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Cite as: AIP Conference Proceedings **2191**, 020072 (2019); https://doi.org/10.1063/1.5138805
Published Online: 17 December 2019

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Understanding the Status of the Carbon Capture and Storage Technology in Italy: A Discussion Based on a SWOT Analysis

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Abstract. In the framework of mitigation actions aimed at counteracting the carbon emissions from the electricity generation sector, Carbon Capture and Storage (CCS) is increasingly being recognized as a viable and practical solution, especially in the short term. Usually, the convenience of a CCS project on a specific technology of power generation plant is established by comparing each investment with and without CCS from a technical and economic point of view. The evaluation of the cost-effectiveness of an investment, however, cannot be limited to the sole quantitative analysis, rather should also embrace the evaluation of qualitative factors, including political and societal aspects. This is all the more evident when the Italian situation is taking into consideration. Within this context, this paper firstly conducts a techno-economic assessment of CCS projects in Italian power plants and, subsequently, proposes a systematic evaluation of those factors influencing CCS investments in Italy. To this end, a SWOT analysis is conducted to emphasize the Strengths, the Weaknesses as well as the Opportunities and Threats of CCS projects, thus trying to propose solutions and countermeasures for the success of such investment decisions in Italy.

Keywords: Carbon Capture and Storage (CCS); Italian power plants; Techno-economic assessment; LCOE; SWOT analysis; Electricity generation

INTRODUCTION

Nowadays, the consequences caused by the consistent release to the atmosphere of greenhouse gas emissions from anthropogenic activities, as those attributed to the power sector, are undeniable [1]. At the same time, it is also unquestionable that the global request for electricity has showed a tremendous increase during the last decade [2]. Being emissions reduction and demand growth definitely opposite goals, focused actions are necessary to target the decarbonisation of the power sector. Within this challenging framework, Carbon Capture and Storage (CCS) has been identified as a promising solution to deal with both the increasing production of electricity and the reduction of carbon emissions, especially in the short term [3]. The CCS acronym refers to the entire chain of capture, transport and storage of carbon dioxide in power plants.

The implementation of the CCS technology within power plants is addressed in literature from different perspectives. The most widespread studied topic consists in the techno-economic assessment of a CCS investment, typically comparing two different plant configurations [4]. Specifically, the comparison is done evaluating on one side the cost of electricity for a power plant without CCS and, on the other side, the cost of electricity for a new power plant equipped with a CO_2 capture unit (characterized by the specific modelled capture technologies) [5]. The most diffused works in literature offer detailed techno-economic assessments of supercritical pulverized coal plant (SPCC), natural gas combined cycle (NGCC) and integrated gasification combined cycle (IGCC) plants, evaluating the suitability of each production technology to be equipped with a capture unit [6-9]. As regard to the specific case of the Italian territory, Pettinau et al. applied a techno-economic analysis to compare USC and IGCC at different capture

74th ATI National Congress
AIP Conf. Proc. 2191, 020072-1–020072-10; https://doi.org/10.1063/1.5138805
Published by AIP Publishing. 978-0-7354-1938-4/$30.00

rate [10]. Fichera et al. added the investigation of NGCC plants to the study of USC and IGCC plants in Italy [11]. Usually, in these papers, the economic aspect is studied through the calculation of two main indicators: *(i)* the levelised cost of electricity, indicated with the acronym LCOE, for both the scenarios of power plants with and without CCS technology and *(ii)* the mitigation cost (MC), i.e. the cost of the CO_2 avoided [12]. Technical features are taken into account on a case-by-case basis by evaluating the capture process, typically distinguishing between pre- and post-combustion and oxyfuel capture technologies [13-14]. Other contributions added a feasibility study on the geological site for the storage of the captured CO_2 [15].

The value of these papers is unquestionable; however, it is also important to highlight those aspects that do not necessarily refer to the sole economic and technological aspects [4]. Political, legal, environmental, social and cultural aspects assume a great significance in the evaluation of the potential diffusion of CCS technologies [16]. Moreover, even the technology and the economy of an investment should be studied in light of this different view, for instance considering the technological maturity and development as well as the finances of the country in which CCS investments are going to be planned.

