CH. 7 - ENERGY

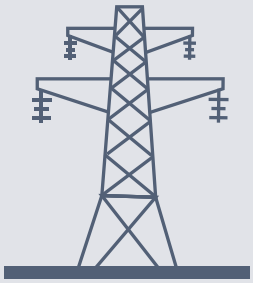
Climate change now requires urgent structural and cultural measures within the economies of all countries, to be implemented as soon as possible. The energy sector plays a central role in reducing polluting emissions, insofar as, including domestic heating and transport, it is responsible for 78% of greenhouse gas emissions within the EU (more than 81% in Italy). On a European scale, new targets have been set for the reduction of energy consumption and the simultaneous development of renewable sources with a low environmental impact, in particular the achievement of at least 27% renewable energy and a minimum improvement of 27% in energy efficiency by 2030.
Italy shows positive results in terms of energy efficiency, given that in 2016 it took 98.5 toe of energy to produce €1 million of GDP, the sixth best value among European countries. In addition, again in Italy, greenhouse gas emissions in the energy sector were reduced by 25.4% in the decade from 2007 to 2016. In Veneto, there has been strong development in renewable sources with production going from 0.7 million toe in 2008 to 1.4 million toe in 2015. Thanks to this, Veneto reached final consumption covered by renewable sources of 17.6% in 2016, exceeding its target of 10.3% set for 2020 well in advance.

Produzione&consumo nel 2015 in Veneto

Produzione primaria

2015 Ktep
1.525

Var. % 2015/08
107,1%



Consumo finale di energia

2015 Ktep
11.010

Var. % 2015/08
-7,3%

Approvigionamento di energia

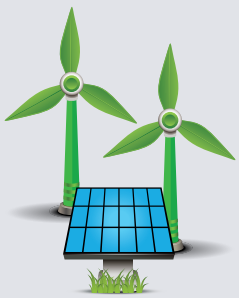
Consumo da fonti rinnovabili (%)

Target 2020

UE28	Italia	Veneto
20	17	10,3

Valore più recente

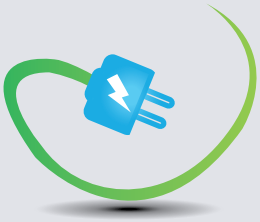
UE28	Italia	Veneto
17,5	18,3	17,6



Dipendenza energetica (%)

2017

UE28*	Italia*	Veneto**
55,1	77	83,4***



*Saldo import-export/Energia lorda disponibile (produzione primaria + prodotti del riciclo + import - export + scambi di stock)
**Saldo import-export/Consumo interno lordo (Energia lorda disponibile - bunkeraggi marittimi internazionali non disponibili per il Veneto)
***2015

Scientists of the UN Intergovernmental Panel on Climate Change (IPCC) observe that to limit global warming to no more than +1.5 °C compared to pre-industrial levels, partly reducing the dramatic effect on the climate and the environment, global greenhouse gas emissions must be reduced by 40% by 2030, as compared to 1990. In addition, carbon neutrality, i.e. eliminating the world's carbon footprint, must be achieved by 2050. The energy sector will play a very important role in this process, making a twofold contribution to the reduction of carbon dioxide emissions: on the one hand by reducing energy consumption and, on the other, through the increasing use of renewable and clean sources for energy production.

In this regard, at European level, specific objectives have been set concerning the energy sector: the achievement of at least 27% renewable energy and an improvement of at least 27% in energy efficiency, by 2030.

In terms of consumption, some positive data for Italy can already be seen by looking at the primary energy intensity of GDP, the indicator that shows the energy efficiency of a country and that is measured in tonnes of oil equivalent[1] (toe) needed to produce 1 million euro (M€) of wealth: from 2006 to 2016, the figure fell from 113.2 to 98.5 toe/M€, a value that puts Italy in sixth place in Europe behind Ireland, Denmark, Malta, Luxembourg and the United Kingdom.

Good energy efficiency in Italy: No. 6 in Europe

This result is indirectly due to Italy's high energy dependence and, consequently, to the higher energy costs compared to the European average, two factors that have determined the need for more efficient production, with particular focus on energy saving.

Moreover, in Italy there has been a change over the years with regard to energy sources,favouring the use of renewables and cogeneration over petroleum products.

