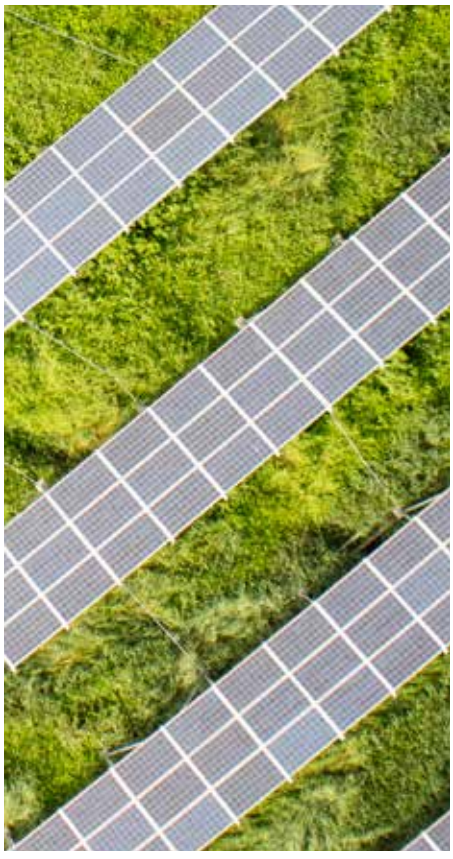
ENERGY TRANSITION

Sectoral Strategic Guidelines



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CONTENTS

KEY MESSAGES

- In July 2021, the European Commission adopted the **"Fit for 55" package**, with the aim of **reducing greenhouse gas emissions by at least 55% by 2030** compared to 1990 levels, boosting the previous target set at 40%.

- At the national level, **Italy has fully met the targets** of the current climate and energy package with a **2020 horizon**, with particularly positive results in reducing emissions and energy consumption.

- Achieving the objectives set for 2030, on the contrary, will require a **decisive change of direction to accelerate the dynamics in progress**, also considering that the Integrated National Energy and Climate Plan, which was drawn up before the increase in the targets, had an estimated additional investment need of 180 billion euro.

- The promotion of the green economy and the reduction of greenhouse gas emissions cannot, however, ignore the need **to guarantee the security of the national energy system**, ensuring the supply system through an **adequate development and maintenance of strategic infrastructures**.

- The priority areas of operation to promote the energy transition to a climate-neutral economy, following a gradual path, are essentially five:

  - **increasing the weight of renewable energy sources in the energy mix.** On the one hand, it is necessary to **upgrade plants** and, on the other, **to adapt the transmission and distribution infrastructures** from a "smart" perspective, and to **develop storage systems** to overcome intermittent production;

  - **electrification of energy consumption.** Priority must be given to the transport and civil-use sectors, promoting on the one hand the **development of an industrial chain** capable of exploiting the potential of the transition to **electric motors**, and on the other the **potential of new heating/cooling technologies**;

  - **energy efficiency.** The greatest opportunities concern the **civil sector** and, in particular, **regeneration projects** of the building stock geared towards the conversion to nearly zero-energy buildings, the dissemination of **energy-efficient building technologies** such as heat pumps and district heating, and the development of smart building solutions;

  - **new technologies and new energy carriers, such as hydrogen and biofuels.** In order to allow the development of alternative energy carriers, it is essential **to intervene on the infrastructure and networks front** (gas mixing, new or converted infrastructures) **and on the industrial and mobility front**;

  - **promotion of energy security.** In the light of developments in the international context, it is appropriate to **strengthen and diversify interconnections with foreign countries**, with reference to natural gas.

- In this context, CDP can intervene, according to **additionality and complementarity criteria, helping to fill the investment gaps** in sectors and territories where market operators fail to mobilise adequate resources, and **providing support to Public Administrations** in the management of authorisation processes, also in order to contribute to their simplification and/or acceleration.

- To ensure **transparency** and accountability of decision-making processes, CDP aims to measure the quality and impact of the supported actions. To this end, CDP uses a **set of KPIs** for monitoring and evaluating each field of action.

1. Context

1. CONTEXT

1.1 EUROPEAN OBJECTIVES FOR THE ENERGY TRANSITION

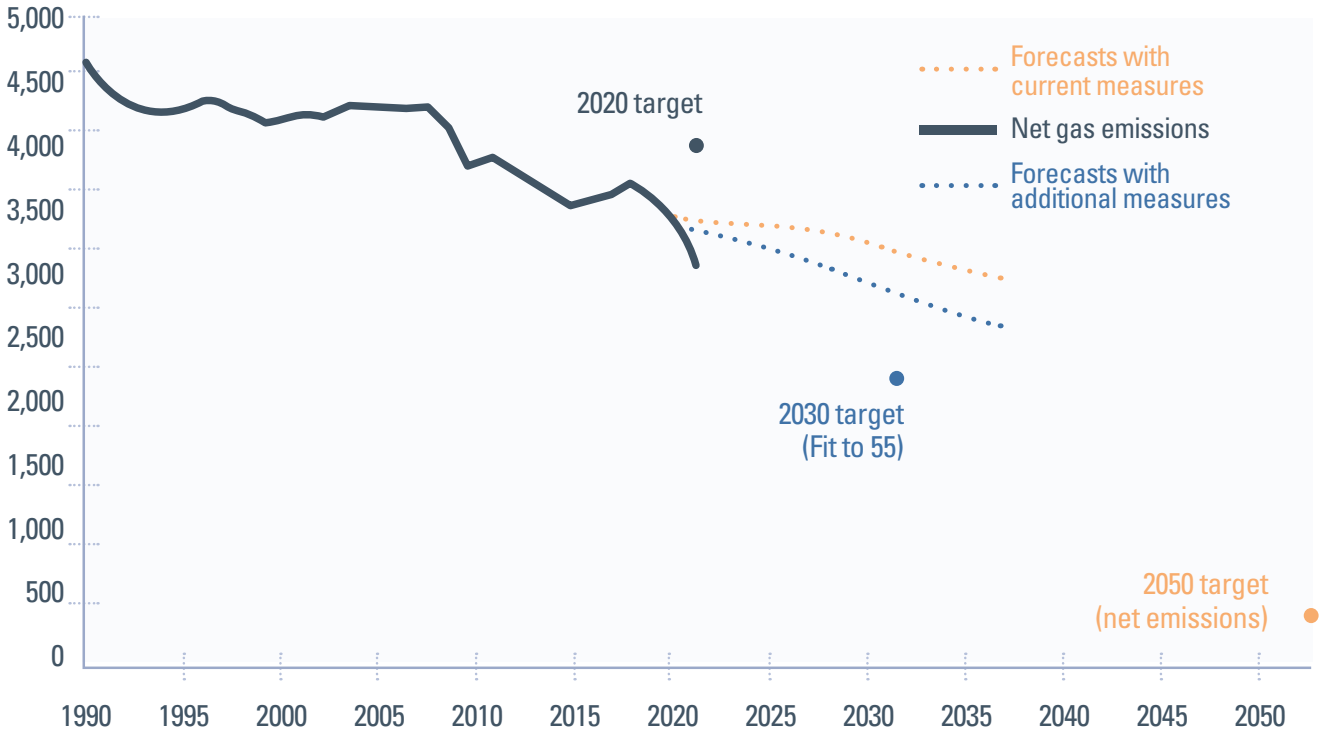
The European Union (EU) has for some time now embarked on a path aimed at reducing its environmental impact seeking **to reach "net zero" emissions** by 2050: a scenario of economy with zero greenhouse gas emissions, where for each emission produced an offsetting mechanism is provided to ensure a **neutral climate impact**.

As part of the European Green Deal, in July 2021 the European Commission adopted the "**Fit for 55" package**, with the new and more ambitious target to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. In addition, following Russia's invasion of Ukraine, the European Commission, as part of the **REPowerEU plan presented in May 2022, further tightened the targets for renewables and energy efficiency**, in order to break free from foreign dependence more quickly.

With reference to the targets set for **2020**, the EU as a whole has shown **good performance, exceeding the target by more than 10%** (20% reduction compared to 1990), also thanks to an acceleration recorded in the last year due to the lockdowns linked to the pandemic crisis.

However, reaching the targets set by the new regulatory framework for 2030 will require **an acceleration of the emission reduction trajectories**, with the need to deploy not only **additional measures** to those envisaged to date, but a **real change of direction**. Under **the current climate legislation**, the European Union would be able to achieve **a reduction of only 60% in emissions by 2050**[1] (chart 1).