In this perspective, Zhang et al. [17] proposed a road mapping process to forecast how research, industries and government can affect either supporting or obstructing the diffusion of CCS technologies in China. Ashworth et al. [18] developed an in-depth analysis of the CCS state-of-art focusing in particular on both the social acceptance and the involvement of stakeholders. The public perception of CCS is also the subject of the paper of Chen et al. [19] who conducted a national survey to properly investigate how CCS and climate change is considered by the public and debating about the support of national policies in China. The fundamental role of a strategic political direction to consolidate the diffusion of CCS is also confirmed by the analysis conducted by Zheng et al. [20]. A more integrated approach to study the success of CCS in China is presented by Viebahn et al. [21]. The authors evaluated the viability of CCS considering the involvement of stakeholders as in [18] but also analyzing commercial, economic, environmental aspects as well as the national storage potential.

As emerge from the literature review conducted so far, the study of qualitative factors is addressed in literature considering different approaches, ranging from road mapping to sensitivity analysis. Some authors also implemented the SWOT (strengths, weaknesses, opportunities and threats) analysis to investigate the status of the CCS development. In this direction, Huaman and Jun [22] proposed a comprehensive review of methods to investigate the viability of CCS investments; here, they also recognized the beneficial information that may derive from a well-structured SWOT analysis. Similarly, Ming et al. [23] conduct a SWOT analysis to orient CCS investment decisions in China.

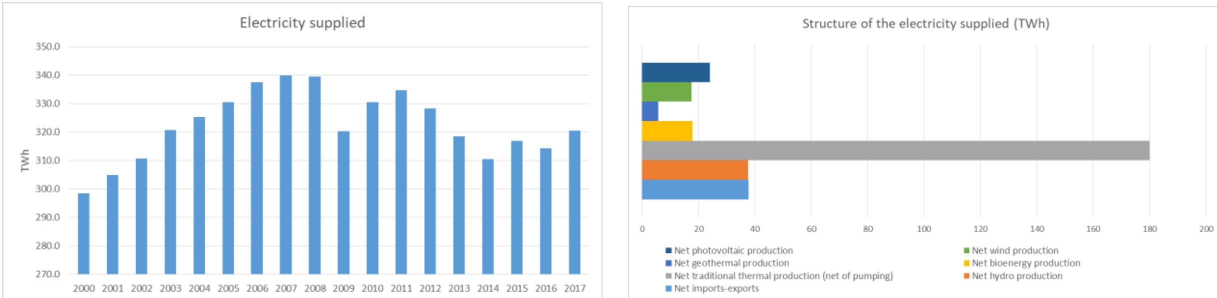
This paper takes inspiration from the cited literature and aims at evaluating the qualitative factors affecting the success of a CCS investment, beyond conducting a techno-economic assessment of the CCS within Italian power plants. To target the first goal, the LCOE (levelised cost of electricity) and the mitigation costs for Italian USC, NGCC and IGCC power plants are calculated in the two usual scenarios of plant without CCS and plant with CCS. Afterwards, the investigation on qualitative factors affecting the development of CCS projects is carried on through the SWOT analysis, i.e. evaluating strengths, weaknesses, opportunities and threats of a particular investment. Actually, this methodology fits for the scope of both defining a well-structured framework reflecting all the above-mentioned aspects and evaluating correlations among them.

THE ELECTRICITY SECTOR, POLICIES AND CCS PROJECTS IN ITALY

In the following, a framework for the status of the CCS in Italy is provided. This analysis serves as background to properly conduct the SWOT analysis. Firstly, an overview of the energy sector in Italy is discussed. Subsequently, a review of the European and national legislations on CCS followed by a brief overview of the pilot projects in Italy are presented.