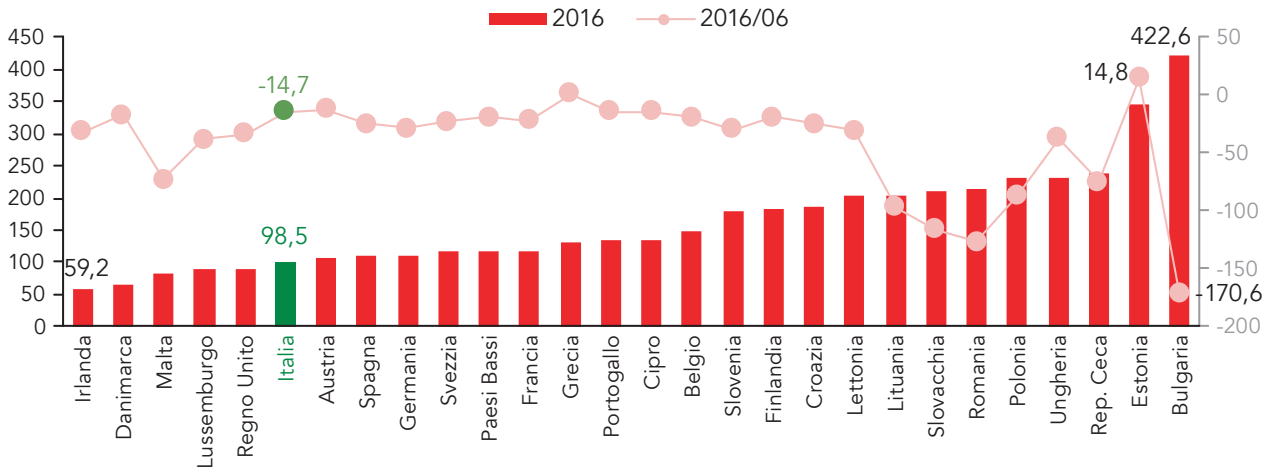
In addition to this, the economic crisis, together with the increase in proportion of energy from renewable sources, has resulted in a decrease in greenhouse gas emissions over the last decade of 23.8% as at 2016, while the fall in emissions from the energy sector, which represent more than 81%, was 25.4%.

In 10 years, -25.4% greenhouse gas emissions from the electricity sector in Italy

Again in Italy, compared to the reference year, 1990, total greenhouse gas emissions fell by 17.5% in 2016, while energy emissions fell by 18.4%. These figures reveal the fundamental importance of the

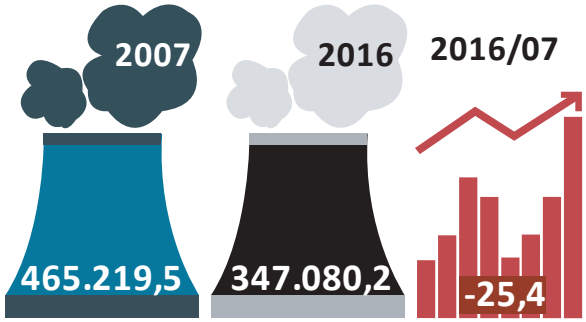
[1] The toe is the unit of measurement of energy and indicates the amount of energy released by the combustion of one tonne of petroleum (crude oil).

Fig. 7.1 - The primary energy intensity of GDP (toe/M€*). EU28 - 2016 and difference 2016/06



(*)Tonnes of oil equivalent/€1 million of GDP
Source: Processing of data from Eurostat by the Regione Veneto Statistical Office

Fig. 7.2 - Greenhouse gas emissions from the energy sector (millions of tonnes and % variations). Italy - Years 2007 and 2016



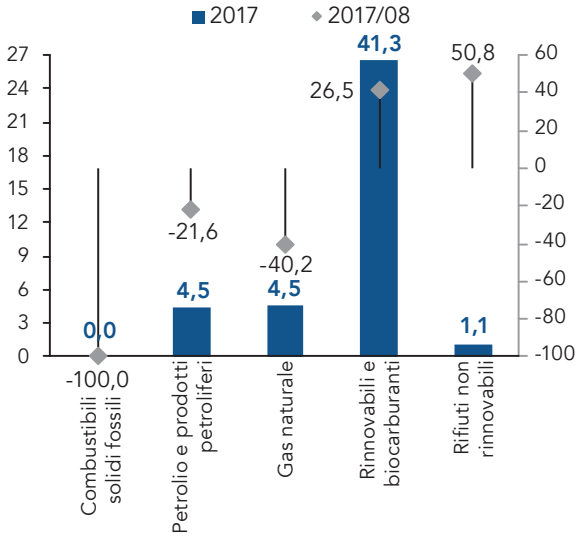
Processing of data from ISPRA by the Regione Veneto Statistical Office

energy sector in the fight against climate change and, at the same time, that the real turning point in the improvement of energy efficiency has occurred only in recent years: in fact, comparing 2007 with 1990, there was actually an increase in both overall emissions and those of the sector in question.
These improvements have been possible, as already mentioned, thanks to the change in the mix of sources used and, in particular, to the significant developments in the use of photovoltaics and biomass.
On the renewables front, progress has been significant, given that their share of gross domestic consumption has reached 17.4% in Italy, exceeding in advance the target of 17% set for 2020 and thus projecting us towards the new goal of 2030.

