EU's climate targets and Italy's coal phase-out in the power sector

Investigating ambitions and implementation in practice

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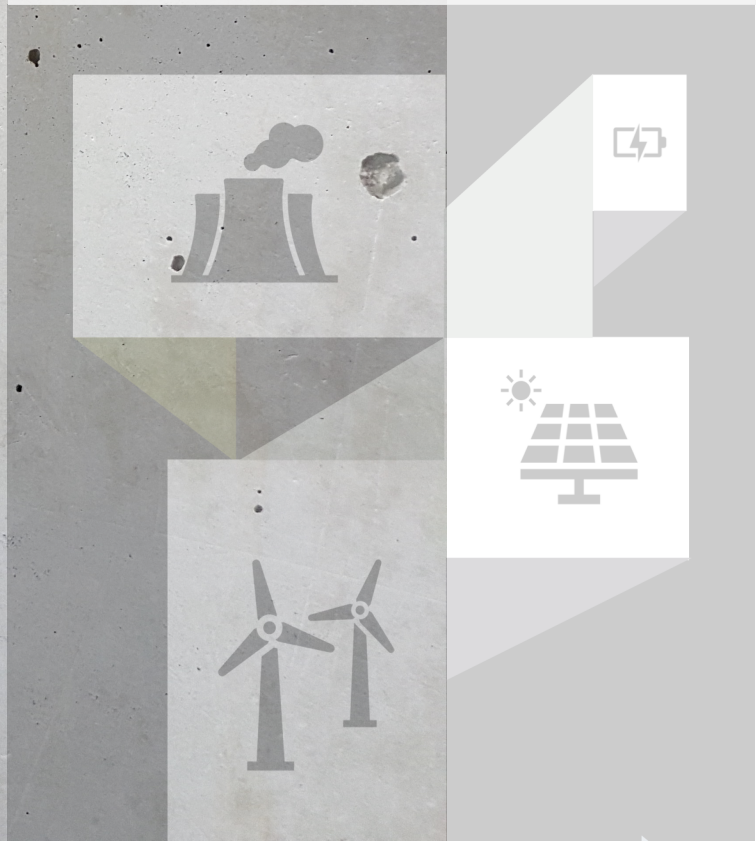

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Abstract: In 2017 Italy announced in its National Energy Strategy its commitment to phase-out coal in the power generation sector by the end of 2025. It included the commitment as part of its decarbonisation efforts in its National Energy and Climate Plan. Thus, the measure will be feeding into the strengthening of EU's 2030 greenhouse gas emissions reduction target, awaited in September 2020. It will also be feeding into the strengthening of EU's Intended National Determined Contribution to the Paris Agreement, awaited in 2021. This work takes stock of the coal phase-out implementation development and compares it with the coal phase-out implementation plan envisaged in Italy's National Energy Strategy and Italy's National Energy and Climate Plan. It emerged that investment delays, red tape, stagnating regulatory reforms, and resistance by some stakeholders are shifting the actual implementation away from what the Italian government defined it to be in the National Energy and Climate Plan, risking yielding a less incisive climate action.

Giuseppe Costanzo

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1. Introduction

This work explores how the implementation of Italy's phase-out of coal in the power generation sector by 2025 is evolving, and in particular, how aligned this is with the implementation initially intended by the central government. The importance of this is far from trivial. The 2018 Special Report of the Intergovernmental Panel on Climate Change (IPCC) alerted policymakers about significant differences of impacts between limiting the global average temperature increase at 1.5°C versus 2.0°C, vis-à-vis pre-industrial levels (IPCC 2018). In particular, the IPCC suggests the former desirable on the latter but that it will likely be reached as early as 2030 under the current global warming rate (IPCC 2018). To this end, while Italy's total greenhouse gas (GHG) emissions are rather modest when compared to the world's total GHG emissions, article 4.4 of the Paris Agreement states that "*Developed country Parties* [Italy being one of them] *should continue taking the lead by undertaking economy-wide absolute emission reduction targets"* (UN 2015: 4, text in square brackets added; Crippa et al. 2019). Moreover, Italy's commitment of phasing-out coal in power generation by 2025 feeds – through Italy's National Energy and Climate Plan – into the European Commission impact assessment of whether it is more beneficial to revise EU's 2030 GHG emissions reduction target from the current 40% to 50% or 55%, the outcome of which is expected in September 2020 (EC 2020a). This, in turn, will feed into the strengthening of EU's Intended Nationally Determined Contribution (INDC)[1], to be presented later in 2021 at the 26th Conference of the Parties (COP) in Glasgow (EC 2020a). These three aspects are further elaborated in the sub-sections below.

[1] INCDs detail how countries signatory of the Paris Agreement intend to contribute to limit the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels (World Resources Institute 2020).

1.1. The straightening of EU climate ambitions

1.1.1. The Paris Agreement

During the 21st COP held in Paris in 2015, world leaders committed to limit "*the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change"* (UN 2015: 3). The Latvian Presidency of the Council of the EU and the European Commission submitted the INDC of the EU and its Member States to the United Nations Framework Convention on Climate Change (UNFCCC) on March 2015; this contains a commitment to "*a binding target of a domestic reduction of at least 40% in greenhouse gas emissions by 2030 compared to 1990*" (CoEU and EC 2015: 1). The EU intends to achieve this goal through a 43% reduction of GHG emissions covered by the EU Emissions Trading System (ETS) Directive – which includes emissions from power generation – and a 30% reduction of GHG emissions covered by the EU Effort Sharing Regulation, both compared to 2005 levels (EC 2014).

1.1.2. The IPCC 2018 Special Report Global Warming of 1.5 °C

From the IPCC 2018 Special Report Global Warming of 1.5°C it emerged that, limiting the global average temperature increase to 2.0°C above pre-industrial levels, as opposed to 1.5°C, would entail far greater undesirable impacts (IPCC 2018). To name a couple, (i) "*there is high confidence that the probability of a sea ice-free Arctic Ocean during summer is substantially lower at global warming of 1.5°C when compared to 2°C. With 1.5°C of global warming, one sea ice-free Arctic summer is projected per century. This likelihood is increased to at least one per decade with 2°C global warming"*, and (ii) "*Coral reefs (…) are projected to decline by a further 70–90% at 1.5°C (high confidence) with larger losses (>99%) at 2°C (very high confidence)*" (IPCC 2018: 8).

To limit the global average temperature increase to 1.5°C, the emission model pathways of the IPCC Special Report indicate that the global net anthropogenic CO_2 emissions should reach net-zero by around 2050 (2045–2055 interquartile range) while non-CO_2 GHG emissions should reach net-zero by around 2070 (IPCC 2018). The IPCC Special Report indicates that, at the

current global warming rate, 1.5°C threshold is expected to be reached as early as 2030 (IPCC 2018).

1.1.3. The proposal for a European Climate Law

The proposal for a European Climate Law is a cornerstone element of the European Green Deal unveiled by the European Commission in 2019 (EC 2020a). The proposal aims at enshrining in EU law the achievement of climate neutrality by 2050 and, based on the outcome of an impact assessment currently ongoing, it wants to hike the 2030 EU GHG emissions reduction target to 50% or 55%, whichever is deemed preferable when also taking into consideration socio-economic aspects (EC 2020a). Achieving net-zero GHG emissions by 2050 was endorsed also by the European Parliament through the resolution of 14 March 2019[2] (EC 2020a). As for the stance of the EU Member States, during the European Council meeting held in December 2019, all 27 – including Italy – but one, committed to achieving climate neutrality by 2050 (EUCO 2019).

Citing the IPCC 2018 Special Report Global Warming of 1.5 °C in its Proposal for a European Climate Law, the European Commission states: "*This urgent challenge* [climate change] *calls for the EU to step up its action to show global leadership by becoming climate-neutral by 2050, covering all sectors of the economy and compensating, by 2050, not only any remaining* CO_2 *but also any other remaining greenhouse gas emissions*" (EC 2020a: 1, italics added).

Furthermore, according to what was stated in the European Climate Law proposal, "*by September 2020, the* [European] *Commission should, based on a comprehensive impact assessment and taking into account its analysis of the integrated national energy and climate plans submitted to the Commission (…), review the Union's 2030 target for climate and explore options for a new 2030 target of 50 to 55% emission reductions compared with 1990 levels"* (EC 2020a: 12).

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[2] European Parliament resolution of 14 March 2019 on climate change – a European strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy in accordance with the Paris Agreement (2019/2582(RSP)).

The European Parliament backed, through a resolution in 2019, an update of the current EU's INDC and to raise EU's GHG emissions reduction target for 2030 (EP 2019). Furthermore, the proposal for a European Climate Law has been referred to the European Parliament committee on Environment, Public Health and Food Safety, commonly referred to as ENVI committee (EP 2020). The ENVI committee draft report presented on 29 April 2020 would set more ambitious targets than the European Commission proposal, namely a 65% GHG emissions reduction target for 2030 instead the 50% or 55% suggested by the European Commission (EP 2020; EC 2020a). Additionally, it would require negative emissions from 2051 onward for both the EU as a whole and each member state (EP 2020).

At this stage, it remains unclear how a strengthening of GHG emissions reduction for 2030 would be redistributed across emissions covered under the EU ETS Directive and the EU Effort Sharing Regulation. However, should the current allocation criteria be maintained, the emissions covered under the EU ETS would need to be reduced by 52% in a 50% GHG emissions reduction scenario and by 57% in a 55% GHG emissions reduction scenario – up from the current 43% (Ferdinand 2019).

1.2. Italy's ambitions to phase-out coal

1.2.1. Italy's 2017 National Energy Strategy

Italy's coal phase-out from power generation was first announced through Italy's 2017 National Energy Strategy, which envisaged the gradual exit of 8 GW of coal-fired power generation to be replaced by a mixture of additional renewables, gas capacity, energy storage, and grid investments (MiSE and MATTM 2017). In particular: (i) 1.5 GW of new gas-fired capacity to be located in the North and North-Central areas; (ii) the construction of a new grid interconnection Sardinia-Continent or Sardinia-Sicily-mainland; (iii) the replacement of two coal-fired power plants in Sardinia with either 400 MW gas-fired capacity or 400 MW of storage capacity (MiSE and MATTM 2017). As for renewables, the strategy envisaged a 55% share in electricity consumption by 2030 (MiSE and MATTM 2017). These are illustrated in figure 1.

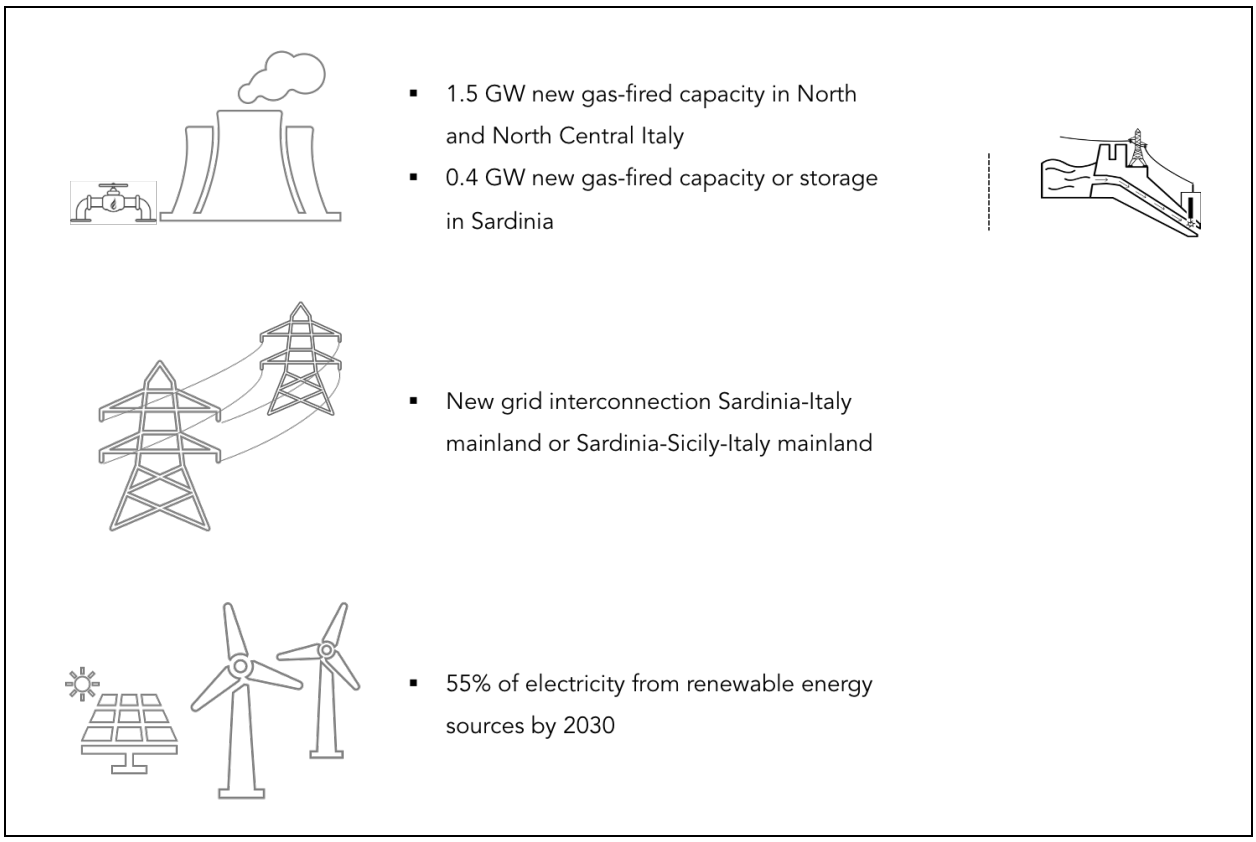


Figure 1: Investment deemed necessary by Italy's 2017 National Energy Strategy to pursuit a complete phase-out of coal in the power generation sector by 2025 (own figure)

1.2.2. Italy's National Energy and Climate Plan

National Energy and Climate Plans were introduced by the Regulation (EU)2018/1999 on the governance of the energy union and climate action (EC 2020b). They detail, among other things, how a given EU member state intends to address GHG emissions reduction (EC 2020b). National Energy and Climate Plans are made of a draft version and a final version, the latter of which must take due consideration of the feedback issued by the European Commission on the draft version (EC 2020b).