CHART 1 - EVOLUTION OF GREENHOUSE GAS EMISSIONS IN THE EU (MTCO2E)



Source: European Environment Agency, 2021

The process initiated for the approval of the "Fit for 55" package, which requires agreement among the various stakeholders, will still take a **long time to define the country-specific targets and to implement them in national legislation**[2].

[1] Bruegel blog post, Fit for 55 marks Europe's climate moment of truth, 2021.
[2] https://www.consilium.europa.eu/it/infographics/fit-for-55-how-the-eu-delivers-the-green-transition/
The Council and the European Parliament will have to formally adopt the texts by 2026.

In this context, it is clear that the Integrated National Energy and Climate Plan (PNIEC) of January 2020 will also have to be updated, revising upwards the objectives for 2030. In summary, the package includes **thirteen lines of action**, including legislative proposals and amendments to current EU legislation[3], aimed at addressing the most important aspects governing energy markets and the sectors most involved in greenhouse gas emissions (Figure 1).

FIG. 1

FIT FOR 55 LINES OF ACTION

1. **Revision of the EU Emissions Trading System**
   Maritime, aviation sector and Carbon Offsetting and Reduction Scheme for International Aviation
2. **Amendment of the Renewable Energy Directive (RED)**
3. **Amendment of the Energy Efficiency Directive (EED)**
4. **Amendment of the CO2 emission performance standards for cars and vans**
5. **Revision of the Regulation on Land Use, Land Use Change and Forestry (LULUCF)**
6. **Revision of the Member States' Effort Sharing Regulation (ESR)**
7. **Revision of the Directive on Deployment of Alternative Fuels Infrastructure**
8. **Revision of the Energy Taxation Directive**
9. **Proposal for a Carbon Border Adjustment Mechanism (CBAM)**
10. **New Social Climate Fund**
11. **Reducing methane emissions in the energy sector**
12. **Revision of the Third Energy Package for gas**
13. **Revision of the Energy Performance of Buildings Directive (EPBD)**

Source: CDP calculations on European Commission data, 2021

Although this is an evolving scenario, also with respect to the REPowerEU boosted targets, it is possible to analyse some initiatives of the July plan for which specific targets have been defined at EU level, which immediately require a paradigm shift for the individual economic systems. More specifically:

- the revision **of the EU Emissions Trading System** , for the sectors defined as "hard-to-abate"[4] includes a new reduction target that goes by 2030 from 43% to 61% of emissions compared to 2005 levels, with a **reshaping of the emission allowances allocated to individual sectors and countries.**

[3] https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/package-fit-for-55.
The last three proposals were adopted and communicated in December 2021.

[4] The European ETS covers the following gases: i) Carbon dioxide (CO2) deriving from the production of electricity and heat, from energy-intensive industrial sectors, including oil refineries, steel mills and the production of iron, metals, aluminium, cement, lime, glass, ceramics, wood pulp, paper, cardboard, acids and large-scale organic chemicals, from air transport; ii) Nitrous oxide (N2O) deriving from the production of nitric, adipic and glyoxylic and glyoxal acid; iii) Perfluorocarbons (PFCs) deriving from the production of aluminium" (ISPRA, 2021).

The range of sectors covered by the ETS will then be gradually extended to maritime transport (in 2023) and, starting in 2025, a separate system will be created to support the energy efficiency of buildings and road transport;

- the revision of the **Renewable Energy** Directive (RED II) proposes to move from the current target - at least 32% of consumption from renewable energy sources at national level - **to** at least 40% by 2030[5], which was further increased to **45% in the REPowerEU proposal** of May 2022;

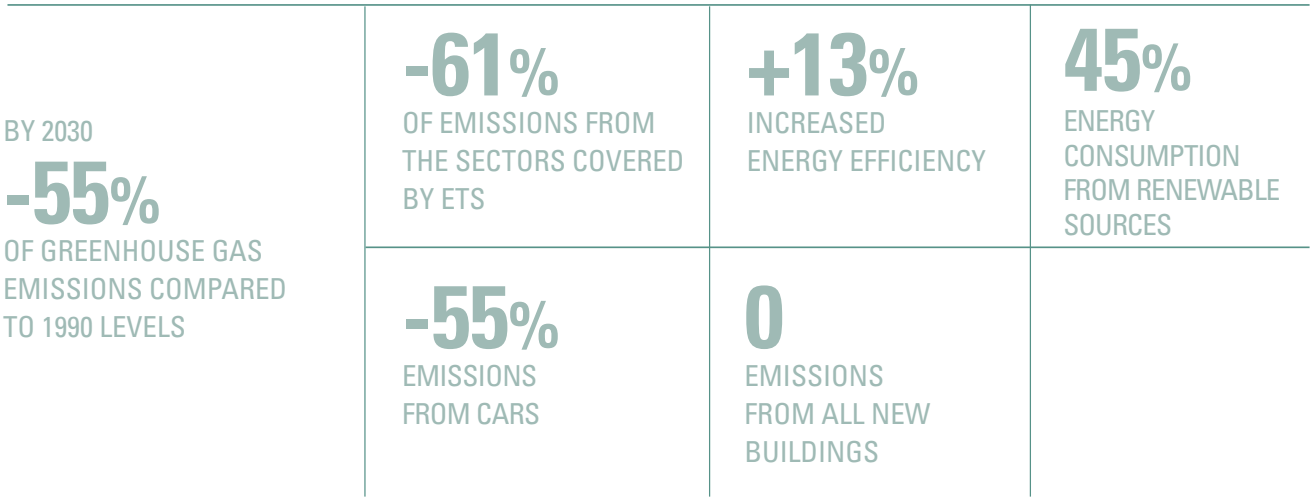
- the amendment of the Energy Efficiency Directive (EED) requires a 9% increase in efforts to reduce primary and final energy consumption[6] (compared to what was envisaged in 2020) and this target has been brought up to **13% by 2030 in the REPowerEU plan**;

- the amendment to the CO_2 regulation provides for a **reduction of at least 55% in car emissions by 2030**, at least 50% in vans and in the registration of **only "zero emission" cars from 2035**;

- the creation of the **Social Climate Fund** includes part of the resources for the renovation of housing and public buildings with a view to **energy saving and security**. Specifically, the Commission proposes to (i) renovate at least 3% of the total covered area of all public buildings each year, (ii) set a benchmark of 49% of renewable energy in buildings by 2030 and (iii) increase the use of renewable energy for heating and cooling by 1.1% per year until 2030[7];

- the revision of the Energy Performance of Buildings Directive provides for (i) **new buildings to be zero-emission** by 2030; (ii) the integration **of minimum efficiency standards at EU level**, with residential buildings upgraded from Class G to Class F by 2030 and to Class E by 2033[8] (figure 2).

FIG. 2 – SOME KEY OBJECTIVES OF THE "FIT FOR 55" AND REPOWEREU PACKAGE



Source: CDP calculations on European Commission data, 2022

[5] https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)698781
[6] Primary energy consumption is defined as the total energy demand within a country excluding non-energy uses (such as natural gas used in the chemical industry or bitumen for road surfaces). Final energy consumption, on the other hand, represents the use by final consumers of all energy arriving directly in buildings (e.g. households, industry). Any discrepancies are mainly attributable to losses in the transformation and distribution processes.
[7] European Commission, 2022.
[8] The target of zero-emission buildings for new public buildings is 2027; Italian Chamber of Deputies, Energy Saving and Efficiency - Studi - Attività produttive, 2022.

1.2 ITALY'S POSITIONING: STRENGTHS AND GAPS

Strenghts

Fully meet and exceed **2020 targets**

Electrification of industry above the EU average

Virtuous dynamics of **energy efficiency of industrial processes**

Gaps

Slow growth in the share of **renewables** in production

Foreign dependence of supply system

Need to adapt networks in a smart and efficient way

Low weight of the **electrical component in the transport sector**

The 2020 climate and energy package provided for the achievement of three key objectives (20-20-20 targets):
- a 20% reduction in greenhouse gas emissions (from 1990 levels);
- a 20% improvement in energy efficiency (in terms of primary and final energy consumption);
- at least 20% of energy from renewable energy sources.

