCTURAL. IN THE LONG-TERM, ELECTRIFICATION AND EFFICIENCY IN FINAL CONSUMPTIONS ARE GOING TO BE THE MAIN DRIVERS FOR DEMAN RECOVERY

Italian Electricity Demand
TWh



Source: MBS Consulting elaborations

24-25

A slight recovery of the economy is expected in the next two years, leading to an increase in the electricity demand, which would reach almost 316 TWh in 2025 (+1.1% y/y). The positive growth is foreseen also in the alternative views: in the high case scenario, the demand would reach 312 TWh, according to a lower economic recovery, and 321 TWh in the low case scenario, where the economic growth is expected to be more sustained.

26-30

In the Reference case, moderate economic growth is driven by supportive measures and electrification allowing demand to reach 339 TWh in 2030. In the Low scenario, stronger economic outlook and system electrification push demand slightly below 360TWh, while in the High scenario the lower economic recovery and electrification bring consumption at 327 TWh.

31-50

After 2030, the progressive electrification of consumption in the transport sector and the diffusion of heating and cooling appliances could be compensated by efficiency measures in the industrial and civil sectors. This could lead electricity demand below 370 TWh in 2040. In the alternave scenarios 2040 demand totals 377 TWh in Low case and 347 TWh in High case.

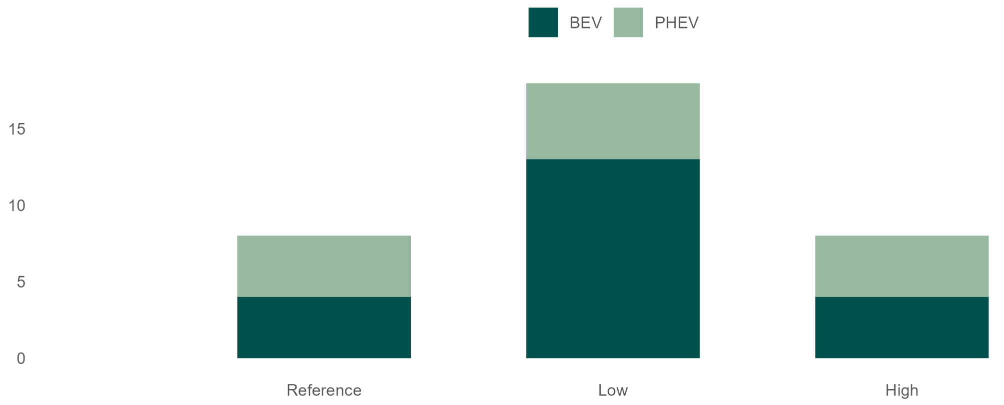
Main updates

Electricity demand hypothesis are in line with the previous update, with a 1 TWh increase in 2024.

5.2.1 E-mobility

ADDITIONAL ELECTRICITY DEMAND FROM EVs CAN SIGNIFICANTLY VARY BASED ON THE FUTURE DEPLOYMENT OF E-MOBILITY APPLICATIONS IN CITIES, EMISSION REDUCTION OBJECTIVES IN TRANSPORTS AND GENERALLY ON LONG-TERM TRANSPORT HABITS

Electricity Consumption from Electric Vehicles in 2030
TWh

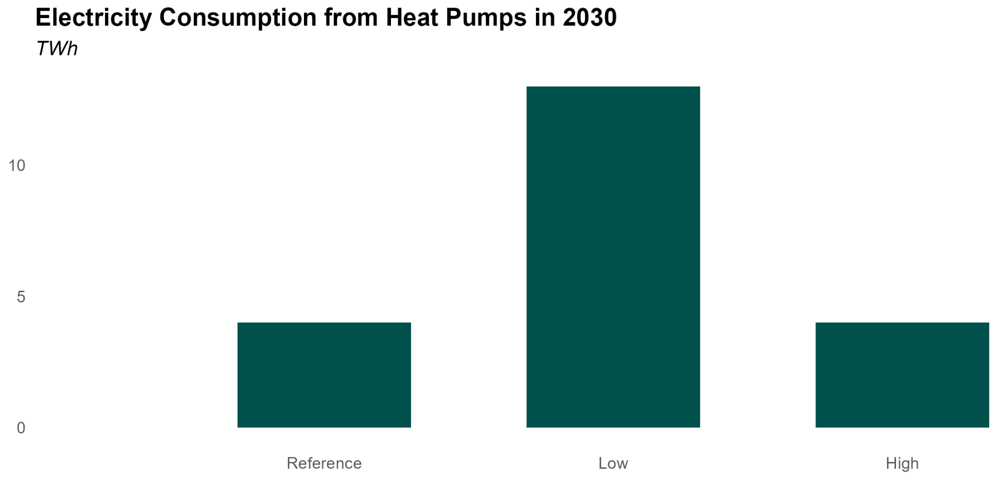


Source: MBS Consulting elaborations

24-40	Electric vehicles are assumed to increase up to 1.2 million in 2025, 4.5 million in 2030 and 11 million in 2040, bringing 2 TWh, 7.6 TWh and 18.7 TWh of additional consumption, respectively. In the Low scenario, a greater diffusion of electric vehicles leads 10.5 million in 2030 and 14 million in 2040. In the High scenario, e-mobility development suffers a 5-year delay compared to the Reference case.
30	The NIECP envisages 6 million electric vehicles in Italy in 2030 - 4 million are pure EVs (BEV: Battery Electric Vehicles) – accounting for about 8 TWh of additional electricity demand. In our Reference view we estimate additional 7.5 TWh to come from BEV and PHEV (Plug-in Hybrid Electric Vehicle). This means that our hypotheses consider a greater consumption per EV compared to NIECP figures. Main differences are most likely connected to the underlying assumptions about e-mobility applications in cities or long-term transport.
31-50	Notwithstanding the newest Green Deal proposals at EU level concerning transports, considering the uncertainty connected to the future expansion of a market which is still in a first stage of development, we assume a BAU trend in the long-term horizon, starting from the annual level of EVs addition reached in 2030.
Main updates	Development of EVs in line with previous market update, considering a potentially accentuated sensitivity towards sustainability goals in the post-pandemic recovery and especially from 2030 on with the likely strengthening of EU standards.

5.2.2 Heating and Cooling

THE ADDITIONAL ELECTRICITY DEMAND FOR HEATING AND COOLING WILL DEPEND ON THE PACE OF GROWTH OF INSTALLATIONS FOR CIVIL AND INDUSTRIAL USES, POTENTIALLY SUSTAINED BY SUPPORT MEASURES FOR DECARBONIZATION



Source: MBS Consulting elaborations

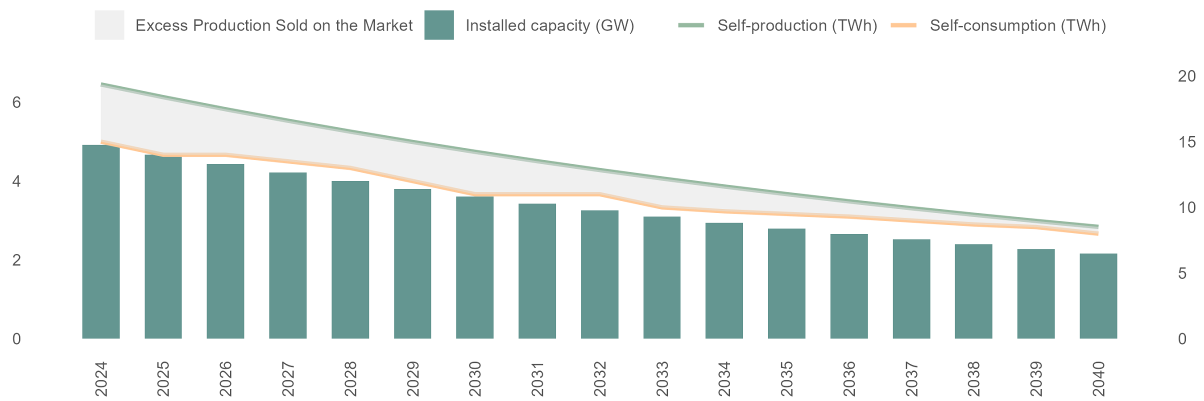
24-40	H&C is expected to account for additional electricity requirements in a range between 2.5 TWh and 8 TWh in 2025, 4 TWh and 16 TWh in 2030, 7 TWh and 18 TWh in 2040, depending on the scenario considered.
30	Our assumptions lead to estimate 6.7 TWh of H&C consumption in 2030, corresponding to around 1.8 million installations for civil uses.
31-50	We assume a BAU trend in the long-term horizon, starting from the annual level of additional installations and consumption reached in 2030.
Main updates	H&C hypotheses are in line with the previous market update, that considers the outcomes of a survey conducted in recent years by REF-E among H&C installers.

5.2.3 Industrial Self-Production and Self-Consumption

INDUSTRIAL SELF-CONSUMPTION WILL GRADUALLY DECREASE AS EXISTING ASSETS REACH END-OF-LIFE AND THE EXEMPTIONS ACCORDED TO CLOSED DISTRIBUTION SYSTEMS WL BE AT LEAST PARTIALLY REMOVED

Self-production, Self-consumption and Installed Capacity

GW,TWh



Source: MBS Consulting elaborations

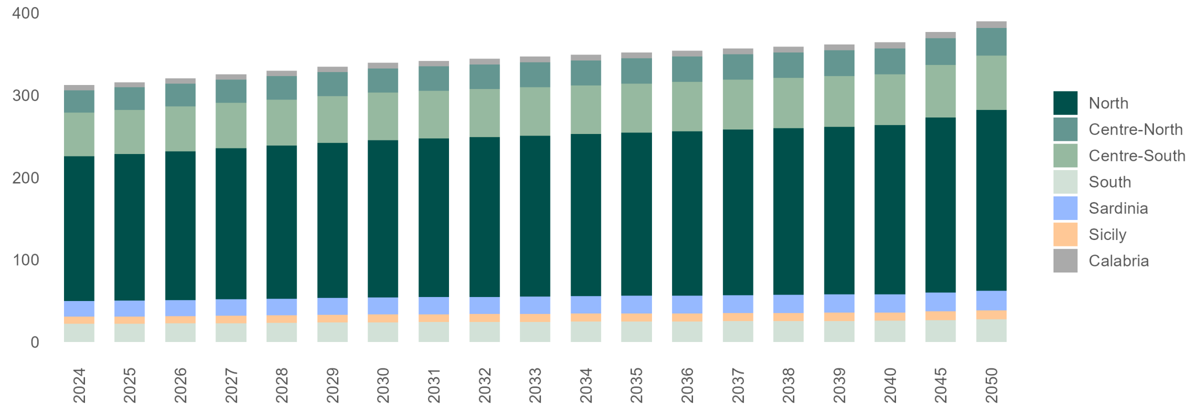
24	Law 91/2014 affirms that grid and general system tariff components should be applied to the electricity consumed and not only to the electricity withdrawn from the public grid. Following this approach, the exemptions accorded to RIU (Re Interne di Utenza) and SEU (Sistemi Efficienti di Utenza) and closed distribution systems, and the benefits currently in force for existing plants related to self-consumption will be at least partially removed for new subjects/projects that apply for similar mechanisms.
25-50	The excess of self-produced electricity that is not consumed by the industrial sites (self-consumption) and is thus sold on the market (differential between self-production and self-consumption) is expected to gradually decrease, consistently with the expected end-of-life of existing power plants that serve industrial sites.
Main updates	Industrial self-production and self-consumption hypotheses have been updated considering the most recent historical data but are in line with the previous update. Self-production/consumption hypotheses are the same in all the three scenarios.

5.2.4 Zonal Distribution of Electricity Demand

ZONAL DISTRIBUTION OF ELECTRICITY DEMAND IS ESTIMATED IN LINE WITH MOST RECENT REGIONAL TRENDS

Zonal Distribution of Electricity Demand, Reference Scenario

TWh

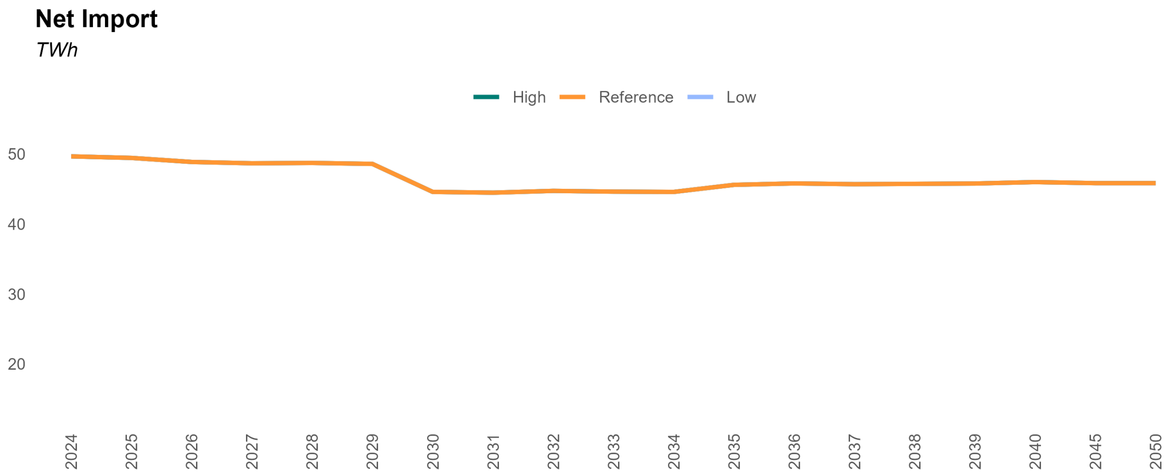


Source: MBS Consulting elaborations

15-20	In 2015, the approval of the European guidelines on capacity allocation and congestion management (CACM) introduced new parameters to be followed in the zonal configuration review process. In 2018, Terna began a process to review the zonal configurations in compliance with such rules.
21-onwards	The current zonal configuration derives from the base case proposed by Terna in compliance with the CACM. Differences compared to the previous configuration: (i) elimination of the limited production poles, (ii) inclusion of a new bidding zone corresponding to the Calabria region, (iii) displacement of the Umbria region from the Centre-North zone to the Centre-South market zone.
24-50	The zonal distribution of electricity demand is based on historical regional data published by Terna and subsequent econometric elaborations. In the Reference case, the zonal distribution of electricity needs is as follows: North (57%), Central-North (9%), Central-South (17%), South (7%), Calabria (2%), Sicily (6%), Sardinia (3%). Slight differences in such figures between the alternative cases are the result of the econometric elaborations performed.
Main updates	The approach adopted and the distribution quotas are in line with the previous update.