To this end, Italy predicts to achieve a 55.9% EU ETS emissions reduction by 2030, provided that the measures laid out in Italy's final National Energy Climate Plan ripple the awaited effects (MiSE 2019). One of the measures concurring to EU ETS emissions reduction will be the complete phase-out of Italy's 8 GW coal-fired power generation by 2025 (MiSE 2019). Italy's National

Energy Climate Plan content largely stems from Italy's 2017 National Energy strategy (European Commission 2019a).

However, the actual coal phase-out implementation appears to be shifting away from the implementation plan envisioned by Italy's 2017 National Energy Strategy and Italy's National Energy and Climate Plan which followed, potentially jeopardising the level of climate ambition while setting back Italy's and EU's decarbonisation objectives.

1.3. Research question

This work takes stock of the Italian developments of the energy transition away from coal, with an added focus on Sardinia. It does so by scrutinising official documents, to understand how aligned the implementation of the coal phase-out is with the actions deemed necessary by Italy's 2017 National Energy Strategy and Italy's National Energy and Climate Plan. Therefore, the following research question is asked:

> How aligned was the implementation of the coal phase-out in the power generation sector with the plans outlined by Italy's 2017 National Energy Strategy and Italy's National Energy and Climate Plan?

Furthermore, to steer the research question, the following sub-research questions are asked:

(i). What process led to and which stakeholders were involved in the decision of phasing-out coal as a fuel in the power sector by 2025?

(ii). To what extent have the measures deemed necessary to phase-out coal changed from Italy's 2017 National Energy Strategy to Italy's National Energy and Climate Plan?

(iii). What feedback did the European Commission issue on Italy's draft National Energy Climate Plan, vis-à-vis the coal phase-out, and how was it embedded in the final version?

(iv). Considering stakeholders at different levels of the governance, how have their actions contributed to altering the coal phase-out implementation envisioned in Italy's 2017 National Energy Strategy and Italy's National Energy and Climate Plan?

2. Theoretical background

This section introduces the theoretical framework premises that the author used to make sense of the world. In particular, this work looks at the actualisation of the implementation of measures (vis-à-vis the coal phase-out on the Italian power generation sector) aimed at managing GHG emissions to contribute, at the EU level, addressing climate change.

To this end, the author recognises the existence of what Beck refers as emergence of the risk society, in which transboundary issues such as climate change, among other things, are seen as phenomena unlikely to be successfully dealt by the classical, State-centred system of the industrial society, in place until the second world war (Arts and van Tatenhove 2005). Arts and Tatenhove (2005) claim that this has led to a decline in the centrality of the state as a political actor, and to an increasing role of politicisation within other spheres of society (Arts and van Tatenhove 2005). In this respect, the author also acknowledges the horizontal and vertical shifts in policy practices identified by Van Kersbergen and Van Waarden (2001). That is a shift from government to multi-actor or network governance, with actors entering the policy arenas and co-determining policy processes and outcomes (horizontal shift), and a shift from intergovernmentalism to transnationalism, supranationalism, and multi-level governance (vertical shift) (Arts and van Tatenhove 2005). The shift is therefore expected to be typical also of those States who are members of the EU, which, as a price of their membership to the EU, they surrender a portion of their respective sovereignty to the supranational arena, consisting of the European Commission, the European Parliament, and the European Court of Justice, while nevertheless maintaining a prominent role through the European Council and the Council of Ministers (Van Tatenhove et al. 2006). The governance of the EU, associated with multilevel governance, entails then a segmentation of the respective State of its members and a change of its role from authoritative allocation from above to the role of activator, involved in multilateral negotiations with the other member States and organisations representing different interests (Van Kersbergen and Van Waarden 2004). Therefore, these horizontal and vertical shifts suggest the encompassment of a much wider array of actors that get a seat at the public policy table. The new role of State, no longer the authoritative allocator from above, suggests it is now the

interjacent entity between the supranational level, tasked with devising a significant portion of the environmental and climate legislation, and the regional and local level, the recipient of the resulting implementation of said legislation. In being placed at the heart of potentially conflicting interests, e.g. dichotomy between the EU climate ambitions and the local communities' desire to preserve existing jobs, the State might be faced with new legislation implementation challenges.

3. Methodology

This section explains how the reminder of this work has been articulated.

In Chapter 4 the data is presented. At first, through the analysis of Italy's 2017 National Energy Strategy, an overview of the coal power sector in Italy is provided, together with how the decision of phasing-out this fuel from power generation by 2025 came about, including the procedure used and the stakeholders involved. Italy's 2017 National Energy Strategy was also used to identify the coal phase-out implementation plan envisaged by the central government, including key investments deemed necessary. Then, National Energy and Climate Plans are introduced, including their purpose and structure. It follows an analysis of Italy's draft National Energy and Climate Plan, to identify further evolution of the coal phase-out implementation plan of Italy's 2017 National Energy Strategy. The chapter continues with the identification of the recommendations from the European Commission to the envisioned implementation of the coal phase-out reported in Italy's draft National Energy and Climate Plan. Therefore, by confronting the draft and final versions of Italy's National Energy and Climate Plan the differences between the two are highlighted, which form the basis to evaluate in how far the commission's recommendations have been taken into due consideration. This concludes the overview of the evolution of the envisaged coal phase-out implementation plan by the central government.

To trace how the implementation of the coal phase-out has evolved in practice, a number of documents have been used. In particular, for what concerns the grid interconnection between Sardinia and Italy mainland, documents from Italy's Transmission System Operator (TSO) Terna – who oversees the project – have been used, namely the 2018 and 2020 Transmission Network Development Plan and the public consultation on the 2020 Transmission Network Development Plan. For what concern each of the coal-fired power plants, it was researched how the respective operator planned to phase them out as well as whether and how they plan to replace them. To do so, permitting documents for these plants have been researched on the Ministry of the Environment webpage dedicated to Integrated Environmental Authorisations and Environmental Impact Assessments.

In Chapter 5 the findings of Chapter 4 are discussed and completed with suggestions for policymakers together with limitations of this work.

Chapter 6 brings the work to an end with the conclusions.

4. From the 2017 coal phase-out announcement till today

This section gathers the data of this work that form the base of the discussion in the following chapter. It provides an overview of the evolution of the envisaged coal phase-out implementation plan by the central government and an overview of the actualisation to date of implementation in practice.

4.1. Italy's 2017 National Energy Strategy: coal phase-out announcement

On November 10, 2017, Italy adopted a new National Energy Strategy, known in Italian as Strategia Energetica Nazionale 2017 (MiSE 2017). The National Energy Strategy is a ten-year energy planning document drafted by the Ministry of Economic Development, also referred to as MiSE, and by the Ministry of Environment, Land and Sea Protection, also simply referred as Ministry of Environment (MATTM 2017). In particular, the 2017 National Energy Strategy defines energy policy scenarios to 2030, including an explicit commitment to phase-out coal as fuel from power generation by December 31, 2025 (MATTM 2017).

As of 2017, there was 8 GW of coal-fired power generation installed capacity unequally distributed across eight plants, reported in figure 2.

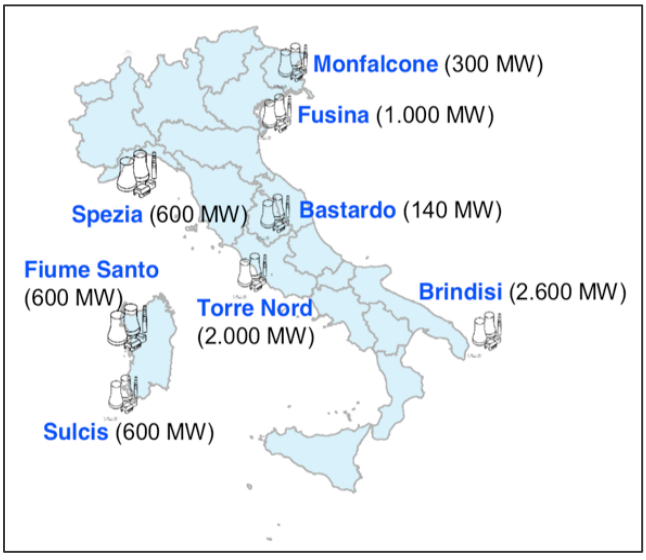
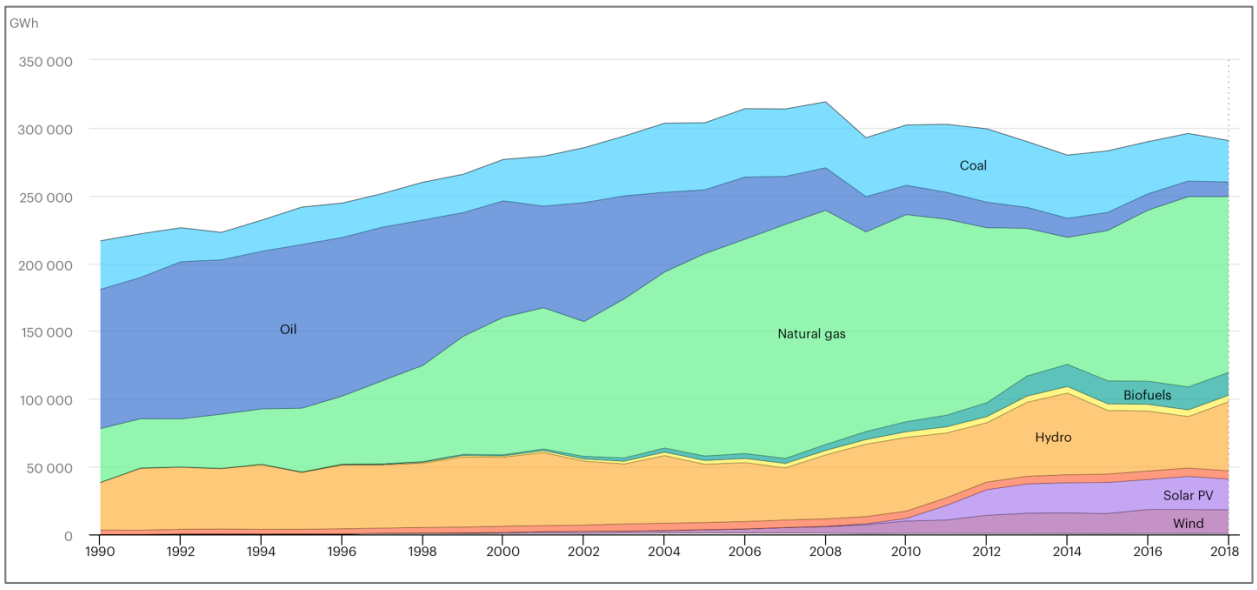


Figure 2: Installed coal generation capacity to be phased out by 2025 (Enel 2019a)

As of 2018, coal accounted for 35,096 GWh of domestically generated electricity, i.e. 11.9% of the total, shown in figure 3 (IEA 2020a).



Source		Coal	Oil	Natural gas	Biofuels	Waste	Hydro	Geothermal	Solar PV	Wind	Other	Total
Generation	(GWh)	35,096	11,527	140,349	16,995	4,857	38,025	6,201	24,378	17,742	661	295,831
	(%)	11.9%	3.9%	47.4%	5.7%	1.6%	12.9%	2.1%	8.2%	6.0%	0.2%	100.0%

Figure 3: Electricity generation by source (GWh), Italy 1990-2018 (adapted from IEA 2020a)

Six of the eight plants (namely those located in Bastardo, Brindisi, Fusina, La Spezia, Portoscuso, and Civitavecchia) are owned by Enel Group, an Italian multinational energy company operating in the sectors of electricity generation and distribution, as well as in the distribution of natural gas (Enel 2019b). Enel held the Italian monopoly of power generation, transmission, and distribution but it lost that position as a consequence of the introduction of so-called unbundling requirements through the EU first directive on electricity and gas in 1996, transposed in the Italian legal system in 1999 (OJEU 1996; Gazzetta Ufficiale 1999).

The coal-fired installed capacity in the location of Monfalcone is owned by the A2A Group, an Italian multi-utility (A2A 2020a). The remaining coal-fired capacity installed in the location of Fiume Santo is part of EP Produzione, an Italian branch of the Czech energy group EPH (EP Produzione 2020a).