7.1 - Energy production and consumption

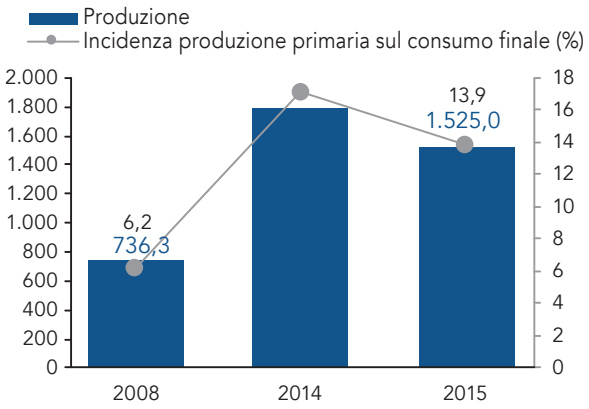
As mentioned above, one of the targets set at European level for 2030 is to achieve at least 27% of final energy consumption from renewable sources. Two factors contribute to this objective: a progressive increase in the use of renewable sources and a progressive decrease in consumption thanks to greater efficiency. With regard to primary production, it can be seen that this has gradually decreased in Europe (EU28) in the decade 2008-2017, from 862 million toe (MtoeTOE) to 758 million toe. In Italy, the dynamics have gone through alternating phases, but it has increased on average, going from 32.9 million toe in 2008 to 36.7 million toe in 2017. This is because of an important change in production systems, which saw a progressive decrease in solid fossil fuels, a 21.6% reduction in oil and petroleum products, as well as more than 40% in natural gas in favour of renewable sources, which in ten years have gone from 18.8 to 26.5 Mtoe. Despite this positive data, it should be noted that Italy is a country heavily dependent on foreign energy, in fact, raw materials are mostly imported and primary production covers only 32.3% of final consumption: just think that, to meet the overall needs of the nation, against the 36.7 Mtoe of primary production, another 157.9 Mtoe are imported.
In Veneto, the available data go as far as 2015, but some changes can be observed since 2008 and, in particular, we can see that primary production has more than doubled, from 7.4 to over 15 Mtoe thanks to the strong development in renewable sources, increasing from 0.7 to 1.4 Mtoe. The deficit situation remains, given that primary production covers just 13.9% of regional final consumption; however, this is an improvement on 2008, when production covered just 6.2% of consumption. Again in this case, the increasingly significant contribution of renewable sources is an important factor, as is the contrac-

Fig. 7.1.1 - Primary energy production in Italy by source (Mtoe and % variations) - 2008 and 2017



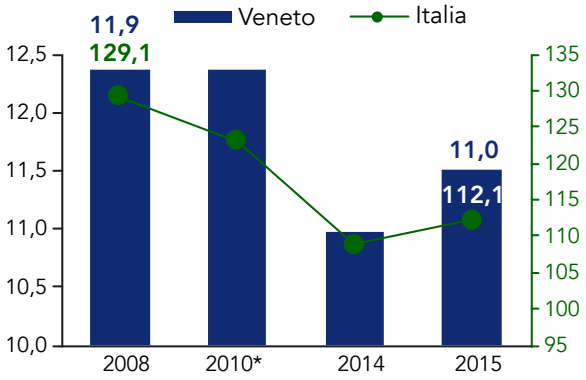
Source: Processing of data from Eurostat by the Regione Veneto Statistical Office

Fig. 7.1.2 - Primary production, (ktoe and incidence of production on final consumption). Veneto - 2008, 2014 and 2015



Source: Processing of data from ENEA by the Regione Veneto Statistical Office

Fig. 7.1.3 - Final energy consumption (Mtoe). Veneto, Italy - 2008, 2010 (*), 2014 and 2015



(*) for Veneto, the data is sourced from ARPAV
Source: Processing of data from ARPAV and ENEA by the Regione Veneto Statistical Office

tion in final consumption itself, which fell from 11.9 to 11 Mtoe over the 8 years considered, a decrease of 7.7%.

In terms of consumption, at national level, figures fell from 129 Mtoe in 2008 to 113.6 Mtoe in 2017. This trend is attributable to the reduction in the industrial and transport sectors, respectively from 34.5 to 24.9 Mtoe and from 40.7 to 35.5 Mtoe, despite the simultaneous slight increase in "other sectors", in particular the "tertiary" and "domestic" sectors, from 53.8 to 54.2 Mtoe.

In detail, in the decade under review, solid fossil fuels and petroleum and petroleum products fell sharply, -64.4% for the former and -26.8% for the latter.

Natural gas also fell, albeit to a lesser extent, by -7.4%, while the contribution of renewable sources and biofuels grew by 26%, thanks above all to the development of heat pump systems, biodiesel and solar thermal energy.