5.3 Net Import

THE RECOVERY OF NUCLEAR CAPACITY FROM THE O&M OPERATION HELD SINCE 2022, AN INCREASE IN HYDRO PRODUCTION IN SWITZERALND, AND ELECTRICITY DEMAND REDUCTION AT EUROPEAN LEVEL LEAD TO AN INCREASE IN NET IMPORT FROM THE NEIGHTBORS COUNTRIES TO THE NORTH ZONE. AS RESULT, NET IMPORT IS GOING TO REACH UP TO 50 TWh BY THE END OF 2024. AFTER 2029, THE COMPLETION OF 600 MW POWER INTERCONNECTOR WITH TUNISIA (MONTEL) WILL INCREASE ELECTRICITY EXPORT



Source: MBS Consulting elaborations

24-25

Continuing the trend registered in 2023 and in the first half of 2024, net import from neighboring countries is going to be higher than historical average. This is manly due to French nuclear power production recovery, after two years operation and maintenance stops, recovery in hydro production in Switzerland, and a general delay in European demand increase. Net import is expected to reach 49.7 TWh in 2024, and stabilize also in 2025.

26-30

Net imports flows are assumed to slowly decrease in the second half of the decade to around 45 TWh in 2030. This is due to: (i) recovering switching conditions and the partial dismission of the nuclear and coal- fired capacity in France and Germany, (ii) demand recovery at European level lead by electrification, and (iii) the achievement of 2030 renewable targets in other European countries, which increases electricity production from RES. Moreover, the go-live of the Tunisia-Sicily cable by the end of 2028, will reduce the net import balance by adding more than 3.5 TWh of export flows.

31-50

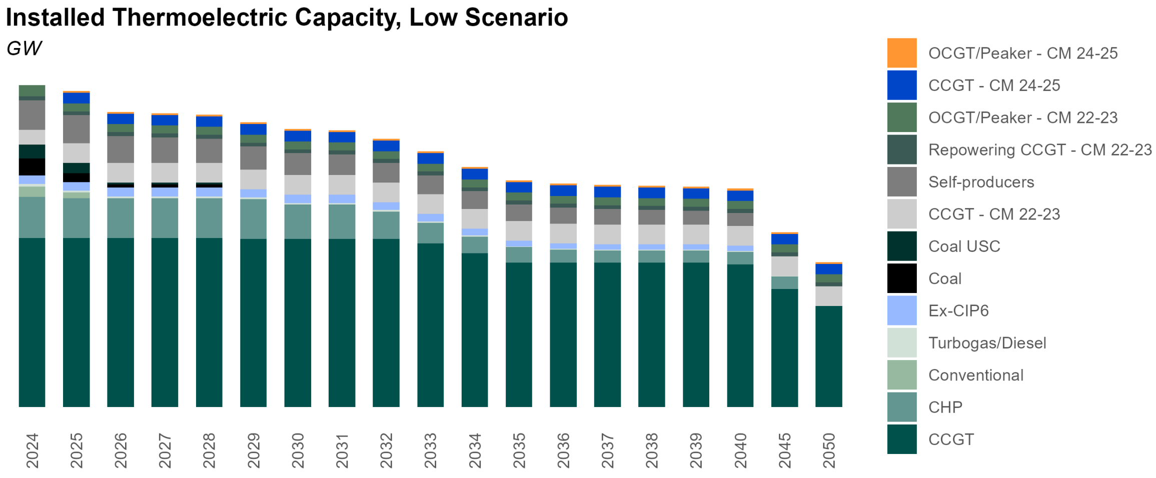
The phase-out of nuclear and coal-fired units in continental Europe could lead to a further net import decrease in the 2030s, until 13 TWh ca. in 2040. The slight increase in net import seen from 2035 is due to an estimated reduction (1 TWh ca.) in the export flows towards Tunisia, following the Tunisian system development plan. In the High scenario, net imports remain sustained as switching conditions only partially improve and no significant nuclear/coal-fired dismission is supposed in continental Europe.

Main updates

Update in short-term trend, in line with 2023 results. In the alternative scenarios, net import values are assumed equivalent to the Reference case under the assumption that national grid security conditions must be ensured.

5.3.1 Installed Capacity, Low Case Scenario

CAPACITY MARKET AUCTIONS WILL COMPREHENSIVELY BRING 7.3 GW OF NEW GAS-FIRED CAPACITY ONLINE BETWEEN MID 2025. SARDINIAN COAL-FIRED UNITS TO BE PHASED-OUT ONLY IN 2029, CONSIDERING THE TYRRHENIAN LINK ENTERING IN 2030



Source: MBS Consulting elaborations

24-25

Due to troubles in completing the permitting process, some capacity procured through the 2022-2023 Capacity Market (CM) auctions will not be realized. According to the latest data published by Terna, the total amount of new gas-fired capacity supported by 2022-2023 CM premium should total around 5 GW, with only 2.8 GW currently operative. 2024 CM capacity should enter the market between late 2024 and mid-2025.

26-30

Auction results show also that Sardinia coal-fired capacity will not be substituted by gas-fired units, as only storage capacity was awarded in the island. Anyway, while coal-fired plants on the peninsula will be phased-out after 2025, Sardinia units are expected to operate until the Tyrrhenian Link infrastructure is fully completed (2029).

31-50

No other thermoelectric capacity investments are envisaged afer the wave of investment brought by the last CM auctions. Most of existing CHP power plants gradually exit the market, substituted by greener solutions. Some ageing CCGT capacity exit the market following strong competitive conditions.

Main updates

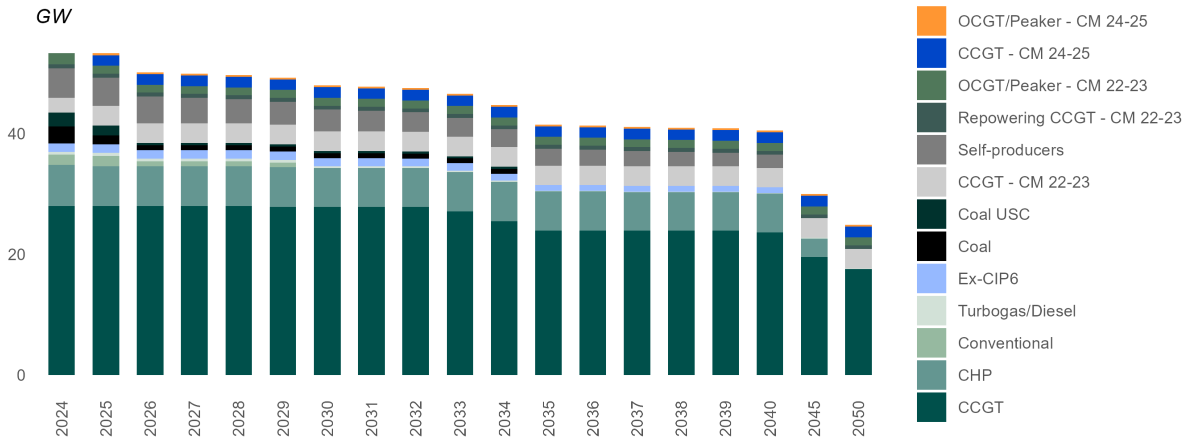
Evolution of new thermoelectric capacity reviewed consistently with latest information diffused by Terna with respect to the results of Capacity Market auctions. All coal-fired units phased-out in 2029 under the hypothesis of a realization of the Tyrrhenian Link infrastructure in line with Terna assumptions. Hypotheses related to existing gas-fired capacity are in line with the previous market update.

5.3.2 Installed Capacity, High Case Scenario

CAPACITY MARKET AUCTIONS WILL COMPREHENSIVELY BRING 7.3 GW OF NEW GAS-FIRED CAPACITY ONLINE BETWEEN 2022 AND EARLY 2025. PHASE-OUT OF COAL-FIRED POSTPONED UNTILL 2034 WHEN TYRRHENIAN LINK BECOME OPERATIVE

Installed Thermoelectric Capacity, High Scenario

GW



Source: MBS Consulting elaborations

24-25

Due to troubles in completing the permitting process, some capacity procured through the 2022-2023 Capacity Market (CM) auctions will not be realized. According to the latest data published by Terna, the total amount of new gas-fired capacity supported by 2022-2023 CM premium should total around 5 GW, with only 2.8 GW currently operative. 2024 CM capacity should enter the market between late 2024 and mid-2025.

26-30

Thermal capacity expected to be stable in the second half of the ’20s in High scenario

31-50

No other thermoelectric capacity investments are envisaged after the wave of investment brought by the last CM auctions. Existing CHP and CCGT power plants are remain operative. Realization of the Tyrrhenian Link in 2035 determine the phase-out of all coal power plants.

Main updates

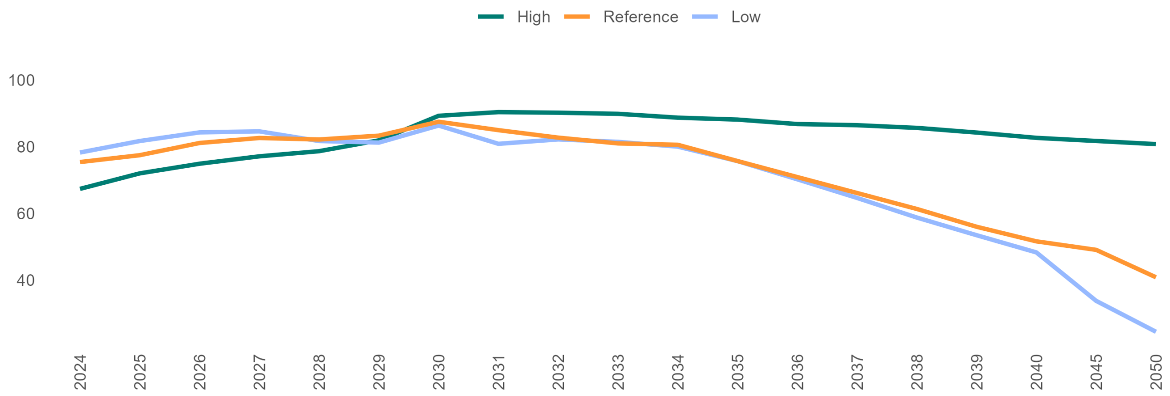
Evolution of new thermoelectric capacity reviewed consistently with latest information diffused by Terna with respect to the results of Capacity Market auctions. Phase-out of coal-fired units positioned until 2035. Hypotheses related to existing gas-fired capacity are in line with the previous market update.

5.3.3 Residual Demand for CCGTs

EXISTING CCGTs COULD OVERCOME 2000 EOH IN THE SHORT-THERM AND RANGE BETWEEN 2000 AND 1300 EOH IN THE MID- AND LONG-TERM DUE TO THE GREATER INCREASE OF PRODUCTION FROM NEW RES INSTALLATIONS AND HIGHER DEGREE OF COMPETITION BROUGHT BY THE NEWBUILD CAPACITY AFTER 2024-2025 CAPACITY MARKET AUCTIONS

Residual demand for CCGTs

TWh



Source: MBS Consulting elaborations

24-25

Existing CCGT fleet is supposed to average around 2300 EOH in the 2024-2025 period, with considerable zonal differences. In the Norther zone, the load factor for CCGTs is around 1800 EOH, while Southern zones have lower values, around 1000 EOH.

26-30

After the phase-out of coal-fired units, the residual demand rebounds but existing CCGTs suffer the competition brought by sustained import levels and new high-efficiency competitors entering with the Capacity Market support. In the Low scenario, residual demand is furtherly reduced by the energy efficiency effect on consumption and the greater renewable penetration. In the High scenario, the progressive increase of residual demand is due to improving switching conditions.

31-50

Existing CCGTs (53%-efficiency) stabilize around 2000 EOH. In the Low scenario, the great renewable penetration influences competitive dynamics and existing units remain close to 1600 EOH. In the High scenario, the improvement of switching conditions is hampered by the high level of imports from abroad, with EOH of existing units over 2000 favored by phase-out after 2035. High-efficiency units stabilize below the 4800 EOH only in the Low scenario.

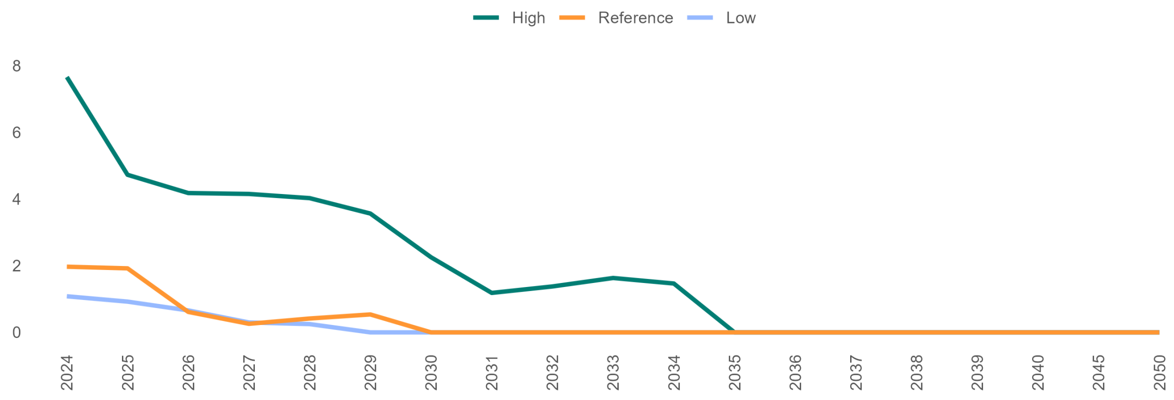
Main updates

CCGTs production varies in the scenarios according to the different hypotheses made for commodities, demand growth and the evolution of the thermoelectric installed capacity.

5.3.4 Coal-fired Production

THE PHASE-OUT OF COAL-FIRED THERMAL PLANTS IS EXPECTED IN 2025, A PART FROM THE SARDINIAN PLANTS THAT ARE GOING TO CLOSE IN 2029 IN THE REFERENCE SCENARIO, AS IN 2030 THE TYRRHENIAN LINK WILL BE FULLY COMPLETED

Coal-fired Production
TWh



Source: MBS Consulting elaborations

24-25

The decrease in the electricity demand and favorable switching conditions are leading to a reduction in the coal production, reaching 1.8 TWh in 2025 in the Reference Scenario. In the High Case Scenario, the share coal production will amount to 4.9 TWh in 2025.

