How austerity put a brake on the energy transformation in Italy

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Introduction

Italy, in the course of the last decade, has sought to diversify its sources of energy in order to redress its trade deficit in this field as well as to reduce the supply risk deriving from its dependence on imports. It has made efforts, at the same time, to green the national economy by promoting more efficient use of energy. In order to meet the 20/20/20 targets of the EU2020 Strategy on sustainable development, a number of measures have been put in place in Italy. The most significant of these has been the provision of very generous incentives for the development of renewable energy, photovoltaic power in particular. While the results on this score have been impressive – by 2012 Italy had already reached its 2017 mid-term target for the share of renewable energy in gross final energy consumption – they have entailed, for reasons that will be explained in this chapter, a high price in terms of economics, equity and efficiency.

The efforts in the energy field were well underway when the financial and economic crisis erupted. Their continuation coincided with five years of austerity policies which jeopardized the success of the environmental policies and achievement of their targets.

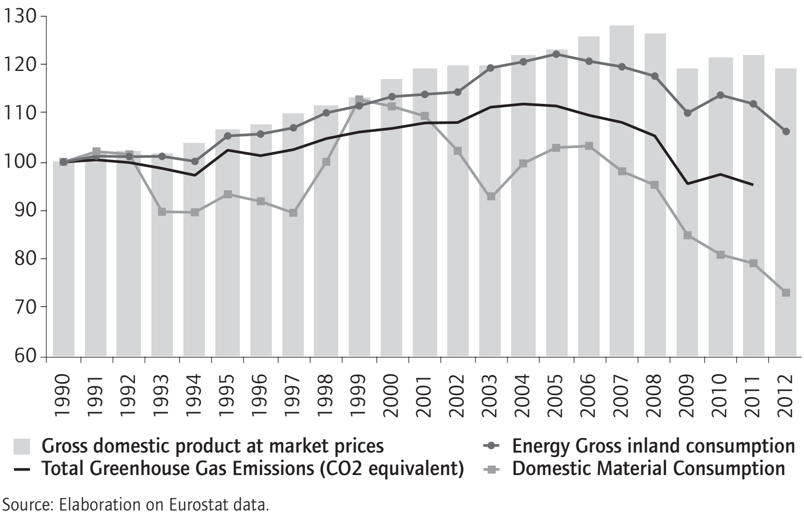
This chapter analyses the management of an energy transition in Italy within a context of crisis, seeking at the same time to assess the role played by austerity policies and their influence on this process. The chapter is structured with an initial presentation of the state-of-the-art of the green economy in Italy and a description of the magnitude and scope of austerity policies, in particular with respect to the environmental and energy sectors. A second section describes the policies designed to foster renewable energy sources and energy efficiency while also providing subsidies for fossil fuels. The third and final section provides a critical assessment of the system of incentives for photovoltaic energy producers. The system enabled a boost in sustainable energy production, making Italy one of the world leaders in solar energy and bringing about a significant reduction in fossil fuel imports. At the same time, it impacted heavily on households' and businesses' electricity bills during the toughest years of the crisis; it turned out to be not so equitable and not so efficient; and it failed to usher in the creation of a national green industry.

