Implementation of bioenergy in Italy - 2021 update

IEA Bioenergy
Technology Collaboration Programme

Country Reports

IEA Bioenergy: 10 2021

This report was prepared from the 2021 IEA World Energy Balances and Renewables Information, combined with data and information provided by the IEA Bioenergy Executive Committee and Task members[1]. Reference is also made to FAOstat and Eurostat data as well as data from national statistics. All individual country reports were reviewed by the national delegates to the IEA Bioenergy Executive Committee, who have approved the content. General background on the approach and definitions can be found in the central introductory report for all country reports.

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HIGHLIGHTS

- Renewables made up 18% of total energy supply in Italy in 2019. Bioenergy represents around 50% of renewable energy supply.
- Solid biomass represents two thirds of bioenergy use, and it mostly used in residential applications (for heating).
- Italy already reached its overall 2020 renewable energy target in 2014. The levels of the different types of renewable energy have actually stalled since.
- Natural gas is the dominating fuel in heat sectors (>60%) and also represents half of Italian power production. The role of biogas per capita is substantial, but still modest (3%) compared to natural gas consumption.
- One third of Italian power production is renewable, split between hydropower, wind energy, solar energy, and biobased electricity.
- Diesel is the dominant transport fuel in Italy; its use is three times higher than gasoline. There is also an important use of LPG and natural gas in Italy. The role of biofuels in transport is relatively stable around 4% in the past decade, with a shift to waste-based feedstock.
- The Italian NECP aims to reach 30% renewable energy in gross final energy consumption by

[1] While data for 2020 are starting to become available at national level, it was decided to consider trends up to 2019 for good comparability and benchmarking between the different IEA Bioenergy member countries. Care should also be taken when using 2020 data for analysing trends as these data are distorted by the COVID19 Pandemic.

2030. Increasing contributions are expected from PV and wind. The Italian NECP and its objectives will be reconsidered in the light of the new European Green Deal targets

- Concerning bioenergy, in the electricity sector Italy aims at safeguarding as far as possible the current production by 2030, except for bioliquids plants that will be phased out. In the heating sector Italy intends to favour technologies able to significantly abate pollutants and GHG emissions. In the transport sector biomethane potential will be further exploited.

- The Italian Recovery and Resilience Plan devotes about 2 billion euros for the production of biomethane for projects aiming at reconverting and improving the efficiency of existing biogas plants or the installation of new plants in the agricultural sector with the aim at using the produced biomethane in the industrial and residential heating and cooling sector and in the tertiary and transport sectors.

COUNTRY PROFILE

Population and land use

Italy is a peninsula situated in Southern Europe. Over 35% of the Italian territory is mountainous. Italy has a total land area of 298 thousand km² and a population of 60.6 million, which represents a relatively high population density of 203 persons per km².

Around one third of the land area is forest land (*of which 34% protected*). 42% is agricultural land, almost evenly split between arable land on one side and permanent crops (vineyards, olive trees) & meadows/pastures on the other side.

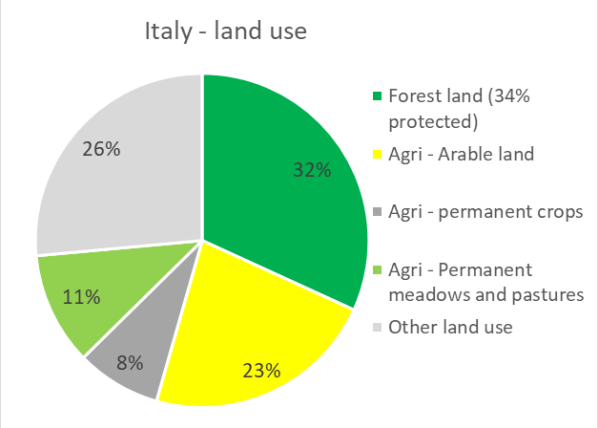

***Figure 1**: Land use in Italy (**2018** figures - Source: FAOstat)*

Final energy consumption

Overall final energy consumption in Italy (*also including non-energy use of oil, natural gas, and coal in industry*) comes down to 1.9 tonnes of oil equivalent (toe) per capita, which is somewhat below the average of IEA Bioenergy member countries. Particularly the role of industry and transport are fairly modest compared to the other countries.

Table 1: Distribution of the final consumption of energy carriers by sector in Italy (2019 figures - Source: IEA (2021) World Energy Balances and Renewables Information)

Final consumption energy carriers	Toe/capita (2019)	% of total	*Median* (toe/capita)*
Industry (energy use)	0.41	21%	*0.67*
Industry (non-energy use)	0.12	6%	*0.21*
Transport	0.59	30%	*0.69*
Residential	0.51	26%	*0.57*
Commercial & public services	0.26	13%	*0.34*
other	0.05	3%	
Total	1.94		*2.34*

** Median of the 25 member countries of IEA Bioenergy*[2]

NATIONAL POLICY FRAMEWORK IN ITALY

TARGETS AND STRATEGIES

According to the EU Regulation 2018/1999 on the Governance of the Energy Union and climate action, at the end of 2019 EU Member States submitted to the European Commission their National Integrated Energy and Climate Plans (NECPs) defining their contribution to reach EU energy and climate targets in 2030 and the measures and policies suitable for this purpose.

Table 2: Renewable energy targets in Italy.

Sector	Share of renewables in gross final consumption per sector by 2030*
Overall target	30%
Heating and cooling	33.9%
Electricity	55%
Transport	22%

** Based on Italian NECP (2019). These targets are likely to be reviewed in the frame of the European Fit for 55 Package of 2021.*

[2] Comparative figures of the different IEA Bioenergy member countries are discussed in the central Countries' Report.

Table 3: Climate targets in Italy

Sector	GHG reduction target by 2030*
Overall target	- 40% compared to 1990 levels
Sectors covered by ETS Directive[3]	- 43% compared to 2005 levels
Sectors[4] covered by ESR Regulation[5]	- 33% compared to 2005 levels

** Based on Italian NECP (2019). These targets are likely to be reviewed in the frame of the European Fit for 55 Package of 2021.*

The higher contributions are expected from solar photovoltaic and wind energy. Renewable electricity is expected to grow up to about 187 TWh in 2030, starting from 115 TWh in 2018: the highest increases are expected to come from solar energy (+50 TWh), followed by wind energy (+23 TWh).

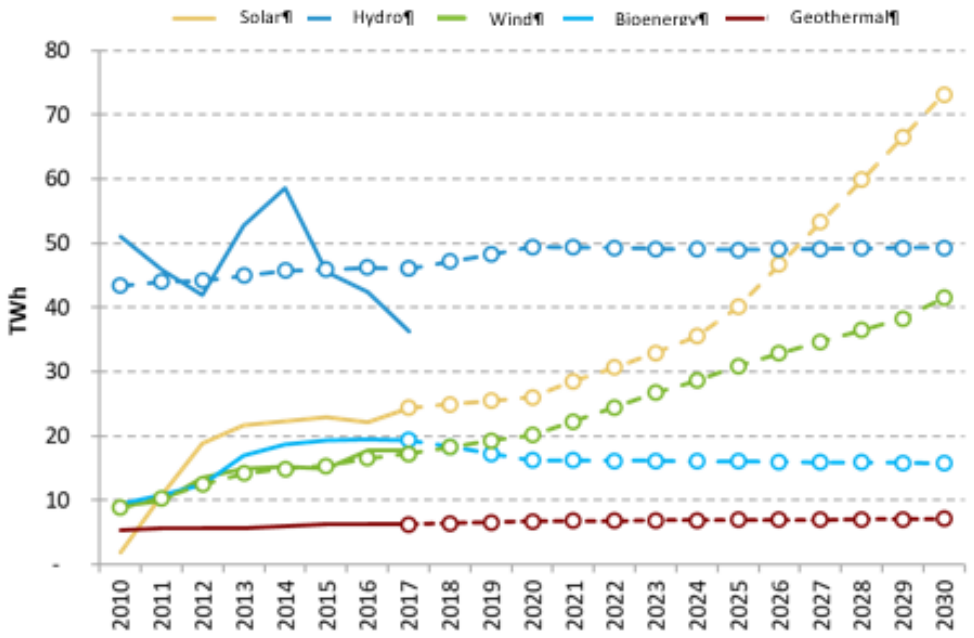

***Figure 2**: Production targets of renewable power towards 2030 (TWh), according to the Italian NECP*

Figure 3 shows the anticipated contribution of bioenergy to the 2030 targets according to the Italian NECP.