26-30

Coal phase-out in the different scenarios depend on the functionality of the main grid infrastructure (Tyrrhenian link). In the Reference case only the units in Sardinia will continue to operate after 2025 until the Tyrrhenian Link is completed in 2030, while in 2028 in the Low scenario. HIn the high scenario coal-powered units may continue to operate until 2035.

31-50

Coal units remain operative only in the High scenario untill phase-out in 2035, with the entrance of the Tyrrhenian Link.

Main updates

Coal production varies in the scenarios according to the different hypotheses made for commodities, demand growth and the evolution of the thermoelectric installed capacity.

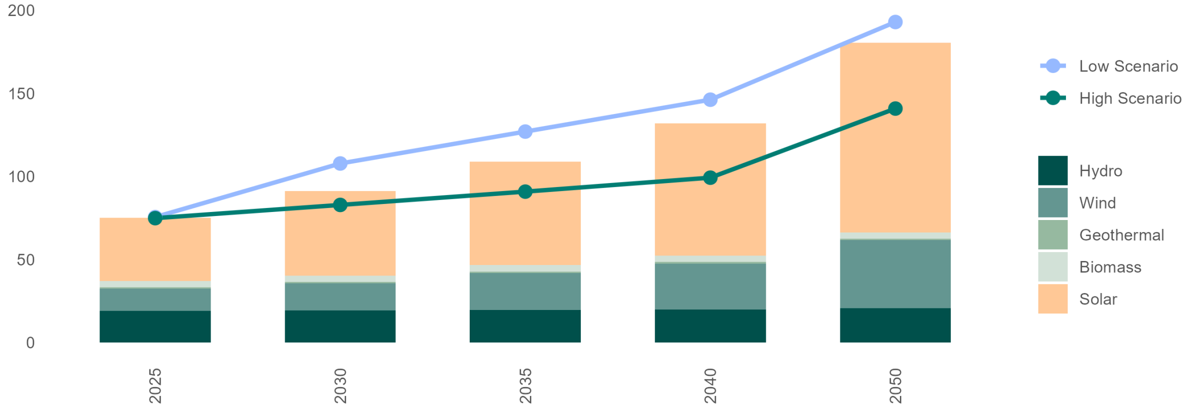
5.4 Reneweable Generation

5.4.1 Renewable Installed Capacity

THE ACCELERATION GROWTH OF RES CAPACITY OBSERVED IN THE LAST YEAR WILL CONTINUE IN THE SHORT-TERM. IN THE LONG-TERM, RES MARKET PARITY WILL CONSOLIDATE DRIVEN BY THE SURGE IN COMMODITIES PRICES AND DECARBONIZATION TARGETS

Net Renewable Installed Capacity

GW



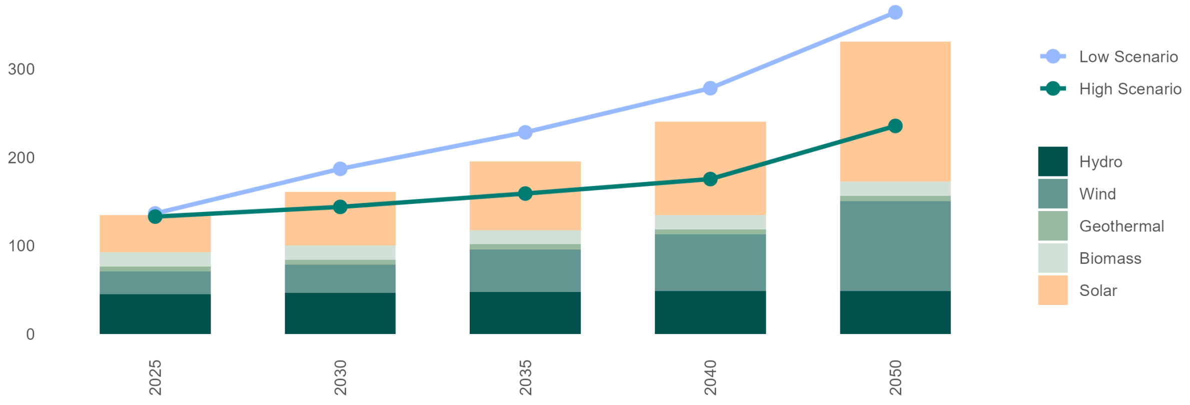
Source: MBS Consulting elaborations

24-27	By the end of the year, 36 GW of solar and 13 GW of wind capacity are expected to be operational. The potential for renewable energy development is assessed based on recent trends, considering both bureaucratic and technical obstacles. This analysis projects an increase of 6.5 GW in solar capacity and 1.5 GW in wind capacity between the end of 2024 and 2027. These estimates are aligned with the installation growth trends observed in recent years, driven by the completion of the authorization process, Fer 1 incentives, signed PPAs, and merchant projects.
27-30	Market parity conditions and FerX incentive scheme will accelerate long-term targets achievement. In the Reference case, there is an ambitious plan for the development of renewables with an estimated 50 GW of solar and 16 GW of wind capacity by 2030, allowing to reach almost 50% of the energy demand. This scenario assumes a market-driven evolution of the sector. Low scenario reach 63 GW of solar and 20 GW of wind capacity by 2030, achieved through a faster decrease in technology costs and more favorable economic conditions boosting investment in new RES capacity.
31-50	The Reference scenario predicts a continued increase in renewables penetration, with solar and wind capacity expected to reach 80 GW and 27 GW respectively, by 2040. A faster transition towards long-term decarbonization goals may be possible with greater-than-anticipated investments in grid infrastructure and high-capacity energy storage solutions. In this best case, more than 105 GW of total RES capacity within 2030, and 146 GW by 2040 might be achieved.
Main updates	The assumptions regarding renewable capacity have been updated in line with the latest available data and consistently with the TSO connection requests.

5.4.2 Renewable Production

THE ACHIEVEMENT OF THE NIECP TARGETS RELATED TO THE ELECTRICITY SECTOR REQUIRES A GREAT EFFORT: IN 2030 RES/GDC RATIO OF 50% COULD BE ACHIEVED ONLY WITH A STRONG ACCELERATION OF PROJECTS RECEIVING THE GREEN LIGHT IN THE NEXT YEARS AND INCENTIVIZED BY FER-X

Net Renewable Production
TWh



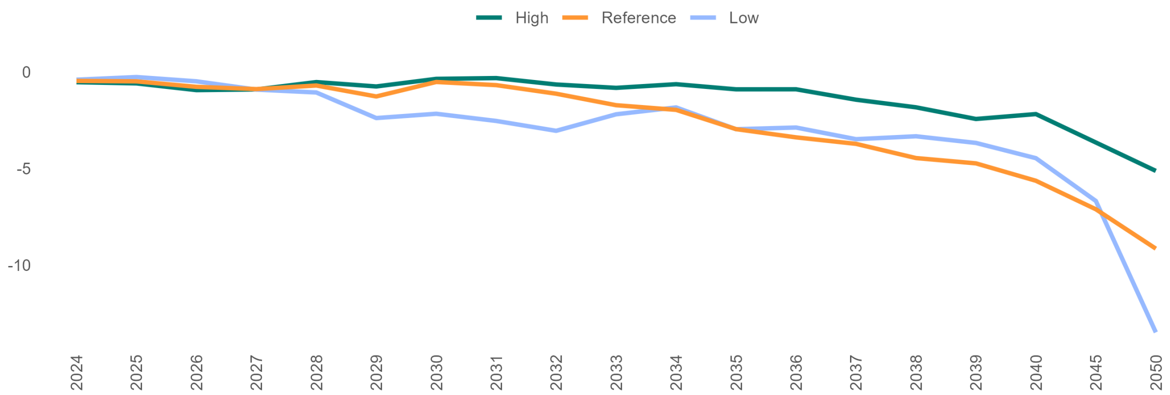
Source: MBS Consulting elaborations

24-25	In the next two years, solar and wind production are assumed to reach past 37 TWh and 42 TWh by 2025. In the Low scenario, instead, the greater amount of investments in decarbonization projects leads to achieve 49 TWh and 52 TWh in the same period.
26-30	Assuming a BAU evolution of the market and the elimination of perming process constraints in the next future, a 90% quota of the 2030 RES/GDC ratio target is expected to be achieved. Only a greener evolution of the Italian system is expected to be able to lead to the full achievement of the target (+55%). The achievement of Green Deal targets – possibly RES/GDC around 70%, yet to be defined – would surely require a greater effort instead.
31-50	The reduction of technology costs and consolidated market parity conditions could allow solar production to almost quadruple and wind generation to more than triple with respect to 2022 values in 2040 in the Reference scenario. Boundary conditions of alternative scenarios lead to different degrees of renewable development and production level.
Main updates	RES production are in line with capacity installation and technology performance.

5.4.3 Day-Ahead Market Overgeneration

OVERGENERATION COULD BECOME SIGNIFICANT IN THE LONG-TERM, FOLLOWING THE HIGH RENEWABLE PENETRATION IN THE ENERGY MIX, PARTICULARLY IN THE SOUTHERN ZONES. ENERGY INTENSIVE STORAGES DEVELOPMENT AND ELECTROLYSIS CAPACITY INCREASE COULD MITIGATE THE MARKET COUNTEREFFECTS

Day-Ahead Market Overgeneration
TWh



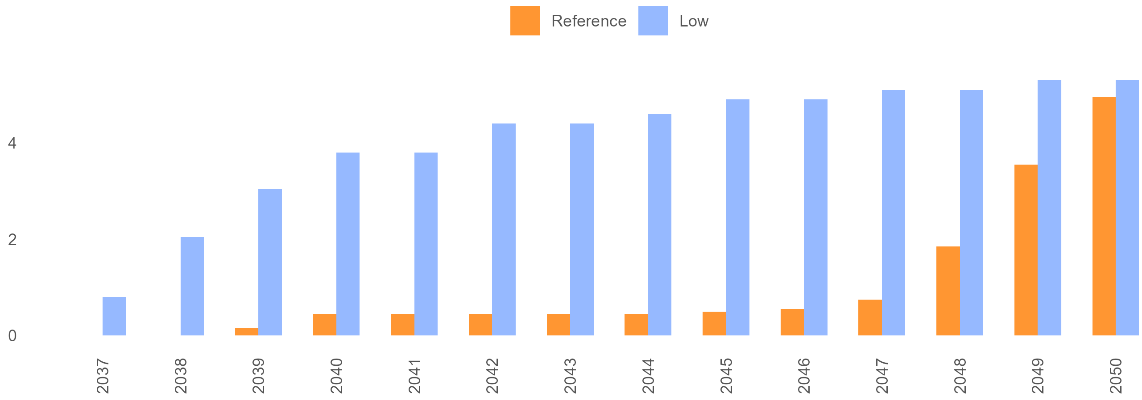
Source: MBS Consulting elaborations

24-25	BAU market conditions and moderate renewable penetration lead to a minimum risk of overgeneration in Reference and High scenario, while a more sustained increase in capacity installation in the south macro- zone could lead to higher overgeneration in some hours in the Low case scenario.
26-30	Greater penetration of renewable energy sources expected after 2027. Consequently, the possibility of overgeneration starting to increase could result in almost 2 TWh of excess electricity in the Low scenario by 2030. The curtailment effect may be emphasized in certain local grid conditions. Moreover, during this decade, overgeneration is likely to be exacerbated by the rapid development of renewable energy sources in the southern regions of the country and the lack of adequate grid reinforcement.
31-50	In order to effectively manage the growing penetration of renewable energy sources and the associated overgeneration phenomena, the 2030s will require significant investments in grid reinforcements and high- capacity energy storage solutions. These measures will be crucial for balancing the grid and ensuring stable energy supply, especially in regions that are particularly prone to overgeneration. This excess energy production could provide opportunities for the installation of electrolysis capacity, which would not only help to take advantage of excess energy production but also support ongoing investments in RES.
Main updates	Day-ahead market overgeneration updated according to new scenario hypothesis concerning RES installation and grid reinforcement.

5.4.4 Electrolyzer Installed Capacity

LONG-TERM RENEWABLE GROWTH IN SOUTHERN REGIONS WILL CAUSE EXCESS ENERGY, ESPECIALLY ON ISLANDS. GRID AND BESS DEVELOPMENT MAY NOT BE SUFFICIENT TO CONTAIN THE PHENOMENA, ELECTROLYSER MAY BE NEEDED. INSTALLED CAPACITY COULD REACH 0.5 GW IN REFERENCE AND 4 GW IN LOW SCENARIO, MAINLY IN SARDINIA AND SICILY

Electrolyzer Installed Capacity
GW



Source: MBS Consulting elaborations

35-40

In the long-term the development of renewable capacity, in particular in the southern zones, increase the presence of systematic overgeneration in the system, mainly in the islands. Grid investments and BESS are going to be insufficient to mitigate the problem, creating favorable conditions for green hydrogen, installed electrolysis capacity could reach almost 0.5 GW in the Reference scenario, concetrated in Sardinia. In the long-term, electrolysis capacity can effectively address overgeneration by providing a means to store excess renewable energy. Additionally, by increasing demand during periods of high RES production, it can help sustain prices and mitigate the cannibalization effect, particularly during the advanced transition phase.

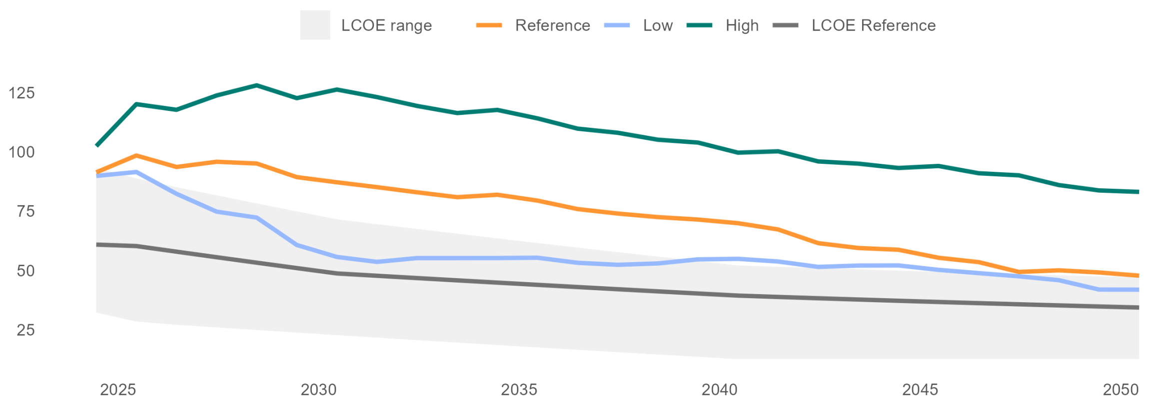
Main updates

Electrolysis capacity introduce in Reference and Low case scenario, considering Day-ahead market overgeneration update according to new scenario hypothesis concerning RES installation and grid reinforcement. Expected load factor at least between 1700 and 2000 equivalent hours. Commodities prices make green hydrogen competitive compared to grey.