1. Structural analysis of the green economy in Italy through the crisis

1.1 Green economy trends

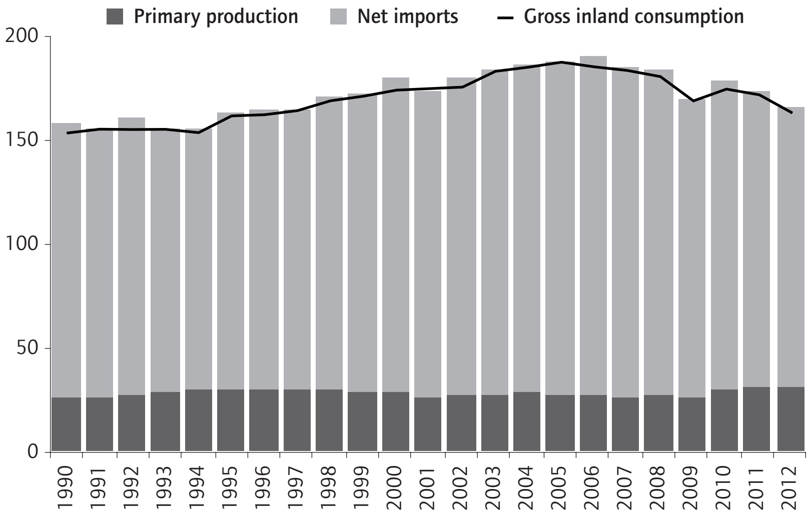
Italy is the fourth-largest greenhouse gas (GHG) emitter in the European Union, responsible for over a tenth of total European emissions. Up until 2004 Italian GHG emissions had been increasing steadily since the early nineties, due primarily to increases in road transport, electrical power and heat production, and oil refining. Since 2005 Italy has been getting greener, gradually reducing its emissions, partially as a result of the economic crisis.

Figure 1 **GDP Greenhouse gas emissions, energy consumption and material consumption in Italy (indexes 1990=100)**



Source: Elaboration on Eurostat data.

Figure 2 **Production, net imports and consumption of energy in Italy (Million tonnes of oil equivalent – Mtoe)**



Source: Eurostat.

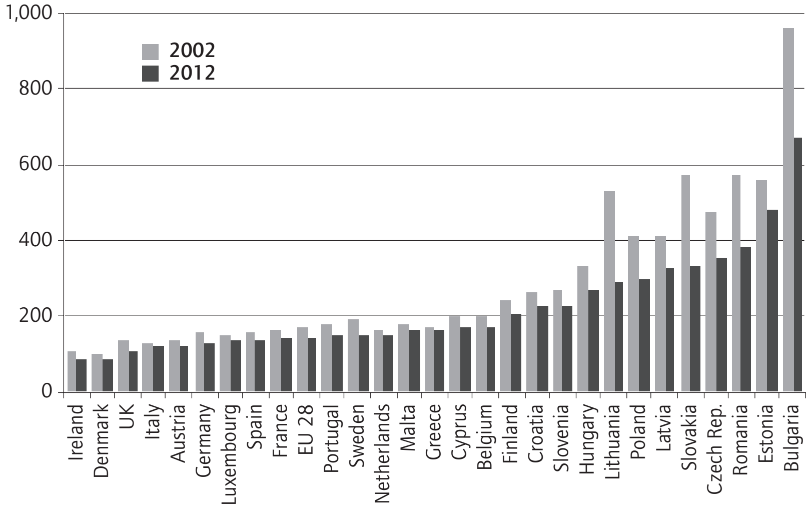
Energy use patterns were then affected by the economic crisis; gross consumption, obviously, follows a curve rather similar to that of emissions. And yet, whereas emissions have dropped by 15% since 2004, primary energy consumption has dropped by 'only' 7.3%. The difference between these two reduction figures accordingly reflects a moderate greening of the Italian economy which consumes proportionally less energy, while the energy consumed generates less pollution. Another hint of the Italian economy's success in 'decoupling' is provided by the fact that CO2 emissions, energy consumption and material use started to decrease in 2005, before the outbreak of crisis.

Of the 163 million tonnes of oil equivalent (Mtoe) consumed in Italy in 2012, primary energy production accounted for only 32 Mtoe (Figure 2). In order to satisfy domestic demand, Italy is strongly dependent on imports, which amount to 165 Mtoe, almost the same as the amount consumed. Energy exports, meanwhile, amount to 31 Mtoe.

This composition of imported, domestically produced, and exported energy has undergone a small change in recent years in the direction of a slight improvement in energy security: domestic production has increased by 8.6% since 2010 and by 14.4% since 2005, while imports have fallen significantly below the maximum of 193 Mtoe reached in 2006. In 2012 the ratio of domestic production to consumption reached its best score since 1990; domestic production was equivalent to 19.5% of consumption, compared with only 14.3% in 2007.