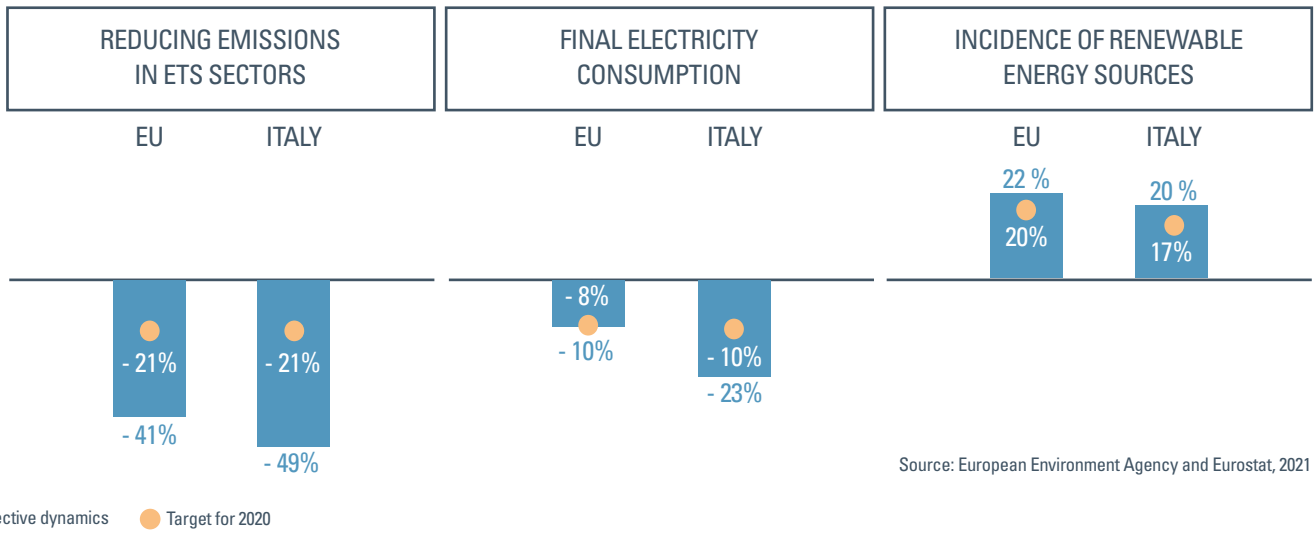
Due in part to the year marked by widespread lockdowns across Europe, with a slowdown in energy consumption, the EU as a whole met its targets, with rare exceptions of slightly underperforming countries. **Italy has shown a particularly brilliant performance.**

In fact, it has contributed to reaching the emissions target by **positioning itself well both with respect to the target of the ETS sectors** – reducing its emissions by almost 50% compared to 2005 levels, more than doubling the EU target of 21% – and to the **specific country target of the non-ETS sectors**[9] by 2020, with a reduction of over 10% compared to the effort initially required (-13%).

Similarly, on the energy efficiency front, Italy has been able to **extensively reduce both final and primary energy consumption** by a margin of over 10%, demonstrating a virtuous path compared to other European countries.

Looking at the incidence of energy produced from renewable energy sources, Italy **largely exceeded the targets set at national level** (20% against a target of 17%), but showed a **less convincing performance than the EU average of** 22% (chart 2).

CHART. 2 – ITALIAN AND EUROPEAN POSITIONING WITH RESPECT TO 2020 TARGETS



Source: European Environment Agency and Eurostat, 2021

[9] Residual, residential, agricultural, waste and transport (excluding aviation) industries.

With regard to the **electricity component alone, in 2020 Italy showed a production from renewable energy sources** (bioenergy, hydroelectric, geothermal, photovoltaic and wind) of just under 40%, with a total amount of about 114 terawatt hours (TWh). The path started in the last two decades has seen **an increase of around 15% in the share**, but it is estimated that reaching the **new targets** set in terms of emissions reduction will require a **contribution of renewables to electricity production of around 70% by 2030**[10]. In this perspective, it will be crucial to accelerate the process given that, with unchanged trends, the targets previously set for 2030 would only be reached in 2090[11].

The development of production from renewable energy sources represents a **twofold opportunity for the Italian energy system**, responding on the one hand to **the reduction of the environmental impact**, on the other, from the perspective of energy security, offering the opportunity to **reduce energy dependence**. Our country imports 73% of energy from third countries, positioning itself above the EU average (57%), which historically depends on neighbouring countries and the US for energy raw materials. Specifically, Italy imports 93% of natural gas and 90% of oil[12].

Italy can also count on a greater availability of the solar source than other European peers, thanks to its geographical positioning. With increasing production from renewable energy sources, **expanding the use of electricity in industrial, construction and mobility processes and products represents a great opportunity** in terms of reducing polluting emissions. In this context, Italy boasts an already extremely virtuous positioning on the industrial front with an electrification level equal to 39% compared to the EU average of 34% in 2015[13].

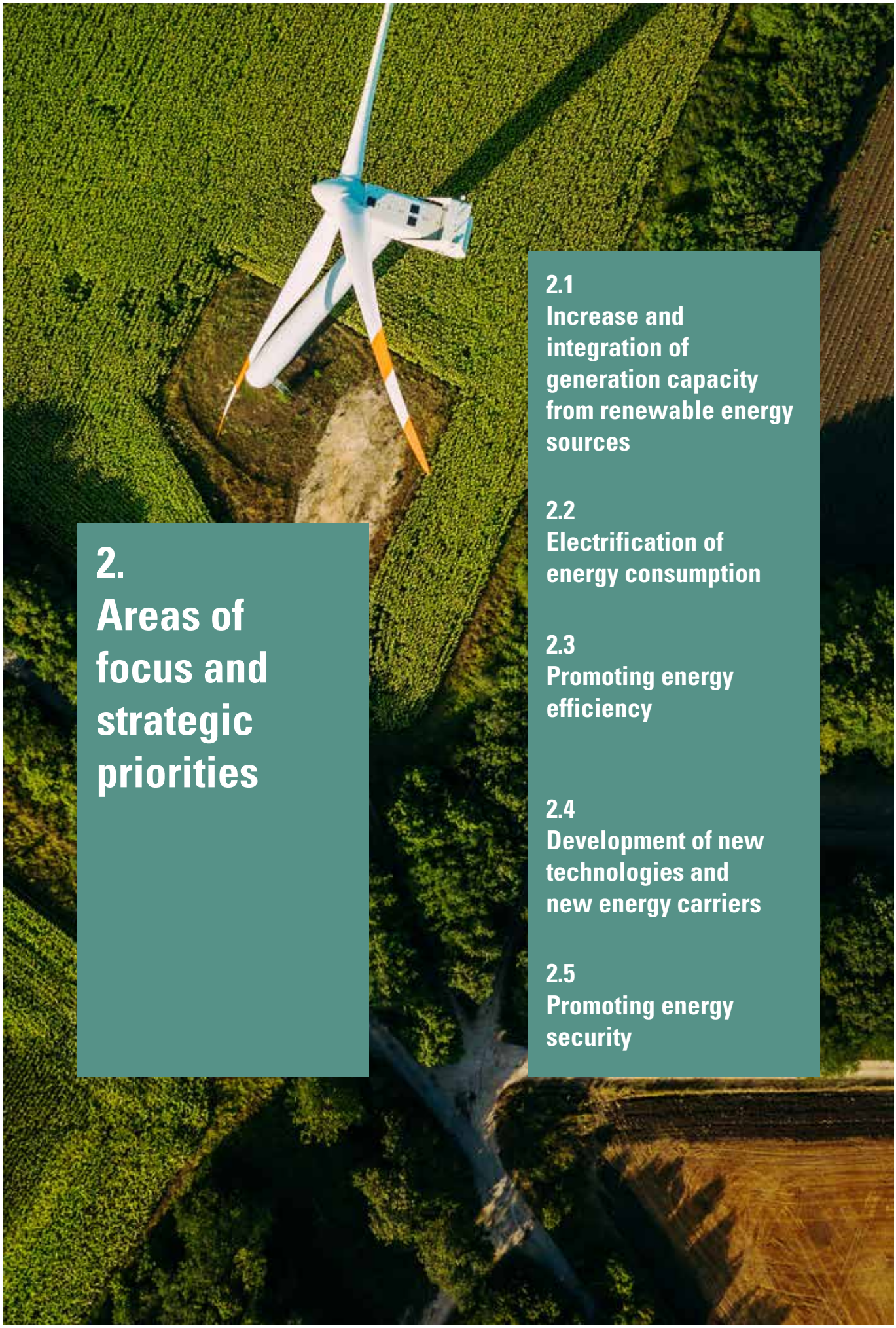
Also with a view to **energy efficiency, the greatest progress was observed in industry**, with an annual increase in energy efficiency of 1.6% and an overall reduction in energy consumption of 14.8 Mtoe (-37%), of which 9.8 Mtoe attributable to energy savings. The **transport sector** has also experienced **steady progress in terms of energy efficiency** (+1.4% per year in the period 2000-2019), with an acceleration in recent years due to the rapid increase in passenger traffic compared to energy consumption[14].