4.1.1. The planning of the coal phase-out in Italy's 2017 National Energy Strategy

For the realization of Italy's 2017 National Energy Strategy public bodies in the field of energy, operators of the electricity and gas transport networks, and experts in the energy sector were involved (MATTM 2017). In a preliminary phase, hearings and meetings were also held with parliamentary groups, state administrations, and regions (MATTM 2017). The resulting proposal was then put to public consultation, receiving over 250 inputs from associations, companies, public bodies, citizens, and academics (MATTM 2017).

The public consultation proposed three coal phase-out scenarios implementable over two distinct time horizons, namely either by 2025 or by 2030 (MiSE and MATTM 2017). The three scenarios considered were (i) the inertial scenario, (ii) the partial scenario, and (iii) the complete scenario (MiSE and MATTM 2017). The inertial scenario entailed a phase-out of coal-fired capacity as it gradually reached its natural end-of-life (MiSE and MATTM 2017). Taking into consideration the aforementioned time horizons, this would have led to the decommissioning of 2 GW coal-fired capacity (MiSE and MATTM 2017). The partial scenario entailed that the coal-fired capacity installed in the locations of Portoscuso and Fiume Santo (Sardinia) together with that installed in Civitavecchia (Italy mainland) would remain in service, while the remainder 5 GW capacity would be phase-out (MiSE and MATTM 2017). The complete scenario entailed the phase-out of the entire productive coal-fired capacity, for a total of 8 GW (MiSE and MATTM 2017). The outcome of the consultation was largely in favour of the complete scenario to be implemented by 2025, which was later reflected in Italy's 2017 National Energy Strategy (MiSE and MATTM 2017). A summary of the three scenarios is reported in table 1 below.

Table 1: Scenarios considered for the coal power generation phase out (own table)

Scenario considered	Scenario features
Inertial	Phase out of 2 GW of coal-fired capacity by 2025 or 2030
Partial	Phase out of 5 GW of coal-fired capacity by 2025 or 2030
Complete	Phase out of 8 GW of coal-fired capacity by 2025 or 2030.

4.1.2. Italy's 2017 National Energy Strategy: the coal phase-out action plan

Italy's 2017 National Energy Strategy states that replacing the coal-fired capacity only with renewable capacity by 2025 "*does not seem to have demonstrated feasibility from a technical and management point of view, in particular for adequacy*[3] *purposes*" (MiSE and MATTM 2017, translated). Instead, it envisages a mixture of additional renewables, new gas-fired capacity, and energy storage (MiSE and MATTM 2017). In particular: (i) 1.5 GW of new gas-fired capacity to be located in the North and North-Central areas, of which at least 50% Open Cycle Gas Turbines; (ii) the construction of a new grid interconnection Sardinia-Continent or Sardinia-Sicily-mainland; (iii) the replacement of two coal-fired power plants in Sardinia with either 400 MW gas-fired capacity powered by natural gas from new liquified natural gas (LNG) terminals or, alternatively, 400 MW of storage capacity (MiSE and MATTM 2017). As for renewables, the strategy envisaged a 55% share in electricity consumption by 2030 (MiSE and MATTM 2017). Further network infrastructures investments are highlighted as being directly necessary; in particular: (i) the reinforcement of the network in the Brindisi hub; (ii) the new Adriatic electricity grid for 1.2 GW; and (iii) storage systems for 3.0 GW, in particular, located in the South and Sicily area (MiSE and MATTM 2017). The evolution of these further network infrastructure is not the main focus of the remainder of this work; however, they are reported in table 2 below.

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[3] Italy's TSO Terna describes adequacy of the electrical system as follows: "*The electricity system is considered adequate if it is equipped with production, storage, demand control, and transport capacity sufficient to meet expected demand, with a margin of adequacy in any given period.*

The adequacy of an electrical system therefore measures the ability to satisfy the load at all times, taking into consideration the fluctuations in demand, the potential unavailability of thermo-electrical systems, the uncertainty that characterizes the producibility of non-programmable renewables systems as well as, in the medium/long term, the possible construction of new capacity or divestment of existing capacity and/or an increased transport capacity between areas of the relevant network. Each of these elements can be associated with a certain level of uncertainty, which is greater the more you move towards longer-term time horizons" (TERNA 2020a: 120).

Table 2: Infrastructure investment deemed necessary by Italy's 2017 National Energy Strategy to pursuit a complete phase-out of coal in the power generation sector by 2025 (own table)

Field	Type of infrastructure
Gas-fired power capacity	▪ 1.5 GW new gas capacity in North-Central North areas; ▪ 0.4 GW new gas capacity in Sardinia split over two plants ▪ LNG terminals in Sardinia
(Renewables)	▪ Increase to 55% of renewable RES in the electricity sector by 2030
Electricity grid	▪ Interconnection Sardinia-Sicily-Italy mainland ▪ Adriatic electricity grid for 1.2 GW ▪ 3.0 GW storage, especially in the South and Sicily area

For completeness, it is worth recalling that the island of Sardinia is connected to the Italian national transmission grid via two submarine cables, namely the so-called SACOI 2 (soon to be replaced by the SACOI 3 as it is nearing the end of its useful life) and the SAPEI cable (MiSE et al. 2018). The planned Sardinia-Sicily-Italy mainland interconnection, the SACOI 3, and the SAPEI are illustrated in figure 4 below.

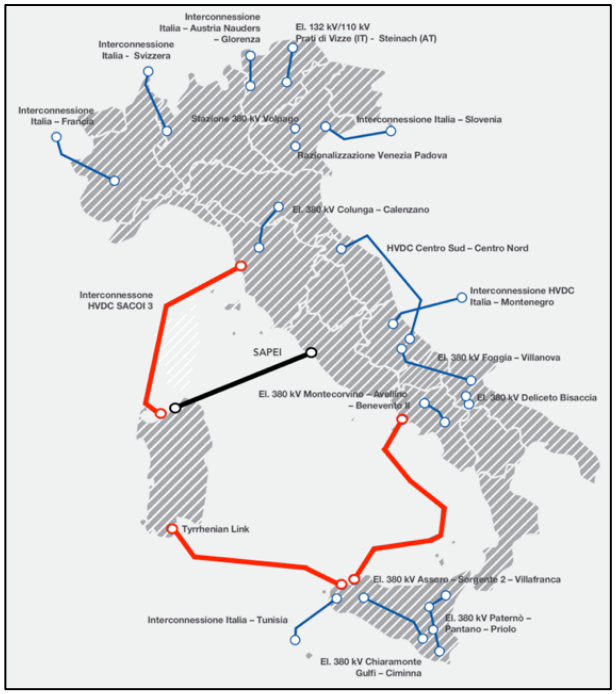

Figure 4: In red, the SACOI 3 and Tyrrhenian Link; in black the SAPEI (adapted from Terna 2020a)

4.1.3. Infrastructural challenges related to new gas-fired capacity in Sardinia

According to Italy's 2017 National Energy Strategy, the infrastructure requirements for the coal phase-out in Sardinia's power generation will require, among other things, either 400 MW or storage or 400 MW of new gas-fired power generating capacity. This would ideally be split over two plants, fed by LNG terminals that would have to be built (MiSE and MATTM 2017). The need for LNG terminals is dictated by the fact that the island of Sardinia is not connected to the national natural gas transmission grid (MiSE and MATTM 2017). This is likely to remain unchanged for the foreseeable future (MiSE and MATTM 2017). Until now, the island has been relying on propane gas as an alternative to natural gas (MiSE and MATTM 2017). Propane gas is distributed via gas canisters or, where available, via the propane gas distribution grid (MiSE and MATTM 2017). However, debate whether and how to pursue the methanation of the island has been going on for decades, also in light of the higher cost that both households, commerce, and industry are faced with vis-à-vis their counterparts in the mainland and Sicily who enjoy access to natural gas from the national grid (MiSE and MATTM 2017). Having definitively abandoned the idea of supplying natural gas to Sardinia from Algeria (due to geopolitical issues), the Ministry of Economic Development, having consulted with Sardinia's regional government and other relevant stakeholders, took under consideration three alternative methanation options, namely: (i) a gas transmission pipeline connecting it to Italy mainland; (ii) a floating LNG terminal; (iii) small-scale LNG terminals (MiSE and MATTM 2017). The latter of the three was selected, i.e. small-scale LNG terminals, citing the highest degree of flexibility it would offer over the other two options (MiSE and MATTM 2017).

At the time of the publishing of Italy's 2017 National Energy Strategy, there were authorization procedures for four distinct small-scale LNG terminals, three located in Oristano (Centre-West part of the island), and one in Cagliari (South-East part of the island) (MiSE and MATTM 2017). The intended final users for the small-scale LNG terminals to be located in Oristano are households, commercial and/or industrial customers, and refuelling stations (MiSE and MATTM 2017). As for the small-scale LNG to be located in Cagliari, the natural gas will be fed into the existing distribution network of propane gas, which has been suitable for natural gas

transportation (MiSE and MATTM 2017). Both small-scale LNG terminal projects are reported in the map depicted in figure 5, below.

Figure 5: Sardinia's coal-fired powerplants and planned/proposed small-scale *LNG terminals at 2017 (adapted from Google 2020, MiSE and MATTM 2017)*

Italy's 2017 National Energy strategy became the programmatic and political basis for the preparation of Italy's National Energy and Climate Plan; this was both envisaged by the very same 2017 National Energy Strategy and permitted by the Regulation (EU) 2018/1999 (MiSE and MATTM 2017; MiSE et al. 2018; MiSE et al. 2019; OJEU 2018). The subsequent updates of the National Energy Strategy are to be undertaken every three years, which suggests that the next update should be published in 2020; the updates will be used, among others, for updating the National Energy and Climate Plan scheduled for 2024. (MiSE and MATTM 2018).

4.2. Italy's 2030 National Energy and Climate Plan

4.2.1. Introduction to National Energy and Climate Plans

National Energy and Climate Plans were introduced by the EU Regulation 2018/1999 on the governance of the energy union and climate action, part of the Clean energy for all Europeans

package adopted in 2019 (EC 2020b). These plans ought to detail how EU Member States intend to address the five dimensions of the Energy Union, i.e. (i) energy security, (ii) the internal energy market, (iii) energy efficiency, (iv) decarbonisation, and (v) research, innovation, and competitiveness. (EC 2020b). This is articulated over four steps, namely: (i) the member State submits to the European Commission a draft version of its National Energy and Climate Plan, the first of which was due by 31 December 2018[4] covering the period 2021-2030; (ii) the European Commission assesses the draft and issues recommendation at least six months before the member State submission deadline of the final version of its National Energy and Climate Plan, the first of which was due by 31 December 2019[5]; (iii) the member State takes due account of recommendations when drafting the final version of its National Energy and Climate Plan prior submitting it to the European Commission; if it does not address a recommendation or a substantial part thereof it must provide its reasons and make them publicly available; (iv) by 31 October 2021 and every two years thereafter, the European Commission shall assess the progress made by the Member State towards meeting its objectives, targets and contributions, and implementing the policies and measures set out in Member States' respective National Energy and Climate Plan (EC 2020b). Where, on the basis of its assessment pursuant to point (iv) the European Commission concludes that insufficient progress has been made by a member State towards meeting its objectives, targets, and contributions, it shall issue recommendations to the member State (EC 2020b). Likewise, if the European Commission outcome of the aggregated assessment of all member States National Energy and Climate Plans put into question the achievement of the EU 2030 targets, it can issue recommendations to all member States to mitigate the risk (EC 2020b). These four passages are presented below in table 3.

The National Energy and Climate Plan must be updated once during the 2021-2030 period (EC 2020b). The update can only reflect increased climate and energy ambitions; alternatively, the

[4] Subsequently by 1 January 2028 and every ten years thereafter.

[5] Subsequently by 1 January 2029 and every ten years thereafter.

member State should provide the European Commission reasons justifying why the plan does not require updating (EC 2020b).

Table 3: Main features of National Energy and Climate Plan (own table)

Content	▪ National objectives, targets, and contributions relating to the dimensions of the Energy Union, including GHG emissions reduction. ▪ Planned policies and measures needed to achieve the objectives, targets, and contributions above. ▪ Investment needed to meet the corresponding objectives, targets, and contributions.
Process	

Annex I of Regulation 2018/1999 details the structure of the general framework for National Energy and Climate Plans that Member States have to abide by when drafting their plan (EC 2020c).

4.2.2. Italy's draft National Energy and Climate Plan

Italy submitted its draft National Energy and Climate Plan on 8 January 2019, eight days past the official deadline (European Commission 2019b). In the draft, the phase-out of coal as fuel in the power generation sector is one of the key elements to the pursuit of Italy's decarbonisation (MiSE

et al. 2018). Below is a breakdown of the sections where the coal-phase out is discussed in the draft.

The first instance in which the coal phase-out is discussed is in the executive summary under section 1.1. *Strategy relating to the five dimensions of the Energy Union*, sub-section ii. *Dimension of decarbonization* (MiSE et al. 2018). There the draft states that the coal phase-out is considered one of the three drivers for the decarbonisation of the sectors covered by the EU ETS, next to a higher CO_2 price level and a significant acceleration of renewables and energy efficiency in manufacturing processes (MiSE et al. 2018).

Next, under section 2.1. *Dimension decarbonisation*, the document reports that Italy predicts achieving a reduction of GHG emissions in the EU ETS sector of 55.9%, a scenario which it considers achievable on the pre-condition that the policies and measures indicated in section 3. *Policies and measures*, of the National Energy and Climate Plan, are realized (MiSE et al. 2018).