The electricity sector in Italy

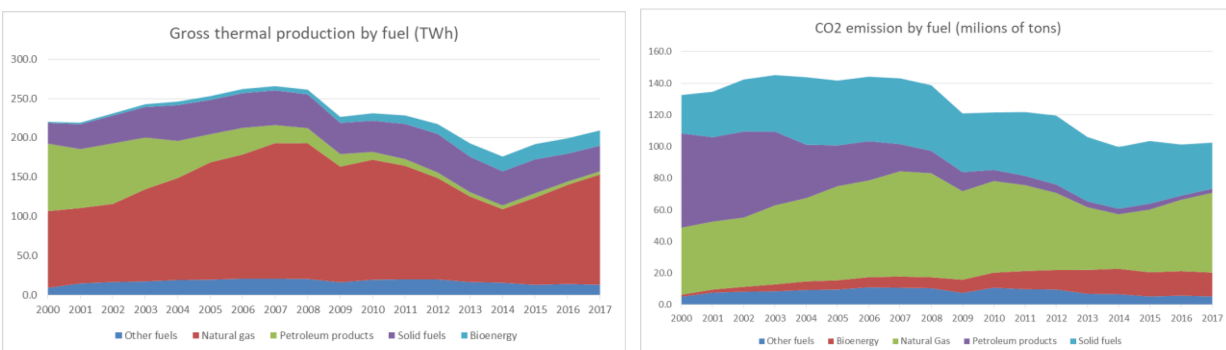
The Italian electricity demand in 2017 reached 320.5 TWh, the 88.2% of it satisfied by domestic production (amounting the installed capacity of 117.1 GW) and the remaining by imports [24]. An overview of the annual electricity supplied to the Italian network is presented in Fig. 1(a), whilst Fig.1(b) plots the details of the structure of the electricity supplied during the year 2017 with reference to the net imports-exports and the net hydro, traditional thermal, bioenergy, geothermal, wind and photovoltaic production.



(a) (b)

FIGURE 1. (a) Electricity supplied to the Italian network; (b) Structure of the electricity supplied *(source: TERNA S.p.A.)*

The Italian fuel mix is characterized by the high utilization of natural gas for the electricity production, as can be seen from Fig. 2(a), where the gross thermal production differentiated by fuel (in TWh) is plotted. Moreover, the production from petroleum products significantly decreases over the decades. Differently, the natural gas remains the lead fuel for the electricity production, despite the decline recorded since 2008. Fig. 2(b) shows the correspondent CO_2 emissions characterized by fuel. The CO_2 emissions show an overall decrease, because of the increment of the production from the renewable sources coupled with the strong reduction in the use of petroleum products.



(a) (b)

FIGURE 2. (a) Gross thermal production by fuel; (b) CO_2 emission for the electricity production by fuel *(source: TERNA S.p.A.)*

With reference to the electricity generation technologies, the majority of Italian power plants are NGCC with a percentage of 79%, followed by the 16% of USC/SC plants and IGCC plants around the 5%; the most diffused plant size is around 650 and 750 MW [25-27]. It is worth noting that the IGCC plants operate mainly at the service of refineries, thus not participating to the national electricity market.

Energy Policy and Regulations

The European Directive 2009/31/CE [28] emphasizes the crucial role of the carbon capture and storage technologies, due to its capacity to significantly reduce the carbon dioxide emissions deriving from industries and, consequently, to mitigate the climate change. This Directive defines a common legal framework for the environmentally safe geological storage of the CO_2. The Italian transposition of the European Directive 2009/31/CE has been completed with the Decree n. 162/2011 [29]. The Italian Decree regulates the search activity, the operation as well as the eventual abandonment of the sites assigned to geological storages ensuring the highest reachable level of efficiency, environmental sustainability and public health's safety. In brief, the Decree: *(i)* gives instructions for the identification of the areas within which the sites for the storage can be selected; *(ii)* poses the conditions for conferring the permissions to the preliminary investigations on the eligibility of the site; *(iii)* lays down financial criteria for the beginning and termination of the investigation activities. Moreover, the Decree also obliges in constituting a database on the storage activities. The Decree has been recently amended through the Law n.122/2016 that in art.32 directly modifies the Decree n.162/2011 [30]. The Directive 2009/31/CE as well as the Italian transposition Decree n.162/2011 with the modifications from art.32 of the Italian Law n.122/2016 are actually in force.

With respect to the environmental laws, the Decree n.162/2011 states that the permissions for the exploration of the geological storage of the CO_2 shall be subjected to the environmental impact assessment procedure established in the Decree n.152/2006 [31]. Referring to the energetic point of view, instead, in 2017 the Italian Government approved the Italy's National Energy Strategy, aiming at achieving competitiveness, sustainability, efficiency and security for the national energy sector [32]. Among the objectives, the decarbonisation of the electricity sector is considered crucial to achieve the sustainability goals established in the Paris Agreement.