[3] Directive (EU) 2018/410 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments.
[4] Transports, Residential, Tertiary, Industry not covered by ETS system, Agriculture and Wastes
[5] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013

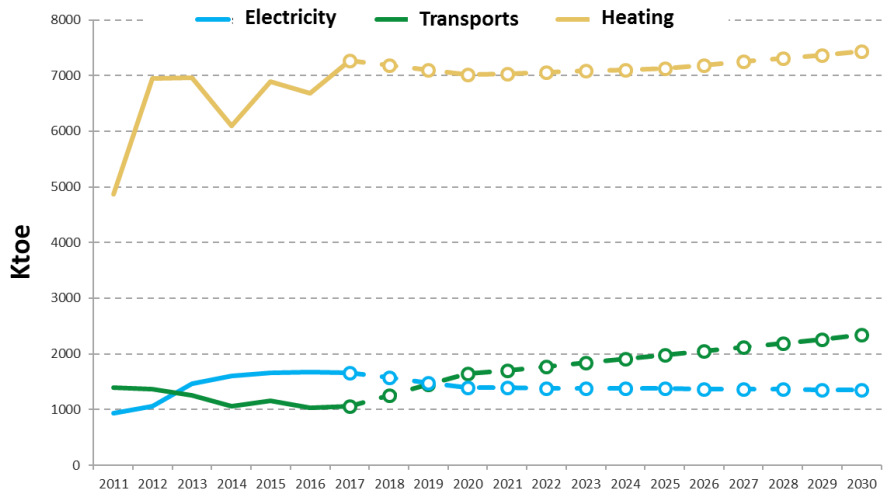

Figure 3: Growth trajectory for the contribution of bioenergy in the different sectors in order to achieve the RES target for 2030 [Source: GSE and RSE]

- In the heating sector bioenergy is facing some problems related to air pollution especially in some parts of the country (i.e., Pianura Padana). So, Italy intends to favour technologies able to significantly abate pollutants and GHG emissions. According to the Italian NECP bioenergy consumption will remain quite stable by 2030. About 80% (in energy content) of biomass in the heating sector is domestic in origin. In the light of the stabilization of consumption, this percentage should remain steady, or slightly decrease, because of the projected increased penetration of more efficient technologies, mainly fed by pellets.
- In the electricity sector, bioenergy still involves high production costs, primarily due to the mobilizing of feedstock. The NECP foresees a slight decrease in bioenergy power installations, mainly due to the gradual phase out of bioliquids ending the incentive period. CHP plants from wastes and residues from the agri-industrial sector are of interest, in particular plants integrated in the production cycle of companies.
- In the transport sector the Italian NECP foresees on one the hand a reduction of the use of first-generation biofuels up to a maximum share of around 3% by 2030 together with the phase out of the use of palm oil and soy oil and their derivatives in 2023. On the other hand, an increase of the consumption of advanced biofuels is expected, with a target of around 8% (more ambitious than the 3.5% envisaged by 2018/2001/EU Directive), mainly through to the contribution of biomethane, which is expected to represent 75% of the total advanced biofuels (1.1 billion of m^3). It is also expected that the exploitation of the potential of UCOs and animal fats of domestic origin will increase. Concerning aviation and maritime biofuels a contribution is expected also from renewable gas, which, however, currently appears difficult to quantify.

On December 11, 2020, EU leaders reached an agreement to increase the 2030 emissions reduction target from 40 to 55%. This will have implications on the targets relating to renewable sources and energy efficiency and on the reference directives that will be revised in the course of 2021.

The Italian NECP and its objectives will also need to be reconsidered in the light of the new EU guidelines.

In January 2021, Italy issued to the EU Commission the “Long Term strategy”, indicating the way to reach carbon neutrality in 2050. In a Scenario in which renewables might cover 85 to 90% of final energy consumption, bioenergy constitutes an important option to decarbonise, in particular the civil and the transport sectors. The Strategy envisions a key role for biomethane, which can be used

for thermal end uses, as an alternative fuel in the transport sector and also for power generation. Furthermore, the capture of CO_2 from bioenergy can be used to produce alternative fuels such as synthetic methane or methanol (for the transport sector) or sequestered in underground deposits, giving rise to the so-called "negative emissions". Finally, sustainable forest management together with the restoration of degraded surfaces and reforestation interventions is considered of fundamental importance to reach carbon neutrality.

A description of renewable energy and climate policies and measures in Italy is available at the IEA's Policies and Measures Database: https://www.iea.org/policies?country=Italy

Specific policies related to renewable electricity, renewable heat and transport biofuels will be highlighted in the chapters about the role of bioenergy in different sectors.

THE CONTRIBUTION OF BIOENERGY IN NATIONAL ENERGY SUPPLY

TOTAL ENERGY SUPPLY

The total energy supply (TES) of Italy in 2019 amounted to 6237 petajoule (PJ). It is still for around 80% dominated by fossil fuels, particularly gas and oil, which represent 41% (2552 PJ) and 34% (2096 PJ) of total energy supply, respectively. Coal represents around 4% of TES (271 PJ).

Renewable energy sources have a share of 18% or 1131 PJ. Around half of renewable energy supply in 2019 came from biomass (571 PJ), followed by geothermal energy (226 PJ), hydropower (167 PJ), wind energy (73 PJ) and solar energy (95 PJ). Electricity imports (137 PJ) represent 2.2% of total energy supply.

Overall TES has declined between 2005 and 2015 but has stabilized in recent years around 6.3 EJ. **Oil** used to be the main source of energy, with 3.6 EJ representing half of total energy supply in the early 2000s; this has dropped to 2.1 EJ in 2019, which is one third of TES. **Natural gas** peaked around 2008 around 2.9 EJ which was 38% of TES; its consumption declined to 2.1 EJ in 2014 (35% of TES), but meanwhile it has grown again up to 2.5 EJ (41% of TES), thereby compensating for the reductions in oil and coal.

The share of **renewable energy** steadily increased from 6% of TES in the early 2000s up to 18% in 2014. However, growth of the different renewable energy types stalled after 2014 and the overall share of renewable energy in TES stabilized around 17-18%.