The contribution of renewables in Italy grows by 26%

7.2 - Objectives for renewable sources

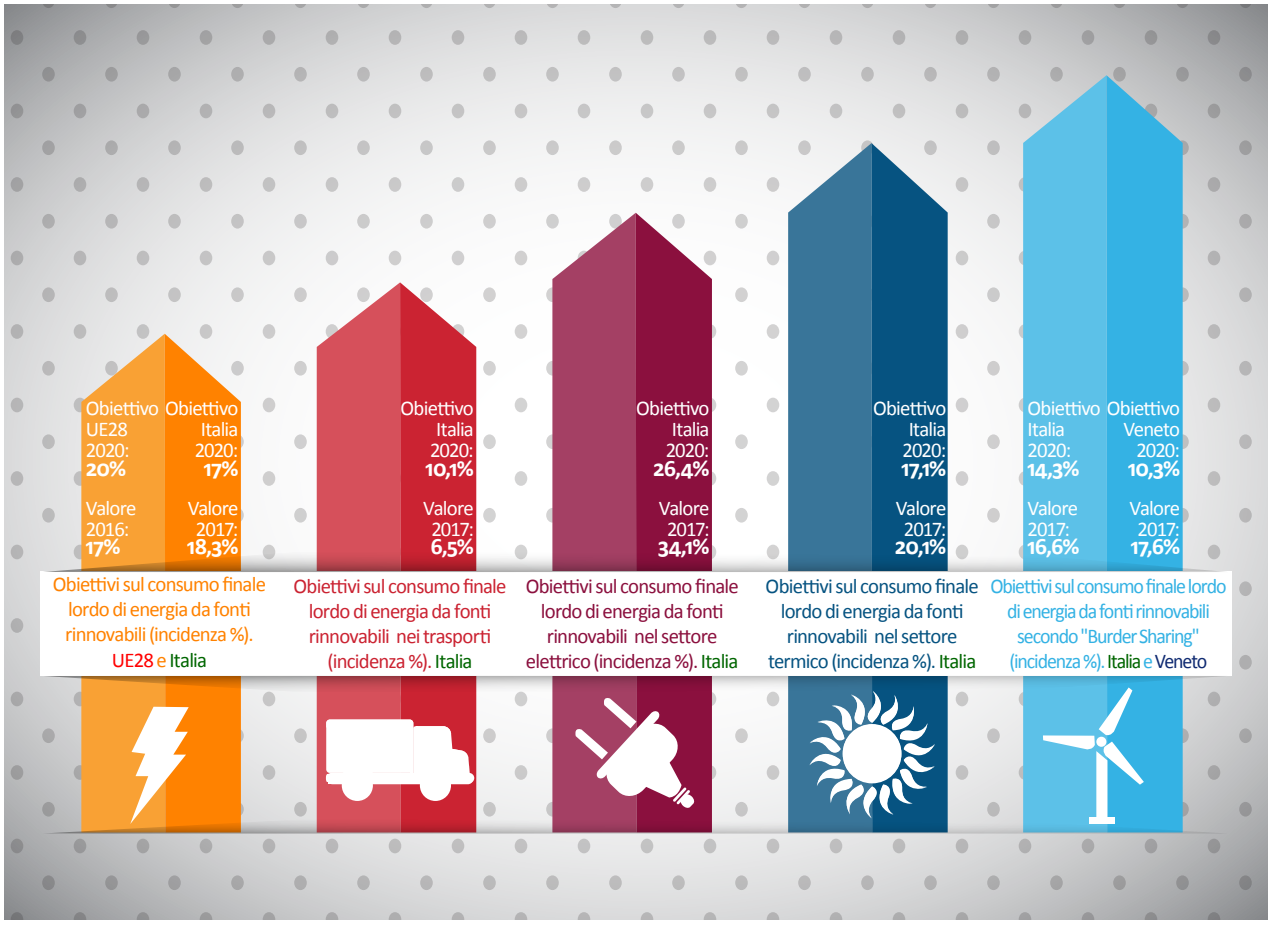
With regard to the issue of climate change and the possible contribution of the energy sector to its mitigation, we address in detail the issue of objectives relating to the development of renewable energy sources. Starting with Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009, the EU had set itself targets for improving energy efficiency and increasing the use of renewable energy sources to be achieved by 2020: in the first case, the target was to increase energy efficiency by 20% compared to 1990, in the second case, it was to achieve 20% of gross final consumption through the use of renewable sources. In 2015, the 193 member countries of the United Nations adopted Agenda 2030 for sustainable development, and Europe immediately pledged to lead the way in its implementation. In November 2016, the European Commission presented the plan to implement Agenda 2030 with the various objectives to be achieved; in particular, the 2030 climate and energy framework includes three fundamental objectives: a reduction of at least 49% in greenhouse gas emissions compared to 1990, the achievement of a share of energy consumption covered by renewable sources of at least 27% and an improvement in energy efficiency of at least 27%. This package is based on the previous 2020 package, of which it is an evolution.

According to these European objectives, the Na-

tional Energy Strategy (NES) presented in 2017 has given the utmost priority to the importance of energy efficiency and renewable sources: in the first case, for Italy the goal is to achieve savings of 10 Mtoe in expected final consumption, thus lowering the trend from 118 to 108; in the second case, the national target is to achieve 28% of total consumption covered by renewable sources. However, it is interesting to see the degree of achievement of the targets that had been set for 2020 to understand, concretely, the direction in which Europe, Italy and Veneto are moving. We recall that, with Legislative Decree No. 28 of 3 March 2001, Italy had implemented Directive 2009/28/EC mentioned above and, subsequently, with Ministerial Decree of 15 March 2012 (known as the "Burden Sharing Decree") it had defined regional targets for renewable sources in order to achieve the national target (covering 17% of gross final consumption by 2020). According to this decree, Veneto was assigned a share of 10.3%. It should be specified that only thermal and electricity renewable sources have been taken into account in the definition of the regional objectives, excluding those for transport and those imported from abroad, insofar as for these the achievement of the objectives depends almost exclusively on instruments available to the State. This implies that the regional objectives are "lower" than the overall national objective and this national objective, "recalculated" as the sum of the regions (and therefore excluding transport and imports), is 14.3% compared to the 17% foreseen for Italy.