In section 2.4.2. *Energy transmission infrastructure*, the document states that the High Voltage Direct Current (HVDC) cable for the transmission of electricity between Sardinia, Sicily, and Continental Italy is under evaluation (MiSE et al. 2018). Furthermore, it states that small-scale LNG terminals are being authorized by the Ministry of Economic Development and the Ministry of Transport, including in Sardinia (MiSE et al. 2018). The final users as intended by the plan include (i) industries, (ii) households by means of the existing infrastructure used to distribute gas propane and those that are being built, (iii) heavy transport and shipping to replace traditional fuels, (iv) the thermoelectric power plants envisaged for the phase-out of the two coal-fired power plants (MiSE et al. 2018).

Under 3.1.1. *GHG emissions and removals* of 3.1. *Dimension decarbonisation* in 3. *POLICIES AND MEASURES*, Italy's draft National Energy and Climate Plan states that the country *"has planned the gradual phase-out of electricity production from coal by 2025, with a first significant step in 2023, offset not only by the strong growth of renewable energy, but also by a plan of infrastructural interventions (in flexible generation, networks, and storage systems) to be carried out in the coming years. The parallel implementation of the two processes is essential to ensure that the result* [i.e. the phase-out of coal for power generation] *is achieved in safe conditions of the energy system.*" (MiSE et al. 2018: 93, translated from Italian, text in square brackets added).

The growth objective for renewable energy in the electricity sector is quantified as follows under section 2.1.2 *Renewable energy*: scaling up the installed capacity of solar PV from 19,682 in 2017 to 26,840 MW by 2025 and 50,880 MW by 2030; scaling up the installed wind power capacity from 9,766 MW in 2017 to 15,690 MW by 2025 and 18,400 MW by 2030 (MiSE et al. 2018). Conversely, the envisaged increase of installed capacity of other renewable energy sources, namely hydropower and geothermal is negligible when compared to solar PV and wind, and it even decreases in the case of bioenergy (MiSE et al. 2018).

Furthermore, under the same section, the draft discusses the infrastructure changes connected to the scenario of coal phase-out to be started in the window 2020-2025; these include: (i) new gas-fired capacity for around 3 GW, of which approximately 50% is substantially connected to the phase-out, and new storage systems for 3 GW in the Central-South, South and Sicily areas; (ii) reinforcement of the transmission network in the Brindisi hub – already authorized by the Ministry of Economic Development and the Ministry of the Environment and currently under construction; (iii) a new electricity grid backbone for at least 1 GW of transport capacity on the Adriatic coast; (iv) the installation of at least 3,000 MVAR of new synchronous compensators, in particular in the South and Central-South areas, to address voltage regulation requirements deriving from the large scale deployment of solar PV and wind power generation; (v) and in particular for the coal phase-out in Sardinia, a new interconnection electricity Sardinia-Sicily-Continent, new gas-fired generation capacity or storage capacity for 400 MW to be located on the island, and the installation of at least 250 MVAR synchronous compensators (MiSE et al. 2018). These are summarized in table 4 below.

Table 4: Infrastructure investment deemed necessary in Italy's draft NECP to achieve the coal phase out by 2025 (own table)

Field	Type of infrastructure
Gas-fired power capacity	▪ 3 GW of new gas-fired capacity, of which approximately 50% is substantially connected to the coal phase-out; ▪ 0.4 GW new capacity in Sardinia split over two plants ▪ LNG terminals in Sardinia
Renewables	▪ Cover 55% of electricity consumption through renewables by 2030 ▪ Solar PV installed capacity: 26,840 MW (2025); 50,880 MW (2030) ▪ Wind power installed capacity: 15,690 MW (2025); 18,400 MW (2030)
Electricity grid	▪ Interconnection Sardinia-Sicily-Italy mainland ▪ Adriatic electricity grid backbone for 1 GW ▪ 3.0 GW storage, especially in the South and Sicily area ▪ Reinforcement of the transmission network in the Brindisi hub ▪ 3,000 MVAR of new synchronous compensators, in particular in the South and Central-South areas ▪ At least 250 MVAR of new synchronous compensators installed in Sardinia

Italy's draft National Energy and Climate Plan acknowledges that the objective of decarbonisation entails problems, vis-à-vis, to the safe management of the Sardinian electricity network and that the interconnection Sardinia-Sicily-Italy mainland is being evaluated as a solution (MiSE et al. 2018). To this end, both Ministry of Economic Development and the Italian Regulatory Authority for Electricity Gas and Water have reserved to undertake separate assessments (MiSE et al. 2018).

4.2.3. European Commission's recommendations to Italy's draft National Energy and Climate Plan

As part of the assessment of Italy's draft National Energy and Climate Plan, the European Commission issued three documents, namely: (i) the "*Summary of the Commission assessment of the draft National Energy and Climate Plan 2021-2030"*, (ii) the *"Commission Staff Working Document Assessment of the draft National Energy and Climate Plan of Italy Accompanying the*

document Commission Recommendation on the draft integrated National Energy and Climate Plan of Italy covering the period 2021-2030", (iii) the *"Commission Recommendation of 18 June 2019 on the draft integrated National Energy and Climate Plan of Italy covering the period 2021-2030"* (European Commission 2019a, European Commission 2019b, European Commission 2019c).

In the first document, i.e. the summary assessment, the Commission observes that "*The Italian draft integrated National Energy and Climate Plan (NECP) largely builds on the 2017 Italian Energy Strategy (…). Overall, the Italian draft NECP is well developed and broadly meets the requirements set by the Regulation. An extensive list of 101 policies and measures cover most of the dimensions, even though it focuses mostly on existing measures, and should provide more clarity on expected developments and budgetary details.*" (European Commission 2019a: 2). Concerning the phase-out of electricity generation from coal and decarbonisation, the summary assessment of the Commission points out that *"The objective of gradually phasing-out coal for electricity generation by 2025 could be further substantiated with a detailed action plan."* (European Commission 2019a: 2).

The Commission Staff Working Document vis-à-vis the coal phase-out in power generation states that *"The draft NECP includes the objective of gradually phasing out of coal for electricity generation by 2025 in favour of an electricity mix based on a growing renewable energy share and, for the remainder, gas. However, this objective is not backed with a detailed and concrete action plan to implement it."* (European Commission 2019c: 6). On renewable energy, the Commission Staff Working Document states *"The policies and measures to support the achievement of the proposed objectives and contributions for renewable energy lack sufficient details. For example, in the electricity sector the objective is to accelerate the production of electricity from renewable energy through the use of reverse auctions and the promotion of long-term Power Purchase Agreements. However, the decree introducing a revised support scheme for renewable electricity production (and renewable heating and cooling) has been pending for a long time, creating significant uncertainty for investment prospects. Further, a tender calendar providing targeted capacities for the 2021-2030 period would add to the completeness of the draft plan. Finally, the final plan could better describe measures for promoting repowering."*

(European Commission 2019c: 7). Furthermore, on decarbonisation the Commission adds that *"the expected development in terms of gas generation and gas infrastructure seem incompatible with the stated long term goals."* (European Commission 2019c: 11). On information completeness vis-à-vis planned infrastructures, the Commission states that *"Information on policy direction and infrastructure investments to meet the interconnection targets as well as to reinforce the transmission and distribution grids in order to support the envisaged phase-out of coal-fired thermoelectric plants as well as the integration of new renewable energy could be further explored in the final plan. The implementation of some key infrastructure projects remains unclear."* (European Commission 2019:c 16).

In the recommendations vis-à-vis Italy's draft National Energy and Climate Plan, with reference to the coal phase-out the Commission recommends Italy to "*Clarify to what extent the development expected in the gas sector is compatible with the stated decarbonisation goals and the envisaged phase-out of coal-fired thermoelectric plants"* (European Commission 2019c: 46) and that *"More details are expected notably: (i) on the consequences of the phase out of coal-fired power plants and expected evolution of the role of gas in the energy mix"* (European Commission 2019c: 45).

4.2.4. Italy's final National Energy and Climate Plan

The following section collects elements of the coal phase-out in the power generation sector from Italy's final National Energy and Climate Plan that are novel, vis-à-vis the draft version.

The final version of Italy's National Energy and Climate Plan states that the Ministry of Economic Development has launched a technical committee on the phase-out of coal for power generation articulated by areas of the electricity market, as well as a dedicated committee for Sardinia, which is both a region and an electricity market (MiSE et al. 2019). Side note: the Italian electricity system is dived into electricity market zones, i.e. zones based on their electricity transport capacity or limit thereof (Terna 2020a). There currently are six geographical zones, namely North, Center-North, Center-South, South, Sicily, and Sardinia (Terna 2020a). An illustration of the market zones over time is reported in figure 6 below.

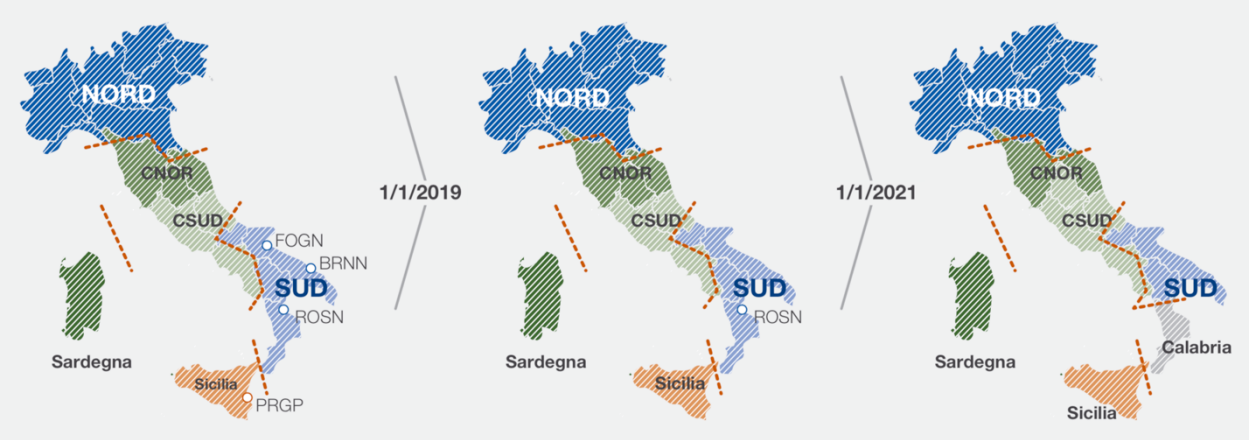

Figure 6: Italian electricity market zones and their evolution over time (Terna 2020a)

The aim of these technical committees is to identify conditions, accelerated paths and methods for the phase-out, while keeping the system safe and proposing solutions to meet the employment needs consequent to the phase-out (MiSE et al. 2019). The technical committees involve various stakeholders including the government of those regions in which coal-fired power plants are present, as well as that of operators and social partners, e.g. labour unions (MiSE et al. 2019). The activities of the technical committees were still ongoing on 31 December 2019 (MiSE et al. 2019).

Italy's final version National Energy and Climate Plan also provides further details on the gas transportation infrastructure in Sardinia (MiSE et al. 2019). To this end, it states that the cost-benefit analysis commissioned by the Italian Regulatory Authority for Electricity Gas and Water should be ready in the spring of 2020; however, upon checking the regulatory authority website as well as Italian media outlets specialising on energy topics, it appears that the analysis is not yet available (MiSE et al. 2019). This cost-benefit analysis has been commissioned to a public entity, namely Ricerca sul Sistema Energetico or RSE, whose sole shareholder is Gestore dei Servizi Energetici or GSE, whose only shareholder, in turn, is the Ministry of Economic Development (GME 2020).

As for the submarine electricity cable that is expected to connect Sardinia to Italy mainland via Sicily, also known as Tyrrhenian Link, Italy's final National Energy and Climate Plan states the

infrastructure is still under consideration while reiterating that it is considered instrumental for the phase-out of coal for electricity generation in Sardinia (MiSE et al. 2019).

Furthermore, concerning the energy transition, the report states that the new gas-powered generation capacity will temporarily increase the consumption of natural gas, with no associated infrastructural development envisaged for the time being[6] (MiSE et al. 2019).

Similar to the draft version, the final National Energy and Climate Plan reference a *"first significant step in 2023"* vis-à-vis the coal phase-out in the electricity sectors, without further detailing what the significant step entails (MiSE et al. 2019). Likewise, the final National Energy and Climate Plan recognises that, a strong growth of renewable energy in the electricity sector is instrumental to achieve the objective of coal phase-out (MiSE et al. 2018; MiSE et al. 2019). To this end, it strengthens the objectives of renewable energy in the electricity sector vis-à-vis the draft version (MiSE et al. 2018; MiSE et al. 2019). In particular, under section 2.1.2 *Renewable energy*, it aims at scaling up the installed capacity of solar PV to 28,550 MW (instead of 26,840 MW) by 2025 and 52,000 MW (instead of 50,880 MW) by 2030 (MiSE et al. 2018; MiSE et al.