Looking ahead to 2020-2030 and 2030-2050, it will be crucial to act on **other sectors in order to achieve EU targets for a complete energy transition**, including in areas where Italy still has room for improvement, such as **electric mobility**. Although our country has seen significant growth in green car registrations (electric, hybrid and plug-in hybrids), which increased from 6.5% to 40% over the last two years, it still lags behind European peers[15]. With 10% of fully electric (and less polluting) vehicles we are about 20% away from Germany, France and the UK[16] and we still have a limited infrastructure network, with about 0.8 charging stations per 100 km against 3.7 in Great Britain and 2.7 in Germany[17].

It will be important to **rethink public mobility services on the territory** in line with the actions of the National Recovery and Resilience Plan (PNRR). At present, the low use of public transport compared to private transport - the Italian motorisation rate is 62% compared to a European average of just over 50% - is flanked by an offer generally characterised by old and inefficient vehicles (average age of 10.1 years compared to approximately 7 years for other peers)[18].

Similarly, the directive on the energy efficiency of buildings is a rather challenging objective. The Italian context shows an improving dynamics, with the majority of new buildings characterised by the highest energy classes (90% class A-B), but still with broad margins of efficiency, considering that to date **more than 60% of residential buildings and about 45% of non-residential buildings belong to the lower energy classes (F-G)**[19] According to the latest available data, from 2005 to 2019 gas emissions connected to the use of buildings in Italy have been reduced by 18% against an EU average of 23%[20].

[10] Terna, Evoluzione rinnovabile - Piano di Sviluppo 2021 (Renewable Evolution - 2021 Development Plan), 2021; Elettricità Futura, Target Green Deal. Non è un Burden ma un'Opportunity Sharing (It Is Not a Burden But Opportunity Sharing), 2021.
[11] Elettricità Futura, November 2021.
[12] Euorstat, data for 2020.
[13] Enel Foundation, Electrify Italy, 2019.
[14] Source: Odyssee-MUR.
[15] UNRAE, 2022.
[16] ANFIA, Focus Italia Mercato Autovetture, 2022.
[17] ANFIA and Roland Berger, Il futuro del settore automotive, 2020.
[18] Mims (2022) and ASSTRA, Aspetti di rilievo per il settore del trasporto pubblico locale, 2021.
[19] ENEA, Certificazione Energetica degli edifici – Rapporto annuale 2021, 2021.
[20] Euroepan Envinronmental Agency, 2021.



2. Areas of focus and strategic priorities

2.1
Increase and integration of generation capacity from renewable energy sources

2.2
Electrification of energy consumption

2.3
Promoting energy efficiency

2.4
Development of new technologies and new energy carriers

2.5
Promoting energy security

2. AREAS OF FOCUS AND STRATEGIC PRIORITIES

- The pursuit of the objectives set at EU level in terms of energy transition requires Italy to make a **decisive change of direction in order to anticipate sustainable development** that combines solid economic growth with an increasingly efficient use of resources, also in order to contribute to **mitigating** the impacts of climate change.

- The energy transition, in fact, is part of the broader challenge centred on the **fight against climate change**, to be pursued both through **mitigation** strategies, on which this document focuses, and **adaptation** strategies, for which reference should be made to the Strategic Guidelines - Safeguarding natural resources.

- The promotion of the green economy, on the other hand, could generate extremely significant impacts. It is estimated that over the next 10 years, the actions needed to reduce greenhouse gas emissions and achieve climate neutrality could generate income in the order of 400 billion euro[21].

- Against this, already within the framework of the Integrated National Energy and Climate Plan - and thus with a view to reducing emissions by 40% and not by the 55% currently envisaged by EU guidelines - the quantification of additional[22].

- More recently, estimates of additional investment needs for 2021-2030 at European level to achieve the "Fit for 55" targets compared to the previous scenario (-40%) exceed 90 billion euro per year[23].

- Actions should be focused on **four interdependent axes** that, if properly implemented, have the potential to trigger a virtuous circle in the energy sector to support both citizens and businesses and the competitiveness of the entire country. It is essential to act on:

  - increasing and integrating generation capacity from **renewable** energy sources;
  - **the electrification** of energy consumption;
  - the promotion of energy **efficiency**;
  - the development of new initiatives and **new energy carriers**.

- With a view to fully achieving the objectives set, a fifth priority axis is added that concerns the promotion of **the security of the national energy system**, ensuring the adequate sizing and diversification of supply sources and managing the **strategic infrastructures** for the use of transitional energy carriers, such as natural gas, in the gradual transition towards a low-carbon economy.

[21] The European House Ambrosetti, European Governance of the Energy Transition, 2021.
[22] Integrated National Energy and Climate Plan, 2020.
[23] The European House Ambrosetti, European Governance of the Energy Transition, 2021.

2.1 INCREASE AND INTEGRATION OF GENERATION CAPACITY FROM RENEWABLE ENERGY SOURCES

- The need to strengthen the role of RES in the national energy mix requires actions both to **increase their generation capacity** and to ensure their **efficient integration into the transmission and distribution networks**. Indeed, the growth of distributed generation and the peculiar non-programmability of renewable energy sources (especially photovoltaic and wind power) call for a real transformation of networks and management methods from a smart point of view, oriented towards a flexible system through the automation/digitisation of network elements and the transformation of end users into prosumers (producers/consumers) able to actively participate in the energy market.

- Based on these considerations, seven strategic lines of action are outlined:

  - Expansion and consolidation of plants to increase renewable capacity from 57 GW at the end of 2021 to a total of 127 GW by 2030, focusing on the technologies with the highest potential, such as photovoltaics and wind power, but also on the development of innovative RES (e.g. green hydrogen, agrivoltaics, and low landscape impact technologies such as offshore floating plants and wave energy conversion systems)[24]. Achieving this objective entails a clear change of direction in the growth path, bringing the annual increase in renewable capacity from 1 GW (2019-2021 average, of which 0.8 GW photovoltaic and 0.2 GW wind) to 8 GW[25]. The actions must be targeted:

    - to the **construction of new plants**;
    - to the **repowering and revamping of existing plants**;
    - to the **rationalisation of the system of plants** which is, to date, uneven and fragmented.

  - Adaptation of electricity transmission and distribution infrastructures oriented towards the development of "smart grids". In order to enable the growth of non-programmable renewable sources envisaged by the Integrated National Energy and Climate Plan, the volume of investments required for 2030 is estimated at 26 billion euro to intervene on distribution and 10 billion euro to intervene on transmission. In the light of the requirements set by the European "Fit for 55" package, this needs to be revised upwards. The development of the smart grid, for which investment needs are more difficult to estimate, requires the mobilisation of resources, in order both to deploy on a large scale technologies that are, at present, mainly prototypes[26], and to drive research and development activities towards the technological frontier. In this context, investments should be targeted in particular a:

    - **the integration of plants powered by renewable energy sources and distributed generation into the transmission and distribution network**, both through infrastructural measures (e.g. increase in hosting capacity, aggregation of plants and small medium-sized storage systems in microgrids and virtual power plants, development of super grids for transport over long distances at a transnational level), and through solutions that facilitate connection, in particular in low and medium voltage (e.g. smart inverters);

    - **the automation/digitisation of network elements and the enabling of demand-side management**, aimed respectively at greater operational flexibility of the network (through, for example, the automation and remote control of stations and substations, the installation of sensors for the identification and resolution of anomalies, the development of systems for the dynamic evaluation of energy flows) and the optimisation of energy consumption by end users (through, for example, the installation of smart meters and demand-response solutions);

    - **the development of energy communities oriented towards self-production and self-consumption of energy**, also in a multi-carrier perspective, in line with European legislation that promotes the creation of "energy citizens" who are both co-owners and co-users of shared renewable generation plants on varying scales. Although in Italy the energy communities remain a niche phenomenon[27], the theoretical potential is significant: it is estimated in about 20 thousand energy communities, corresponding to 3.5 GW of new generation capacity from RES, 1.3 GWh of installable storage capacity and 5.5 GWh of avoidable network leaks each year[28];

[24] Elettricità Futura, November 2021.
[25] Elettricità Futura, November 2021.
[26] Valenti, M. and Graditi, G., (2020) "Le Smart Grid per un futuro energetico sostenibile e sicuro", Focus ENEA, Energy, Environment and Innovation, 2, pp. 105-108.
[27] Existing studies provide different estimates. Wierling et al. (2021) count 37 energy production cooperatives with a total of 64 production units out of 470 cooperatives. RSE, on the other hand, counted 20 operational ones in 2020, plus 6 in pilot projects. Finally, in a 2021 study, ENEA identifies 14 entities that are similar to energy communities, largely pre-existing the development of EU and Italian legislation.
[28] Energy Strategy Group, Politecnico di Milano, 2020. It should be noted that the National Recovery and Resilience Plan estimates that energy communities and collective self-consumption systems could increase renewable generation capacity by at least 2 GW by 2026, corresponding to about 7% of the total renewable generation capacity needed to reach the target of 30% of total final energy consumption by 2030 (6 GW per year).