The performance of the indicator for the development of renewable sources is certainly positive both in Europe and in Italy. In 2016, the most recent year available for the EU28 as a whole, the European Un-

Fig. 7.2.1 - Energy targets for renewable sources by sector - EU28, Italy and Veneto



Source: Processing of data from Eurostat and GSE by the Regione Veneto Statistical Office

ion reached 17% coverage, a value that is growing but is not yet enough to reach the 20% set for 2020. In Italy, the situation seems more positive given that in 2014 it had already reached 17.1%, further increased in subsequent years, to reach 17.4% in 2016 and even 18.3% in 2017. There is uneven contribution by the individual sectors, given that, in 2017, the electricity sector already exceeded 34% compared to a target of 26.4%, the thermal sector was at 20.1%, also already beyond the 2020 target of 17.1%, while the transport sector remains behind, decidedly more critical, still stuck at 6.5% against a target set for the same year of 8% and 10.1% for 2020.

In 2017 Italy has already reached 18.3% of energy from renewable sources...

At regional level, the situation appears decidedly positive, given that the objective of 10.3% has already been far exceeded in 2016, the most recent year available for monitoring, with 17.6%.

...and Veneto 17.6% in 2016!

7.3 - Energy dependence, efficiency and intensity

One crucial issue that emerges from the energy balance of a country is the dependence on foreign countries for the supply of primary sources. Gross domestic consumption is the amount of energy needed to meet a country's or region's energy needs; the ratio of imports of primary sources to gross domestic consumption shows how dependent a country is on other countries to meet these needs. Within the European Union, there is still a situation of partial energy dependence on raw material producing countries and the trend from 2008 to 2017 shows a certain stagnation, with the index fluctuating between 54.6% in the first year and 55.1% in the last year. These values are derived from diverse situations: whereas energy dependence for solid fossil fuels remains lower, in the order of 44%, the problem increases for natural gas, which exceeds 74%, and reaches almost 87% for oil and petroleum products.

For Italy, the situation is even more complex, since the general dependency ratio, although improving in the

Italian energy dependence is still strong: 77%

Fig. 7.3.1 - Energy dependence (*). EU28 and Italy – 2008:2017

Dipendenza Energetica	2008	2017
UE28	54,6%	55,1%
Italia	82,8%	77,0%

Dipendenza da import di gas naturale	2008	2017
UE28	61,7%	74,3%
Italia	90,3%	92,3%

Dipendenza da import di combustibili solidi fossili	2008	2017
UE28	45,7%	44,0%
Italia	101,8%	100,2%

Dipendenza da import di prodotti petroliferi	2008	2017
UE28	84,7%	86,7%
Italia	91,9%	91,5%

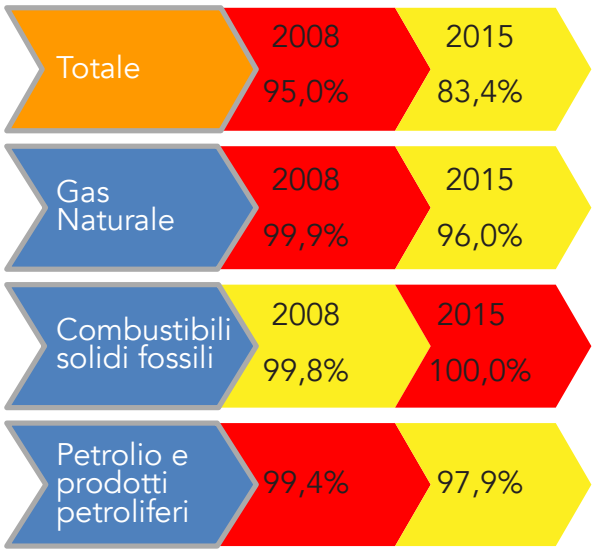
(*)Energy dependence is given by the % of imports as a proportion of gross domestic consumption.
Source: Processing of data from Eurostat by the Regione Veneto Statistical Office

decade considered, stood at 77% in 2017. Apart from the total dependence for solid fossil fuels (100%), foreign dependence for natural gas, oil and petroleum products is still over 90%, only partially mitigated by the reduction over the years in the use of petroleum products in favour of renewable sources.
The Veneto region is in a particularly poor position due to the scarcity of fossil natural resources, which are still an integral part of the energy system. The greater dependence is justified by a particularly high demand due to a series of factors, such as the high level of industrialisation of the area, the climate that forces us to make significant use of heating systems and the high volumes of road traffic, since the region is crossed by the main national and international road links.
Energy dependence settled at around 83% in 2015, an improvement on 2008 when it reached 95%. As already mentioned, there is a high level of dependence for the main energy sources, especially for natural gas, whose index, again in 2015, is 96%, while for oil and oil derivatives it is 97.9%.

In Veneto, energy dependence was 83% in 2015, though it has fallen over the decade.