Absolute values of emissions and consumption are, naturally, strongly dependent on the size of a country's population and economy. A better measure for assessing progress on the path towards decarbonisation of the economy, or a decoupling of energy consumption and economic activity, is represented by the energy intensity of the economy. Compared to other major economies, Italy's energy intensity has traditionally been low. However, over the last 30 years it has shown less improvement than in many other countries, though since 1990 it has decreased by 10%. Today Italy uses 117 kilograms of oil to produce 1000 euros of GDP. Only Ireland, Denmark and the UK do better than this, while the average for the EU28 is 143 (Figure 3).

Figure 3 **Energy intensity of the economy (kilogram of oil equivalent [kgoe] per 1000 euros)**



Source: Eurostat.

These developments are the result of several different policies conducted in Italy in recent years. In terms of energy efficiency, Italy has continued along the path of adopting stronger national measures, working towards the target of reduction – in comparison with 2005 – of final energy consumption by means of energy-efficiency policies by 3% in 2010 and by 9.6% in 2016 (targets set in the Second National Energy Efficiency Action Plan – NEEAP – of 2010). The intermediate energy-saving target has been exceeded (-3.6% in 2010), mostly as a result of policies implemented in the building sector. These include the Energy Performance of Buildings Directive (EPBD) which has been fully adopted, a 'White Certificate' scheme, and a tax rebate granted for renovations carried out to improve energy performance in residential buildings. By 2012 the energy saving amounted to 4.7% of the 2005 level, displaying a trend that will not deliver the 2016 target without a substantially greater effort in the direction of energy-efficiency policies.

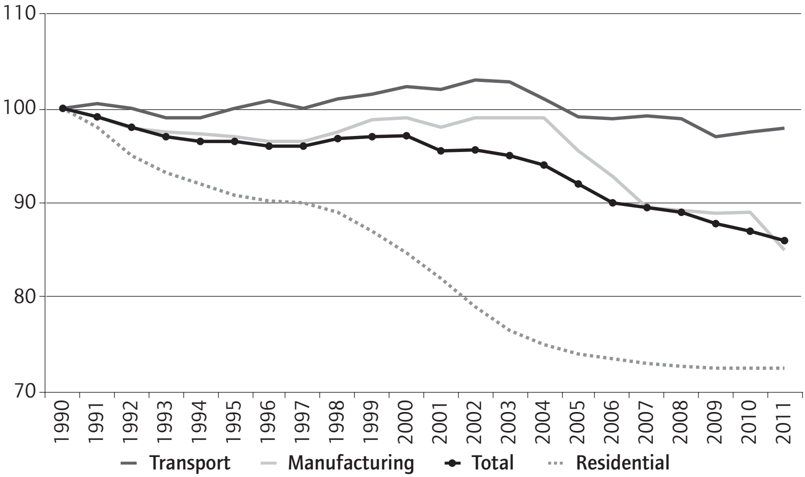
Since 2009, Italy has improved its energy-efficiency policy implementation in almost all sectors but the final results are highly differentiated according to sector (Figure 4). The building sector had been subject to particular focus through a process driven by implementation of the Energy Performance of Buildings Directive (EPBD[1]). The residential sector thus shows a consistent improvement throughout the last two decades with a reduction of energy consumption by nearly 30% per unit of production. Manufacturing has also shown increased efficiency over the past six years, while transport displays no significant progress.

Furthermore, transport is the sector with the highest final energy consumption (33% of total consumption in 2012) so that lack of improvement here acts as a brake on the system as a whole. The manufacturing and residential sectors each account for a quarter of total final consumption, the weight of services being much lower (13%). The legislator is targeting the sectors with the higher shares in energy consumption in the expectation that more than two thirds of potential savings would come from the building and transport sectors.

Heating accounts for 45% of energy consumption and is therefore a major focus of any energy strategy. As will be shown later, most of the public efforts in the direction of energy efficiency are indeed concentrated in this field.

1. Directive 2002/91/EC

Figure 4 **Development of energy efficiency in Italy – ODEX Index[2] (1990=100)**



Source: Enea elaborations on MSE data.