5.4.5 Solar Market Parity

DESPITE THE REDUCTION IN COMMODITIES PRICES IS LOWERING ELECTRICITY PRICES, SOLAR PV CONTINUES TO BE COMPETITIVE, WITH CAPTURE RATES HIGHER THAN THE LIVELIZED COST OF ELECTRICITY

Fixed-tilt Solar PV LCOE Range and Captured PUN
€/MWh



Source: MBS Consulting elaborations

24-25

Even if some increase in technology costs has been observable in the last year, the solar energy sector continues to achieve market parity; as baseload prices are expected to settle above 100€/MWh during the 2024-2025 period, solar power plants are projected to capture rates that are significantly higher than the estimated levelized cost of electricity (LCOE) across all scenarios. This indicates a positive outlook for the solar energy industry, which is likely to remain competitive and profitable in the near future.

26-30

Despite the potential cannibalization effect on unlevered projects located in southern regions, market opportunities for merchant investments are expected to strengthen in the coming years.

31-50

The long-term outlook from 2030 on wards appears promising for the renewable energy sector, as the ongoing reduction in technology costs and the adoption of improved PPA best practices are expected to support non-incentivized investments. However, the cannibalization effect could become a significant factor in certain regions, such as Sardinia and Sicily, where the grid infrastructure may not be capable of efficiently redirecting energy flows.

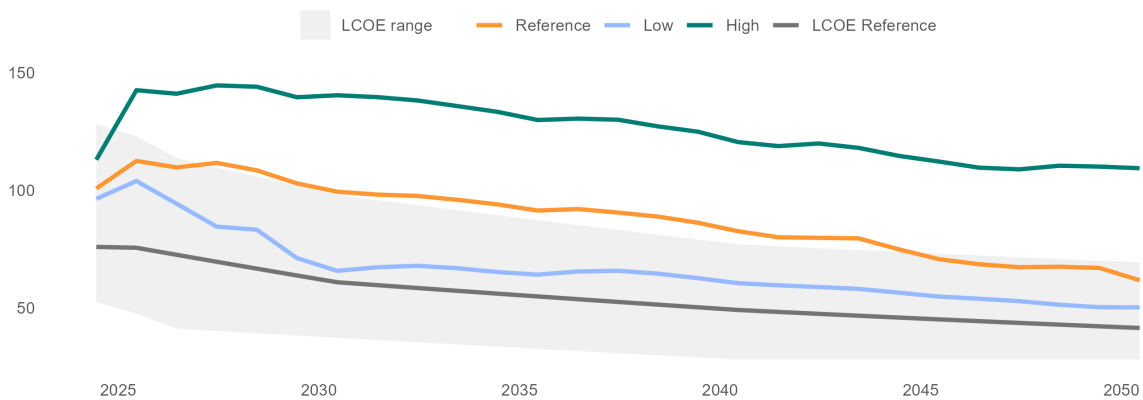
Main updates

Captured prices driven by the commodities prices dynamics. No development of tracker technology assumed in the High scenario until 2040. LCOE metrics: 30-year me horizon, full equity financing, discount factor 7%.

5.4.6 Wind Market Parity

DESPITE THE REDUCTION IN COMMODITIES PRICES IS LOWERING ELECTRICITY PRICES, WIND MARKET PARITY IS GUARANTEED BY CAPTURED PRICES HIGHER THAN THE LIVELIZED COST OF ELECTRICITY

Wind LCOE Range and Captured PUN
€/MWh



Source: MBS Consulting elaborations

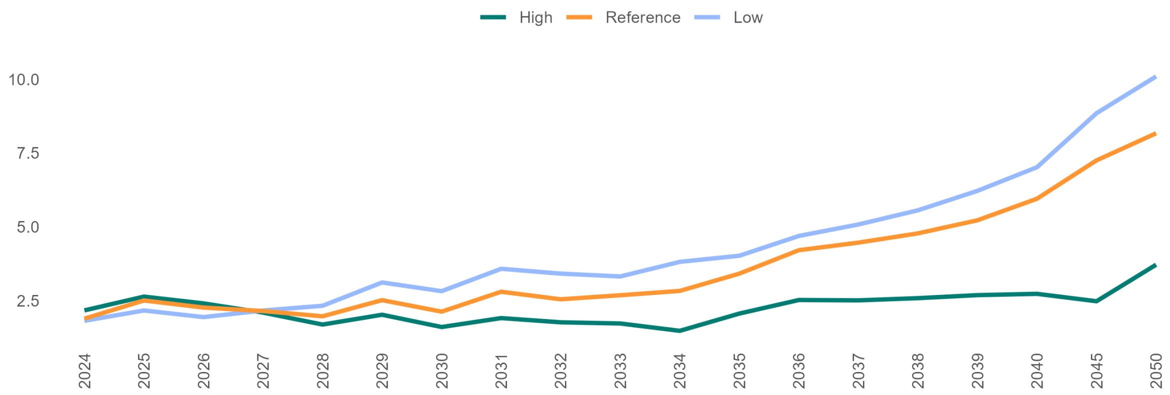
24-25	Wind market parity consolidates despite some increase in technology costs benefitting from the bullish trend of commodities that influence market prices. With yearly captured prices aligned to baseload prices, wind power plants are expected to achieve promising results, above the estimated levelized cost of electricity (LCOE) in all the scenarios.
26-30	Market opportunities for merchant investments are expected to consolidate, as wind assets do not suffer from cannibalization effects. Site-specific matters may however influence project economics.
31-50	Long-term perspectives from 2030 on wards are promising, following the continuous reduction of the cost of technologies and improved PPA best practices to support non-incentivized investments.
Main updates	Captured prices driven by the great surge in commodities prices. LCOE metrics: 35-year time horizon, full equity financing, discount factor 7%.

5.5 Storage

5.5.1 Pumped Hydro Production

DAY-AHEAD MARKET OPPORTUNITIES FOR PUMPED HYDRO POWER PLANTS CAN ARISE IN THE SHORT-TERM BECAUSE OF THE EFFECT OF VOLATILE PRICES, WILL MANIFEST IN THE LONG-TERM BECAUSE OF THE CONTINUOUS INCREASE OF NON-PROGRAMMABLE RENEWABLE PRODUCTION

Pumped Hydro Production
TWh



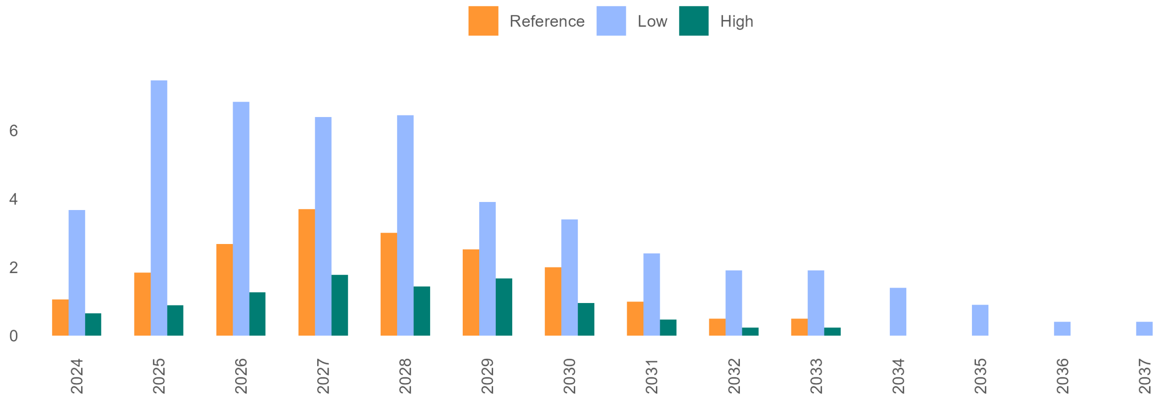
Source: MBS Consulting elaborations

24-25	Within-day price spreads on the DAM could disclose opportunities for pumped hydro units, although the Ancillary Services Market (especially the real-me balancing phase) is expected to continue to be their main source of revenues.
26-30	Renewables development gradually increases the opportunities on the DAM. An accelerated development compared to the expected BAU trajectory could lead pumped hydro production volumes to reach 3.5 TWh in the Low scenario.
31-50	With a penetration of non-programmable renewable sources above 50% of total electricity needs, market opportunities furtherly increase: pumped hydro units help mitigate the solar cannibalization effect and help contain network congestions.
Main updates	Pure pumped hydro capacity currently amounts to about 4 GW and is not assumed to increase further in the future.

5.5.2 Power Intensive Electrochemical Storage

POWER INTENSIVE ELECTROCHEMICAL STORAGES CAN BE IN THE MONEY IN THE MID TERM: REVENUES DERIVE MAINLY FROM ANCILLARY SERVICES MARKET PARTICIPATION AND SPECIFIC SERVICES SUPPLY, AND COULD BE FURTHERLY SUSTAINED BY THE CHANGES BROUGHT BY THE FUTURE MARKET DESIGN REFORM. IN THE LONG RUN INCREASE IN RES QUOTA AND MORE VOLATILE PRICES FAVOR CONVERSION TO ENERGY INTENSIVE STORAGE

Power Intensive Electrochemical Storage
GW



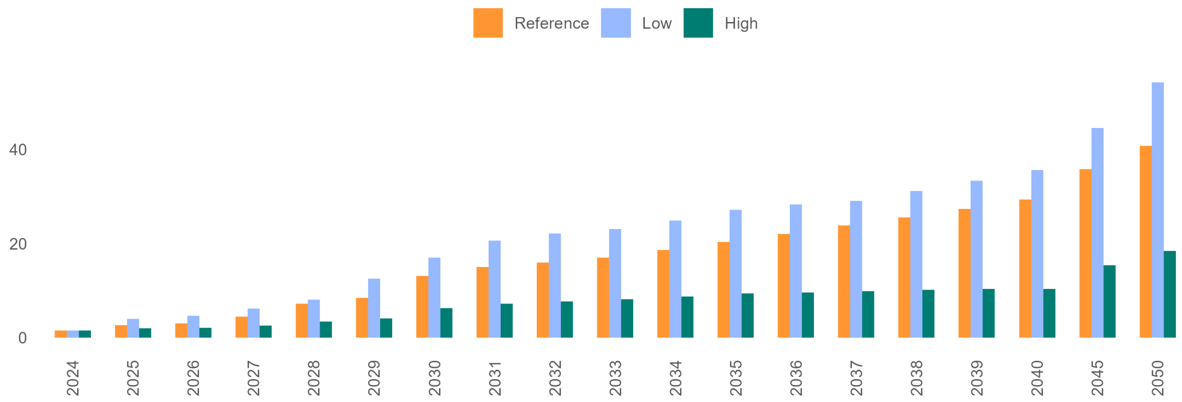
Source: MBS Consulting elaborations

24-25	The first BESS (Battery Energy Storage System) projects are expected to come online in 2023 following the results of the Fast Reserve auctions held in December 2020. The pilot project proposed by Terna is based on the supply of a specific ultra-fast frequency regulation service paid with a fixed yearly capacity remuneration and is the first experience of development electrochemical storages in the italian market.
26-30	PI storages (1 hour of storage capacity) penetration is sustained by growing needs on the BM as non-programmable renewable capacity progressively increases, in the first years. After reaching the peak in the mid 20s, power intensive gradually contract, due to opportunities for converting their units in energy intensive storage to capture the increase volatile dynamics on DAM. Increased overgeneration and contraction in ASM volumes reduce determine a gradual end in PI investments
31-50	Power intensive BESS capacity gradually disappear in the Reference and High scenario, progressively replaced by energy intensive BESS as they reach the end of the operational life, and remain available only in the Low scenario where higher RES capacity generate operativity signals on the ancillary service market.
Main updates	Power intensive storage updated taking in account ASM volumes dynamics and economic convenience.

5.5.3 Energy Intensive Electrochemical Storage

2024 CAPACITY MARKET AUCTION STARTED THE DEVELOPMENT OF ENERGY INTENSIVE STORAGES IN THE ITALIAN MARKET. LONG-TERM DEVELOPMENT OF SUCH KIND OF ASSET WILL BE KEY IN FOSTERING THE INTEGRATION OF RENEWABLES IN THE SYSTEM, WHEN THE GREAT SOLAR PENETRATION CREATES OPPORTUNITIES FOR TIME-SHIFTING APPLICATIONS ON THE DAY-AHEAD MARKET

Energy Intensive Electrochemical Storage
GW



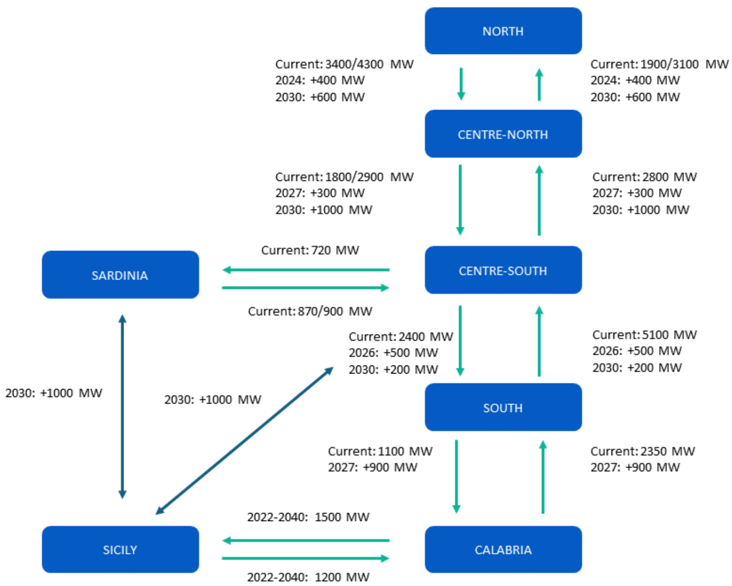
Source: MBS Consulting elaborations

24	2024 Capacity Market auction started the development of energy intensive storage in the Italian market, with more than 1.5 GW of new storage capacity – quite completely energy intensive (4 hours) – expected to hit the market by 2024 (possibly with some delays due to issue on the supply chain), with Sardinia and North to host about 0.8 GW and about 0.6 GW respectively.
25-30	The Day-Ahead Market presents promising market opportunities for merchant energy-intensive storage applications with a storage capacity of 4 hours. This is due to the increasing price spread volatility and the presence of overgeneration resulting from the development of renewable energy sources. Additionally, the gradual decrease in technology costs further enhances the attractiveness of energy-intensive investments.
31-50	Energy intensive applications reach an overall installed capacity of 22 GW in 2040. The larger installed capacity achieved in the Low scenario (near 31 GW in 2040) is consequence of greater opportunies both on the DAM and on the ASM.
Main updates	Energy intensive storage updated taking in account overgenertiaon dynamics and price volatility on the DAM.