It is also interesting to understand the level of energy efficiency, that is, how much energy is actually consumed to produce wealth. We have seen that Italy is among the top countries in Europe for the best energy efficiency. In 2015, the most recent year available for regional data, Veneto shows primary energy intensity that appears lower than the rest of the country. However, this figure must be contextualised because 2015 has some peculiarities: in fact, the balance of natural gas imports, which makes up gross domestic consumption, is decidedly lower than the average of other years, and this results in lower than average gross domestic consumption, 9.7 Mtoe compared to over 11 Mtoe. This leads to a reduction in primary energy intensity, which is given by the ratio of gross domestic consumption to GDP. In reality, the final energy consumption[2] is in line with the average of the other years, and the decrease in gas imports is attributable to a greater use of stocks accumulated in previous years. On the basis of this consideration, in order to make a more reliable comparison with the rest of Italy, the final energy intensity was calculated, taking the final energy consumption and GDP as a reference. In this case, the value for Veneto is 76.7 toe/M€, slightly higher than the Italian equivalent, which stands at 74.9 toe/M€, but still below the European average, which is close to 80 toe/M€. In detail, the ratio is considered of final energy consumption of each sector to its added value. Industry, agriculture and transport all have regional values that are better than the national average. Some critical issues remain in the services sector which, according to estimates, has a higher final intensity than the Italian average and, presenting an added value second only to that of transport, causes an increase in the overall final energy intensity.

Fig. 7.3.2 - Veneto's energy dependence (*) - 2008 and 2015



(*)Energy dependence is given by the % of net imports (import/export balance) as a proportion of gross domestic consumption.
Source: Processing of data from ENEA by the Regione Veneto Statistical Office

[2] Final energy consumption is given by: Gross domestic consumption - Transformation inputs + Transformation outputs + Exchanges, transfers and returns - Energy sector consumption - Transport and distribution losses - Statistical differences - Final NON-energy consumption.

Table 7.3. - Total final energy intensity, of manufacturing, agriculture, civil sector and transport* (toe/M€ at 2010 prices). Veneto - 2015

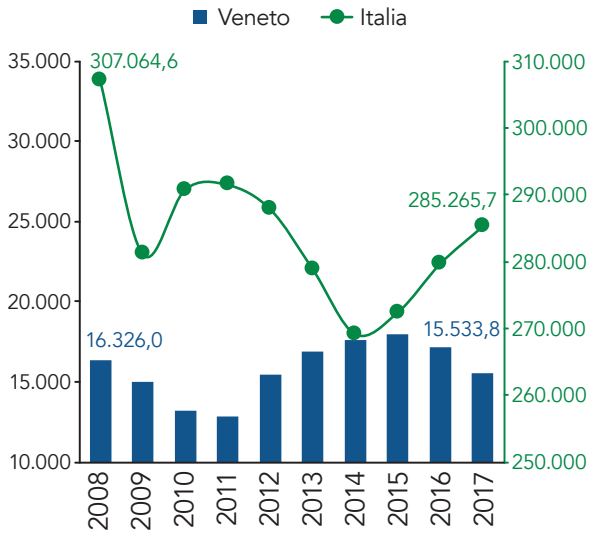
	Final consumption Veneto	GDP/Value Added Veneto	Final energy intensity Veneto	Final energy intensity Italy
Total	11,010,000	143,610	76.7	74.9
Manufacturing	2,688,000	39,108	68.7	77.5
Agriculture	167,000	2,567	65.1	97.7
Service sector	4,879,000	82,073	59.4	31.1
Transpor	3,271,000	143,610	22.8	25.4

(*) Calculated as the ratio between final energy consumption (toe) of the individual sector and the value added at constant 2010 prices of the same sector and between total final energy consumption and GDP at constant 2010 prices.
Source: Processing of data from ENEA and Istat by the Regione Veneto Statistical Office

7.4 Electricity

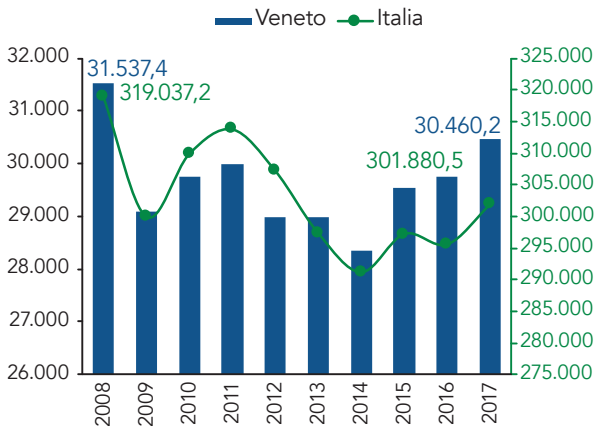
Production in the electricity sector shows different trends in Veneto and Italy from 2008 to 2017: on a national scale, there was a decline from 2008 to 2009, followed by alternating phases, reaching in 2017 values above the level of 2009, although still far from the over 307,000 GWh of 2008. In the Veneto region, there was an immediate decline, reaching record lows in 2011, with subsequent recovery up to 2015, in part due to the strong development of renewable sources. In the last two years, on the other hand, there has been a further contraction, which led to production in 2017 of just over 15,500 GWh. In the same decade, consumption, unlike production, followed similar trends for Italy and Veneto, that is to say a fall in 2009, recovery in 2010 and 2011 and a subsequent decline that continued until 2015. Since this final year, in Veneto there has been a constant growth in consumption, returning to over 30,000 GWh for the first time since 2008. In Italy, the trend since 2015 has been more uncertain, with a decline in 2016 and a new upward drive in 2017, to over 300,000 GWh.