Transport, accounting for 33% of energy consumption, represents a real challenge since no substantial results have been achieved so far; nor does any radical policy or investment seem to be planned in order to alter the configuration of demand for passenger and freight transport, to encourage inter-modality, improve vehicle efficiency, and promote more efficient driving styles. On the contrary, traditional forms of transport have continued to obtain direct support and subsidies of nearly 5 billion euros have been made available for road haulage over the last decade. The composition of infrastructure investments has also largely served to encourage the use of motor vehicles and private transport. Legambiente (2013) has calculated that between 2000 and 2012 the framework law for infrastructure (*legge obiettivo*) disbursed a total of 84.5 billion euros, 60 bn (71%) of which was for roads and motorways, with only 24.5 bn allocated to national and local railways and urban underground systems. This distribution of subsidies reveals a lack of will to gradually move freight on to rail and maritime transport, and commuters on to public transport.

2. The ODEX index, developed by the ODYSEE project, measures energy intensity net of structural changes and other factors not related to energy efficiency (more appliances, more cars, etc.). It is therefore a better proxy for energy efficiency than those traditionally used.

As is frequently pointed out, statistical sources still lack a comprehensive measurement tool for the green economy that would enable distinct identification of value added and employment for green activity within individual sectors. Since 2008 we have, nevertheless, estimates of the investment in environmental protection – which includes machinery, equipment and special accessories – made by each economic sector.

Between 2008 and 2010 total gross fixed capital investment fell in Italy by 9% in nominal terms. Investment intended to reduce pollution was much worse hit, having fallen by an average of 29%, including an 8% drop in investment for climate and air protection, a 25.5% drop for investment in water management and a 58% drop in investment for waste management.

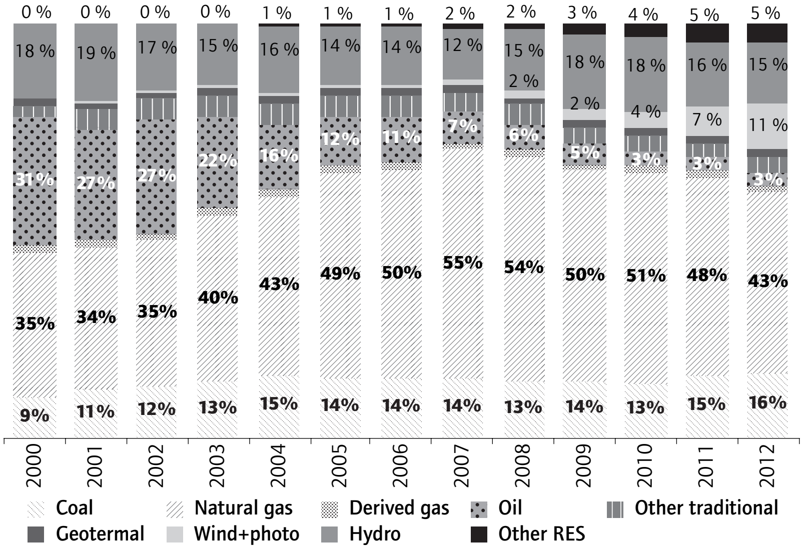
The other highly important change with regard to a greening of the economy is to be found in the structural change in electricity generation facilities. Electricity production had displayed an upward trend over many years until the economic crisis caused a sharp downturn in consumption. Over the past three years electricity production has remained stable at around 300 TWh. Figure 5 shows two major phenomena that have developed over the last decade.

The first of these is represented by the gradual substitution of natural gas for oil. Use of oil for energy production decreased from 31% in 2000 to 7% in 2007, while the share of gas increased from 35 to 55% (in 12 years the use of coal, meanwhile, increased from 9 to 16%).

The second phenomenon is the growth of renewable energy sources (RES), particularly wind and photovoltaic power, since 2008. Electricity from renewable sources increased from 17% in 2007 to 33% in 2012, pushing oil down to 3% and gas to 43%. Other renewable sources, such as hydro and geothermal power, showed much lower levels of development, attributable to the limited availability of suitable sites for their installation.