- **development of storage systems** to ensure the coverage of energy needs, overcoming intermittent production inherent in the non-programmable and non-predictable nature of renewables, and solving over-generation issues. Based on the Integrated National Energy and Climate Plan, it is necessary to develop by 2030 at least 6 GW of new centralised storage systems, both electrochemical (batteries) and hydroelectric (pumping), for a total investment requirement of at least 10 billion euro[29]. It should be noted that this need for accumulation could increase in light of the updating of the new Integrated National Energy and Climate Plan targets for 2030. At the same time, it is necessary to support the development of technologies that enable energy storage through other carriers such as power-to-gas for storage in the form of hydrogen or methane and high-efficiency cogeneration systems and district heating networks for storage in the form of thermal energy.

2.2 ELECTRIFICATION OF ENERGY CONSUMPTION

- According to the latest available data, the electricity component accounts for just under a quarter of final energy consumption at national level (23%), while oil and natural gas account for about one third of consumption each[30]. **It is estimated that the greatest potential for electrification is attributable to the transport and residential sectors**, with a potential increase in electrification from 3% to 41% and from 15% to 53% respectively in the period from 2015 to 2050. However, further increases are also possible on the industrial front (currently at 39%), up to an estimated 42% in 2050. However, the most important margins in this sector – particularly in the hard-to-abate sectors – lie in the development of new technologies and different energy carriers (e.g. hydrogen), considering that for high temperature processes, electrical technologies require costs that are not competitive with "traditional" systems[31].

- The main development options in the **construction sector** are to be found in the most efficient forms of heating/cooling systems: it will be possible to strengthen **the installation of heat pumps** which, thanks to a potential increase in capacity deriving from actions on networks, represent a key to efficiency and electrification for residential and non-residential buildings. These are systems capable of reducing electricity consumption by up to 50% compared to traditional systems[32] (see section 2.3 of this document).

- In the transport sector, given that it accounts for about one third of greenhouse gas emissions in Italy[33], the opportunity to intervene in support **of electrification in both mass and private mobility is evident**[34]. In the mobility sector, compliance with EU targets would, on the one hand, ensure an improvement in the air conditions of Italian cities, which at European level rank last in terms of air quality - with Milan being in 303rd position out of the 323 observed[35] – and, on the other hand, clash with a supply chain that is not yet ready to face a real technological revolution based on the transition from endothermic to electric engines. In this context, the need emerges, on the supply side, to position Italian players towards new engines, also supporting the growth of transport segments other than cars (e.g. local public transport), and, for a correct indirect increase in demand, to develop the charging infrastructures necessary **to bring public and private charging points for public use from about 26,000 at the end of 2021 to over 100,000 by 2030**[36]. In pursuing these objectives, priority should be given to:

  - **strengthening the industrial sector to support national component manufacturers**, automotive in general and trucks, in the transition to new technologies, through the **support of research and development programmes** aimed at anticipating product and process innovations. At the same time, it will be necessary to train and update those employed in the sector to **form a highly specialised workforce** able to implement the technical and digital challenges. It will therefore be essential to promote **training programmes** for the retraining of workers in the sector, so as to avoid a mismatch between demand and supply of work, while ensuring the presence of professionals with suitable engineering/electronic profiles;

  - **promoting a suitable collaboration between the public and private sectors** in terms of financing and development of projects as tailor-made as possible with respect to the peculiarities of the individual territories. In general, it will be important to make the relationship with local communities more fluid, but also to ensure that local authorities have forms of financing for the entire sustainable LPT chain, from electric "fuel", to vehicles, to the installation and management of charging points;

[29] Terna, Development Plan, 2021; Integrated National Energy and Climate Plan, December 2019.
[30] ARERA, 2021 Annual Report, 2021.
[31] Enel Foundation, Electrify Italy, 2019.
[32] EnelX, 2022.
[33] Enel Foundation, Electrify Italy, 2019.
[34] Here, the electrification of local, public and private mobility is discussed in more detail, while for the electrification of transport infrastructure (e.g. green ports, railways) please refer to the Strategic Guidelines - Transport and Logistics Hubs.
[35] European Environment Agency, European city air quality viewer, 2021.
[36] Motus-E, Dicember 2021.

- **ensuring a homogeneous and widespread diffusion of charging points** with adequate development in terms of i) the entire coverage of the national territory, ii) power and speed (ultra-fast charging models in the motorway and extra-urban network, but also urban hubs for fast charging), iii) urban, extra-urban areas and smaller villages.
  It is also appropriate to encourage the development of **smart charging technology solutions** (e.g. smart charging, vehicle to grid - V2G) that allow to streamline the relationship between demand and supply, for a better distribution of energy loads, thus reaching a "cost-wise" and "grid-wise" supply. Private charging would, for example, favour the use in the evening and at night, when there is greater energy availability than in the daytime, and an energy storage system would represent a lower load for the system.

2.3 PROMOTING ENERGY EFFICIENCY

- The achievement of the EU energy transition objectives cannot be separated from the promotion of energy efficiency, in accordance with the European principle of energy efficiency first. Between 2000 and 2019, Italy recorded an increase of 18.1% in energy efficiency in the final sectors[37], achieving improvements on all fronts, but in a non-uniform way.

- Unlike industry and transport, in the residential sector the improvement in energy efficiency was rather limited (+0.7% per year). Overall, between 2010 and 2019, energy consumption in the residential sector increased by 16%, mainly due to the increase in the number of homes and changes in lifestyle and housing comfort (increase in the number of household appliances per home), only partly offset by greater energy savings[38]. The civil sector (residential and services) today represents the most energy-intensive sector in Italy, absorbing 41.1% of final energy consumption, followed by transport (29.8%) and industry (20.7%).

- Given these trends, **energy efficiency measures must focus, as a priority, on the civil sector**, where the potential for energy savings is more than 60% of the national 2030 target set by the Integrated National Energy and Climate Plan, for an overall reduction estimated at around 15 Mtoe (of which 8 Mtoe in the residential sector and 7 Mtoe in the services sector). The investment needs for 2030 amount to over 170 billion euro, of which 100 billion euro additional to the scenario envisaged before the -Integrated National Energy and Climate Plan. In the light of the requirements set by the European "Fit for 55" package, the investment gap is to be revised upwards compared to what was estimated on the basis of the Integrated National Energy and Climate Plan scenario. In this context, investments should be directed towards:

  - **regeneration novation projects of the building stock**. In order to reach the target of zero direct emissions from the residential sector, it is necessary to increase the annual rate of building renovation from the current 0.81% to 1.16% by 2050[39]. Considering jointly the residential and services sector, it is necessary to double the annual renovation rate of the national building stock, bringing it from 0.8% to 2.1%, in line with the estimates of the European Commission as part of the Renovation Wave strategy[40]. To this end, priority should be given to:

    - **in-depth renovation measures**, drawing on an appropriate mix of technical, tax and regulatory measures, promoting in particular measures aimed at converting near zero-energy buildings (nZEB), which to date represent less than 0.03% of the existing building stock on a regional basis[41];

    - the **promotion of energy-efficient technologies such as heat pumps and district heating**. For heat pumps alone, the cumulative investment needs in the period 2020-2030 for installation in 20% of existing buildings and in all new buildings can be estimated at over 30 billion euro[42]. At the same time, the spread of district heating should be encouraged, especially that based on the distribution of heat generated from renewable sources, waste heat or co-generated in high-efficiency plants (so-called efficient district heating). Compared to the 9.3 TWh distributed today, the potential for the development of district heating is at least four times the current share, for an estimated saving in climate-changing emissions equivalent to the shutdown of about 4 million independent apartment boilers[43].