6 Transmission Grid

6.1 Grid Reinforcements

IMPORTANT GRID REINFORCEMENTS TO BE REALIZED ALREADY IN THE MID 2020s BUT MAJOR IMPROVEMENTS ARE EXPECTED TO BE COMPLETED IN THE 2030s – TYRRHENIAN LINK AND ADRIATIC LINK. GREAT RES DEVELOPMENT GENERATE SIGNAL FOR FURTHER GRID REINFORCEMNTS AS INTER-ZONAL CONSTRAINT ARE NOT FULLY OVERCOM



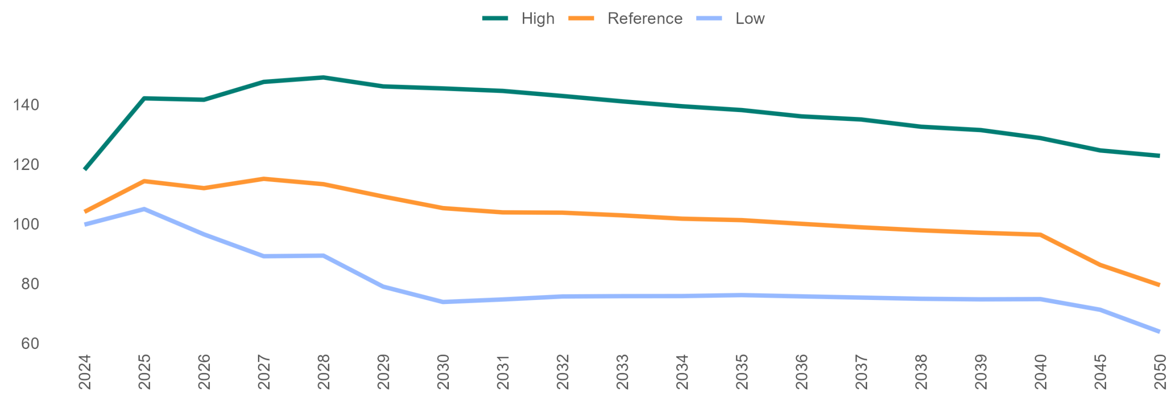
24-25	In all the scenarios proposed, network constraints are aligned with the most recent indications provided by Terna.
26-30	Grid reinforcements are anticipated to enhance grid flow management and alleviate inter-zonal congestions on the mainland. By 2030, two significant HVDC infrastructures are expected to become operational: the Tyrrhenian Link, crucial for phasing out Sardinian coal-fired units, and the Adriac Link, aimed at reducing bottlenecks between southern and northern regions. These infrastructures are projected to be introduced with some delay compared to the Terna-Arera timeline.
31-50	Under BAU assumption, a progressive reduction of inter-zonal constraints in the mainland is assumed to take place since 2035. In the Low scenario, the implementation of the 30 GW Hypergrid infrastructure proposed by Terna is considered. In the High scenario, instead, the long-term network development is more limited.
Main updates	BAU grid development hypotheses based on the latest Development Plan published by Terna (2023). Assumptions in the alternative scenarios are consistent with other boundary conditions.

7 Power Market Prices

7.1 Baseload PUN

MORE FAVORABLE ECONOMIC CONDITIONS LEAD TO A REDUCTION IN COMMODITIES LEVELS TRANSFERING TO ELECTRICITY PRICES IN THE SHORT-TERM. A GRADUAL STABILIZATION OF PRICES IS EXPECTED IN THE MID AND LONG-TERM, CONCURRENTLY WITH COMMODITIES, DEMAND, AND NET IMPORT STABILIZATION.

Baseload PUN
€/MWh



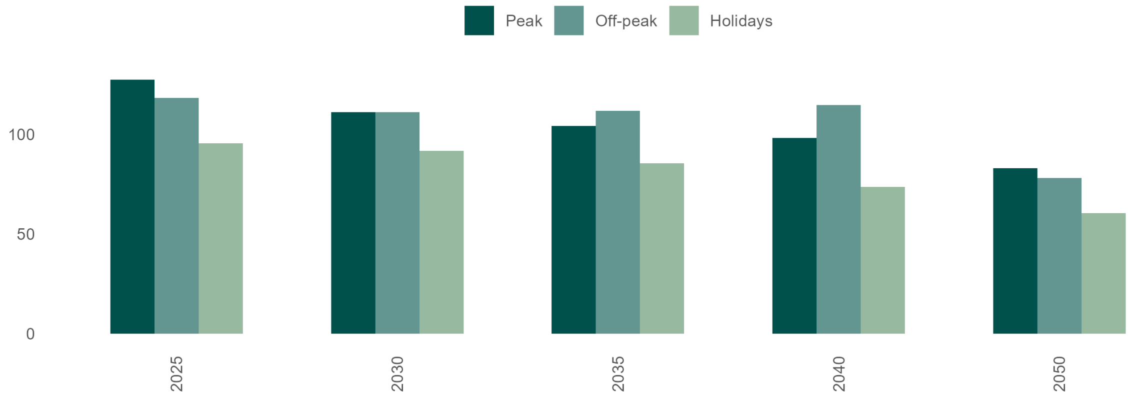
Source: MBS Consulting elaborations

24-25	In the Reference scenario, markets dynamics are expected to relax in the next two years, with gas market continuing to stabilize. In 2025, possible tensions in the gas market and recover in demand supporting the ETS mechanism should increase prices, averaging around 104 €/MWh. In a Low case scenario, more favorable economic conditions bring prices below 100 €/MWh.
26-30	In the later half of the 2020s, a gradual decline in commodities prices is expected due to the recovery of gas supply and economic growth. This decline, along with the increased development of RES, adoption of BESS technologies, and completion of crucial network infrastructure, is projected to bring prices below 110 €/MWh in the Reference case. A stronger focus on system decarbonization could even drive prices down to 75 €/MWh in the Low scenario.
31-50	In the long run, power prices are expected to be supported by ETS dynamics, with CCGTs being the marginal technology in the system for at least 85% of the me, causing the baseload PUN to largely reflect their average variable production costs. Depending on the level of decarbonization achieved in each scenario, the projected PUN range for 2040 is between 130-75 €/MWh.
Main updates	Downward revision of commodities levels determines reduction in power prices during the mid 2020s. Long-term price trends are in line with previous update.

7.1.1 Peak-Load/ Off-Peak PUN

RENEWABLES PENETRATION, LED BY SOLAR ENERGY, IS EXPECTED TO STRONGLY AFFECT PEAK / OFF-PEAK DYNAMICS AFTER 2030, WHEN THE INVERSION OF PRICE SPREADS BETWEEN TIME SLOTS IS EXPECTED TO OCCUR

Average PUN per Time Slots, Reference Scenario
€/MWh



Source: MBS Consulting elaborations

24-25 The positive price spread between evening and central hours of the day is expected to persist in the short- term, as renewables penetration remains under 40% of gross domestic consumptions.

26-30 Sustained solar development will sharpen the price decrease in the central hours of the day, especially in correspondence of large sunlight availability and low demand levels (e.g., during spring), gradually closing the gap between peak and off-peak prices.

31-50 The reverse trajectory of hourly price differentials is expected to continue in the long-term, favoring the increase of prices in off-peak hours. The growing penetration of energy intensive electrochemical BESS and the generally greater operativity of storage units could dampen the cannibalization effect produced by non- programmable solar power plants.

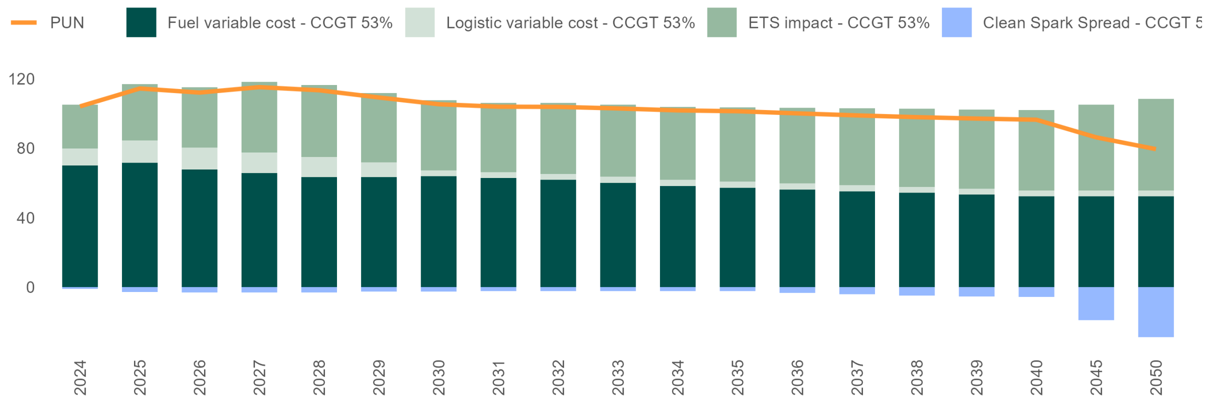
Main updates The evolution of the price for the different categories of hours is in line with the previous market update.

7.1.2 Baseload PUN Components, Reference Scenario

CONTRACTION IN ELECTRICITY DEMAND AND INCREASE IN NET IMPORT REDUCE CSS FOR EXISTING CCGTs IN THE SHORT-TERM. AFTER THE PHASE-OUT OF COAL-FIRED UNITS, THE CCS IS EXPECTED TO REMAIN CLOSE TO NULL, AS THE GROWING PENETRATION OF RENEWABLES AND THE CM-SUPPORTED NEWBUILDS AFFECT COMPETITIVE DYNAMICS

Baseload PUN Components, Reference Scenario

€/MWh



Source: MBS Consulting elaborations

24-25 The stabilization of commodities prices, high net import from foreign countries, and low recovery demand increase market competitiveness for CCGTs. As a result, negative CSS for thermal plants, around -3 €/MWh is foreseen.

26-30 In the second half of the 2020s, existing CCGTs will benefit from coal-fired units phase-out. This, coupled with electricity demand recovery, will increase baseload CSS. However, this benefit will be challenged by the slow decrease trend of imported flows, competition from CM new built and the growing trend of renewables.

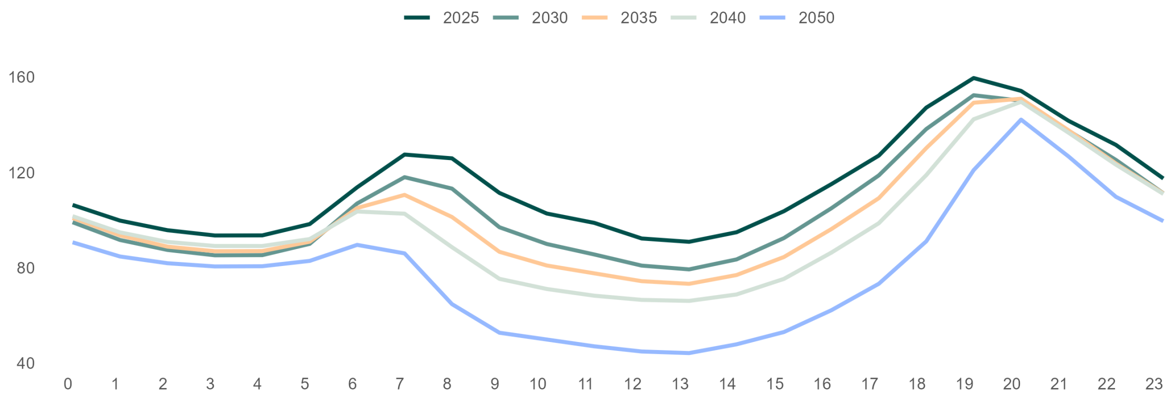
31-50 In the long-term, renewables are expected to dominate the generation mix. However, due to the decreasing trend of imported flows and increase in demand, existing CCGTs are favored and are expected to remain the marginal technology in the system for at least 85% of the hours.

Main updates The increase in net import from northern countries is the main driver of downward price variations in the short- and mid- term, compared to the previous scenario. Long-term price trends are in line with previous update.

7.1.3 PUN Hourly Storage

INCREASING SOLAR PENETRATION SIGNIFICANTLY IMPACTS PRICES DURING CENTRAL HOURS OF THE DAY AND EXACERBATES DAILY PRICE DIFFERENTIALS IN THE LONG-TERM. THE EFFECT IS PARTIALLY MITIGATED BY THE DEVELOPMENT OF STORAGE UNITS

Hourly PUN Shape
€/MWh



Source: MBS Consulting elaborations

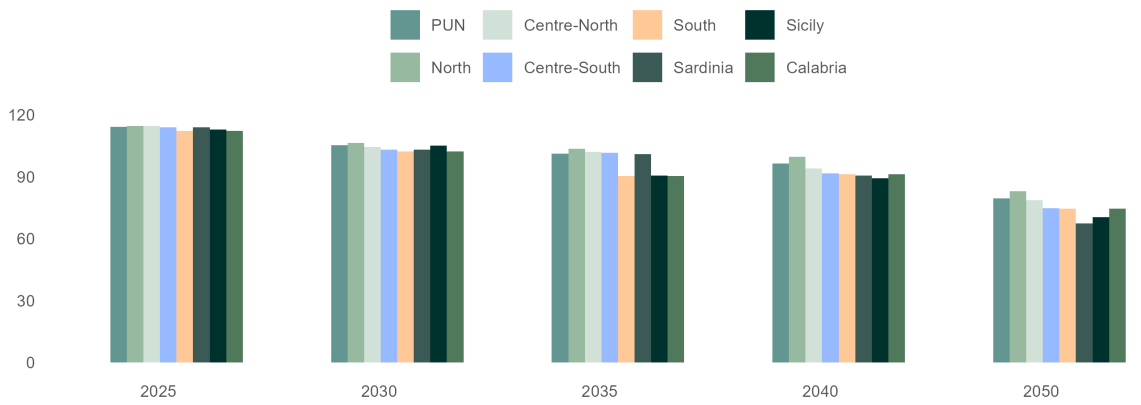
24-25	The effect of solar production during central hours of the day is still moderate as penetration remains limited. Price differentials during attain the day current average levels.
26-30	As solar penetration increases and the cannibalization effect intensifies, the spread between central and morning/evening peak hours increase. The development of single-axis tracker installations, grid reinforcements, and power intensive storages only partially contain such effect.
31-50	As within-day price differential and the number of hours in which prices reach 0 €/MWh increase, supporting investments in electrolysis capacity, time-shifting applications on the DAM become interesting and trigger new investments in energy intensive storage units.
Main updates	The PUN hourly shape is in line with the results of the previous update. Lower short- and mid-term absolute values incorporate the effects of updated commodities assumptions.