Energy production from renewable sources grew therefore in terms both of capacity installed and production actually generated. By 2012, there were 47 GW of active RES plants, compared with just 24 in 2008. In 2012 alone, Italy has seen an increase of 3.6 GW of photovoltaic installed power capacity, 1.2 GW of wind power, 1 GW of biomass and 140 MW of hydro (GSE 2013).

Figure 5 **Energy mix in Italy: shares of electric energy production by source, 2000-2012 (%)**



Source: Elaborations on GSE 2013.

Even more important is the contribution in terms of production, which increased from 83 to 92 TWh in just one year, reaching 27.1% of Italian gross electricity consumption (it was 24% in 2011). Hydropower has fallen (from 45.8 to 41.9 TWh) while geothermic power remained stable (at around 5.5TWh), but all other RES showed a sharp increase in production: wind power rose by 33% compared to 2011, reaching 13.4 TWh in 2012; bioenergy rose by 16% reaching 12.5 TWh; photovoltaic power showed a huge increase of 56%, reaching 18.8 TWh (GSE 2013).

The geographical distribution of the generation of electricity from renewable sources is uneven. Although renewable energy plants can now be found in all the regions of Italy and in 98.5% of municipalities, the varying distribution of natural resources and the configuration of the territory mean that some renewable sources are more concentrated in specific regions, such as Tuscany in the case of geothermal power plants, Puglia and Sicily which have a high production from wind power, and Lombardy which has a high incidence of bioenergy. This uneven geographical distribution, together with the inherently intermittent character of some of the renewable sources, means that it is urgent to create a national smart grid system.

1.2 Energy prices and components

This huge leap forward in production from renewable energy sources has been made possible by a very generous system of incentives which is, together with Italy's high level of dependency on imported energy, the factor that determines energy price developments. Prices in Italy are significantly higher than the European average for both households and industrial consumers, with the difference being more marked in the case of the latter. Nevertheless, over time Italian energy prices increased in line with trends in the rest of the EU, with taxes and levies representing the most rapidly increasing component due to the high dependency on imports and the high number of incentives which consumers had to finance through their energy bills. The resulting disadvantage in terms of competitiveness for small Italian businesses is considerable (Figure 6A).

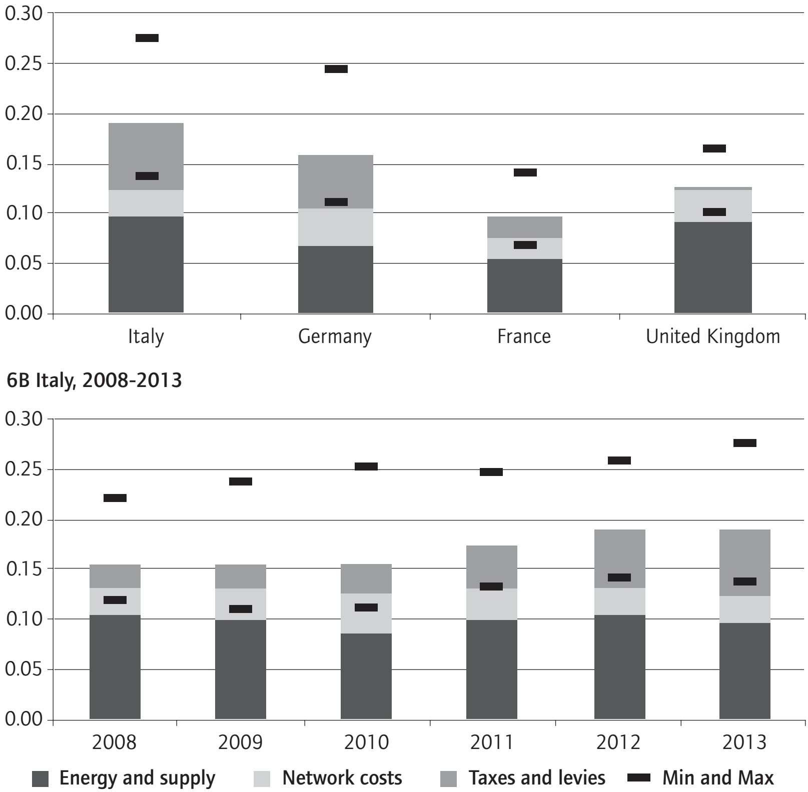
According to government projections (SEN 2013), the price gap between Italy and other European countries is expected to be eliminated in 2020 when the 5 billion euros of additional costs for incentives for energy efficiency, thermal renewables, and the development of the network, will be offset by more than 13 billion in savings expected from energy price reductions (9 billion) and a reduction in the volumes of energy consumed. The total cost of energy – the energy bill – can be split into three components: energy and supply costs, network costs, and taxes and levies. The energy component of bills has decreased since 2008 for both industrial and domestic consumers (on average by 7 and 4.2% respectively[3]), but during the same period the taxes and levies increased so much (by between 57 and 208 percent for different categories of consumers) that the final result has been an increase in prices for both households and businesses. In the case of households, in particular, the increase has ranged between 0.3% for those with lower and 32% for those with higher consumption (i.e. more than 15 MWh). In the case of industrial consumers, between 2008 and 2013, the bills increased by 25% for firms consuming less energy and by 15.3% for energy-intensive businesses (i.e. between 20 and 70 GWh).