[37] To measure energy efficiency, reference is made to the ODEX index. Source: Odyssee-MURE.
[38] Source: Odyssee-MUR.
[39] Strategia per la qualificazione energetica del piano immobiliare nazionale (STREPIN), 2020.
[40] The European House Ambrosetti, European Governance of the Energy Transition, 2021.
[41] ENEA, "Rapporto Annuale Efficienza Energetica, Analisi e Risultati delle policy di efficienza energetica del nostro Paese", 2021.
[42] The European House Ambrosetti, European Governance of the Energy Transition, 2021.
[43] Politecnico di Milano and Politecnico di Torino (2020). Assessment of the diffusion potential of efficient district heating in the country.

- the **development of new technologies for the construction of smart buildings** capable of managing and optimising the integration of systems for the production, management and storage of energy from renewable sources. The potential energy savings related to the adoption of "smart" energy management systems in buildings, based on the adoption of data analytics tools, is estimated at up to 20% in the residential sector and up to 30% in the non-residential sector[44]. In this context, the most promising applications concern, in particular, modelling for forecasting and estimating energy demand through real-time monitoring systems, the automatic detection of anomalies or faults in system elements, and the profiling of users in terms of energy demand.

- In the **transport sector**, where the potential energy savings represent 26% of the national target for 2030, it is necessary to focus both on the efficiency of vehicles in circulation (development of vehicles for private, public and commercial use with alternative traction on CNG methane, liquefied natural gas and electricity), and on the efficiency of transport modes (increase in freight transport by rail and waterways for medium-long distances and promotion of smart/shared forms of mobility for the transport of people)[45].

- In the **industrial sector**, whose energy saving potential accounts for about 11% of the national target for 2030, further progress in energy efficiency comes through plant upgrades and/or renovation of machinery and research and development projects (e.g. innovation of production processes). In this context, investments should promote measures for:

  - **the energy efficiency of small and medium-sized enterprises**, which face greater difficulties in adopting energy efficiency measures due to a lack of specific skills, limited training opportunities, difficulties in accessing adequate financial products[46];

  - **energy efficiency for companies operating in the hard-to-abate sectors**, where the greatest potential can be identified in the development of technologies such as hydrogen and CCU (Carbon Capture Utilization) and CCS (Carbon Capture Storage) systems[47].

2.4 DEVELOPMENT OF NEW TECHNOLOGIES AND NEW ENERGY CARRIERS

- Where **electrification projects are not scalable and energy efficiency measures are reduced**, there is room for both **new carbon capture, storage and use technologies** (CCS, CCU) that allow to isolate the greenhouse gas produced by the industry for permanent storage or reuse in other production cycles, and new energy carriers, such as hydrogen. Although these technologies are mistrusted by the public for fear that companies in hard-to-abate sectors will use them as an alibi, the development of these technologies has seen a particularly virtuous dynamic in global emissions reduction in recent decades and, with proper technological development, they can be extended to all innovative uses and processes (e.g. Direct Air Capture -DAC). With respect to technologies at the forefront of innovation, the production of bioenergy from biomass of various origins (animal, vegetable, waste) also represents an opportunity both for the energy transition and for a vision of the economy in a circular perspective for the proper re-use of resources. To date, the production of electricity from bioenergy represents 16% of the total from renewable sources[48], but a proper strengthening of this sector could respond on the one hand to the reconversion of the current traditional system of the refinery and, on the other, to a greater use of renewable sources with the virtuous recycling of waste materials in sectors such as agriculture, as well as, in the future, to the decarbonisation of the transport sector thanks to the use of advanced biofuels.

- With regard to hydrogen, it is currently the **most efficient energy carrier for storing any surplus from renewable sources**, thanks to the process by which energy can be converted[49]. Green hydrogen and, with a view to transition, low-carbon hydrogen[50] epresent an alternative to the current use of methane, with a particularly significant use potential for our country both from an infrastructural point of view, with the possibility of exploiting the current network (mix of carriers, possible reconversion), and for the degree of penetration of gas consumption by consumers (92% of Italian households)[51].

- Hydrogen is the subject of a broader development programme at EU level – the European Clean Hydrogen Alliance – which is expected to produce 10 million tonnes by 2030 through the installation of 40 GW of electrolysers and a 13% share of the European energy mix by 2050. Hydrogen from renewable sources also plays a central role in the REPowerEU plan as a future

[44] Pizzuti S., Chinnici M., e Romano S. (2020). "Tecnologie, dispositivi e strategie per smart building", Focus ENEA, Energia, Ambiente e Innovazione, 3, pp. 117-119.
[45] For the precise identification of the strategic priorities in this area, please refer to the Strategic Guidelines – Transport and Logistics Hub[5].
[46] CNA and the Fondazione per lo Sviluppo Sostenibile (2021), "Non senza le PMI: il ruolo delle piccole e medie imprese nella transizione energetica dell'Italia".
[47] See section 2.4 of this document.
[48] Terna, data at 2020.
[49] Enel Green Power, 2020.
[50] This is known as blue hydrogen, which is obtained by reforming natural gas combined with CCS technologies in order not to disperse the gases released by the process.
[51] Confindustria, Piano d'azione per l'idrogeno, 2020.

carrier that can increasingly replace the use of gas. The Commission plans initiatives to boost production and imports at EU level, with dedicated funds and the development of appropriate infrastructure, including three import corridors through the Mediterranean, the North Sea and, when possible, through Ukraine.

- **For Italy, the 2030 objective is to increase the penetration of hydrogen in final energy demand to 2%**, with an underlying electrolysis capacity of 5 GW[52]. The prospect of lower production costs for green hydrogen makes the carrier increasingly competitive, but to achieve full deployment, it is important to insist on technology development (so as to enable cost reduction), pilot demonstration projects for the entire supply chain, and adequate infrastructure development. In order to boost the growth of the hydrogen market, it is necessary to move simultaneously along short- and long-term lines, both in the industrial and infrastructure sectors. In the short term, therefore, it will be important to prioritise the demand side for the conversion of the hard-to-abate and mobility sectors, while, in the medium to long term, the production side will have to be strengthened, in line with a virtuous increasing use of renewables. In particular, the actions to be pursued in this area include:

  - **supporting the transition of the refinery sector through a conversion of existing plants** towards biorefineries, aimed at producing energy from organic or waste materials of various kinds, also with a view to promoting biofuels;
  - supporting a greater **use of hydrogen in industry**, expanding its application spectrum (currently concentrated mainly in Oil & Gas and chemistry) also thanks to measures to cover the high initial costs and potential risks, and in mobility (in particular in heavy transport, or where there is no possibility of rail electrification);
  - **promoting a partial mixing of hydrogen in the gas network**, with a maximum blend of 15-20% hydrogen, aimed at the gradual decarbonisation of the final use of the gas network for residential use and heating without massive measures on current equipment;
  - supporting **the development of the network infrastructure (new or conversion)**, with projects on specific routes, to **directly connect production plants to end users**, in order to achieve the full potential for performance efficiency in terms of environmental sustainability;
  - promoting **the development of the industrial supply chain**, enhancing the scientific skills already present in the region, also via the creation of **hydrogen valleys** (ecosystems for the consumption and production of hydrogen). In this sense, support would be appropriate for the development of the innovative technologies needed, through **research and development activities and experimental pilot projects** to initiate a hydrogen-based economy system[53] but also, with a view to transition, through more innovative systems aimed at reducing the environmental impact of biogas and bioenergy production in general.

2.5 PROMOTING ENERGY SECURITY

- In pursuing a gradual and orderly transition to a low-carbon economy, one cannot ignore the need to ensure the **security of the national energy system**, which has become extremely important again in the light of **the changing international context** linked, in particular, to the invasion of Ukraine.

- Indeed, the emergency highlighted the **vulnerabilities** of our country in terms of energy security, with reference to the **natural gas supply infrastructures**, which, in the most recent simulations, were close to the critical threshold of inadequacy[54]. Supply from abroad is currently ensured by five gas pipelines with six entry points into the national network and three regasification terminals that, combined, guarantee a nominal import capacity of around 130 billion cubic metres per year **highly concentrated in a limited number of countries with high geopolitical risks**. In the case of gas, Italy depends for almost three quarters of its national supply from Russia (40%) and Algeria (31%)[55].