[6] This passage appears to be unclear, given that the Italian Regulatory Authority for Electricity Gas and Water is undertaking a cost-benefit analysis for gas infrastructure transportation in Sardinia, and that LNG terminals and gasifiers will have to be built to supply natural gas to the envisaged 400 MW gas capacity – which could arguably be considered as new infrastructure development. To note that in its recommendations to Italy, the European Commission wrote: "*Clarify to what extent the development expected in the gas sector is compatible with the stated decarbonisation goals and the envisaged phase-out of coal-fired thermoelectric plants"* (European Commission 2019c: 46). And "*More details are expected notably: (i) on the consequences of the phase out of coal-fired power plants and expected evolution of the role of gas in the energy mix"* (European Commission 2019c: 45). However, it is unclear whether the Italian statement is a direct consequence of the European Commission's recommendation. To avoid speculations, it is not further discussed here.

2019). Similarly, it aims at scaling up the installed wind power capacity to 15,950 MW (instead of 15,690 MW) by 2025 and 19,300 MW (instead of 18,400 MW) by 2030 (MiSE et al. 2018; MiSE et al. 2019). There are no noteworthy changes concerning hydropower, geothermal, and bioenergy (MiSE et al. 2019).

With regards to measures to promote repowering of existing renewable energy power plants, and in particular wind turbines, the final National Energy and Climate Plan provides additional details than previously given in the draft version, in line with the recommendations of the European Commission (MiSE et al. 2019). In particular, the final version provides details about how it intends to cut red tape and simplify repowering procedures, e.g. by exempting certain repowering operations from being subjugated to Environmental Impact Assessments (EIAs) or environmental screenings (MiSE et al. 2019). However, it fails to provide a timetable outlining when Italy intends to do so.

As for the European Commission critique about Italy's slow-moving decree to introduce a revised support scheme for renewable electricity production which should include Power Purchase Agreements (PPAs), Italy's National Energy and Climate Plan does provide further details vis-à-vis the draft version. In particular it mentions that a contribution to the development of PPAs will derive from the Ministerial Decree 4 July 2019, which tasks Italy's energy markets handler, i.e. Gestore del Mercato Energetico or GME, to establish a discipline for the creation of a market platform for the long-term negotiation of energy from renewable sources, *"to promote the negotiation of production from plants to newly built renewable sources, fully rebuilt or reactivated, subject to an upgrade or refurbishment, which came into operation after 1 January 2017 and which do not benefit from incentives on the energy produced."* (MiSE et al. 2019: 125, translated from Italian). This however suggests that it will still take some time until a market platform for the long-term negotiation of energy from renewable sources is up and running. Finally, as for the European Commission recommendation to Italy to include a tender calendar providing targeted capacity for 2021-2030, said calendar does not figure in Italy's final National Energy and Climate Plan.

4.2.5. Tyrrhenian Link project: timeline uncertainties

The Tyrrhenian Link project is a High Voltage Direct Current submarine infrastructure that is intended to transport electricity from Sardinia to Italy mainland via Sicily, for a total of 880 km (Terna 2020a). Each section, i.e. Sardinia-Sicily and Sicily-Italy mainland, will consist of two cables each having a capacity of 500 MW (Terna 2020a). Italy's TSO Terna will oversee the entire project and first officially included the project its yearly Transmission Network Development plan in 2018 (Terna 2018). In it, Terna estimated the beginning of works by 2025 while it provided no indication on the exact date of completion. It stressed, however, that a fast-tracking of permitting could accelerate the entry into service (Terna 2018).

When in June 2020 Terna provided an update of the forecasted timeline, the TSO indicated that a first portion of the infrastructure, 500 MW on the Sicily-Italy mainland section is now expected to be operative by 2025, while the full electricity transportation capacity, i.e. 1,000 MW, through the entire cable section, i.e. from Sardinia to Italy mainland via Sicily, is now expected to enter into service in 2028 (Terna 2020b). The new timeline by Terna is based on the assumption of the presence of regulatory fast track mechanisms for authorization that can cut red tape and associated bureaucratic delays; however, it has been pointed out to TSO that to date such fast track mechanisms do not exists and would need to be created in order to be used as envisaged by the TSO (Terna 2020b).

As for Sardinia's new regional government that took office in March 2020, its main representative, President Solinas, criticised the Tyrrhenian Link (Caretto 2019). In his view, the interconnection would undermine Sardinia's energy sovereignty by making the island dependents on Sicily's energy system (Caretto 2019).

4.3. Review of the Integrated Environmental Authorization of Italy's coal-fired capacity and the permitting request for new gas-fired capacity

In order to operate, some powerplants need what is known as an Integrated Environmental Authorisation (MATTM 2006). The Integrated Environmental Authorization is the provision that authorizes the operation of some installations under certain conditions (MATTM 2020a). This is

to ensure compliance with the requirements of the EU directive on Integrated Pollution Prevention and Control, relating to industrial emissions and to the environmental performances associated with the Best Available Techniques (MATTM 2020a). The objective of the Integrated Environmental Authorization is the prevention and reduction of pollution from the activities listed in Annex VIII and the installations listed in Annex XII of the Italian Legislative Decree of April 3, 2006, n. 152, part second (MATTM 2020a). It provides measures aimed at avoiding whenever possible or otherwise at reducing emissions to air, water, and soil (MATTM 2006). Energy-related activities are covered under the Integrated Environmental Authorization, including combustion plants having a thermal combustion power above 50 MW (MATTM 2006). Among the installations for which an Integrated Environmental Authorization is required, there are thermal power plants and other combustion plants having a thermal power of at least 300 MW (MATTM 2006).

The Ministry of Environment is the authority responsible for the Integrated Environmental Authorization at the state level (MATTM 2020a). Besides issuing the Integrated Environmental Authorisation, the aforementioned Ministry can initiate a review of said authorisation when: (i) the pollution caused by the installation is such as to make it necessary to revise the emission limit values set in the authorization or to insert new limit values into the authorization; (ii) the best available techniques have undergone substantial changes, which allow a significant reduction in emissions under acceptable economics; (iii) the operational safety of the process or activity requires the use of other techniques; (iv) new EU or national laws require it (MATTM 2006).

4.3.1. State review of coal-fired powerplants Integrated Environmental Authorization

With decree 430 of 22 November 2018, the Ministry of Environment ordered a review of the Integrated Environmental Authorization issued to coal-fired power stations (MATTM 2018). Citing Italy's 2017 National Energy Strategy commitment to phase-out coal in the power generation sector, the operators of coal-fired powerplants have been requested to indicate a date for the definitive phase-out of the use of the fuel, with the phase-out to occur no later than

31 December 2025; operators were also asked to submit a detailed decommissioning plan (MATTM 2018). Enel, who operates by far the highest number of coal-fired power plants in Italy, contested this request for four of the six coal-fired power stations it operates in Italy (Enel 2019b, Enel 2019c, Enel 2019d, Enel 2019e). As for the Enel coal-fired plant located in La Spezia plant, the utility has requested the authorization to the Ministry of Economic Development to dismiss it by 1 January 2021, while for the plant located in Bastardo, Enel requested to dismiss it already by 1 January 2020 (Enel 2019f; Enel 2019g).

In particular, the utility believes that: (i) the Integrated Environmental Authorization is not the appropriate tool to prescribe the phase-out of a specific fuel for power generation, in this case, that of coal; (ii) Italy's National Energy Strategy of 2017 – prescribing the coal phase-out – is merely a political commitment; (iii) power stations can only be definitively taken out of service following a formal Ministry of Economic Development clearance to the disposal of production capacity (Enel 2019b, Enel 2019c, Enel 2019d, Enel 2019e). Using these three points, Enel appealed the decision to the regional administrative court, asking for the cancellation of the Integrated Environmental Authorization review as requested by the ministerial decree 430 of 22 November 2018; however, it subsequently withdrew the appeal soon after (Patrucco 2019; Manes 2019).

Sardinia's regional government also appealed, on 6 February 2019, the ministerial decree 430 of 22 November 2018 that instructs coal-fired power stations operators to detail their coal phase-out strategy (Quale Energia 2020; Regione autonoma della Sardegna 2019). However, it was not possible to retrieve further updates on the matter. Furthermore, the new regional government, which took office in March 2020, expressed its will to phase-out coal in power generation only by 2030 (Quotidiano Energia 2019). Furthermore, it did indicate new gas-fired capacity as the most desirable option for its replacement (Quotidiano Energia 2019).

4.3.2. Request to replace existing coal-fired capacity with new gas-fired capacity

Instead, Enel requested and received from the Ministry of Economic Development the authorization to phase-out the 2.6 GW coal-fired capacity installed in Brindisi by 1 January 2021

and replace it with a 1.68 GW gas-fired capacity, for which Enel has communicated to have submitted the application to start the EIA procedure (Enel 2020a; Enel 2020b). As for the 2.64 GW coal-fired capacity installed in Civitavecchia, Enel intends to replace it with 1.68 GW gas-fired capacity, which the Ministry of Environment subjugated to EIA procedure (MATTM 2019a; MATTM 2019b). Concerning the 0.6 GW coal-fired capacity installed in La Spezia, Enel has communicated to have submitted the application to start the EIA procedure for replacement with 0.84 GW gas-fired capacity (Enel 2020c). Finally, Enel plans on replacing the 1.136 GW coal-fired capacity installed in Fusina with 0.84 GW gas-fired capacity, which the Ministry of Environment also subjugated to EIA procedure (MATTM 2019c; MATTM 2019d).

A2A, owner of the 0.976 GW coal-fired capacity installed in Monfalcone, did communicate that it has submitted an application for EIA procedure to replace its coal-fired capacity with 0.86 GW gas-fired capacity (A2A 2020a; A2A 2020b).

Both Enel and A2A envisage that their new gas-fired capacity will be initially operating as Open Cycle Gas Turbine, and only in a second phase it will be adjusted into Combined Cycle Gas Turbine (Enel 2020a; Enel 2020b; Enel 2020c; Enel 2020d; 2A 2020a; A2A 2020b).

As for the 0.64 GW coal-fired capacity installed in Fiume Santo (North Sardinia), its operator EP Produzione, submitted some of the alternatives it is considering; however, these appear to be included in an attachment which has not been made available to the general public (EP Produzione 2019). In March 2020 the utility stated that is considering converting the coal-fired capacity to new gas-fired capacity and/or to biomass (EP Produzione 2020b).

4.3.3. Outcome of the review of the Integrated Environmental Authorization

The Ministry of Environment granted a 16-year renewal of the Integrated Environmental Authorization for the coal-fired power stations located in Civitavecchia in 2019 and for both of those located in Sardinia, namely in Fiume Santo and Portoscuso, earlier in 2020, conditional to the phase-out of coal as fuel by 31 December 2025 (MATTM 2019e; MATTM 2020b; MATTM 2020c).

5. Discussion

This section will discussion the findings of Chapter 4.

5.1. Solar PV and wind power ambitions risk going unmet

Italy's draft National Energy and Climate Plan states that the country has planned to pursuit the phase-out of coal in a gradual manner with a first significant step in 2023; however, it fails to further detail said significant step (MiSE et al. 2018). Furthermore, it envisions a *"strong growth of renewable energy"* (MiSE et al. 2018: 93). While the connotation *"strong growth"* does not provide immediate quantitative information, it is worth pointing out that Italy experienced its fastest growth of solar PV between 2010-2011 to later plateau from 2013 onwards (GSE 2020). To put this perspective, while between 2010 and 2011 the country added just over 9.5 GW of solar PV in one year, from 2013 till 2019 the country only added a yearly average of just under 0.45 GW, as shown in figure 7 below.

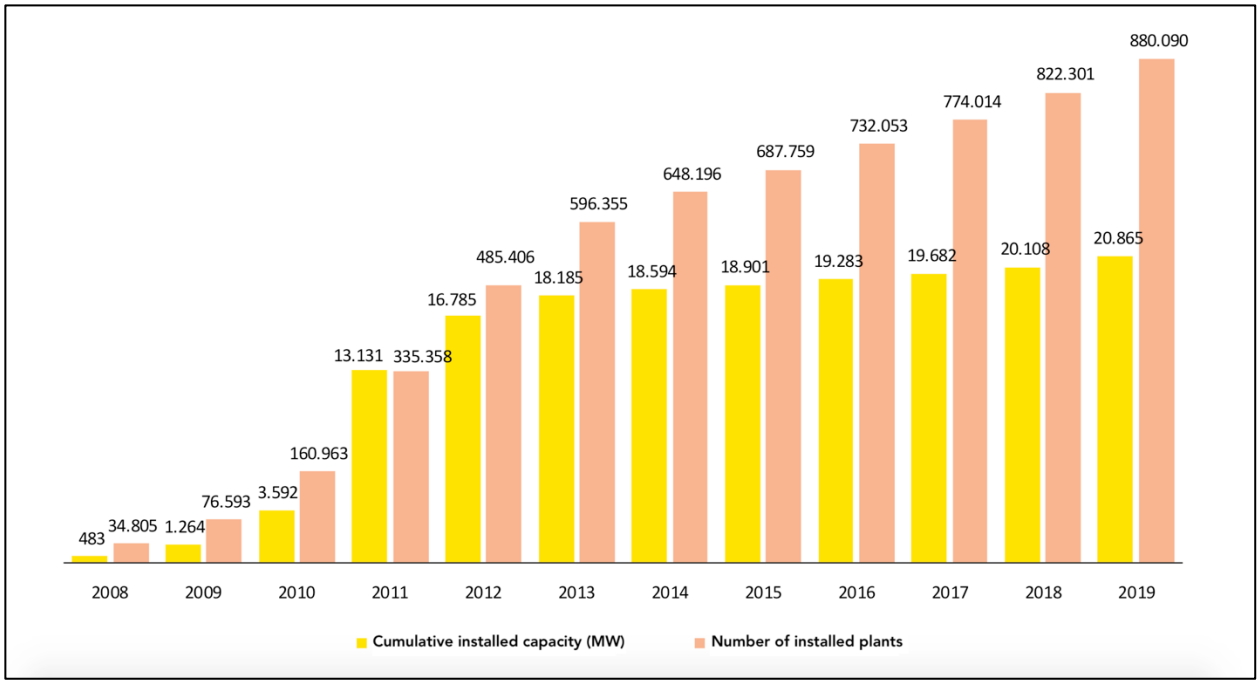

Figure 7: Evolution of the installed capacity (MW) and number of solar PV plants in Italy between 2008-2019 (adapted from GSE 2020)

The reason for such a sharp increase between 2010-2011 is vastly amenable to very attractive subsides offered by Italy's government at the time (Terna 2020). These were later watered down, thus weakening the economic interest to invest in new solar PV capacity (Terna 2020).