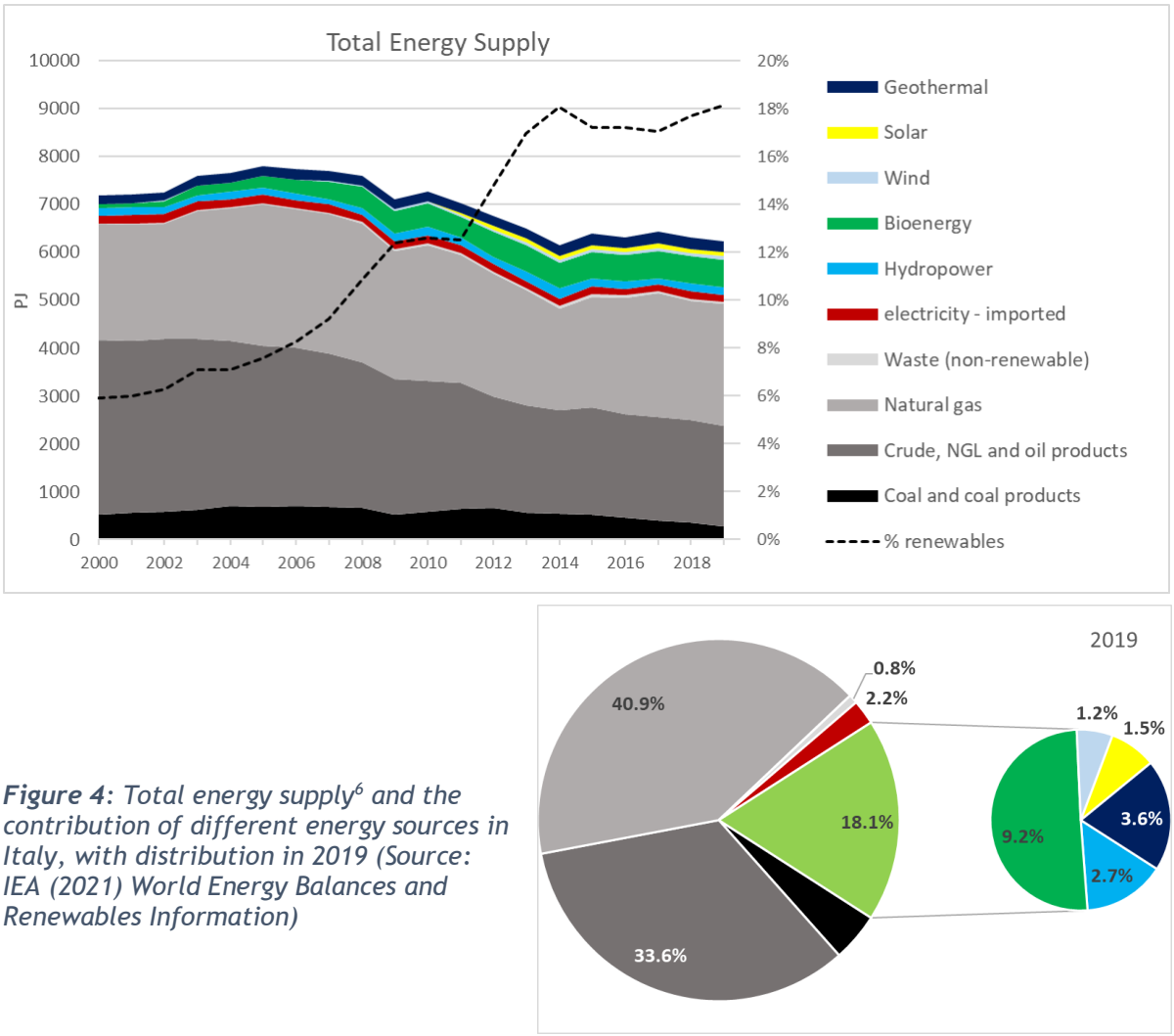

***Figure 4**: Total energy supply[6] and the contribution of different energy sources in Italy, with distribution in 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)*

Figure 5 shows the evolution of the different types of bioenergy. There was substantial growth of bioenergy between 2000 and 2012, but levels stabilized since. Solid biomass represents 63% of total bioenergy sources – most in residential use - while liquid biofuels (16%) and biogas (15%) are also quite important.

[6] Total energy supply refers to the use of resources. In terms of the role in the energy system this distribution overestimates the role of resources producing electricity with a high share of unused waste heat.

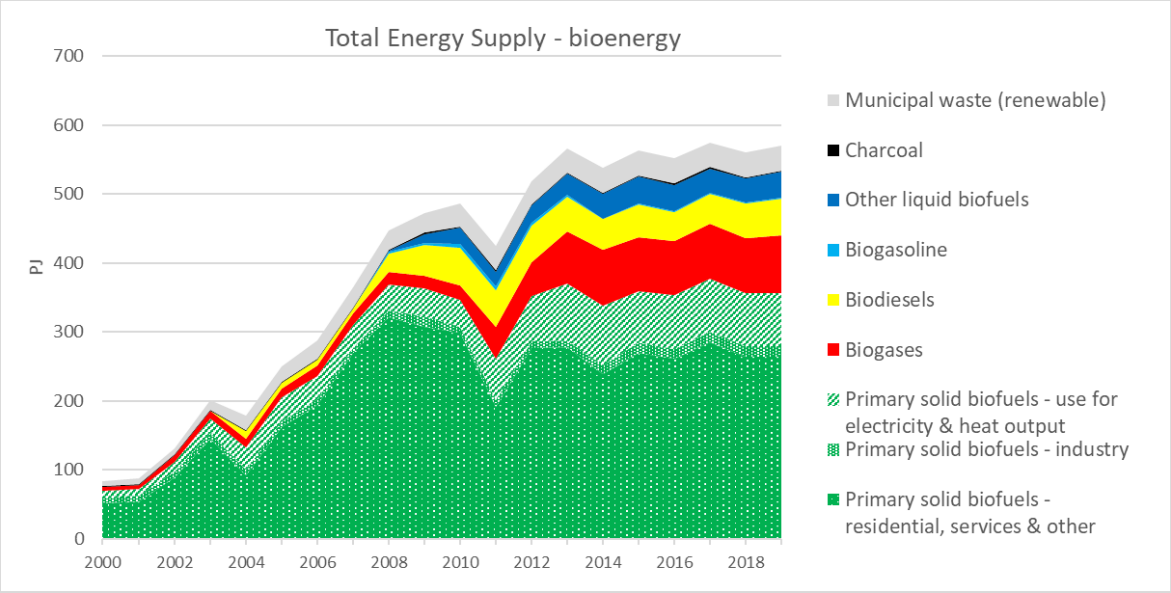

***Figure 5**: Development of total energy supply from bioenergy in Italy 2000 – 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)*

Evolution of the bioenergy carriers:

- Solid biofuels are mostly consumed in residential applications at a fairly stable amount around 260 PJ in the past decade (*except for 2011, which may be related to a mild winter*). The use of solid biofuels in industry is quite low (15 PJ). Application for electricity and heat production has grown to a level of 80 PJ in 2014 and has also stabilized since.
- Liquid biofuels were introduced in 2004 and saw a strong growth between 2007 and 2010 from 8 to 83 PJ. This stabilized afterwards and only in recent years there is some growth up to 92 PJ. A considerable amount of liquid biofuels (38 PJ) is used outside the transport sector.
- Biogas had a peak growth between 2010 and 2013, growing from 20 to 80 PJ in a few years' time. This has also stabilized since.
- The use of MSW for energy production has consistently grown in the 2000s to a level of 35 PJ, which has also stabilized since.

Table 4 displays the 2019 total bioenergy supply values on a per capita basis. Compared to the other 24 member countries of IEA Bioenergy (expressed per capita), Italy ranks at the higher end for biogas, and in the middle for solid biofuels, liquid biofuels and renewable MSW.