7.2 Baseload Zonal Prices

IN THE SHORT-TERM, ZONAL PRICES ARE EXPECTED TO DIVERGE DUE TO DIFFERENCES IN THE DEMAND-OFFER BALANCE BETWEEN ZONES. IN THE LONG-TERM, THE STRONG DEVELOPMENT OF RENEWABLE ENERGY SOURCES IN THE SOUTHERN MACRO-ZONE AND IMPROVEMENTS IN THE TRANSMISSION GRID WILL AVOID ZONAL PRICES SPREAD EXPLOITATION

Baseload Zonal Prices, Reference Scenario

€/MWh



Source: MBS Consulting elaborations

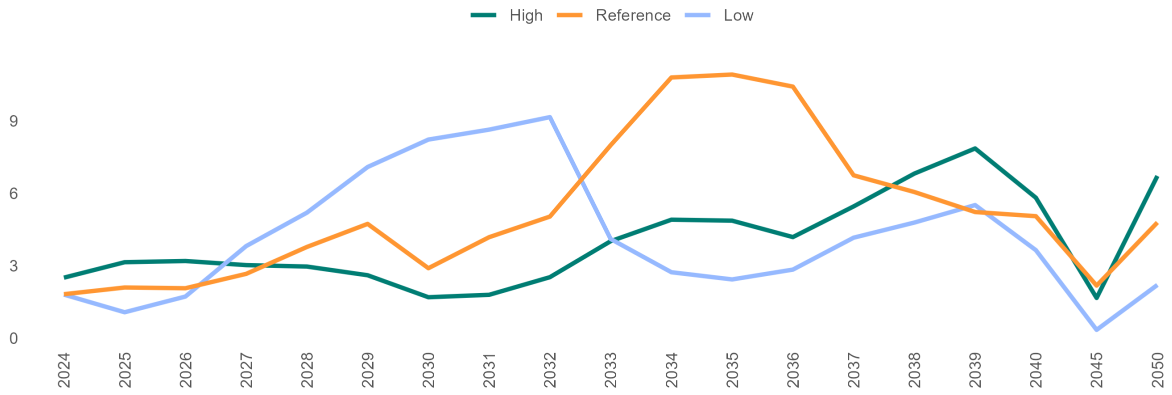
24-25	Network congestions are generally not a major issue on the mainland. Electricity demand still below the historical level and gradual growth of renewable generation result in lower prices in the southern regions, while higher CCGT operations in the northern zones lead to higher than PUN prices, consistent with recent historical trends.
26-30	Renewable penetration will increase the number of inter-zonal congestions until 2030, when the completion of the Adriatic Link is expected to partially contain the effect in the mainland and improve south-to-north energy exchanges. Nevertheless, a greater development of renewables energy sources in the southern zones is expected to gradually increase congestions occourence, favoring price separation.
31-50	Despite the realized grid improvements, bottlenecks are expected to occur anyway between northern and southern zones, leading to different prices levels between them in 2030s. Further grid reinforcements are assumed from 2035, with consequent minimization of inter-zonal congestion issues on the mainland, while criticalities remain evident in the islands.
Main updates	The dynamics of zonal prices are in line with the previous update.

7.3 Evolution of Baseload PUN-South Price Differential

THE EVOLUTION TREND OF THE SPREAD BETWEEN THE PUN PRICE – BASICALLY DRIVEN BY THE RESULTS OF THE NORTH MARKET ZONE – AND THE PRICE OF SOUTHERN MARKET ZONES STRONGLY DEPENDS ON THE ASSUMPTIONS RELATED TO RENEWABLES PENETRATION, STORAGE DEVELOPMENT, AND THE TIMING OF REALIZATION OF GRID INFRASTRUCTURES

Baseload PUN-South Price Differential

€/MWh



Source: MBS Consulting elaborations

24-25

The spread between PUN and southern market zones (here represented by the South zone) is expected to mantain recent historical levels in the short-term, with Soutern zone at discount. Dynamic driven by a general reduction in electricity demand and a growing share of RES in the generation mix, resulting in lower prices compared to Northern zones, where despite the increase in import flows CCGTs remain necessary to close demand fixing on average higher prices.

26-30

In the Reference and Low case integration of renewables technologies contributes to further widen the spread, notwithstanding network interventions. In the High scenario, the spread is reabsorbed as renewable development is more contained switching conditions for gas-fired units gradually improve until in 2030, when coal generation become less competitive compared to gas.

31-50

In the Reference case, the great penetration of renewables in southern regions widens back the spread in the first half of the 2030s, providing the market signal for new electrochemical BESS to enter the market and for new grid investment to be realized. In the Low scenario, the anticipated and greater development of storage and network investments helps reduce the spread instead. Continuos RES development widen again the spread in the second half of the 2030s.

Main updates

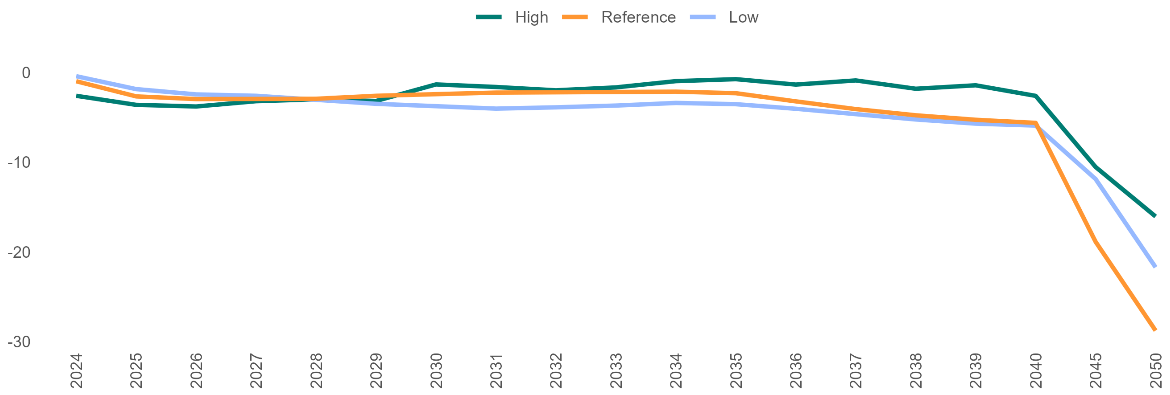
The evolution of the spread between the PUN and southern zonal prices depends on the assumptions related to renewables, storage, and grid developments.

7.4 Clean Spark Spread

7.4.1 Baseload CSS for Existing CCGT Units

BASELOAD CSS EXPECTED TO DECREASE IN THE SHORT-TERM AS HIGH IMPORT AND RES PENETRATION AFFECT CCGTS PRODUCTION. IN MID- AND LONG-TERM VALUES EXPECTED TO STABILIZE BETWEEN -1 AND 2 €/MWh RANGE. MISSING MONEY ISSUES LIKELY TO ARISE IN THE SECOND HALF OF THE 2020s AND TO BE AMPLIFIED IN ALTERNATIVE SCENARIOS

Baseload CSS for Existing CCGTs
€/MWh



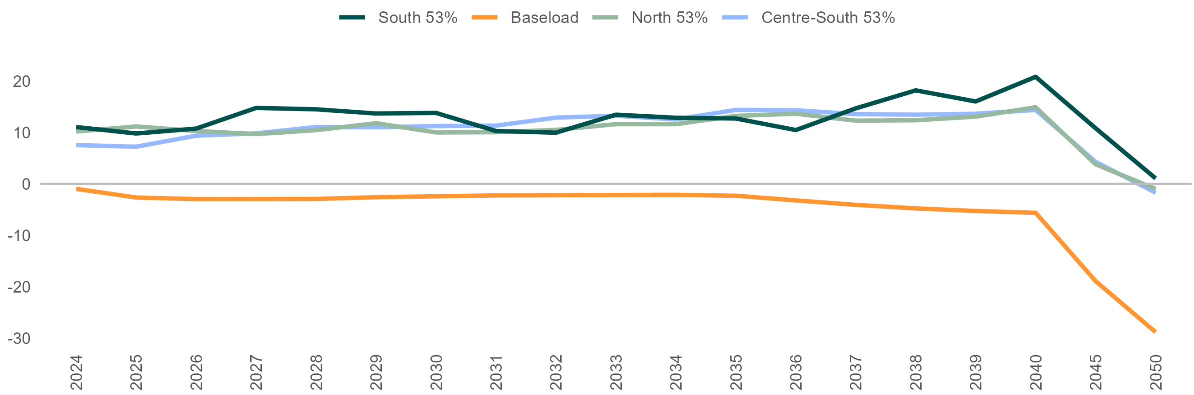
Source: MBS Consulting elaborations

24-25	Increase competition for the existing fleet brought by the expected energy outlook characterized by subdued electricity demand, greater share of RES and import in the energy mix affecting CSS for existing CCGTs, averaging -1.8 €/MWh between 2024-2025.
26-30	Market competition is expected to increase with the import flows stabilization from the northern borders, the rise in renewable capacity, and the entry of new high-efficiency CCGTs, which were acquired through Capacity Market auctions. These factors will keep the baseload CSS in negative territory. In the Low scenario, where renewable development is greater and the competition within the thermoelectric sector is stronger, this effect will be even more pronounced, with CSS averaging around -3 €/MWh.
31-50	After 2030, a significant decrease in net import flows and the exit of some ageing capacity allow existing CCGTs (53%-efficiency) to remain the marginal technology in the system for at least 85% of the hours, with the baseload CSS below -2 €/MWh for all the horizon. Greater renewable penetration in the Low scenario, maintain the baseload CSS below 4 €/MWh also in the long-term. In the High case scenario, reduced renewable development favor CCGT production increases baseload CSS, which remains below 1 €/MWh.
Main updates	CSS estimations are aligned with market dynamics.

7.4.2 Day-Ahead Market Profitability for CCGT Units

IN THE SHORT-TERM, EXISTING UNITS ARE EXPECTED TO SUFFER FROM WEAKER SWITCHING CONDITIONS, BUT THE GROWING PENETRATION OF SOLAR IS EXPECTED TO BOOST EVENING PRICE SPIKES IN THE MID- AND LONG-TERM. HIGH-EFFICIENCY UNITS TO MAXIMIZE DAM VOLUMES WHILE PRESERVING A DOUBLE DIGIT CAPTURED MARGINALITY

Captured CSS of CCGT Units, Reference Scenario
€/MWh



Source: MBS Consulting elaborations

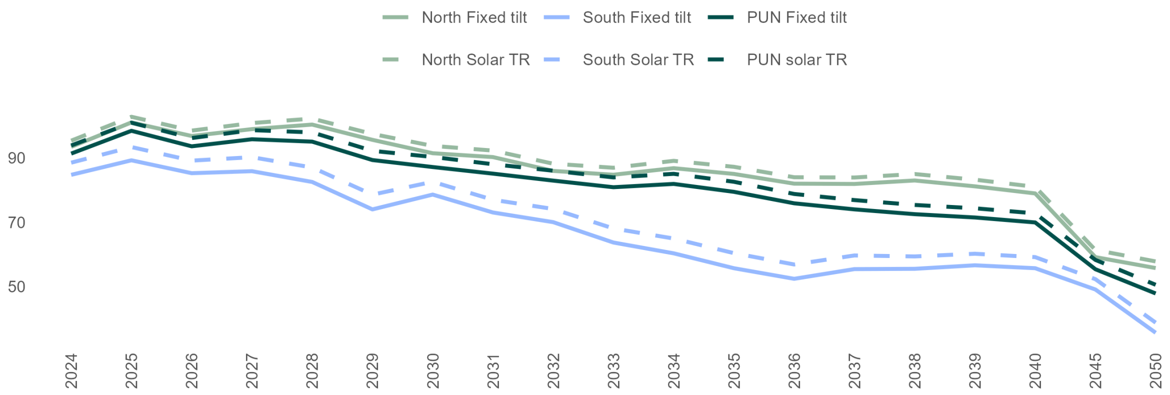
24-25	Captured CSS evolve depending on the zone mix, with southern bidding zones suffering the high operativity of coal-fired units and significant risk of operation at loss, while CCGT producing in the northern zone manage to guarantee positive margins at around 11 €/MWh , favored by the current market dynamics.
26-30	As renewable capacity increases, existing units tend to concentrate their operations during evening hours to maximize captured margins. The high-efficiency gas-fired capacity captured CSS is subject to competitive market conditions as new projects enter the market with support from the latest CM auction. Despite this, the high efficiency of these projects enables them to maintain an average captured margin of 10 €/MWh.
31-50	Growing renewable penetration intensifies overgeneration phenomena and accentuates evening price spikes, determining an increasing trend for captured marginality for existing units in the first half of the 2030s, but load factors reduce progressively on increasing renewables share and increase competition from high efficiency units.
Main updates	Expected load factor and marginality of CCGT units depend on updated hypothesis concerning commodity prices, market dynamics and new thermoelectric installed capacity.