In its final National Energy and Climate Plan, Italy envisioned scaling up the installed capacity of solar PV to 28,550 MW in 2025 and 52,000 MW by 2030 (MiSE et al. 2019). Reaching the 2025 goal would require an extra 7,685 MW on the recorded 2019 solar PV cumulative installed capacity, or in other words, an average increase of 1.28 GW per year, almost three times higher the average installed capacity yearly between 2013 and 2019 (GSE 2020; MiSE et al. 2018; MiSE et al. 2019). Additionally, assuming the 2025 solar PV goal is met, reaching the 2030 goal would require an average yearly addition of 4,690 MW from 2026 till 2030 (MiSE et al. 2019).

Less striking but following a similar trend, the cumulative installed wind power capacity grew on average 341 MW per year over the period 2013-2018, from 8,561 MW to 10,265 MW, as seen in figure 8 (GSE 2019). However, to reach the envisioned 2025 cumulative installed wind power capacity of 15,950 MW, the average yearly addition from 2018 should be of 812 MW, i.e. more than double the average observed over the 2013-2018 period.

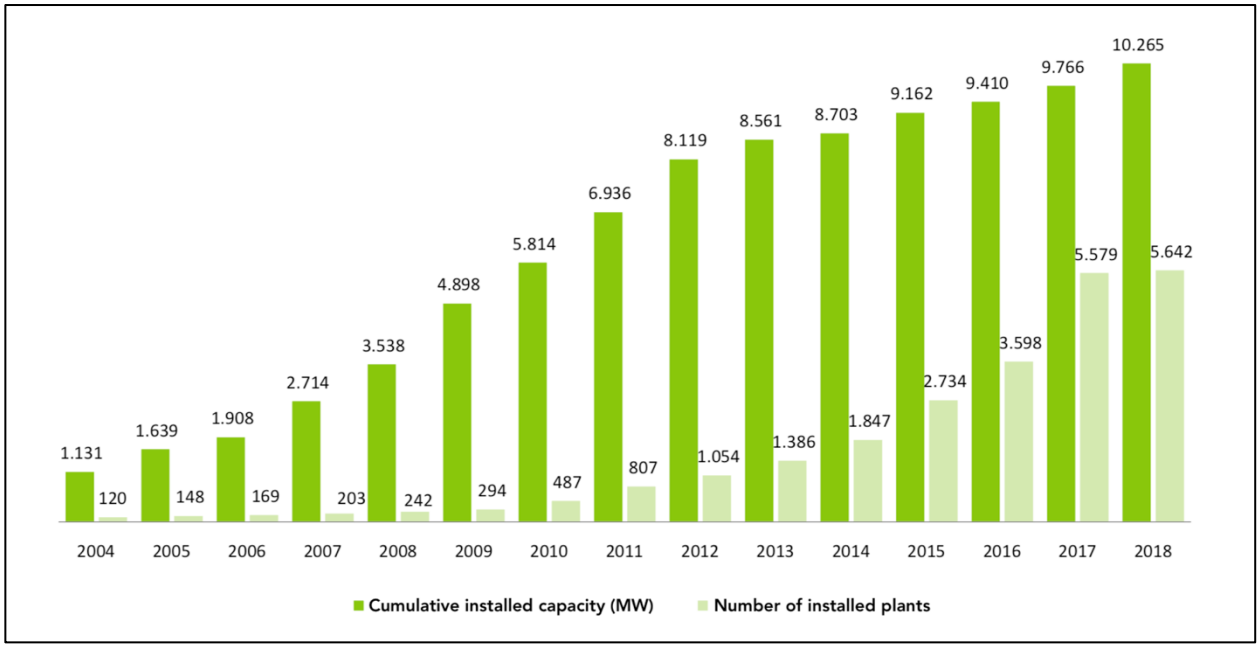

Figure 8: Evolution of the installed capacity (MW) and number of wind power plants in Italy between 2004-2018 (adapted from GSE 2019)

The evolution of the solar PV and wind power installed capacity over the recent years suggests that, if Italy is to meet its 2025 and 2030 solar PV and wind power installed capacity and electricity generation targets – which are considered instrumental for the phase-out of coal in power generation – fresh (regulatory) efforts might be required, as the market alone might be unable to deliver on the government envisaged target.

A possible way forward could be the promotion of so-called renewable power purchase agreements (PPAs). PPAs are long-term contracts, with a stable return on investment on agreements lasting more than 10 years, in which the electric utility, large consumer, or reseller agrees to purchase energy directly from the power plant operator of the same at a fixed price per kWh (Solare B2B). The advantage is dual: from the investors' perspective, the bankability of the installation is made possible by the optimal long-term risk allocation; from the electricity buyers' perspective, the main advantage is that of hedging against the fluctuating cost of electricity (Solare B2B 2019; Parola 2020). Of particular interests are corporate PPAs, i.e. PPAs where the buyer is a large company or a group of companies (Solare B2B). These contracts are gaining traction in Europe, the Middle East and Africa (EMEA) area as illustrated in figure 9 (Bloomberg NEF 2020).

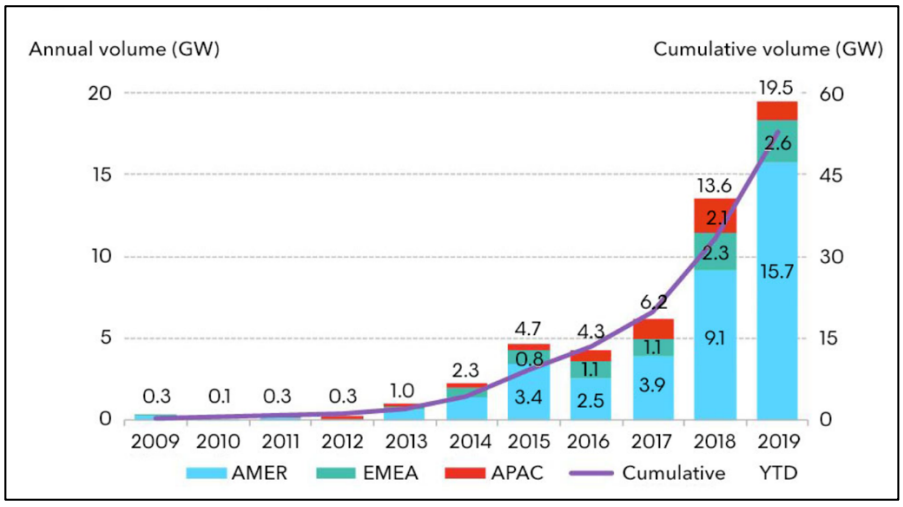

Figure 9: Global corporate PPA volumes (Bloomberg NEF 2020)

Bloomberg New Energy Finance reports: "*Though nearly half of the* [2019] *activity still came from Sweden, Norway, Finland and Denmark, companies are now beginning also to sign long-term clean energy contracts in markets like Spain, Poland, France and Italy for the first time*" , suggesting that Italy is only beginning to use corporate PPAs (Bloomberg New Energy Finance 2020, text in square bracket added). This might be not entirely surprising given that until at least 2019 the Italian legislation did not allow the sale of electricity produced by a plant to an entire industrial pole (Solare B2B). According to Lorenzo Parola, lawyer and expert in the legal aspects of energy markets, there exist several barriers to PPAs in Italy, including (i) slow and cumbersome authorization processes, obsolete guidelines, and the existence of a sort of veto power in the hands of each of the many entities involved in the authorization process; (ii) uncertainties about how PPAs will be regulated at EU level; (iii) technical aspects related to the governance of the grid not further explored here (Parola 2020).

Italy's final National Energy and Climate Plan mentions that a contribution to the development of PPAs will derive from the Ministerial Decree 4 July 2019, which tasks Italy's energy markets handler, i.e. Gestore del Mercato Energetico or GME, to establish a discipline for the creation of a market platform for the long-term negotiation of energy from renewable sources, "*to promote the negotiation of production from plants to newly built renewable sources, fully rebuilt or reactivated, subject to an upgrade or refurbishment, which came into operation after 1 January 2017 and which do not benefit from incentives on the energy produced.*" (MiSE et al. 2019: 125, translated from Italian). However, the creation of said market platform is expected to take some time – a resource that is of the essence when considering the ambitious wind power and solar PV targets that Italy intends to achieve by 2025 and 2030.

However, PPAs are not necessarily a silver bullet for addressing barriers to the deployment of renewable power capacity. While it can address the lack of subsidies it might have little influence on other barriers, e.g. within authorization process, grid connection, and market design, which if present, should be promptly identified and addressed.

Therefore, if renewables are not going to be backed by timely supportive actions, Italy's ambitious goals to dramatically scale up solar PV and wind power installed capacity risks going unmet, putting in jeopardy the decarbonisation goals of the National Energy and Climate Plan.

5.2. New gas-fired capacity: the risks of technology lock-in and stranded assets

In its final National Energy and Climate Plan, the Italian government envisioned, among other things, the need for new gas-fired capacity for (i) 1.5 GW in Italy's North and North-Central areas; (ii) 0.4 GW (or, in alternative, 0.4 GW of energy storage) in the island of Sardinia, split over two plants; (iii) 1.5 GW in Italy mainland but not directly connected to the phase-out of coal (MiSE and MATTM 2017; MiSE et al. 2018; MiSE et al. 2019). Therefore, by 2025 a total of 3.0-3.4 GW new gas-fired capacity would be needed, 1.5-1.9 GW of which to phase-out coal. As for the remaining 1.5 GW, Italy's National Energy and Climate plan does not provide further details. A possible explanation might be that this 1.5 GW new gas-fired capacity is intended to balance the intermittence that will derive from the additional solar PV and wind power capacity that Italy aims to install by 2025 and 2030. However, the operators of four of Italy's coal-fired powerplants requested permitting to replace them with a cumulative 5.9 GW gas-fired capacity. Whether this new gas-fired capacity is intended to purely phase-out coal or also balance the intermittency of additional renewable, it is 2.5-4.4 GW above what Italy's National Energy and Climate Plan considers necessary.

Thermal power generation overcapacity is a phenomenon that Italy already experienced in a recent past that lead to the decommissioning of 15 GW of the 77 GW installed by 2012 (Terna 2020a). Contributing factors to this overcapacity were (i) the reduction in electricity consumption due to the economic downturn resulted from the Great Financial Crisis of 2008, and (ii) the surge of electricity from renewable sources, mostly from solar and wind (Terna 2020a). As a result of the overcapacity, the average operating hours of thermal power capacity in Italy dropped from 3,757 h/year in 2006 to 2,059 h/year in 2014; slightly recovering in the following years but mostly maintaining well below 3,000 h/years (Terna 2020a). Gas-fired capacity makes up the vast majority of the thermal installed capacity in Italy, mostly configured as Combined Cycle Gas Turbines (Costanzo 2020). The latter experienced a much drastic reduction in the number of average yearly operating hours than the entire group of thermal power plants: the average

operating hours of those generating electricity only fell from 4,186 h/year in 2006 to 1,159 h/year in 2014, subsequently keeping between 1,561 h/year and 2,438 h/year in the years that followed until 2018 (Costanzo 2020).

The reduction in the number of operating hours has been an issue for the economic viability of thermal power plants. While recognising the need for flexible power generation – such as gas-fired capacity – that allows for the deployment of larger shares of intermittent renewables, Italy's 2017 National Energy Strategy indicated that the country would need to reduce its thermal power generation capacity to just 52 GW to operate thermal power plants in Italy in a financially sustainable manner, 10 GW less than those installed at 2018 (MiSE and MATTM 2017).