Table 4: Total energy supply per capita in 2019 for different bioenergy carriers

	Supply per capita	*Median IEA Bioenergy members*
Bioenergy	9.4 GJ/cap	*10.6*
Solid biofuels	5.9 GJ/cap	*7.0*
Renewable MSW	0.6 GJ/cap	*0.8*
Biogas	1.4 GJ/cap	*0.7*
Liquid biofuels	1.5 GJ/cap	*1.5*

Source: IEA (2021) World Energy Balances and Renewables Information

Table 5 indicates the amounts of the different bioenergy carriers compared to some relevant reference points, namely the amount of forest in the country (for solid biomass), the amount of generated MSW (for renewable MSW used for energy), the amount of natural gas consumed in the country (for biogas) and the amount of fossil oil products consumed (for liquid biofuels).

Table 5: Comparison of the supply of different bioenergy carriers in 2019 to specific reference points

	Compared to reference points			*Median**
Bioenergy	9.2 %		of total energy supply	*7.2 %*
Solid biofuels	57.2 GJ/ha_forest		compared to the domestic hectares of forest land (excl. protected)	*21.3 GJ/ha_forest*
Renewable MSW	1.24 GJ/ton_MSW		compared to the total generated MSW in the country	*1.4 GJ/ton_MSW*
Biogas	0.033 GJ/GJ_NG		compared to natural gas supply	*0.023 GJ/GJ_NG*
Liquid biofuels	0.044 GJ/GJ_oil		compared to oil products supply	*0.028 GJ/GJ_oil*

Source: energy data from IEA (2021) World Energy Balances and Renewables Information; forest figures from FAOStat; waste figures from World Bank
** Median of the 25 member countries of IEA Bioenergy*[7]

Specific comments in relation to the reference points:

- The amount of solid biofuels compared to the domestic forest area is relatively high (~3 ton_dry mass of wood per hectare[8]). Mind that some of this biomass does not come from forests (e.g., cuttings from vineyards or olive plantations); some biomass is also imported from other countries.
- Biogas is relatively high per capita, but still only represents 3% of domestic gas consumption (which has a dominant role in the Italian energy mix).
- The use of renewable MSW for energy production is somewhat behind other European countries with well-developed waste management systems, so further steps can still be taken there.

[7] Comparative figures of the different IEA Bioenergy member countries are discussed in the central Countries' Report.
[8] Counted with a typical calorific value of wood (dry mass) of 19 GJ/ton$_{\text{dry mass}}$

ROLE OF BIOENERGY IN DIFFERENT SECTORS

OVERVIEW

The overall 2019 share of renewables in **final energy consumption** among electricity, transportation and heat sectors is almost 17%, with bioenergy making up 9% of the energy share (Table 6). Mind that these figures are slightly different from the shares in total energy supply.

***Table 6**: Role of bioenergy and renewable energy in electricity, transport energy and fuel/heat consumption in 2019*

Sector	Share of bioenergy	Share of renewable energy	Overall consumption
Electricity[9]	5.9%	35.2% *(14.1% hydro)*	329 TWh (1186 PJ)
Transport energy (final consumption)	3.6%	4.7%	1501 PJ
Overall fuel and heat consumption[10]	Direct biomass: 13.0% Biobased heat: 1.9%	15.4%	2178 PJ
TOTAL FINAL ENERGY CONSUMPTION	**9.3%**	**16.7%**	**4824 PJ**

Source: IEA (2021) World Energy Balances and Renewables Information

The following paragraphs will consider the evolutions in the different sectors.

ELECTRICITY

The Italian power system is still dominated by **natural gas**, which represents 43% (140 TWh) of Italian electricity *consumption*. The share of natural gas power actually fell down from 50% (170 TWh) in 2008 to 30% (<100 TWh) in 2014 but has picked up again in recent years to compensate for the reduction in other fossil based power (particularly coal). **Oil** represented more than 25% of electricity consumption (85 TWh) in the early 2000s, but this level has steadily dropped to 3% (10 TWh) recently. **Coal** power has been fairly stable around 50 TWh up to 2015, representing up to 15% of Italian electricity consumption. In recent years this dropped to 21 TWh (6% of electricity consumption).

[9] Renewable electricity production compared to final consumption. Potential renewable shares of imported electricity are not included.

[10] This includes final consumption of fuels and heat in industry, the residential sector, commercial and public services and agriculture/forestry. Transport fuels are excluded. Energy used for transformation and for own use of energy producing industries is also excluded.
Electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported.

Mind that an important share of electricity consumption (between 10 and 15%) is imported from neighbour countries.

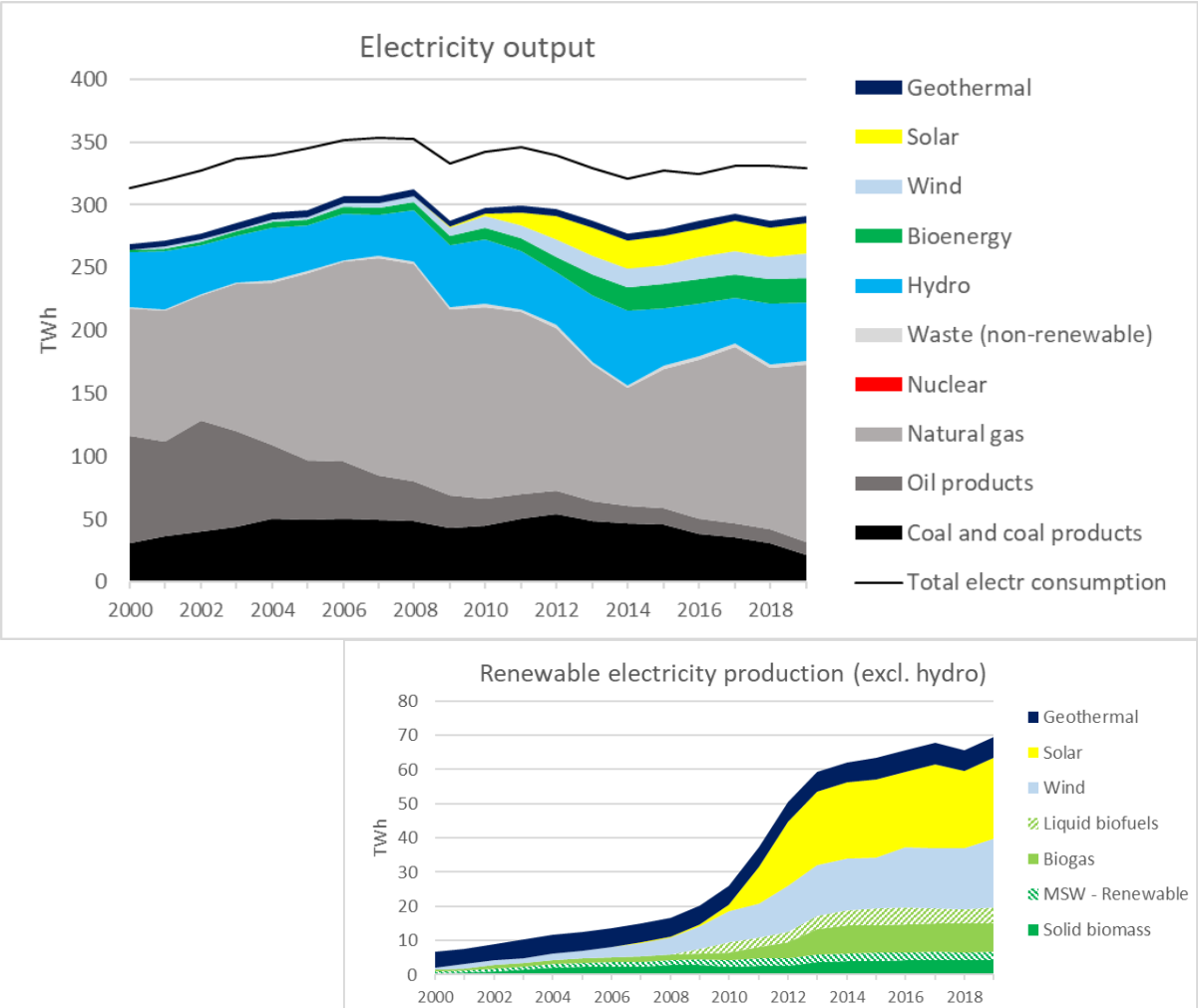

Figure 6: Evolution of the electricity mix in Italy 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