7.5 Captured Prices of Renewable Sources

7.5.1 Solar Captured Prices

PROGRESSIVELY INCREASING CANNIBALIZATION EFFECT IS EVIDENT ON SOLAR PRICES FROM THE LATE 2020s, ESPECIALLY IN SOUTHERN MARKET ZONES, WHERE RENEWABLE PENETRATION IS GREATER AND INTERCONNECTION CAPACITY WITH NORTHERN ZONES IS LIMITED

Solar Captured Prices, Reference Scenario - detail of North and South market zones
€/MWh



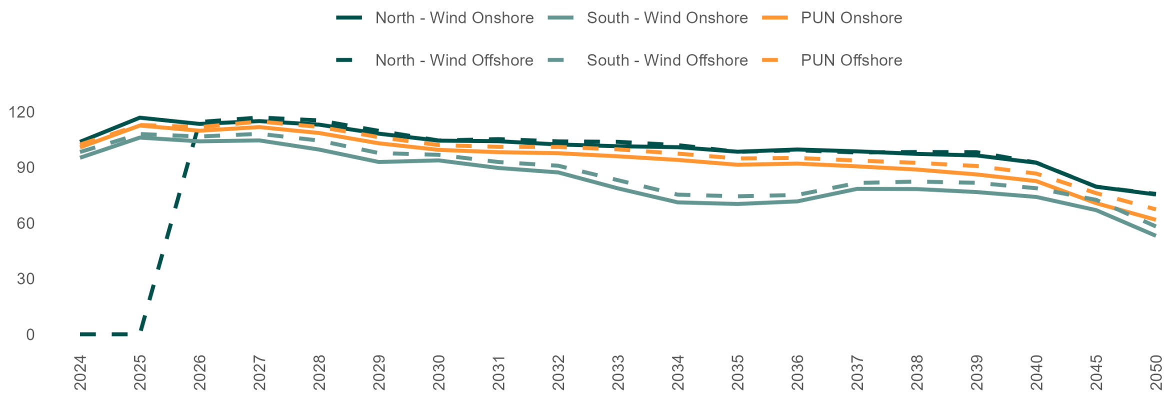
Source: MBS Consulting elaborations

24-25	Solar power plants benefit of power prices, with captured prices around 98€/MWh in the North zone, and 87 €/MWh in the Southern zones.
26-30	Increasing pace of installations and the consequent cannibalization and overgeneration effects – only partially limited by power intensive storages and grid developments – have an impact on zonal captured prices, which trend diverges compared to baseload prices, decreasing below 95 €/MWh also in the Northern zones.
31-50	The increasing occurrence of overgeneration serves as a market signal for the entry of energy-intensive storages, which partially mitigate the cannibalization phenomenon. After 2030, the cannibalization effect becomes more noticeable in the captured prices of solar energy, parcularly in southern market zones with higher renewable penetration, resulting in captured prices below 50 €/MWh in the long run.
Main updates	Short- results supported by the trend of commodities prices and their effect on power prices. Mid and long- term results are affected by the high degree of cannibalization effect.

7.5.2 Wind Captured Prices

WIND GENERATION IS LESS CONCENTRATED THAN SOLAR PRODUCTION AND ITS GREATER DISTRIBUTION OVER THE SEASONS AND THE HOURS OF THE DAY LEADS CAPTURED PRICES TO ALIGN WITH – OR EVEN OUTPERFORM – BASELOAD PRICES

Wind Captured Prices, Reference Scenario - detail of North and South market zones
€/MWh



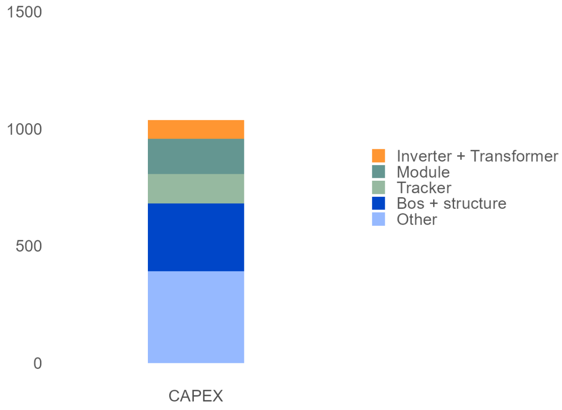
Source: MBS Consulting elaborations

24-25	Captured prices are aligned to zonal baseload prices and benefit from power prices, with captured price above 100€/MWh in all the zones.
26-50	Captured prices remain basically in line zonal baseload prices also in the long-term. The overgeneration induced by the growing solar production has a major impact in the early 2030s, but the results of both sources remain more connected to zonal market dynamics than to the evolution of the price shape. Also, both sources benefit from a production profile which is more distributed over the hours of the day and over the year.
Main updates	Short- results supported by the trend of commodities prices and their effect on power prices. Mid and long- term results are affected by the high degree of cannibalization effect.

7.5.3 Investment costs and IRR of Solar and Wind

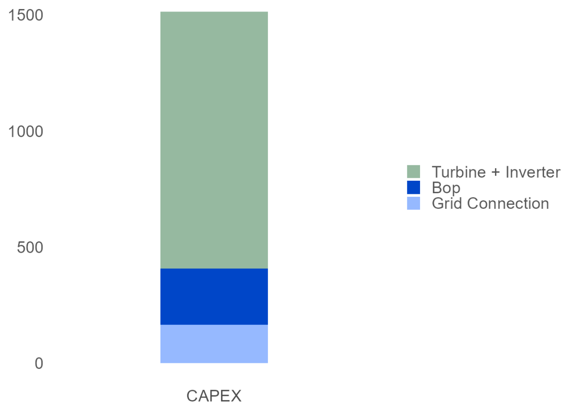
THE INTENSE COMPETITION IN THE PV MODULES MARKET DRIVES DOWN INVESTMENT COSTS FOR SOLAR IN THE MID AND LONG TERM, EVEN THOUGH GRID CONNECTION AND LAND COSTS MAY RISE. CONSEQUENTLY, THE IRR FOR PV INVESTMENTS IS EXPECTED TO STABILIZE AT AROUND 7%. TURBINES AND INVERTERS CONSTITUTE 75% OF WIND CAPEX, WHICH IS APPROXIMATELY €1.5 MILLION. AS THE COSTS OF WIND TECHNOLOGIES DECREASE, OVERALL CAPEX WILL REDUCE, LEADING TO A STABILIZATION OF THE IRR AT AROUND 7%

Capex Utility Scale Tracker
€/kW



Source: MBS Consulting elaborations

Capex Utility Scale Wind
€/kW



Source: MBS Consulting elaborations

Solar

The high competition in the PV modules market, predominantly led by Chinese manufacturers, has driven the costs of PV modules down to around €150,000 per MW. Nearly 30% of the total cost for a module is attributed to polysilicon, a relatively inexpensive but highly volatile material. Other critical materials with high demand and low availability, such as silver, could potentially increase the price of the technology in the future. Generally, due to market competitiveness, PV modules account for only 15% of the total solar CAPEX.

Two significant costs impact the total CAPEX for solar technologies. The cost of connecting to the grid, which varies greatly by project, is expected to rise in the coming years. This is due to the increasing number of projects in remote locations, complicating high-voltage grid connections. Additionally, the cost of land acquisition or rental, which constitutes nearly 8% of the total cost, has increased in recent years. The anticipated acceleration of new installations in the coming years may further drive up land demand for solar projects, as available sites diminish, thereby increasing rental costs.

Other residual costs, such as design, administration, internal development, engineering, mitigation works, and contingencies, are highly project-dependent and account for nearly 30% of the total solar CAPEX. This cost structure typically results in an IRR of around 7% (base case considering South zone, pre-tax captured prices, 30 years time horizon) for solar projects, with regional variations according to different zonal captured prices.

For agri-voltaic projects, a markup of 20%-40% on the total investment cost must be applied, leading to a lower expected IRR of around 6%.

Wind

The primary cost for a wind plant is the turbine and inverter, which account for 60% of the total cost. Grid connection represents 10% of the wind CAPEX, which is approximately €1.5 million for an onshore wind project. In the short and mid-term, technology costs are unlikely to decrease due to the low rate of new installations, which limits the potential for economies of scale. However, as the technology matures, particularly in Northern countries where installation rates are higher, there may be a reduction in technology costs. Despite this, the CAPEX for a wind project is expected to remain above €1 million until 2040. This cost structure typically results in an IRR of around 7% (base case considering South zone, pre-tax captured prices, 20 years time horizon) for onshore wind projects, with regional variations according to different zonal captured prices.

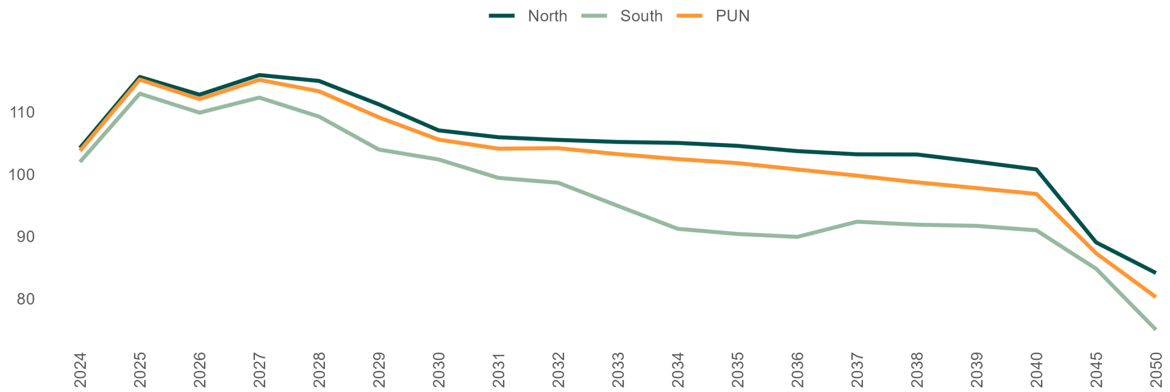
Main updates	Cost structure for solar and wind has been adjusted on the basis of current technologies' trends.

7.5.4 Hydro Run-of-River Captured Prices

HYDROPOWER GENERATION IS MORE SENSITIVE TO SEASONAL WATER INFLOWS TRENDS THAN TO HOURLY VARIABILITY, SO THAT CAPTURED PRICES REMAIN BASICALLY IN LINE WITH BASELOAD PRICES

Small-size, Run-of-river Hydro Captured Prices, Reference Scenario

Small-size, Run-of-river Hydro Captured Prices, Reference Scenario



Source: MBS Consulting elaborations

24-25	Captured prices are basically aligned to zonal baseload prices and benefit from high power prices.
26-50	Captured prices remain basically in line zonal baseload prices also in the long-term. The overgeneration induced by the growing solar production has a major impact in the early 2030s, but the results of both sources remain more connected to zonal market dynamics than to the evolution of the price shape. Also, both sources benefit from a production profile which is more distributed over the hours of the day and over the year.
Main updates	Short- results supported by the trend of commodities prices and their effect on power prices. Mid and long- term results are affected by the high degree of cannibalization effect.

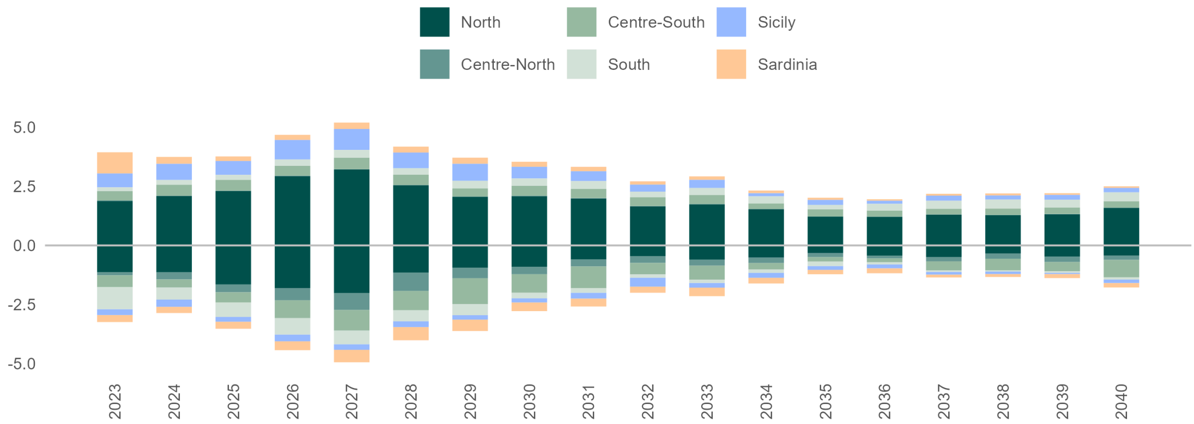
8 Ancilliary Services & Fuels Mix

8.1 Ancilliary Services Volumes, Reference Scenario

ANCILLARY SERVICES NEEDS ARE EXPECTED TO SHRINK IN THE FUTURE FOLLOWING THE MOST RECENT PAST, AS A CONSEQUENCE OF PECULIAR MARKET CONDITIONS AND CHANGES IN THE SYSTEM MANAGEMENT APPROACH ADOPTED BY THE TSO. IN THE LONG-TERM BESS AND GRID DEVELOPMENT CAN IMRPOVE THE ANCILLARY SERVICES MARKET

ASM Ex-ante Zonal Volumes, Reference Scenario

TWh



Source: MBS Consulting elaborations

24-25

Procured ex-ante ancillary services volumes are expected to partially recover from 2022, but remaining lower compared to the past as a consequence of (i) greater availability of thermoelectric running reserve due to reversed switching conditions, (ii) changes in the network management approach adopted by Terna since the beginning of the cost-containment incentive scheme (2022), (iii) feasibility intervals imposed to power plants in the new Intra-Day Market structure.

26-31

The exit of coal-fired units on the mainland and the progressive increase in the energy mix of renewable production are compensated by the entry of (i) new thermoelectric and energy intensive storage capacity sustained by the Capacity Market mechanism, and (ii) the diffusion of power intensive BESS that are going to reduce the need of ex ante scheduling, given the availability of flexible resources in the system.

31-50

ASM ex-ante volumes are expected to contract and then remain stable during the 2030s as consequence of a more efficient purchase, thanks to flexible resources and grid reinforcement. On the other side an increase of MB can be expected in line with the increasing volatility driven by the strong development of RES in the scenario, sustaining units operativity.