Apart from the juridical aspect, an overview of the available technical reports is fundamental. The first contribution in this direction comes exactly from the European Commission, with the Guidance Document 1, 2, 3 and 4 of 2011 [33]. These documents provide specific criteria for the eligibility of the site and the characterization of the storage activities in accordance to the current technological state-of-art and serve for all State Member, Italy included. In addition to the documents in [33], the Italian Standardization Body spread the UNI EN 1918-2:2002 entitled "Gas supply systems – Underground gas storage – Functional recommendations for storage in oil and gas fields", subsequently withdrawn and replaced by the UNI EN 1918-2:2016, currently valid. This standardization norm gives instructions for the design, construction, testing, operation, maintenance and abandonment of underground gas storage fields. Finally, a best practise manual with particular reference to the saline aquifers for the storage of the carbon dioxide has been developed from the IEAGHG (International Energy Agency Greenhouse Gas R&D Programme) [34].

As emerge from the juridical and technical review conducted so far, the key elements of both the Directive and the standardization norm mainly address the storage of the CO_2, the most critical aspect of the entire supply chain of the carbon capture, transport and storage chain.

Experiences from past pilot projects

The most important CCS projects in Italy were activated by Enel, the major Italian company responsible for the supply of electricity. The first project was the ENEL CCS1, a post-combustion capture and storage project in Porto Tolle power station, located in North Italy. The project began in 2006 and the goal was to start the capture of CO_2 from the retrofit of one 660 MWe coal fired unit. The storage of the CO_2 captured was planned by 2015. However, in 2011, the Italian State Council annulled the Environmental Ministry's decree approving this project due to environmental concerns from activists and local industries [35].

In the plant of Brindisi, South Italy, another project was activated by 2007 with the aim of building a pilot plant for the CO_2 separation via ammine scrubbling. In 2008, Enel and the Italian energy company Eni signed an agreement to accelerate the technological maturity for the processes of capture, transport and storage of CO_2 [36]. This agreement aimed at integrating the Enel post-combustion project with the Eni injection project in an exhausted gas field at Cortemaggiore, North Italy. The start of this project was scheduled in 2010 but, unfortunately, it failed due to red tape and, additionally, the dismantling of the plant is expected by 2025 [37].

At the actual stage, the sole project active in Italy is the CARBOSULCIS, in South Sardinia. The aim of this project is to investigate the feasibility of methane recovery and CO_2 storage in the areas of the Sulcis coal basin in which mining activities cannot be conducted. Subsequently to this experimentation phase, the second part of the project will consist in the construction of a pilot demonstrative 50-80 MW plant with capture and storage units [38, 39].

With respect to other initiatives worldwide, the Boundary Dam Carbon Capture Project, owned by Sask Power in Canada, is worth of mention, being it the first pilot project implemented. The project was completed in 2014 and the retrofit of an old carbon-fueled unit permits now to produce 120 MW of base-load electricity. It employs post-combustion amine as capture technology. As reported in the last monthly report available from the owning company, in June 2019 the unit captured 2851 tons of CO_2 with an average 83.66 MW of produced power [40].

THE TECHNO-ECONOMIC ASSESSMENT

As stated in the introduction, it is common in literature to compare two different operating scenarios for power plants. The first scenario refers to the plant without CCS, the second scenario considers the plant equipped with a CCS capture unit and evaluates the cost of transport and storage of the captured CO_2. The comparison is done at fixed plant size and technology and excluding retrofit actions.

The economic assessment takes into account several input data:

- technological issues, such as the power generation technology or the chosen capture technology;
- plant characteristics, i.e. age, geographical information, efficiencies of the different processes;
- economical aspects, including capital costs, variable costs (both fixed and variable), fuel costs, maintenance and similar.

When dealing with the techno-economic assessment of a plant through the calculation of the LCOE (Levelised Cost Of Electricity) and the MC (Mitigation Cost), the implemented procedure is simple and substantially consists in the calculation of these two indicators through the following equations in Eq.1) and Eq.2). The LCOE is expressed as cost per unit of production, i.e. €/MWh, for the construction and operation of a power generation plant over an estimated financial life. The MC, expressed as €/tonCO_2, indicates the costs of transport and storage of the captured carbon dioxide. Their expression are given in the following:

$$LCOE = \frac{TCR * FCF + FOMC}{NPR * NPO} + VOMC + HR * FC \qquad 1)$$

$$MC = \frac{LCOE_{CCS} - LCOE_{NO-CCS}}{ER_{NO-CCS} - ER_{CCS}} \qquad 2)$$

The LCOE fundamentally includes three main cost components: fixed, variable and fuel costs. The fixed cost component is calculated considering the total capital requirement (TCR) multiplied by the fixed capacity factor (FCF) and the fixed O&M costs (FOMC); these two elements are then weighted on the net annual generation (NPR) multiplied by the net power output of the plant (NPO). The contribution from the variable O&M costs is assessed through the term VOMC and the fuel cost (FC) through the term HR*FC, being HR the heat rate. The mitigation cost MC in Eq.2) is calculated dividing the difference between the two LCOE of the plant with and without CCS (evidenced by the subscripts) and the difference between the emission rates for both plant configurations (again as can be inferred from the subscripts).

The main technical and economic assumptions assumed in this study are summarized in Table 1. It is worth noting that Italian data referring to existing power plants are often difficult to obtain and, when available, are often partial. Therefore, considering a typical plant size of 700 MW (coherently to the typical widespread size in Italy) the data reported in the following derives from technical reports or have been averaged by the authors in accordance with the Italian standards [41-45].

Table 1. Technical and economic values of some parameters involved in the study, differentiated by the power plant technology

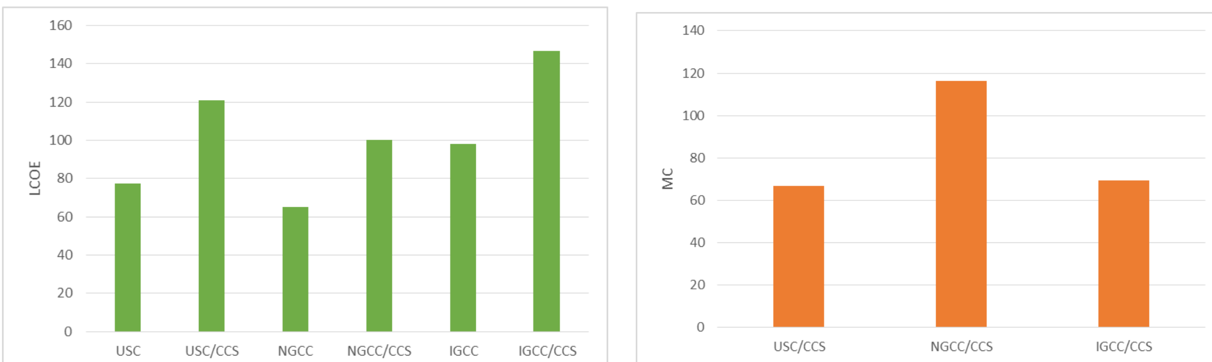
Parameter	USC(USC/CCS)	NGCC(NGCC/CCS)	IGCC(IGCC/CCS)
Power plant size [MW]		~ 700	
Capacity factor [%]	85	85	85
Estimated lifetime [y]	40	30	30
Discount rate [%]	0.1	0.1	0.1
FCF [fraction/year]	0.1023	0.1061	0.1061
LCOE [€/MWh]	77.31(120.77)	65.33(100.25)	98.06(146.59)

The main assumptions for the CCS processes are briefly summarized in Table 2. The capture technology chosen for the USC and NGCC plants is the MEA post-combustion, i.e. using monoethanoloamine, whilst for the IGCC the capture technology is the solvent scrubbing pre-combustion. The data reported in Table 2 derive from available technical reports and have been averaged to the Italian case where needed [46-49].

Table 2. CCS assumptions for the different power plant technologies

Parameter	USC/CCS	NGCC/CSS	IGCC/CCS
Capture technology	MEA post-combustion		Solvent scrubbing pre-combustion
Efficiency, HHV [%]	45(35)	52(47)	40(30)
Emission rate [tCO_2/MWh]	0.8(0.15)	0.4(0.1)	0.85(0.15)
CO_2 pressure [MPa]	11	13	15
Capture system efficiency [%]	90	90	90
CO_2 captured [Mt/y]	3.82	1.13	3.30
Mitigation cost [€/tCO_2]	66.86	116.4	69.33

The results of the calculation are graphically reported in Fig.3. A first peculiar consideration emerges from the fact that the LCOE increases in the scenarios with CCS with respect to the reference scenarios. This is due to both the installation costs (obviously greater with respect to the construction of a traditional power plant) and the loss of efficiency that typically characterizes the CCS plants, and for which, as a further consequence, the cost of the fuel increases. The LCOE is lower for NGCC power plants for both the reference scenario without CCS and the scenario integrating CCS. However, for NGCC plants the mitigation cost is considerably higher with respect to the other technologies. USC and IGCC have similar values of the mitigation cost, but very different from the LCOE viewpoint. In this case, in fact, USC plants have a better economic performance.