- It should be borne in mind that, in addition to playing a major role in the national energy balance[56], natural gas can play an important role as a **transitional energy source**, representing the least polluting hydrocarbon[57] and being characterised by greater flexibility in storage.

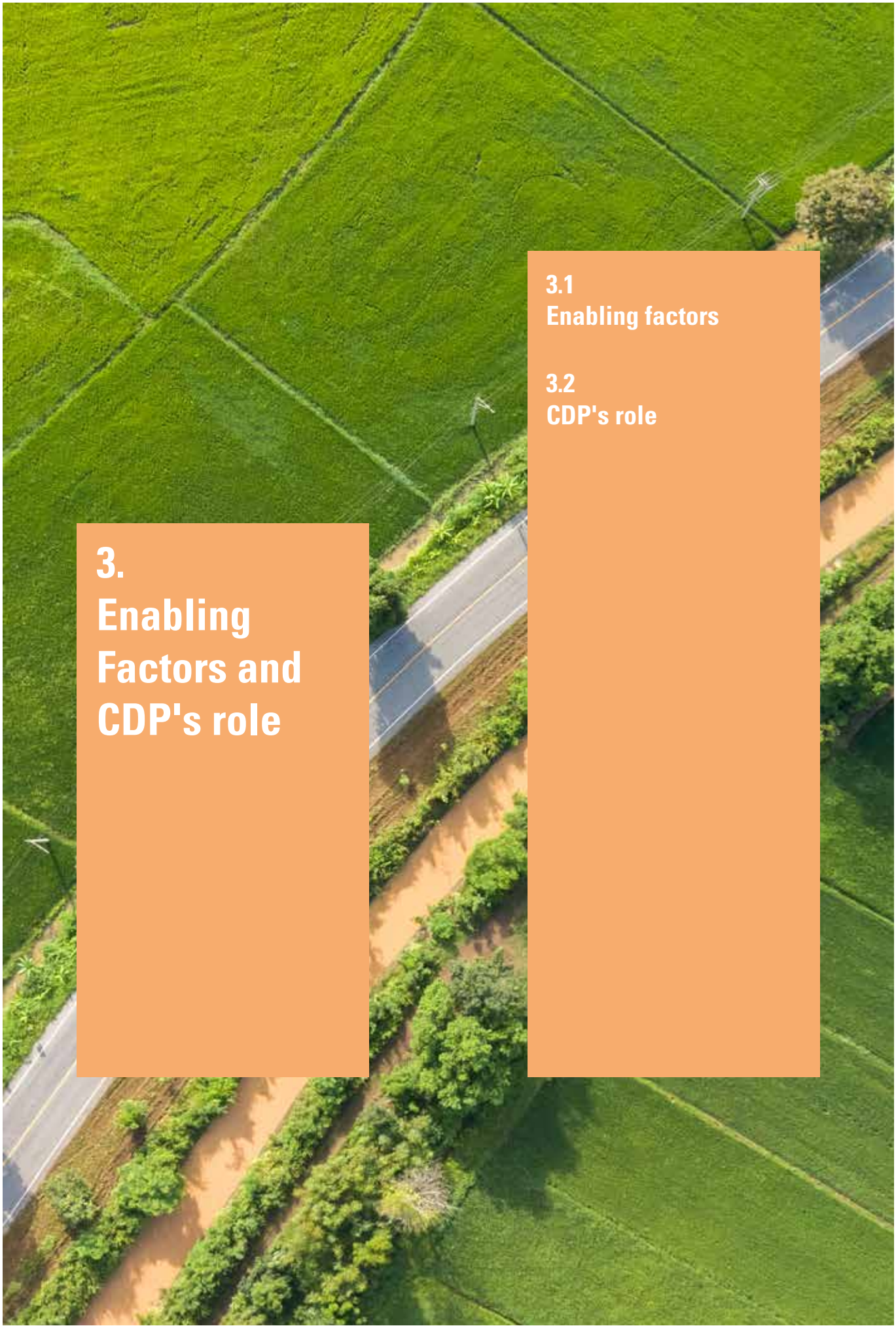
[52] Italian Ministry for Economic Development, National Hydrogen Strategy – Preliminary Guidelines, 2020.
[53] Confindustria, Piano d'azione per l'idrogeno, 2020.
[54] The supply of natural gas from abroad is ensured by five gas pipelines with six points of entry into the national network, and three regasification terminals; together, they guarantee a nominal import capacity of about 130 billion cubic meters per year. According to the simulations, carried out on the basis of the "N-1 Formula" in compliance with EU Regulation 2017/1938 and sent to the European Commission, the national system would face serious difficulties in meeting the maximum daily gas demand in the event that the flow were to be completely interrupted at the main entry point on the national network, where the methane pipeline transporting Russian gas arrives (in Tarvisio, in Friuli-Venezia Giulia).

- It is necessary to outline a **strategy that simultaneously aims at stemming the emergency in the short term**, in order to cope with the possibility of having to find more than 30 billion cubic metres of Russian gas per year, and to **invest in the development of energy security in the medium to long term in a sustainable manner**. Based on these considerations, two lines of action can be identified:

  - **strengthening and diversifying interconnections with foreign countries**, not only in the natural gas sector, but also in the electricity sector. With regard to natural gas, in particular, there is an opportunity in the short term to increase the effective use of the existing natural gas pipelines from North Africa and to increase the TAP capacity, also in view of the gradual depletion of the deposits in other strategic areas (e.g. North Sea). More generally, the actions must be oriented towards **giving value to the geographical position** of Italy, which can aim at playing a leading role as a **natural hub of the Mediterranean area**, also with reference to new energy carriers, such as hydrogen and biogas.

  - **monitoring of supply infrastructures**, especially regarding natural gas. In this context, the actions must aim at **increasing the regasification capacity** to allow a remodulation of gas towards LNG in the short-medium term. In addition to ensuring the full operation of existing terminals[58], it is possible to provide for the construction of **new regasification terminals**, focusing on **floating storage regasification units**, which represent a faster, cheaper solution with a lower socio-environmental impact than onshore systems.

[55] Italian Ministry for Ecological Transition, 2022.
[56] In 2021, natural gas, with about 75 billion cubic metres, accounted for more than two fifths of domestic energy consumption (42%) and almost half of electricity generation (48%). Source: ARERA, Bilancio energetico nazionale, 2021.
[57] For the same amount of energy used, the carbon dioxide produced by the combustion of natural gas is 25-30% less than oil products, and 40-50% less than coal. Source: Snam.
[58] In 2020, the use of the three existing regasification terminals (the Panigaglia terminal, the Rovigo offshore terminal, and the Livorno floating terminal) was 75% of their theoretical capacity.



3. Enabling Factors and CDP's role

3. ENABLING FACTORS AND CDP'S ROLE

3.1. ENABLING FACTORS

- The effective pursuit of the strategic priorities outlined above is linked to at least two enabling context factors:

1. the **simplification and harmonisation of governance**, which, following the Legislator's will expressed in the constitutional reform of 2001 to assign energy matters to the concurrent legislative powers of the State and the Regions, is extremely complex, as responsibilities are divided among multiple institutional players with different competences and interests that do not always converge. Overcoming this fragmentation is necessary on the one hand to ensure the certain and homogeneous application of national legislation at local level (today, for example, the procedures for installing new renewable energy plants follow different patterns in the various regions); and on the other hand to strengthen local stakeholder involvement mechanisms for the prevention of NIMBY (Not In My BackYard) and NIMTO (Not in My Term of Office) phenomena that slow down and hinder investments in the territory;

2. the **streamlining of authorisation processes** aimed at **guaranteeing certain and stable procedures** both for the construction of plants and commissioning them and connecting them to the transmission/distribution grids, as well as **speeding up the time** required to issue permits, which is significantly longer than that of European peers (e.g. 5 to 9 years for the construction of large wind farms, compared to the six months required by law, against a European average of 24 months). Shortening the timeframe is essential not only to align Italy with international benchmarks, but also to avoid the rapid obsolescence of technologies awaiting authorisation. In wind power, for example, only 0.64 GW have been authorised[59] of the 20 GW of authorisation applications submitted since 2017.