Renewable power already represented 15% of electricity consumption in the 2000s, predominantly through hydropower. Between 2008 and 2013 there was a strong growth to 34%, but this level has stabilized since. **Hydropower** fluctuated between 30 and 50 TWh in the past decades. **Biomass-based electricity** grew from 6 TWh in 2008 to 19 TWh in 2014 and has stabilized since. **Solar** power grew from zero to 22 TWh between 2008 and 2013, representing 7% of electricity consumption. In contrast to other countries, the level of solar power has actually stalled in the past 5 years. **Wind** power also grew between 2008 and 2013 from 5 TWh to 15 TWh. Further growth levels have been modest since. In 2016 there was a step increase to 18 TWh, and in 2019 a step to 20 TWh. **Geothermal** power is relatively important in Italy, producing around 2% of electricity consumption. Its level was fairly constant around 5-6 TWh in the past decades.

Policy framework

Italy has managed different schemes to support the growth of renewable energy sources in the electricity sector (including bioenergy), summarized in the below table:

Table 7: Summary of the support schemes for RES in the electricity sector

SUPPORT SCHEME	VALIDITY PERIOD (1)	DURATION OF THE INCENTIVE (1)	SOURCES/ TECHNOLOGIES	PLANT CAPACITY(2)	SUPPORT TYPOLOGY(3)	DESCRIPTION OF THE INCENTIVE	TYPE OF ENERGY ELIGIBLE TO THE INCENTIVE	ENERGY REMUNERATION(4)
MD 4th July 2019	2019-	20-30 years	PV, wind, hydro, purification gas	<=250kW	FIT	Constant tariff	Injected	Included in the tariff
				>250kW	SFIP	The tariff is obtained by the difference between the incentive and the energy price	Injected	Market
MD 14th February 2017	2018-	20 years	RES available locally	>=0,5 kW	FIT + PT	Constant or indexed rate at an efficient avoided cost	Produced	Included in the tariff
MD 23rd June 2016	2016 - 2017	15-30 years	RES-E including CSP but not PV	<=500kW	FIT	Constant tariff	Injected	Included in the tariff
				>500kW	SFIP	The tariff is obtained by the difference between the incentive and the energy price	Injected	Market
MD 6th July 2012	2013-2016	15-30 years	RES-E - not PV	<=1MW	FIT	Constant tariff	Injected	Included in the tariff
				>1MW	SFIP	The tariff is obtained by the difference between the incentive and the energy price	Injected	Market
5th PV Energy Account	2012-2013	20 years	PV	<=1MW	FIT + PT	Constant tariff	Produced	Included in the tariff
				>1MW	SFIP + PT	The tariff is obtained by the difference between the incentive and the energy price	Produced	Market

CSP Energy Account	2008-2016	25 years	CSP	All	FIP	Constant tariff	Produced	Market or NM or SP
All-inclusive FIT	2008-2012	15 years	RES-E not PV	<=1MW(5)	FIT	Constant tariff	Injected	Included in the tariff
1st – 4th PV Energy Account	2006-2012	20 years	PV	All	FIP(6)	Constant Tariff	Produced	Market or NM or SP
Green Certificates/ New GRIN Tariff	2002-2012	8-15 years	RES-E(7)	All	Green Certificates / SFIP	Green Certificates Market or withdrawal by the GSE at a price linked to the energy market price / The tariff is obtained by the difference between the incentive and the energy price	Produced	Market or NM or SP
CIP6/92	1992-2001	8-15 years	RES - E	ALL	FIT	Tariff partly linked to fuel prices	Injected	Included in the tariff

Footnotes to the table

(1) Indicative period of eligibility to the support scheme without prejudice of specific or transitional provisions.

(2) Not less than 1 kW

(3) FIT: Feed in Tariff
FIP: Feed in Premium
SFIP: Sliding Feed in Premium
PT: Premium tariff

(4) Access to Simplified Purchase (SP) or Net Metering (NM) is regulated on the basis of the plant typology and capacity

(5) 200 kW for wind power plants

(6) The 4th Energy Account provided a FIT + PT for the power plants entered into operation from 2013

(7) Including specific CHP power plants connected to district heating systems

In addition to the previous mechanisms, there have been other facilitating measures available for RES in the electricity sector:

- Simplified purchase, accessible by all renewable non-programmable power plants and for other power plants up to 10 MVA. It allows the operator to have the energy injected into the grid retired by GSE, who is responsible for bidding the energy into the market.
- Net Metering, accessible by renewable power plant and CHP power plants up 200 kW (extended up to 500 kW in 2015). It provides to the producers an economic contribute to pay back part of the cost of purchased energy. The value of the contribute is determined based on an economic valorisation of the energy injected into the grid.

The most part of bioenergy plants were installed thanks to the incentives provided by the "all inclusive" Feed in Tariff (in particular biogas power plants with a capacity less than 1 MW, for an overall capacity of more than 870 MW of the 1.1 GW currently supported in 2020) and Green Certificates (in particular large solid biomass and bioliquid power plants for a capacity respectively of about 1.4 GW and 750 MW in 2020).

HEAT/FUEL

Figure 7 shows the role of different fuels/energy carriers for providing heat in different sectors (industry, residential sector, commercial and public services and other). It also includes heat sold to customers, e.g. through district heating. Fuel use by energy producing industries for transformation and for own use is excluded. Mind that electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported in the IEA database.

The overall consumption of fuel/heat steadily declined from 2005 to 2014, though it seems to stabilize in recent years. The provision of heat is still largely dominated by fossil fuels (75%), with natural gas being the main energy source (61%). The share of oil is going down steadily, representing 12% of fuel/heat provision in 2019. The direct use of biomass for heat represents 13% (284 PJ) – its share has stabilized in the past decade. Mind that around 2012-2013 a different methodology was implemented to estimate biomass consumption in households.