Fig. 7.4.1 - Net production (*) of electricity (GWh). Veneto and Italy - 2008:2017



(*) Net production corresponds to gross production net of ancillary production services.
Source: Processing of data from Terna by the Regione Veneto Statistical Office

Fig. 7.4.2 - Final consumption of electricity (GWh). Veneto and Italy - 2006:2015



Source: Processing of data from Terna by the Regione Veneto Statistical Office

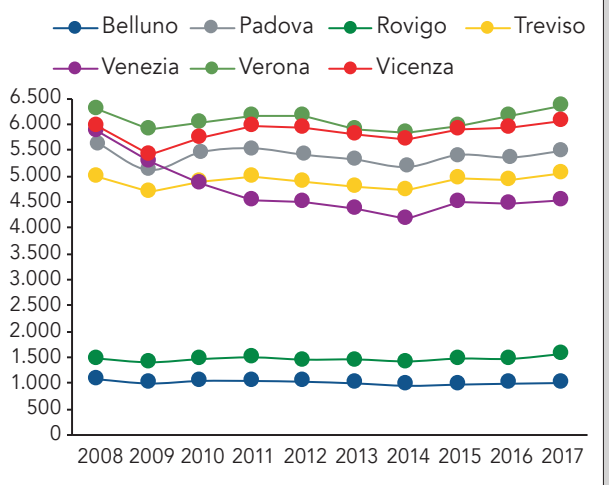
Veneto continues to be heavily energy dependent

A comparison of production and consumption data shows that Italy fails to achieve full self-sufficiency for the whole decade considered: production covered an average of 93.7% of consumption, although the situation improved slightly in the last two years, reaching 94.7% in 2016 and 94.5 in 2017. Due to the more than ten-year decline in production, the Veneto region has decidedly lower values, with an average of just 53.3% of consumption, with the worst performance in 2011 (42.9%), and the highest (62%) in 2014 due to the combined effect of the decline in thermoelectric production and hydroelectric production, subject to climatic factors.

On a provincial scale, final consumption of electricity decreased from 2008 to 2009, rising again until 2012, followed by alternating phases in the following 4 years and a further rise in 2017. Venice is an exception because, as a result of the fall in production in Porto Marghera, it showed a downward trend until 2014, only hinting at a recovery in the last three years.

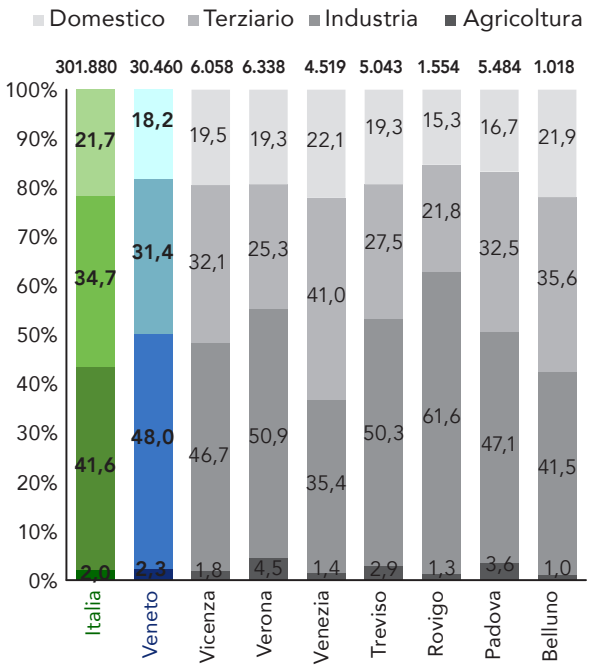
As for the production sectors, in all the provinces of Veneto except Venice, manufacturing uses the most electricity. Venice represents a unique situation due to the strong impact of tourism, which determines an imbalance in consumption in favour of the tertiary sector (of which tourism is part), which reaches 41% against 35.4% of the industry.

Fig. 7.4.3 - Final electricity consumption (GWh) by province. Years 2008:2017



Source: Processing of data from Terna by the Regione Veneto Statistical Office

Fig. 7.4.4 - Final electricity consumption by sector (percentage and GWh) in Italy, Veneto and Veneto provinces. 2017



Source: Processing of data from Terna by the Regione Veneto Statistical Office

In the production of energy from renewable sources, the national trends are mirrored in Veneto: on both scales, from 2008 there was a continuous upward trend as far as 2014, followed by a decline in 2015, stability in 2016 and a further decline in 2017. The decline in production in the last 3 years in Veneto is mostly due to a lower contribution by hydropower, which is still the biggest renewable source and is greatly influenced by climatic conditions: just think that in 2014 it had produced more than 5,550 GWh of electricity while in 2017 "just" 2,950.