Striking the optimal amount of gas-fired capacity needed to ensure power plants can be operated in a financially sustainable manner is not only a matter of financial sustainability of power plants. In the light of the urgency to decarbonise the entire economy, building more gas-fired capacity than deemed necessary can lead to either sub-optimally used assets or to a technology lock-in. Combined Cycle Gas Turbine power plants average service life of 20 years, meaning any additional gas-fired capacity becoming operative between 2020-2030 will be able to generate power until 2040-2050 (RSE 2016). To this end, it is important to keep in mind that a potential replacement of fossil origin natural gas with hydrogen or synthetic methane obtained through carbon-neutral power-to-X[7], means great conversion losses vis-à-vis the storage of electricity (Agora Verkehrswende et al. 2018). In particular, producing hydrogen from electrolysis will result in 33% of conversion energy loss, while producing electricity derived methane would incur in a 47% conversion energy loss (Agora Verkehrswende et al. 2018). When electricity derived methane is later employed for power generation in Combined Cycle Gas Turbine powerplants – whose electric efficiency can average 56-60%, the resulting final efficiency would

[7] Power-to-X includes power-to-hydrogen, i.e. the process of using electrolysis to split water into hydrogen and oxygen using electricity (IRENA 2020). The hydrogen can also be made react with CO_2 to produce synthetic methane (IRENA 2020).

be of just 26-28% (RSE 2016). This suggests that resorting to power-to-X gases for gas-fired capacity should be limited in scope to cover for those situations where direct electrification or when bulk storage of electricity through more efficient such as pumped hydroelectric storage – whose efficiency ranges between 70-85% – are not technically suitable or economically viable (Abdin and Rajab 2018). While the author acknowledges that (i) hydrogen derived from steam methane reforming combined with carbon capture and storage, and (ii) biomethane could be regarded as low carbon alternatives to natural gas of fossil origin, they are not further discussed here.

Another aspect that should be taken into consideration when planning new gas-fired capacity is that methane is a greenhouse gas whose global warming potential is 84-87 times bigger than that of CO_2 over a 20-year period, and 28-36 times bigger over a 100-year period (IEA 2020b). Methane emissions from anthropogenic origin represent around 60% of all emissions and the energy sector accounts for the second largest contributor to man-made methane emissions, as shown in figure 10 (IEA 2020b). Methane emissions in the energy sector are mostly attributable to coal as well as natural gas operations including extraction and transportation (IEA 2020b). Therefore, the planning of additional new gas-fired capacity should look beyond the simple direct greenhouse gas emissions resulting from the combustion of natural gas and take due consideration of the methane emissions.

Therefore, should the 5.9 GW of gas-fired capacity be approved without due consideration of (i) the existing overcapacity of thermal power plants, (ii) how to replace natural gas from fossil origin with low carbon or carbon neutral gases, and (iii) the life cycle emissions of natural gas, this could hinder the implementation of the decarbonisation objectives detailed in the National Energy and Climate Plan.

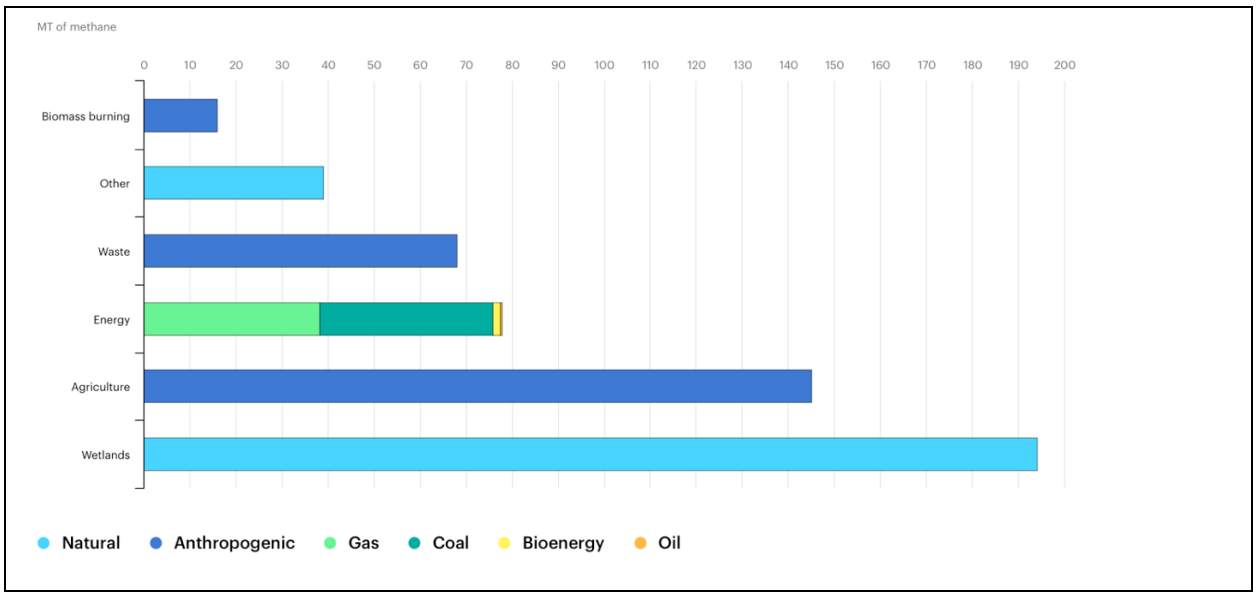

Figure 10: Sources of methane emissions (IEA 2020b)

5.3. Sardinia: new gas-fired capacity versus energy storage

Since announcing the coal phase-out in 2017, the Italian government had envisioned adding either a 400 MW of new gas-fired capacity or, alternatively, 400 MW energy storage (MiSE and MATTM 2017). Three years later the announcement and five years ahead of the phase-out deadline, the debate over which of the two options should be selected remains wide open, with a final decision yet to be made (Mise and MATTM 2017). EP Produzione, the utility running the 0.64 GW coal-fired capacity installed in the north of Sardinia, has announced on March 2020 that it intends to replace that with new gas-fired and/or biomass-fired capacity; however, at present no official permitting procedure has been initiated (EP Produzione 2020). Enel appears to have given no communication of its official plan for the 0.59 GW coal-fired capacity installed in the south of Sardinia.

The average construction time of a Combined Cycle Power Plant, estimable in three years, in addition to permitting delays (RSE 2016). When considering this together and the aforementioned lack of natural gas transport infrastructure, it remains wide-unclear whether the entry in operation by the end of 2025 of 400 MW gas-fired capacity in Sardinia is feasible. These potential barriers to gas-based electricity could make the coal phase-out more difficult.

Sardinia's regional government currently in power, which favors a coal phase-out only by 2030 (instead of 2025) and new gas-fired capacity over energy storage, can be also regarded as a barrier to the implementation of Italy's National Energy and Climate Plan, vis-à-vis the coal phase-out strategy (Quotidiano Energia 2019).

5.4. Tyrrhenian Link project

The Tyrrhenian Link, the proposed sub-marine electricity grid connecting Sardinia to mainland Italy via Sicily by means of two cable each having a 500 MW capacity, was formally announced in Terna's 2018 Transmission Network Development Plan (Terna 2018). Despite the 2017 official government announcement of phasing-out coal from electricity generation by 2025, the 2018 Terna's Transmission Network Development Plan envisaged for the Tyrrhenian Link works to begin in 2025 while forecasting its entry into service by a no better-specified point in time than *"long term"* (Terna 2018). The plan also mentioned that, in the event of fast-tracking regulatory mechanisms for authorization, the construction works and the entry into service could have been anticipated (Terna 2018). However, as of June 2020 the design of the Tyrrhenian Link has not yet been completed and permitting has not yet started (Terna 2020b). This, in spite of the fact that the infrastructure is considered by Terna as instrumental to the nationwide phase-out coal and to better integrate ever-increasing shares of electricity from variable renewable energy sources (Terna 2020b). Furthermore, in June 2020, Terna acknowledged that the interconnection could be fully operative only in 2028 (Terna 2020b). When considering the construction timeline of other sub-marine electricity transportation infrastructures in Italy, the forecast given by Terna seems optimistic at best. By comparison, the realisation of the 420 km SAPEI 1,000 MW HVDC interconnection between Sardinia and the mainland required 7 years, from 2005 till 2011 (Canazza 2019). Similarly, the HVDC interconnection between Italy and Montenegro, with its 423 km required 8 years to be completed, from 2011 till 2019 (Canazza 2019). This, taken together with the fact that neither the design nor the formal approval for the 880 km Tyrrhenian Link has been completed, casts serious doubts about the likelihood of the project to be completed by 2028, let alone 2025. Therefore, the delayed entry into service of the Tyrrhenian Link can be also

regarded as a barrier to the implementation of Italy's National Energy and Climate Plan, vis-à-vis the coal phase-out strategy.

Finally, to note that the Sardinian government opposes the Tyrrhenian Link projects, claiming it would jeopardise the island's energy sovereignty, subjugating it to Sicily's energy system. The claim could be argued to be unsupported by the evidence. Sardinia already counts two submarine interconnections, the SAPEI 2 (soon to be replaced by the SAPEI 3) and the SACOI, which connect the island to two Italian electricity markets, namely those of Centre-North and Centre-South (Terna 2020a). As pointed out by the Polytechnic of Milano these have been used to import/export electricity to the mainland and have contributed to making Sardinia a net exporter of electricity over the years (Politecnico di Milano 2020). It is unclear how a third interconnection to a third electricity market in Italy undermine the energy sovereignty of Sardinia. Furthermore, the electricity transmission grid – which the existing and planned interconnections are part of – is managed by Italy's TSO Terna, not Sicily. Finally, at least 69% of electricity generated in Sardinia is either coal- or syngas-derived (Politecnico di Milano 2020). According to the environmental declarations of both Sardinian coal-fired power plants and of the Sarlux Integrated Gasification Combined Cycles power plant, the coal and the petroleum products used to produce the syngas are imported. This begs the question about the conceptualisation of energy sovereignty that President Solinas holds. Regardless of the veracity of Solina's claims, his government opposition to the Tyrrhenian Link can also become a barrier to the timely development of the project, thus to the coal phase-out implementation plan laid out in the National Energy and Climate Plan.

5.5. Changes in the central government coalition

Italy has a reputation for political instability; in particular, the country has often had more than one government between general elections, held every five years (Governo Italiano 2020). For example, the coal phase-out was announced in 2017 under the Gentiloni government, the last of the three governments Italy had under its seventeenth parliamentary term (Governo Italiano 2020). With the general elections held in 2018, Italy entered its eighteenth parliamentary term,

and since then has already had two governments, namely the Conte I and the Conte II (Governo Italiano 2020). At each new general election, the composition of the Senate and the House of Representative is subject to change, which in turn can alter the political line of the parliament. Government reshuffles, such as the one that led to the formation of the Conte II, can also alter the political line of the government. Similar situations might occur in the regional parliaments and governments. These changes might influence the agenda-setting and with it the priority with which topics such as the coal phase-out are dealt with, e.g. should coal be phased-out in 2025 or 2030? What energy sources should replace it? What role should efficiency play? While the stances of the various political parties in the various government coalitions and oppositions have been left out, if further investigated they might shed some lights on the motives behind some of the decisions that have been taken vis-à-vis the phase-out of coal in power generation.

5.6. Recommendations to policymakers

This work has highlighted two main risks that are emerging in the implementation of the coal phase-out in the power generation sector in Italy. Namely, these are: (i) a delay in the phase-out of the two power plants located in the island of Sardinia and, (ii) the exacerbation of the overcapacity characterising the existent thermal power generating system in Italy. The materialisation of these risks is expected to result in a coal phase-out implementation which is less ambitious than intended, with a consequent delay is GHG emissions reduction, thus, a weaker climate action.

To mitigate these risks, policymakers already have alternatives at their disposal. In Sardinia, instead of the 400 MW gas-fired capacity, it could be opted to proceed for the deployment of energy storage and renewables. The Polytechnic of Milan RELAB study on decarbonising Sardinia by 2050 indicates that the island has a significant potential to further develop pumped hydroelectric storage, indicating that the island currently operates only one plant of 240 MW (Politecnico di Milano 2020). To this end, Lanati et al. (2019) point out the island has the potential to develop an extra 2.05 GW of pumped hydroelectric storage. By the time the Tyrrhenian Link

will be completed, Sardinia will be connected to three electricity market zones (instead of the current two), namely the Centre-North, Centre-South, and Sicily, as illustrated in figure 11.

Figure 11: Italian electricity market zones (adapted from Terna 2020a)

This would allow Sardinia to take advantage of the relative high shares of installed capacity of and power generation from wind power and solar PV that characterise the Centre-South and the Sicily electricity markets, as shown in figures 12, 13, 14, and 15. The Polytechnic of Milan points out that already today there are many hours in which import and export of electricity occurs simultaneously. It regards this as an indication of the fact that the existing interconnections between Sardinia and Italy mainland are often used as an escape route between the Centre-South and Centre-North electricity market areas (Politecnico di Milano 2020).