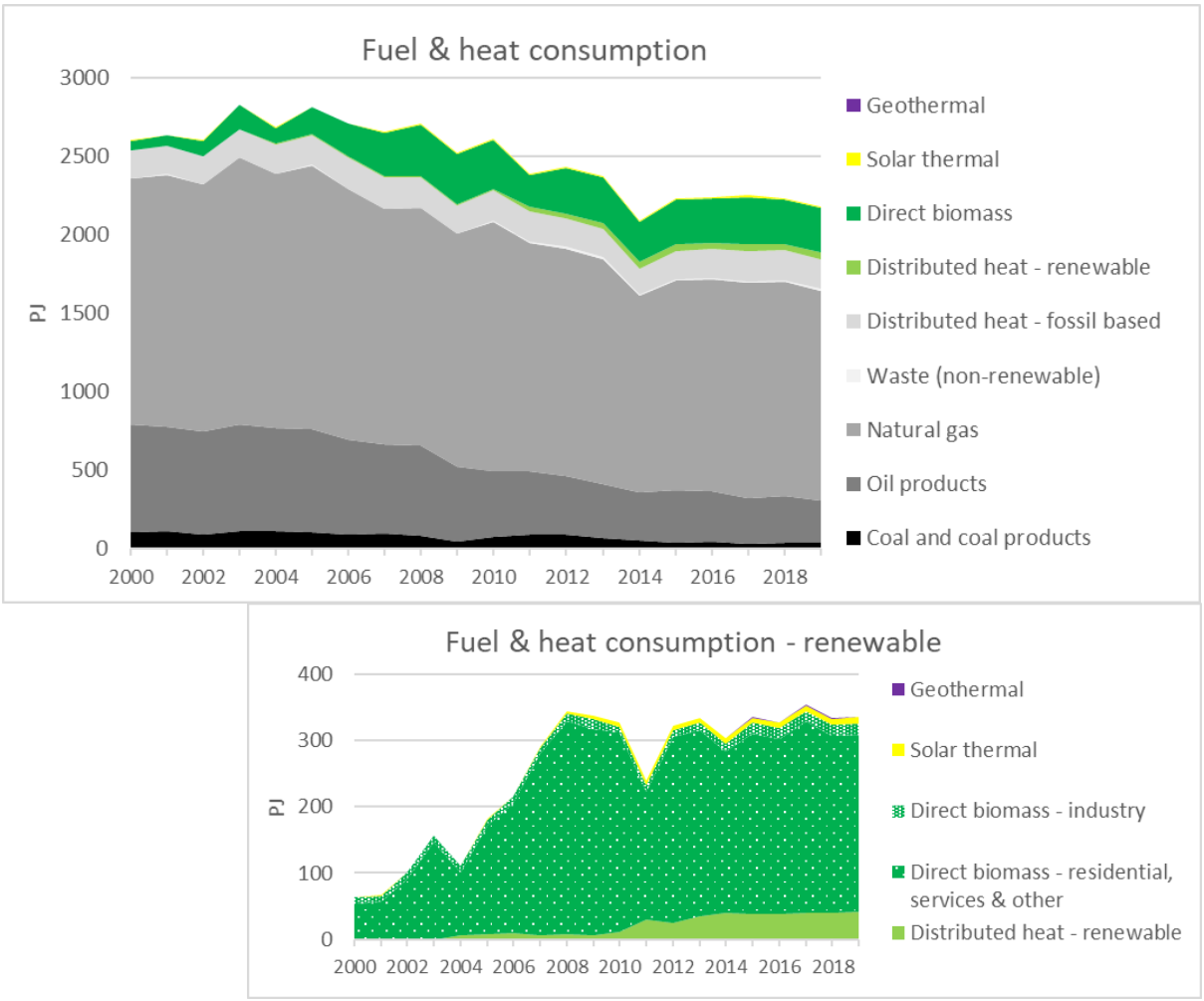

***Figure 7**: Evolution of fuel and heat consumption in Italy 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)*

Heat output generated and sold by CHP plants and heat plants (e.g., through district heating) represents around 10% of fuel/heat provided. Figure 8 shows that this is still for more than 80% fossil based, with a dominant – and still growing - role for natural gas; the role of oil is going down (now at around 12%). The use of biomass for heat output increased between 2009 and 2014 and has stabilized around 18% of overall heat output.

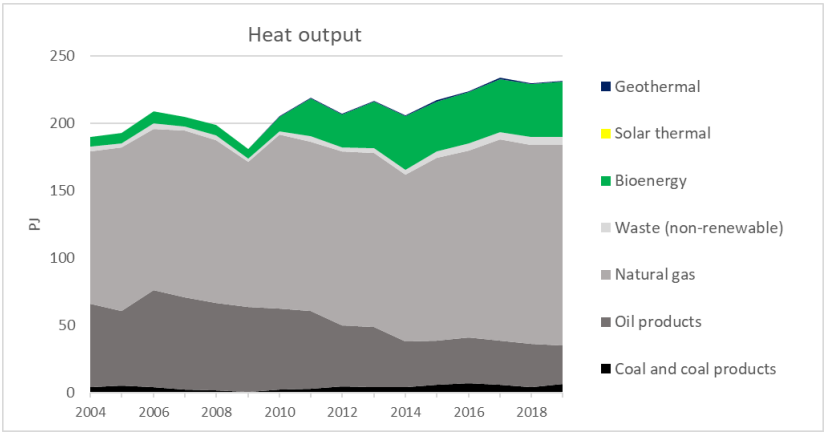

***Figure 8**: Evolution of fuels for heat output in Italy 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)*

Policy framework

In Italy, renewable energy sources for heating and cooling (including bioenergy) are supported by:

- Grants for the generation of thermal energy from renewable energy sources and for small-scale energy efficiency projects (Conto Termico)
- Tax deductions
- White certificates

According to the "Conto Termico" small-scale renewable thermal energy production (including biomass fireplaces, boilers, and stoves) and energy efficiency projects will receive an incentive (a grant) proportionate to the investment. The incentive considers the amount of renewable thermal energy production or energy saving achieved. The scheme was introduced in 2013 and updated in 2016 (MD 16th February 2016).

Tax deduction for energy saving in buildings (provided by the Budget Law 2007) allows deducting 65% of the costs incurred to improve the energy efficiency of buildings from IRPEF (personal income tax) or from IRES (corporate income tax). The deduction is staggered over 10 years. Eligible interventions include replacement of heating systems with heat pumps and biomass appliances. Tax deduction for building renovations (art. 16-bis DPR n. 917/86) allows the deduction from IRPEF (personal income tax) of the 50% of the costs incurred for restructuring the dwellings and common areas of residential buildings located in Italian territory. The deduction is staggered over 10 years. The various types of works eligible for tax deduction include the installation of renewable energy appliances for heating and cooling including bioenergy installations.

The Law Decree n. 34 of May 19th, 2020, instituted the so called "superbonus" which raises the deduction rate of expenses incurred from 1 July 2020 to 30 June 2022 to 110%, for specific interventions in the field of energy efficiency, anti-seismic interventions, installation of systems photovoltaic or infrastructure for charging electric vehicles in buildings. Among the eligible interventions, there is also the substitution of existing centralized heating systems with more efficient appliances like biomass boilers.

White certificates (Ministerial Decree 11 January 2017 and following amendments) are tradable securities, which certify energy savings in final energy uses. The White Certificate scheme rests on the obligation for gas and/or electricity distributors with more than 50 000 final customers to achieve pre-set annual energy savings targets. Electricity and gas distributors may meet their obligations by implementing energy efficiency projects or by purchasing securities on the white certificates' market or via bilateral contracts, from 'voluntary parties' which implement energy saving actions with final users and sell the White Certificates so obtained. Eligible interventions include the use of renewable energy sources for heating and cooling purposes.

TRANSPORT

Figure 9 shows an overview of the energy used in transport in Italy, split up by different fuels/energy carriers.