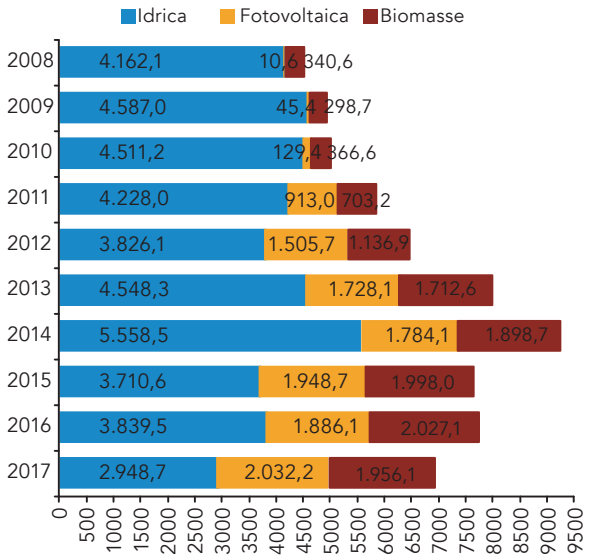
Renewable sources under strong expansion

However, it is interesting to note the change in the decade 2008 to 2017 in the incidence of renewable sources as a proportion of the total production of electricity, which rose from 18.2% to 35.1% and from 26.1 to 42.3% respectively in Italy and the Veneto region. The particularly high percentages for the Veneto region are the result of the marked devel-

Fig. 7.4.5 - Gross production of electricity from renewable sources (GWh). Veneto and Italy - Years 2008:2017

Source: Processing of data from Ismea by the Regione Veneto Statistical Office

Fig. 7.4.6 - Gross production of electricity from renewable sources by type of source (GWh). Veneto - 2008: 2017



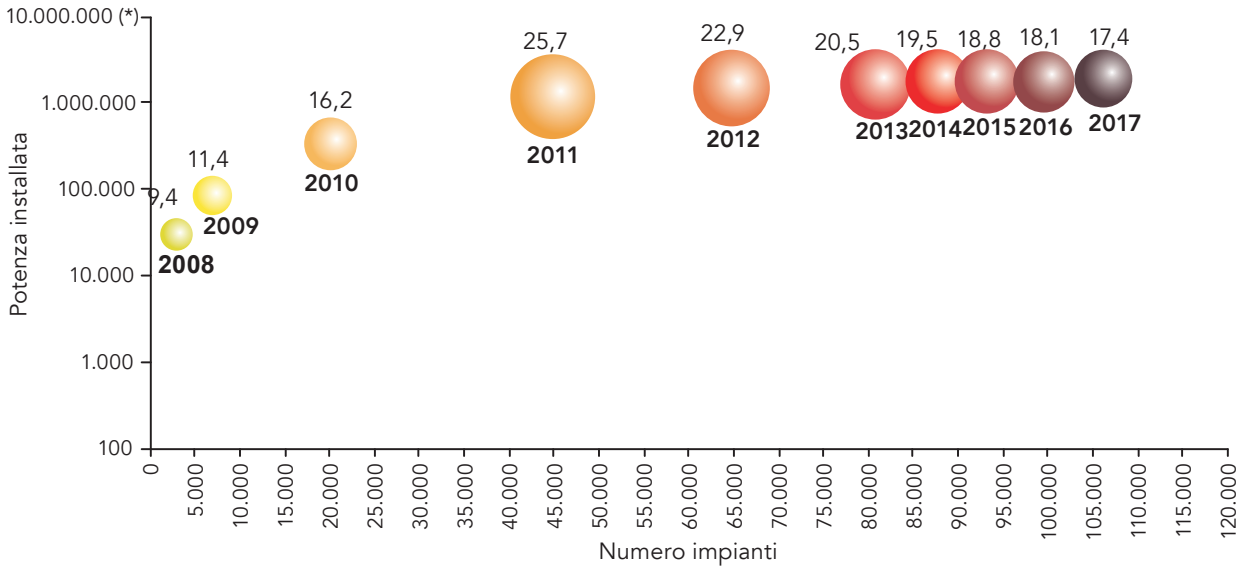
Source: Processing of data from Ismea by the Regione Veneto Statistical Office

opment of the photovoltaic and bioenergy sectors, but also the progressive reduction in overall production already mentioned earlier. The main renewable source in Veneto, as mentioned, is still hydropower, although with downward trend as a proportion of total production, due to the strong growith in photovoltaics and bioenergy. In 2017, these two sources exceeded the combined share of 57% of regional renewables, with 29.2% and 28.1% respectively, recording from 2011 to 2015 a veritable "boom" characterised by very high growth in production and consolidation over the last two years.

The photovoltaic sector has experienced a veritable boom

With regard to photovoltaics, the number of installations has risen from just over 3,000 in 2008 to over 106,000 in 2017. At the end of 2017, the total installed power in the photovoltaic sector in Veneto exceeded 1,850,000 kW with an average of 17.4 kW per installation; this latter value has decreased since 2011, indicating a structural change in the sector, i.e. a greater number of installations, but they are smaller in size.

Fig. 7.4.7 - Number, power(**) and average power(***) of photovoltaic installations in operation in the Veneto Region per year - 2008:2017



(*) Logarithmic scale
(**) Power measurements are expressed in kilowatts (kW).
(***) The diameter of the bubbles represents the average power
Source: Processing of data from GSE by the Regione Veneto Statistical Office