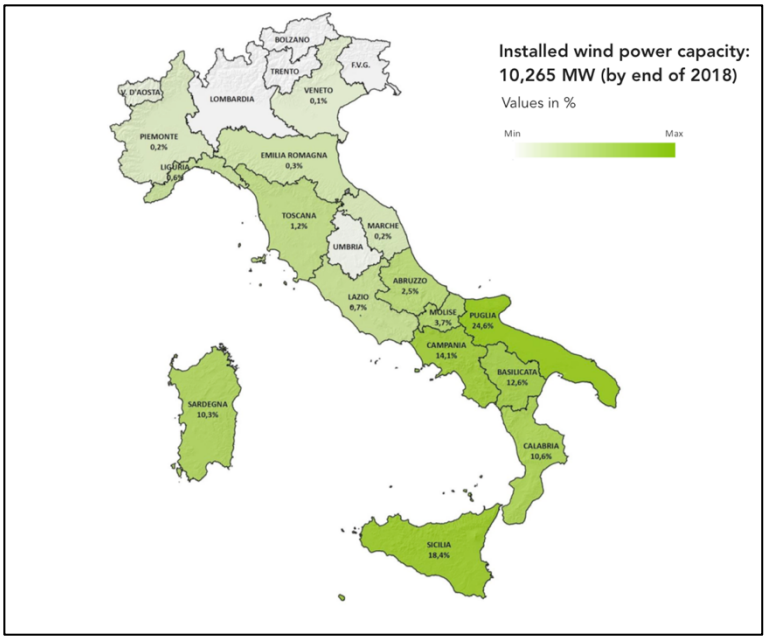

Figure 12: Share in % of installed capacity of wind power by region at the end of 2018 (adapted from GSE 2019)

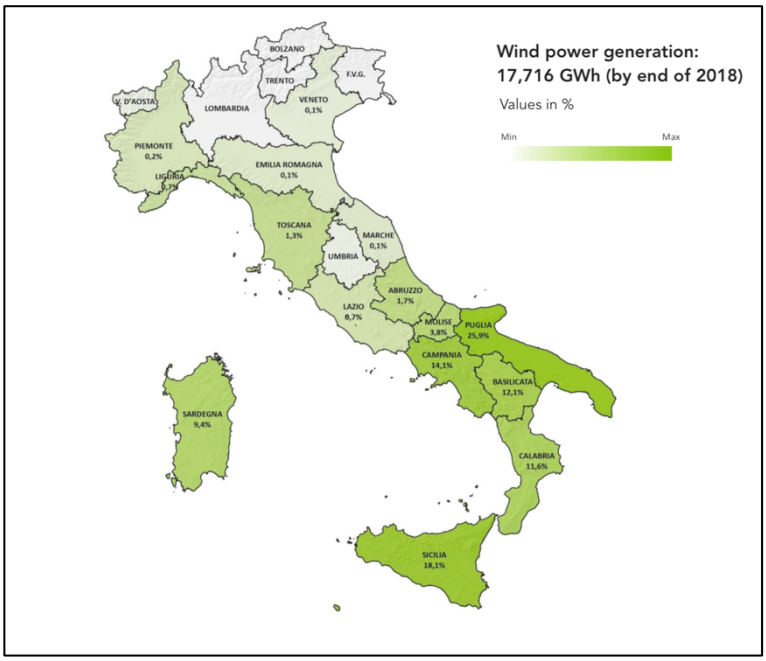

Figure 13: Share in % of wind power generation by region at the end of 2018 (adapted from GSE 2019)

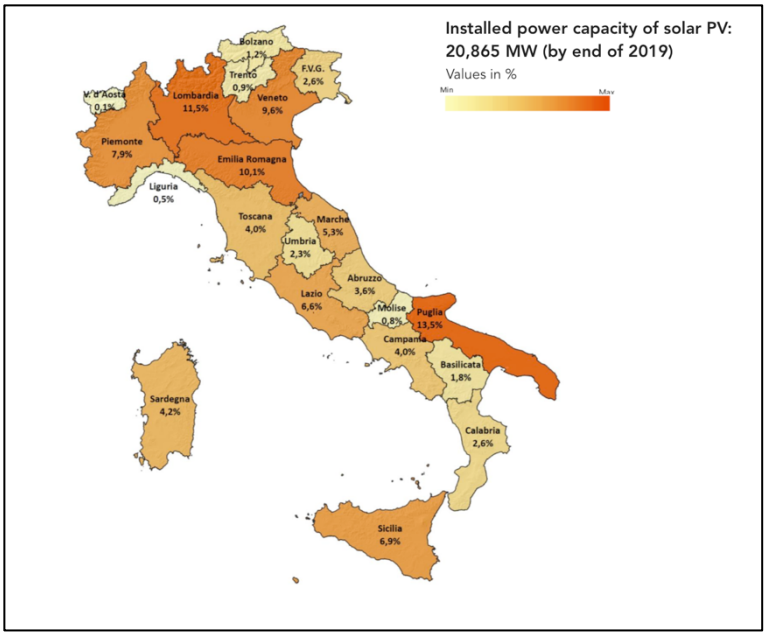

Figure 14: Share in % of installed capacity of solar PV by region at the end of 2019 (adapted from GSE 2020)

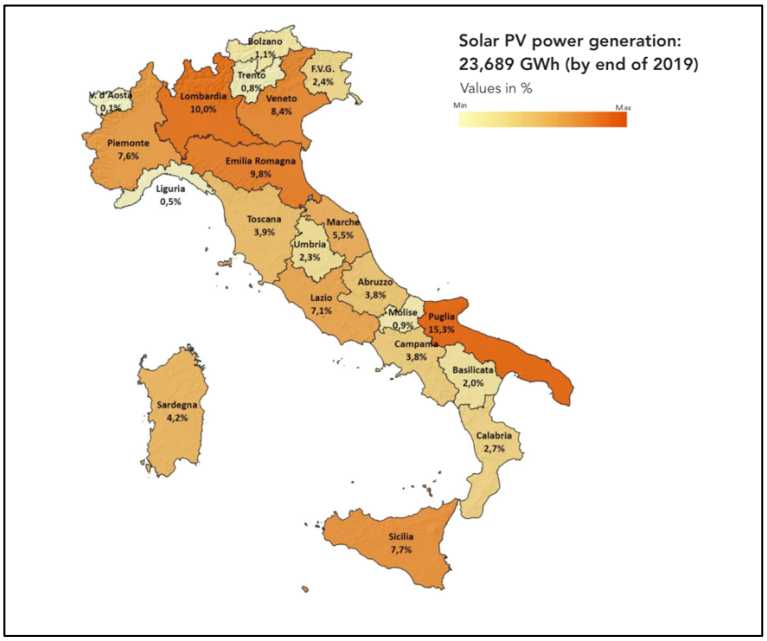

Figure 15: Share in % of solar PV power generation by region at the end of 2019 (adapted from GSE 2020)

It is also worth pointing out that Sardinia is home to Sarlux 570 MW Integrated Gasification Combined Cycles power plant, which produces electricity from syngas obtained from the on-site

gasification of refinery residues from the Saras refinery complex, where the Sarlux plant is located (Avelli and Collodi 2017). The electricity produced is exported both to the national grid and the refinery (Avelli and Collodi 2017). The Sarlux plant accounted for roughly a third of the electricity produced in Sardinia in 2019 and it can adjust its output to respond to changes in power demand (Politecnico di Milano 2020; Avelli and Collodi 2017). Meanwhile, since the early 2000s, and especially in the last 10 years, following the increasing penetration of wind and solar PV, Sardinia has increasingly become a net exporter of electricity, as seen in figure 16 (Politecnico di Milano 2020). In 2018 alone the region exported the equivalent to 33.6% of the island's demand (Politecnico di Milano 2020). The development of pumped hydroelectric storage as well as other types of storage could allow a further decoupling between the time electricity is generated from the time electricity is consumed.

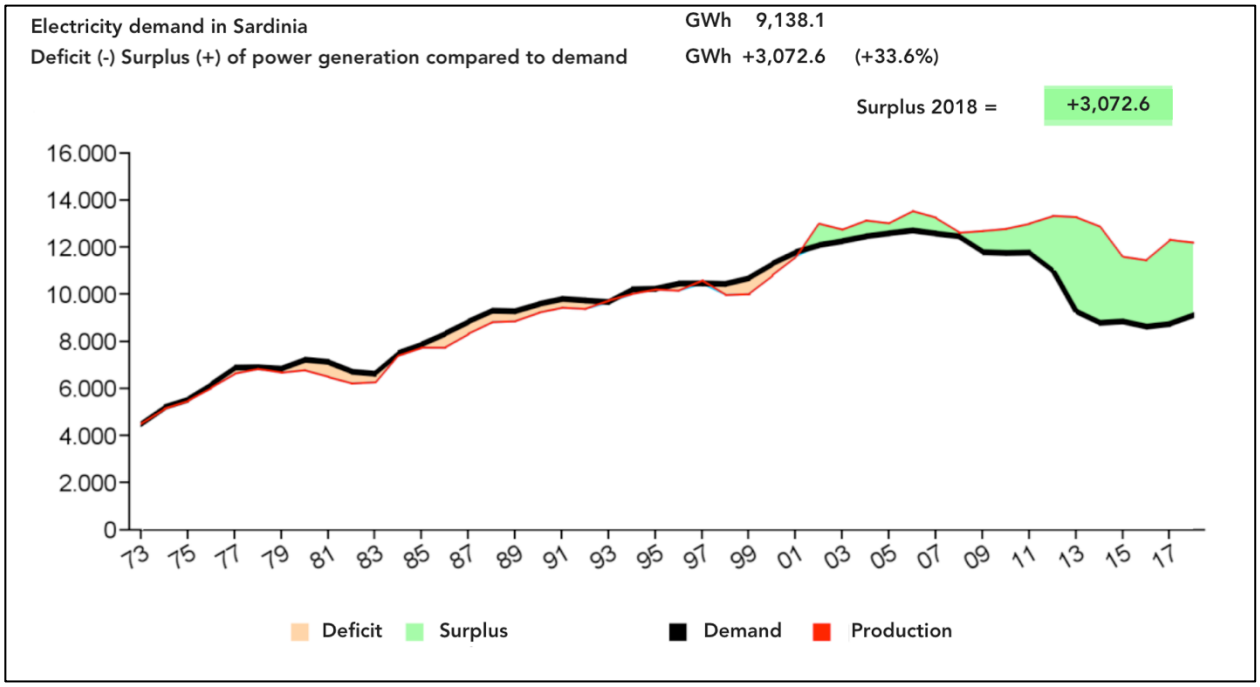

Figure 16: Trend in annual electricity demand and generation in Sardinia and resulting deficit/surplus balance (adapted from Politecnico di Milano 2020)

As for the risk of exacerbating overcapacity in the thermal power sector, the lessons learned from the ongoing overcapacity situation should themselves be a sufficient warning to regulators to

ever-more carefully scrutinise the permitting applications for any new gas-fired capacity. To this end, EIA procedures can be an opportunity for regulators to make better-informed decisions. Furthermore, while this work does not look at the Italian energy planning procedure, it might be useful to consider undertaking a revision that aims at creating mechanisms that contribute to avoiding the build-up of overcapacity.

A third risk identified, both directly and indirectly related to the phase-out of coal, is that of missing the solar PV and wind power installed capacity goals. While this work does not venture deep into Italy's red tape issue, the European Commission's feedback to Italy's draft National Energy and Climate Plan is clear on the need for Italy to speed up the regulatory framework that would allow for the promotion and uptake of PPAs and repowering.

6. Conclusions

The scientific evidence presented by the IPCC indicates that limiting the global average temperature increase to 1.5°C above pre-industrial levels as opposed to 2.0°C is desirable, as it entails significantly lower impact risks. To achieve that, the IPCC suggests that CO_2 emissions must reach net-zero by 2050, followed by non-CO_2 GHG emissions by 2070. The EU, a signatory of the Paris Agreement, has pledged to reach net-zero GHG emissions by 2050. It is currently working on a proposal that would enshrine climate neutrality into EU law and would revise the 2030 GHG emissions reduction targets from minus 40% to minus 50-65%, compared to 1990 levels. This target revision will be based on, among other things, the final National Energy and Climate Plans of member states and will be the base for the strengthening of EU's INDCs at COP 26 in 2021.

In 2017 Italy announced an ambitious plan to phase-out coal from power generation by the end of 2025, which at the time powered 8 GW of power plants and accounted for 15% of electricity domestically generated. Three years later, the actual implementation is shifting away from the implementation envisaged in Italy's 2017 National Energy Strategy and Italy's National Energy and Climate Plan.

In particular, it remains still unclear how Sardinia – which hosts 1.2 GW of coal-fired capacity – will manage the transition away from coal, given the infrastructures deemed necessary are not on schedule and pivotal technology decisions are yet to be made. The 1,000 MW Sardinia-Sicily-Italy mainland planned interconnection, the Tyrrhenian Link, is planned to enter fully into service only in 2028, beyond the end of 2025, and even 2028 has been found to be an optimistic estimate at best. Furthermore, no decision has been taken to date on whether to opt for new gas-fired capacity or, alternatively, invest in energy storage, casting doubts about whether either will be ready by the end of 2025. The Sardinian regional government has shown hostility toward the central government coal phase-out implementation plan, asking for an extension until 2030, advocating for new gas-fired capacity, and protesting the Tyrrhenian Link project, claiming it undermines the island energy sovereignty – a claim, however, whose grounds appear to be unfounded.

As for Italy as a whole, in the face of 15 GW of thermal power capacity decommissioned since 2012, and of 10 GW overcapacity rendering thermal power plants economically unviable, the operators of the coal-fired power plants have requested the approval of 5.9 GW of new gas-fired capacity. This is in spite of the fact that Italy's 2017 National Energy Strategy and Italy's National Energy and Climate Plan only envisage 1.5 GW of new gas-fired capacity in relation to the coal phase-out.

It also remains wide unclear how Italy will reach its ambitious solar PV and wind power capacity additions to 2025 and 2030, in the light of the modest progress shown over the past years attributable to weakened economic incentives and a PPA and repowering regulatory framework which is still in its bare infancy.

In light of this, policymakers and regulators are in the position to take corrective actions; however, this remains challenging, also in light of the discording stances and interests at different levels of the energy governance.

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