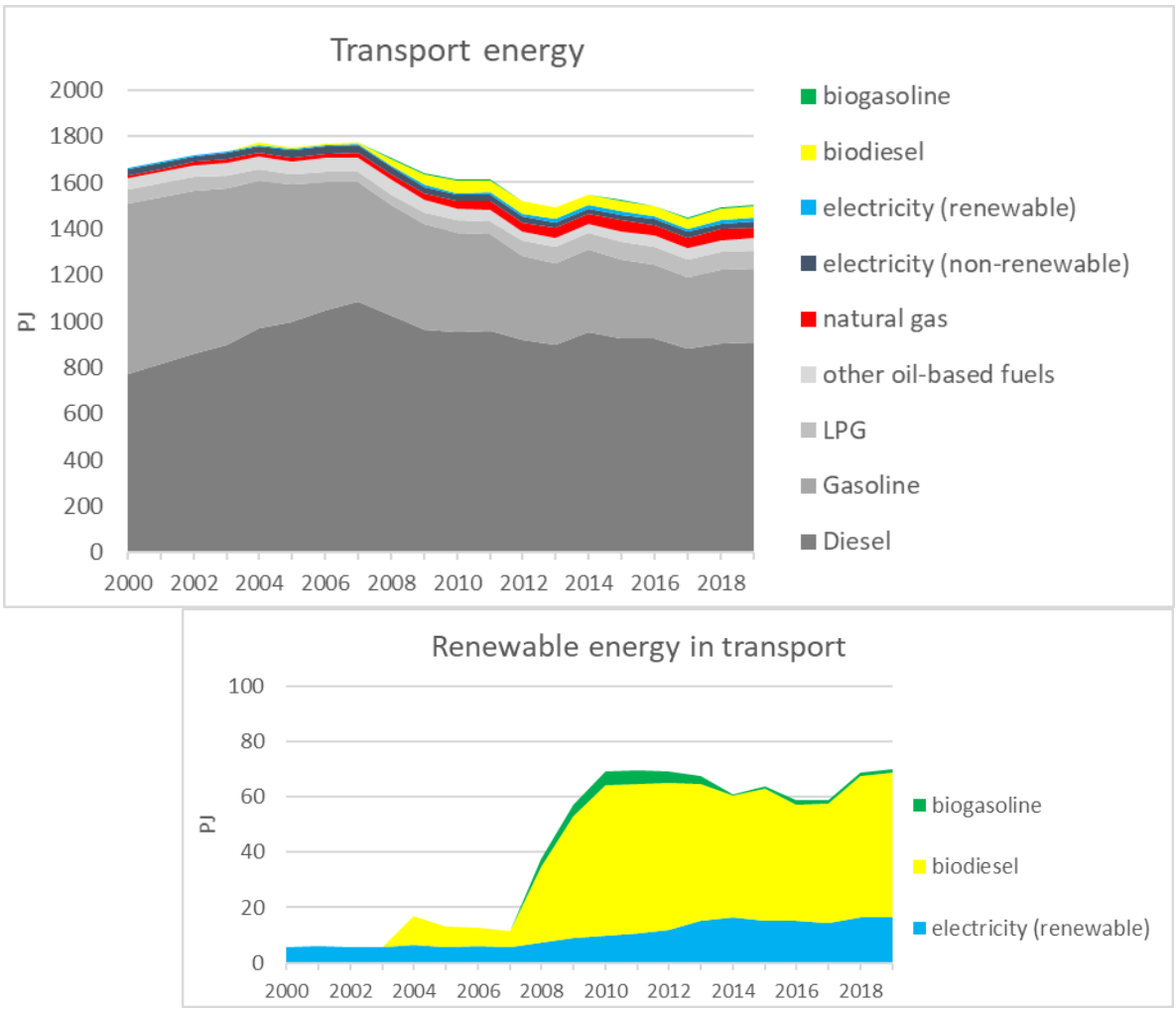

***Figure 9**: Evolution of transport fuels in Italy 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)*

Diesel is the dominant transport fuel in Italy, representing 60% of transport fuel consumption, while the share of gasoline dropped to 22% in the past decades. There is also an important use of LPG and natural gas in Italy, representing respectively 5% and 3% of overall transport fuel consumption.

In 2004, biodiesel was introduced and there was a very strong growth between 2007 to 2010 up to a level of 3.6% of transport fuel consumption. After this peak, the level of biofuels in transport stabilized at the same level. The main biofuel remains biodiesel, which is also consistent with the dominant role of diesel fuels in the Italian transport system. In 2019, biodiesel represented on average 5.4% (by energy) of diesel fuel consumption. Ethanol was introduced in 2008 and its levels went up to 1.2% (by energy) of gasoline consumption (in 2010-2012). Meanwhile gasoline consumption has dropped to much lower levels (0.4% of gasoline).

The statistics don't make distinction between natural gas and biomethane use in transport. According to GSE, 1.7 PJ of biomethane use can be allocated to the transport sector.

Electricity represents a share of 2.8% of total transport energy use. This is mostly in rail - the use of electricity in road vehicles is still marginal in 2019 (0.08% of total transport energy use) but can be expected to grow in the coming years.

Policy framework

To comply with the 10% EU RES target in the transport sector in 2020, Italy introduced, through the regulations implementing Directive 2009/28/EC, a blending obligation of biofuels for suppliers of fossil fuels (diesel and gasoline) (Legislative Decree 3rd March 2011 n. 28 and MD 10th October 2014 and following amendments).

The obligation can be met by acquiring, in whole or in part, the equivalent quota or corresponding rights from others, buying the so-called Biofuel Certificates (CICs). It is relevant to say that a mandatory quota for "advanced biofuels" has been introduced. Advanced biofuels are produced from a list of non-food materials and include agricultural and industrial wastes (apart from UCOs and animal fats), residues, ligno-cellulosic materials, cellulosic materials, algae etc. According to the provisions of the Ministerial Decree 2 March 2018 on the support of biomethane, advanced biomethane and other advanced biofuels different by biomethane in the transport sector, the mandatory quota for advanced biofuels must be fulfilled for 75% by biomethane and for 25% by other advanced biofuels. The Ministerial Decree 30 December 2020 introduced a new mandatory quota concerning the supply of advanced biofuels in addition to the existing quotas established by the Ministerial Decree 2 March 2018.

Table 8: Mandatory quota for biofuels and "advanced biofuels"

Year	Q% overall biofuels (including advanced biomethane and biofuels)	Q% advanced biomethane (MD 2 March 2018)	Q% advanced biofuels (MD 2 March 2018)	Q% advanced biofuels (MD 30 December 2020)
2015	5%			
2016	5.5%			
2017	6.5%			
2018	7%	0.45%	0.15%	
2019	8%	0.60%	0.20%	
2020	9%	0.68%	0.23%	
2021	10%	1.5%	0.5%	0.5%
2022	10%	1.875%	0.625%	0.6%
From 2023	10%	2.25%	0.75%	To be defined

All the biofuels released for consumption in Italy must comply with the sustainability criteria stated by Renewable Energy Directive (2009/28/EC) and Fuel Quality Directive (2009/29/EC). Furthermore, they must be certified by specific certification bodies according to the National Certification Scheme (MD 23 January 2012) or according to voluntary schemes approved by the European Commission or according to bilateral or multilateral agreements with third countries.

The scheme provides extra incentives for advanced biofuels and UCO and animal fats (double counting mechanism – 5 Gcal of advanced biofuels released gives rights to a certificate instead of 10 Gcal for conventional biofuels).

Not complying with the obligation leads to a fee of euro 750 for every missing Biofuel Certificate in a certain year without prejudice of the maximum quota of Biofuel Certificates that can be postponed to the next year (20% in 2018, 5% from 2019 onwards).