(a) (b)

FIGURE 3. (a) LCOE and (b) MC for the different plant configurations

THE SWOT ANALYSIS: METHODOLOGY

The SWOT analysis is a commonly employed tool for the comprehensive evaluation of an investment. The core idea of this methodology is to gain a more detailed understanding of the internal and external environment in which the investment will take place. This increased knowledge will orient strategic decisions and avoid unnecessary (and undesirable) operations. The structure of the SWOT analysis can be well explained by deepening the significance of its acronym. Actually, each analysis identifies the strengths (S), the weaknesses (W), the opportunities (O) and the threats (T) of an investment. Factors S and W are internal factors, i.e. they strictly depend on the investment in itself, whilst O and T are external factors, i.e. they are established by the surrounding environment.

Identification of the strengths

As stated, strengths refer to internal factors, i.e. they depend on the investment. Their identification and discussion is presented below.

1. Italy has a current pilot project in South Sardinia, which can provide fundamental experience and knowledge for further implementation on the industrial scale. Besides, lessons can also be drawn by the past failed projects, in the measure that can help in highlighting what needs to be either improved or avoided.

2. Stakeholders and investors are interested in the recent diffusion of CCS and are willing to invest their know-how on the national and international market.

Identification of the weaknesses

Weaknesses, along with strengths, are internal factors. In the following, the main identified weaknesses of the CCS development in Italy are listed.

1. A first important aspect regards the high costs associated to each CCS investment. This mainly applies to plants with minor sizes, such as those of the demonstration phase of a project. Plants with higher power sizes, in fact, succeed in benefitting of economies of scale and will reasonably benefit also from the shared utilization of the infrastructures devoted to the transport and storage of CO_2 captured [50].
2. The integration of a capture unit to power plants causes the loss of the 20-30% of efficiency. Due to this, more fuel will be burned to produce electricity and, as an evident result, costs will increase.
3. In Italy, there is a lack of incentives and funds related to the CCS technology. This actually corresponds to a poor interest showed from the institutions. It should be recognized that the national legislation allows for credits associated with carbon storage; but, unfortunately, they are not adequate to cover the high costs linked to the investment [50].
4. Despite the maturity achieved by the CCS technology thus far, some aspects still need appropriate and deep studies. For instance, further scientific developments should be addressed to the capture technologies. Actually, even if pre- and post-combustion capture technologies are to some extent consolidated, oxyfuel combustion capture is at an early stage.
5. The economic limit is also coupled to technological risks, such as those that can emerge during the construction of a new installation. Reasonably, investors and stakeholders are not attracted from an investment characterized by doubtful revenues.

Identification of the opportunities

Opportunities are external factors, i.e. they depend on the environments and, generally, from the surroundings conditions, thus are not contingent to the specific investment. Some of these aspects are reported below.

1. It is fundamental to develop actions aiming at increasing the awareness on climate changes at all social levels. What is more important is the need to suggest solutions, such as the CCS, and to highlight their advantages and utility in order to trying to target the mitigation of the consequences due to the carbon dioxide emissions.
2. The development of CCS in Italy strictly depends on the role assumed by the government. Actually, it is advisable to provide incentives to both attract investors and reduce eventual consequences due to the risks associated to the investment.
3. The enhancement of the international cooperation is beneficial from different perspectives: it may provide know-how and it can be inspiring for the Italian political context, in the meaning that it could improve the path towards *ad hoc* defined CCS legislations.
4. The network of collaboration between countries can lead the way to the sharing not only of competences and expertise, but also of resources or infrastructures.

Identification of the threats

Finally, threats are investigated. They are external factors and can be assumed as follows.