3.2 CDP'S ROLE

- In this context, CDP can help fill those gaps, intervening **additionally and complementarily** with the market, taking into account the **critical issues** that characterise the energy sector, particularly in the transition towards a low-carbon economy, such as:

  - **sub-optimal investment rates** attributable, on the one hand, to the need for **massive initial resources** and, on the other hand, to the **long timeframes for raising capital**, which limit the availability of projects with an attractive risk-return profile for market players; this problem is particularly intense in the field of green infrastructures and technologies at the **forefront of innovation**, such as systems for the capture, storage and use of carbon, batteries for accumulating energy from renewable sources, the development of hydrogen and smart grids;

  - the **presence of negative externalities**, which limit the costs associated with unsustainable choices and conduct by individual market players (e.g. emission of pollutants), and positive externalities, which limit the ability to fully capture the benefits generated by investments, particularly in energy efficiency and research and development activities;

  - the **presence of information barriers** on the benefits and costs of green technologies that hinder investment opportunities by smaller market players and their adoption by end users.

- CDP may act - also depending on the degree of autonomy it may enjoy in the various markets/sectors and the specific characteristics of the different counterparties - in order to:

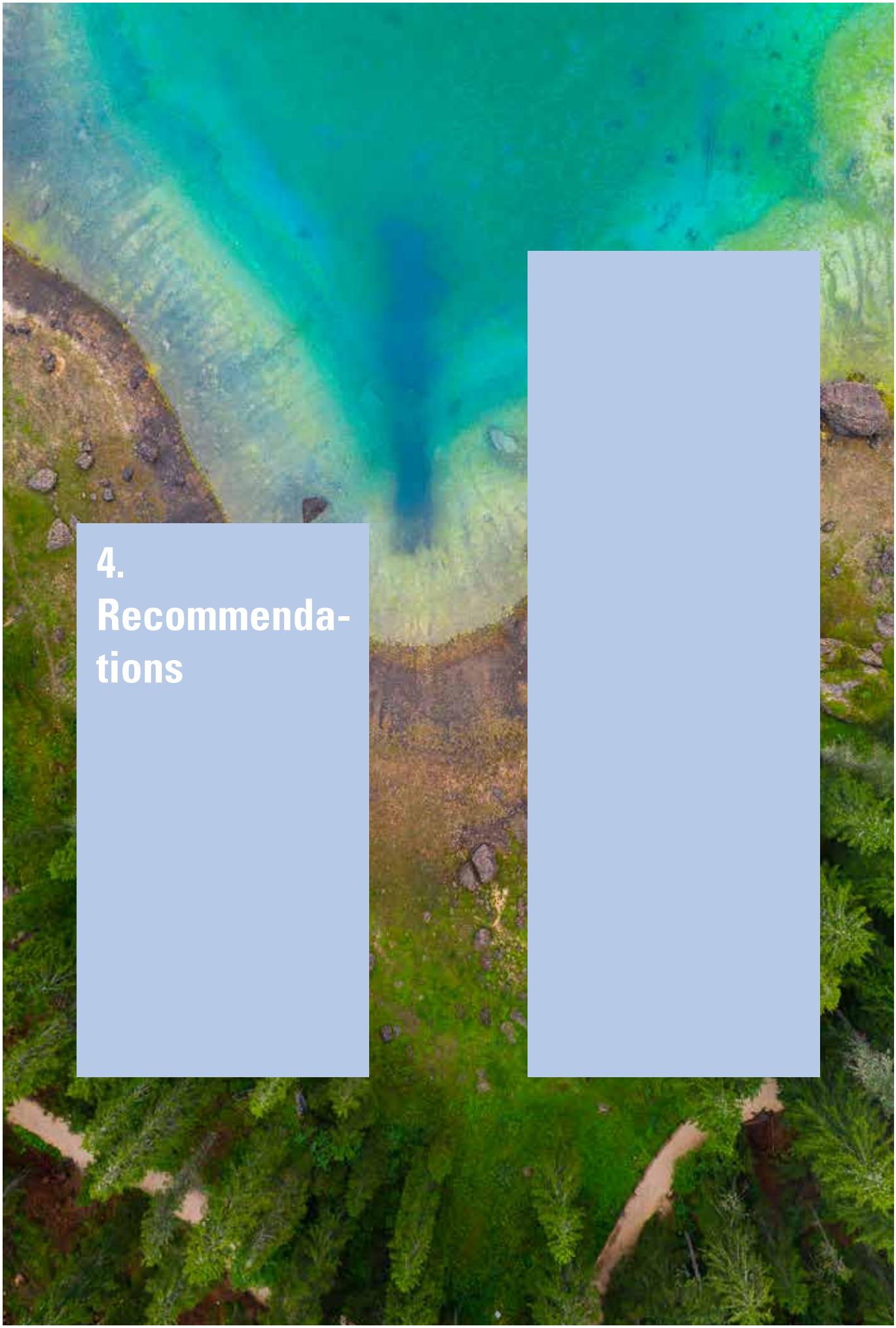
  - **contribute to bridging investment gaps** in sectors and local areas where market players are unable to mobilise adequate resources, in terms of both volumes and growth rates, including through the use of **blended finance** instruments;

  - **promote investment** in sectors that require **long-term commitment** capacity (e.g. network infrastructure);

  - **provide support to Public Administrations** in the management of authorisation processes, also in order to contribute to their simplification and/or acceleration.

- To specifically assess the relevance, priority and strategic coherence of actions in the focus areas identified, CDP is inspired by **additionality and complementarity** criteria, identifying the most appropriate operational instruments based on the characteristics of the counterparties (type, geographical location, etc.) and the characteristics of the market (e.g. degree of maturity, profitability).

[59] Legambiente (2021). "Scacco matto alle rinnovabili".



4. Recommendations

4. RECOMMENDATIONS

For each of the areas of focus, the **specific strategic guidelines** for **prioritising** (although not exhaustively) CDP actions in **Energy Transition** are summarised below.

AREA OF FOCUS

INCREASE AND INTEGRATION OF GENERATION CAPACITY **FROM RENEWABLE ENERGY SOURCES**

STRATEGIC PRIORITIES

A.1	Increasing **generation capacity from RES**, through the construction of **new plants**
A.2	Increasing **generation capacity from RES**, through the r**epowering/ re-vamping** of existing plants
A.3	Fostering the consolidation of **existing plant operators**
A.4	Fostering **the integration of RES power plants** and distributed generation ones into the transmission and connection network
A.5	Promoting **the automation/digitisation of network elements** and enabling demand-side management to increase network flexibility and optimise energy consumption by end users
A.6	Promoting the diffusion of **energy communities** for self-production and self-consumption of energy
A.7	Promoting the **ment of storage systems** to overcome the intermittent production inherent in the nature of RES and solve problems related to over-generation

AREA OF FOCUS

ELECTRIFICATION OF ENERGY CONSUMPTION

STRATEGIC PRIORITIES

B.1	Strengthening **industry** to support **automotive** and truck **component** operators in the transition to new technologies and train a highly-specialised workforce capable of implementing technical and digital challenges
B.2	Promoting suitable **public-private sector collaboration** in terms of financing and project development
B.3	Ensuring a **homogeneous and widespread diffusion of charging points**, also with a view to smart recharging technology solutions that make the relationship between supply and demand more efficient

AREA OF FOCUS

PROMOTING **ENERGY EFFICIENCY**

STRATEGIC PRIORITIES

C.1	Supporting the **regeneration of the building stock** by promoting **deep renovation**, the dissemination of energy efficiency technologies (**heat pumps, district heating**) and the development of technologies for the construction of **smart buildings**
C.2	Promoting the **energy efficiency** of **small and medium-sized enterprises**
C.3	Promoting the **energy efficiency** of companies operating in the **hard-to-abate sectors**

AREA OF FOCUS

DEVELOPMENT OF **NEW TECHNOLOGIES AND NEW ENERGY CARRIERS**

STRATEGIC PRIORITIES

D.1 Promoting a **partial mixing of hydrogen in the gas network**

D.2 Supporting the **development of network infrastructure** (new or conversion) to directly connect production facilities to end users

D.3 Promoting the **development of the industrial supply chain**, enhancing the scientific skills already present in the region, also via the creation of **hydrogen valleys**

D.4 Supporting **greater use of hydrogen in industry and mobility** by broadening its application spectrum

D.5 Supporting the **transition of the refinery sector through a conversion of existing plants** for the production of energy from organic or waste materials

AREA OF FOCUS

PROMOTING **ENERGY SECURITY**

STRATEGIC PRIORITIES

E.1 Strengthening and diversifying i**nterconnections with foreign countries**, with reference to both the **natural gas** sector

E.2 Monitoring **supply infrastructures**, especially with regard to natural as, through measures aimed **at increasing regasification capacity**


cdp