Biomethane and advanced biofuels

The Decree of 2nd March 2018 provides incentives for biomethane injected into the natural gas grid and for advanced biofuels to be used in the transport sector. The Decree provides measures for:

- biomethane injected into the natural gas grid without a specific intended use - Guarantees of Origin (art. 4).
- Biomethane injected into the natural gas grid to be used in the transport sector (art. 5)
- Advanced biomethane injected into the natural gas grid with the obligation to connect third parties to be used in the transport sector (art. 6)
- Advanced biofuels, different from biomethane (art.7).

Biomethane injected into the natural gas grid to be used in the transport sector is supported by the above-described biofuels' blending obligation. Double counting is recognised.

Producers of advanced biomethane injected into the natural gas grid to be used in the transport sector (art. 6) can decide to sell the biomethane produced to the GSE, the company in charge of the management of the scheme, obtaining the gas market price (equal to the monthly weighted average price for natural gas on the market), minus 5%. The producer will also obtain a premium corresponding to the value of the CICs, reflecting the calorific value of the biomethane purchased. Under this mechanism, the value of one CIC is set at 375 €. One CIC will be issued for every 5 GCal of advanced biomethane produced. The advanced biomethane producers can alternatively decide to trade directly their biomethane without the intervention of the GSE, obtaining only the premium of 375 euro/CIC.

The producers of advanced biofuels, different from advanced biomethane, can obtain from the GSE a premium of EUR 375/CIC for every 5 GCal of biofuels sold to obliged fuel retailers who participate in the scheme and upon proof submitted by those retailers that the said quantity has been placed in the market for use in transport. Obliged fuel retailers purchase the biofuel at a maximum price linked to fuel prices (based on the average Platt's published levels, minus 5%).

The Decree applies to production plants starting operations between 2018 and 2022. The scheme is also open to existing plants for the production of biogas which are converted partially or totally in plants for the production of advanced biomethane between 2018 and 2022.

The total amount of biomethane that can access to the provisions of the Decree is **1.1 billion Standard Cubic Metre/year**. Currently we reached about the 20% of the limit.

The incentives are funded by transport fuel suppliers

COMPARISON WITH RENEWABLE ENERGY TARGETS

According to Eurostat[11], the following renewable energy shares in *gross final energy consumption* were reached.

***Table 9**: Share of renewables in different sectors in Italy, according to Eurostat, and compared to the 2020 target*

	2005	2010	2015	2019	*2020 target*
Overall share	7.5%	13.0%	17.5%	18.2%	*17%*
In heating & cooling	8.2%	15.6%	19.3%	19.7%	*17%*
In electricity	16.3%	20.1%	33.5%	35.0%	*26%*
In transport	1.0%	4.8%	5.7%	9.0%	*10%*

Italy already reached its overall renewable energy target in 2014, but levels have rather stabilized since.

Mind that some of these figures can differ from the IEA derived data because of different accounting rules. Particularly in transport the Eurostat shares are higher, which is due to the multiple counting of advanced biofuels and renewable electricity towards the transport target. Since 2014 there was a shift from conventional biodiesel to waste oil-based biodiesel, which can be double counted to the transport target, but the actual biofuel volumes hardly changed.

The heating & cooling figure in Eurostat also includes heat pumps.

[11] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_335a&lang=en

RESEARCH FOCUS RELATED TO BIOENERGY

Research and innovation in the field of bioenergy have concentrated in recent years in improving environmental performances of heating appliances with the aim of abating pollutants emissions also to comply with the NECP provisions. New technological solutions capable of significant emission reductions are emerging in the field of wood biomass and pellet appliances, like stoves, boilers, or district heating networks.

Among the most innovative proposals are the new condensing systems; filter systems for small and medium-sized boilers, both integrated and external to the boiler body, for a drastic reduction in emissions. Home automation solutions for remote management of systems via smartphone are also available.

RECENT MAJOR BIOENERGY DEVELOPMENTS

The economic crisis due to COVID 19 pandemic induced the European Union to issue the Next Generation EU, a new financial instrument for the EU recovery with an endowment of 750 billion euros. 37% of the funding deriving from Next Generation EU will have to be invested in projects aiming at reaching the 2030 EU targets with a view to the 2050 target of the EU carbon neutrality. With 191.5 billion euros of funding, Italy is the main beneficiary of the Next Generation EU.

The National Recovery and Resilience Plan (NRRP), sent to the European Commission at the end of April 2021, describes how the Next Generation EU funds will be used. It establishes six Mission. The mission number 2 is dedicated to a “green revolution and ecological transition” and financed with more than 59 billion euros.

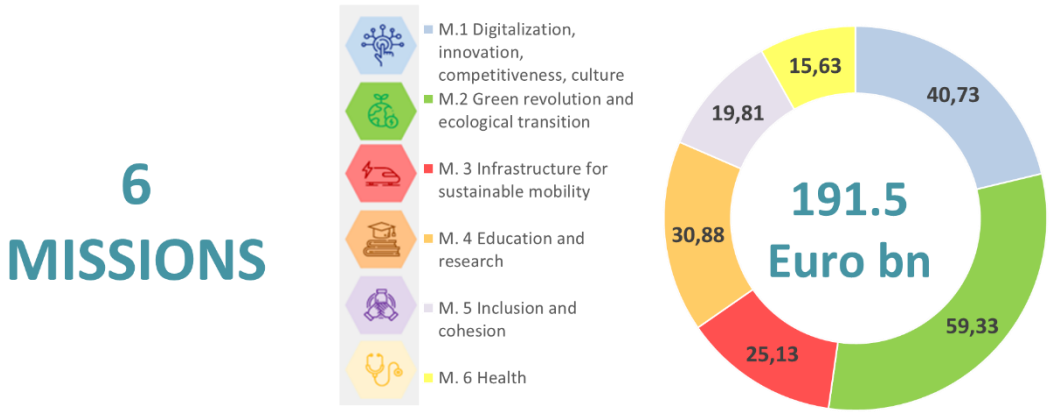

Figure 10: the Italian National Recovery and Resilience Plan (NRRP)

Into the framework of Mission number 2, the Italian NRRP promotes investments (about 2 € bn) in biomethane production from organic wastes and residues with the aim of:

- reconverting and improving the efficiency of existing biogas plants in the agricultural sector towards the production of biomethane to be used both in the industrial and residential heating and cooling sector and in the tertiary and transport sectors;

- supporting the construction of new biomethane production plants (contributing to the 40% of the investment);
- promoting sustainable practices in the biomethane production (low GHG emissions, low soil use) also creating consortia for the treatment of digestate and effluents to produce fertilizers of organic origin;
- promoting the replacement of obsolete and low-efficiency vehicles in the agricultural sector (old tractors) with biomethane-fuelled vehicles;
- improving the efficiency in terms of heat recovery and reduction of emissions of existing small-scale agricultural plants for which it is not possible to access to the conversion measures.

The NRRP intends to promote the use of biomethane in in the civil and in the industrial sector. So, a dedicated support mechanism will be provided by the end of 2021.

LINKS TO SOURCES OF INFORMATION

Eurostat, Energy from renewable sources https://ec.europa.eu/eurostat/web/energy/data/shares

GSE (Gestore Servizi Energtici) home page: https://www.gse.it/

GSE (Statistics on renewable energy sources) https://www.gse.it/dati-e-scenari/statistiche

Italian National Energy and Climate Plan https://www.mise.gov.it/index.php/it/energia/energia-e-clima-2030

IEA Policies database https://www.iea.org/policies

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