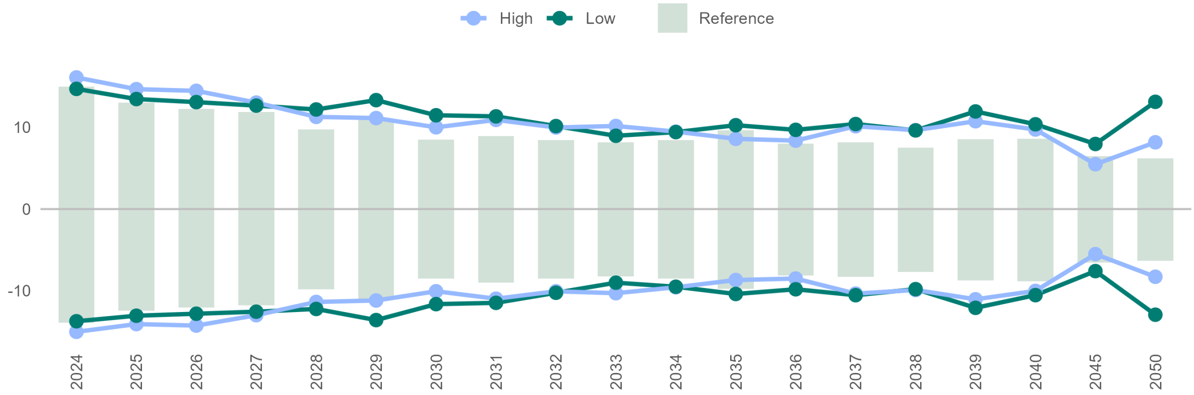
Main updates

ASM volumes incorporate the most recent trends – which are reckoned to be structural in the market – over the entire me horizon simulated. Upward and downward volumes resulting from our model are very symmetric due to the deterministic approach adopted in the simulations. The contingent portion of balancing market linked to real time imbalances are not included in the estimations.

8.2 Ancilliary Services Volumes, Alternative Scenario

ANCILLARY SERVICES EX-ANTE VOLUMES EVOLVE ACCORDING TO THE COMPOSITION OF THE GENERATION MIX AND DAM DYNAMICS IN THE DIFFERENT SCENARIOS. IN THE POST-2030 SCENARIO, STORAGE SYSTEMS AND GRID REINFORCEMENTS ARE EXPECTED TO LIMIT THE EXPANSION TREND IN THE THREE SCENARIOS

ASM Ex-ante Zonal Volumes, Alternative Scenario
TWh



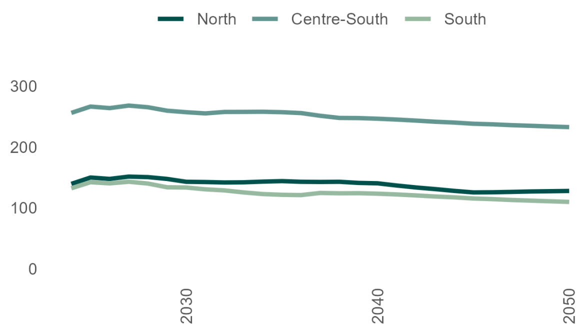
Source: MBS Consulting elaborations

24-25	Procured ex-ante ancillary services volumes are expected to remain low compared to the recent past also in the alternative scenarios, with some differences determined by the different degree of competition in the thermoelectric sector on the DAM – that translates into different levels of running reserve.
26-31	Rapid growth of non-programmable renewable generation in the Low scenario is counterbalanced by grid developments and a faster development of energy intensive storages. In the High scenario the development of less flexible resources increases the need to purchase more volumes on MSD.
31-50	In the Low scenario, further grid development and a major development of energy intensive storage assets help containing ASM volumes. In the High scenario instead ASM volumes remains stable, because of an increased presence of CCGT on the DAM and the of still active coal plants untill 2025, furthermore development of energy intensive storage allows to beer regulate the system.
Main updates	ASM volumes incorporate the most recent trends – which are reckoned to be structural in the market – over the entire me horizon simulated. Upward and downward volumes resulting from our model are very symmetric due to the deterministic approach adopted in the simulations. The contingent portion of balancing market linked to real me imbalances are not included in the estimate.

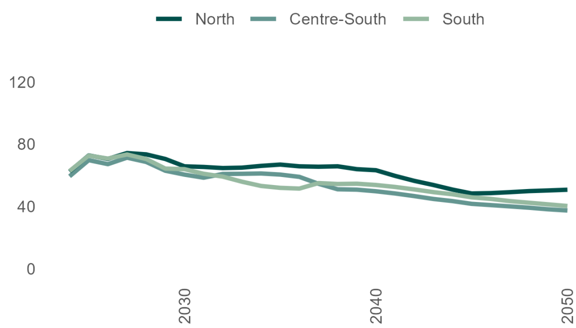
8.3 Ancilliary Services Market prices

GRID BOTTLENECKS RESOLUTION AND BESS PENETRATION ARE AMONG THE MAIN DRIVERS OF THE FUTURE ASM COMPETITIVE DYNAMICS. THE CAPACITY MARKET STRIKE PRICE (IN DELIVERY YEARS) COULD BECOME THE REFERENCE UPWARD PRICE, WITH MAJOR IMPACTS IN THE CENTRE-SOUTH MARKET ZONE

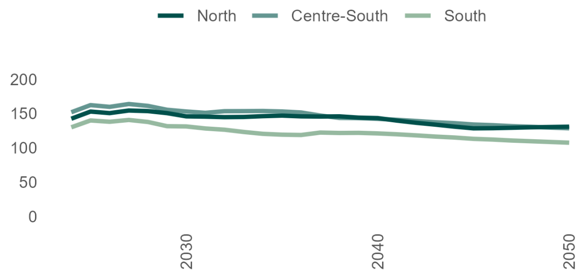
Start-up



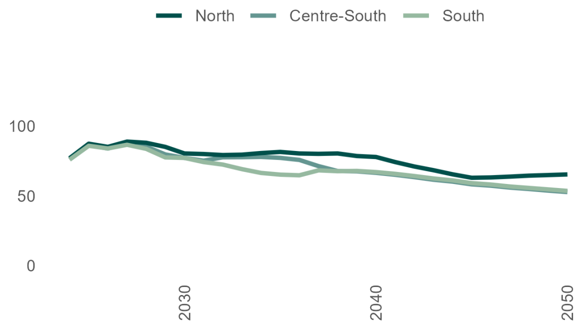
Shut-down



Upward regulation



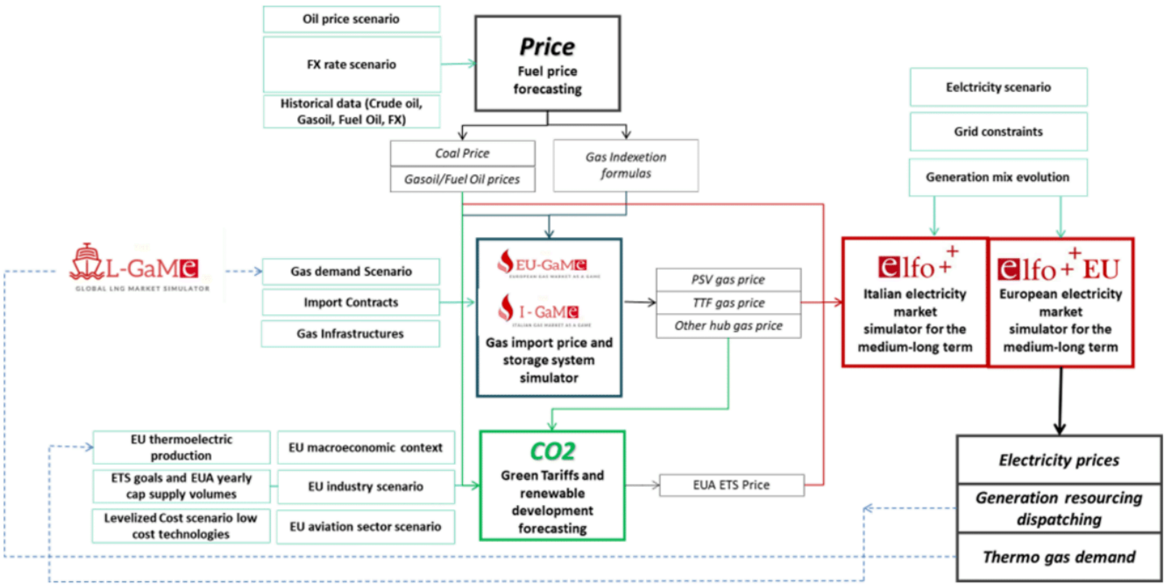
Downward regulation

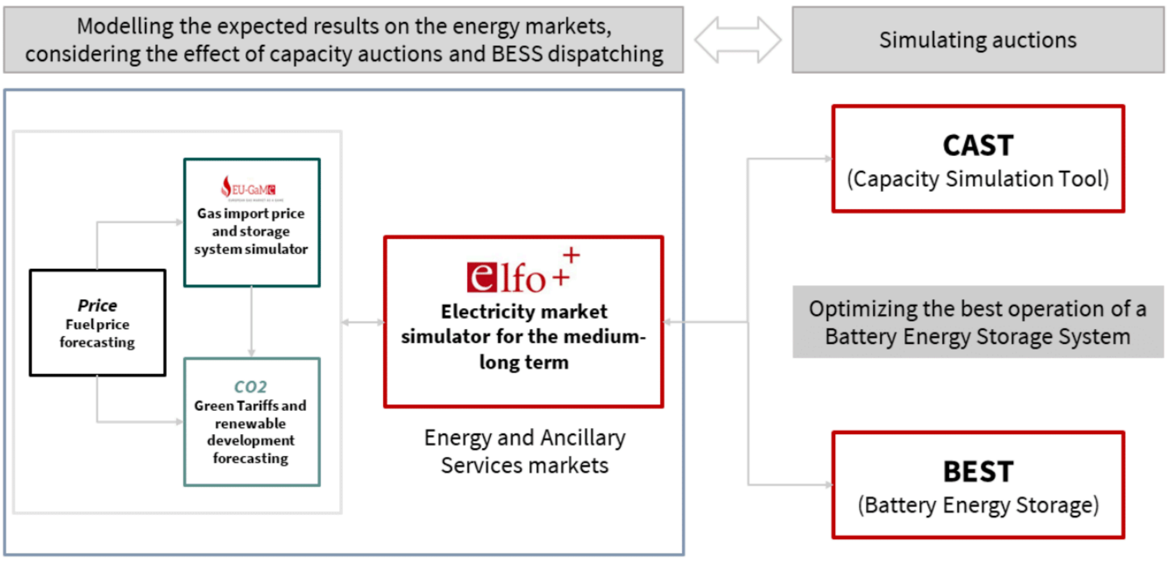


Source: MBS Consulting elaborations

24-25	During the first years of delivery of the Capacity Market, the strike price is expected to have a cap effect on prices for start-up and upward regulation, especially in the Centre-South market zone. However, the recent downward trend of ASM volumes could foster price competition all over Italy compared to past years.
26-50	Price competition on the ASM is expected to grow progressively as innovative technological solutions will be gradually available in the system at an increasingly competitive price (e.g., electrochemical storages). Under the hypothesis of an extension of the capacity remuneration mechanism, the strike price, together with the LCOS of batteries, could become the main factors influencing ancillary services prices in the future.
Main updates	Price projections are based on a statiscal approach describing the historical bidding strategies of market players on the ASM. Historical distribuotins of price spreads between DAM and ASM prices for each type of service are assumed constant in the future. Compared to the previous release, the new ASM price projections incorporate the effects of updated hypothesis determining DAM dynamics and prices.

9 Our Suite of Market Models





ELFO ++ suite has been included among the benchmark models for energy systems' planning in the World Bank database and it is included in the top list of electricity market simulation models prepared in 2017 by the Joint Research Center of European Commission. ELFO ++suite and its database are used for research acvities in numerous universities with which REF-E has a consolidated collaboration (Florence School of Regulation, University of Milan-Bicocca, Bocconi University, Milan Catholic, Milan Polytechnic, Turin Polytechnic, University of Pavia, University of Padua, University of Verona, others).

10 Acronyms

ACER	Agency for the Cooperation of Energy Regulators
AL	Adriatic Link
ARERA	Autorità di Regolazione per Energia Reti e Ambiente
ASM	Ancillary Services Market
BAU	Business-As-Usual
BESS	Battery Energy Storage System
BM	Balancing Market
CALA	Calabria, market zone of the Italian system
CCGT	Combined Cycle Gas Turbine
CDS	Clean Dark Spread
CM	Capacity Market
CNOR	Centre-North, market zone of the Italian system
CpC	Cost per Cycle (referred to BESS)
CRM	Capacity Remuneration Mechanism
CSS	Clean Spark Spread
CSUD	Centre-South, market zone of the Italian system
DAM	Day-Ahead Market
EC	European Commission
ECB	European Central Bank
EI	Energy Intensive (referred to BESS)
ETS	Emission Trading System
EV	Electric Vehicles
FED	Federal Reserve (US)
GCV	Gross Calorific Value
GDC	Gross Domestic Consumption
GDP	Gross Domestic Product
GHG	Green House gases
GME	Gestore dei Mercati Energetici
GSE	Gestore dei Sistema Energetico
GY	Gas Year
H&C	Heating and Cooling
HVDC	High Voltage Direct Current
IDM	Intraday Market
IMF	International Monetary Fund
IPEX	Italian Power Exchange
LNG	Liquefied Natural Gas
NDP	National Development Plan
NIECP	National Integrated Energy and Climate Plan
NORD	North, market zone of the Italian system
NRRP	National Recovery and Resilience Plan

OCGT	Open Cycle Gas Turbine
OECD	Organization for Economic Co-operation and Develpment
OTC	Over-the-counter
PdS	Piano di Sviluppo (Development Plan, Terna)
PEV	Pure Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
PI	Power Intensive (referred to BESS)
PSV	Punto di Scambio Virtuale
PUN	Prezzo Unico Nazionale
PV	Photovoltaic
RES	Renewable Energy Source(s)
RES-E	Electricity from Renewable Energy Source(s)
RIU	Reti Interne di Utenza
SARD	Sardinia, market zone of the Italian system
SEU	Sistemi Efficienti di Utenza
SICI	Sicily, market zone of the Italian system
STEG	Société Tunisienne de l'Electricité e du Gaz
SUD	South, market zone of the Italian system
TAP	Trans Adriatic Pipeline
TIDE	Testo Integrato del Dispacciamento Elettrico
TL	Tyrrhenian Link
TSO	Transmission System Operator
TTF	Title Transfer Facility
TYNDP	Ten-Year Network Development Plan
WACC	Weighted Average Cost of Capital

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