1. The identification of the storage potential in Italy is difficult for two main reasons. On one side, a developed knowledge of the geological sites has not been deepened from the perspective of carbon storage. On the other side, there is a lack of studies assessing the storage capacity and the suitability of sites.
2. The current European Direction (as well as the corresponding Italian transposition) assigns to the infrastructure designers the total responsibility of the project and of the injection [50]. Obviously, this discourage the private investors. Therefore, a more active role of the governments is desirable to promote CCS investments.
3. Social public acceptance of CCS, in particular in relation to the storage of the captured capture underground, is a critical aspect that can seriously affect any decision on the development of CCS within the national border. This is fundamentally due to the fact that governments and, generally, public institutions fail to increase the

understanding on both the technology and the advantages that it can be bring. Therefore, a well-structured awareness-raising campaign could help in providing more information at the social level and to rekindling a sense of personal engagement.

IDENTIFICATION AND EVALUATION OF STRATEGIES

Beyond the distinction of the factors in the SWOT matrix in internal and external factors, a further discussion arises from the typology of intervention strategies. In this sense, four different strategies may be identified:

1) SO – strength/opportunity. This strategy is aggressive, leveraging on the strengths of the investment in order to maximize opportunities. In this direction, in Italy, the experience gained within the current pilot project in Sardinia, as well as the previous failed projects, can help in boosting solutions to guarantee the development of the CCS. In this sense, opportunities such as the definition of international agreements can reinforce the solidity of the project. This strategy can also be accompanied by a strong stance of the national government in enacting legislative actions to support the diffusion of CCS.
2) WO – weakness/opportunity. In this case, the strategy is considered conservative since the opportunities are exploited to reinforce the points of weakness of the investment. In this regard, the possible arising cooperation between governments and private stakeholder can be the keystone for formulating policies and regulations aiming at improving the direct involvement of the investors in the development of CCS. Actually, one of the major concerns is properly the lack of incentives useful to attract investors.
3) ST – strength/threat. Here the strategy can be identified as competitive, thus being fully aware of the strengths of the investment, undesirable threats are avoided. A possible competitive behaviour in Italy can arise by creating a social public acceptance of the project in Sardinia, for instance highlighting not only the environmental advantages, but also raising awareness on the employment opportunities deriving from the carbon and CCS supply chain.
4) WT – weakness/threat. This strategy is defensive, deep knowledge of the weaknesses of the investment, the decision maker carefully take decision to avoid threats. In Italy, a defensive strategy can be implemented by fostering the research on incentivizing the research for the technological improvement of the capture technologies, especially for the oxyfuel combustion. Another typical defensive strategy can be recognized in an accurate financial campaign before moving any concrete steps towards the definition of a CCS project.

CONCLUSIONS

The successful development of CCS strictly depends on both quantitative and qualitative aspects. However, despite qualitative aspects can be more easily measured, qualitative aspects are more difficult to evaluate. Industries, society, public perception, regulations and incentives are some of the key elements that should be taken into consideration to evaluate any CCS development process. In addition to this, site-specific factors related to the country in which CCS is planned affect the analysis as well.

To achieve the goal of raising awareness on the successful development of CCS in Italy, a techno-economic assessment of CCS is presented. Afterwards, the influence of qualitative factors on the development of CCS in Italy is evaluated through a SWOT analysis coupled with the definition of possible and differentiated strategies.

With respect to the techno-economic aspects, CCS in Italy are affordable, especially for USC power plants, which is a positive feedback for the CCS project currently active in the Sulcis basin. Although the NGCC plants are the most diffused electricity generation technology in Italy, their involvement in the capture process is not convenient neither in terms of the levelised cost of electricity nor in terms of the mitigation cost. IGCC results are more convenient with respect to the NGCC, but it has to be pointed out that their diffusion in Italy is at the service of refineries. From the qualitative point of view, the status of the CCS in Italy is critical, mainly due to the lack of regulations aiming at supporting the local investors. Other critical aspects can be identified in the common social acceptance of CCS technologies and in the partial knowledge of suitable sites in which the captured carbon dioxide can be effectively stored in a secure way. On the contrary, strengths can be recognized in the experience and know-how achieved during the past (although failed) and the current projects in the Sulcis basin.

From the conducted analysis, it generally emerges that the development of CCS projects in Italy will be a long lasting process, in which the government will play the most impacting role. Actually, institutions should define proper regulations or incentives, as well as promote the concrete involvement of investors and people, being investors necessary to implement any action from the financial point of view and people fundamental to guarantee continuity and support from the social viewpoint. Coupling these observations with the results deriving from the quantitative analysis, the CCS project in the Sulcis basin can have good chance in succeed where previous projects failed.

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