3. This is the average of the changes for the six different consumption bands. It should be noted that in the lowest bands (less than 20MWh for industrial consumers; less than 1 MWh for households) the energy component increased by 1.9% and 4.2% respectively.

Figure 6 **Electricity price components for industrial consumers for selected European countries and for Italy (€/KWh)**

6A Selected European countries, 2013

6B Italy, 2008-2013



Source: Eurostat.
Note: Values represent simple average with minimum and maximum for consumption bands.

1.3 Progress towards international targets

During recent decades the alarming environmental and climate-change trends led the international community to define common objectives on a global level. Italy is subject to two basic sets of targets, those fixed by the Kyoto Protocol and those proposed as sustainable development targets in the context of the EU 2020 Strategy.

In Europe, the Kyoto targets for the period 2008–2012 were subdivided into two emission budgets with different levels of ambition: Emission Trading System (ETS – covering power stations and energy-intensive industrial plant sectors[4]) and non-ETS. Italy decided to reduce ETS emissions by 13% with respect to 2005 levels and non-ETS emissions by 18%. By the end of 2012 it had reached the ETS but not the non-ETS targets, generating a surplus of 9 Mt CO2 in the former and a deficit of 23 Mt CO2 in the latter.

According to the EEA (2013), one reason why Italy has 'not been on track' towards its targets is that it had originally placed more emphasis on emission reductions in the non-ETS sectors. Achieving significant domestic emission reductions in these sectors may indeed have been more difficult than in the ETS due to the much broader spread of sources (e.g. transport, agriculture) and to typically higher marginal abatement costs than in the ETS sectors (essentially constituted of points sources).

The EU 2020 Strategy sets three major targets which Italy should aim to reach by 2020:

— Reduction of CO2 emissions by 20% compared to the 1990 level. Taking 1990 as the baseline for Italian emissions, the index rose until 2004, reaching a maximum level of 112 and decreasing rapidly thereafter. By 2012 it had fallen to 89. An important contribution to this reduction was obviously supplied by the economic crisis which triggered a 10-point drop between 2008 and 2009. Meanwhile, however, a number of other more virtuous factors also contributed to this result.

— A 17% overall share of renewable energy sources (RES) in gross final energy consumption, on the basis of sectorally differentiated targets (26% for electricity supply, 17% for heating and 10% for transport). By 2012, Italy had achieved a 13.5% share of renewable energy and is therefore well on track to reach its target; indeed, it represents one of the fastest cases of progress in RES contribution to energy consumption. In particular, Italy reached the electricity sector

4. Installations covered include power stations and other combustion plants, oil refineries, coke ovens, iron and steel plants and factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. In 2012, aviation was incorporated into the scheme. Italy has 1 232 installations that are included in the EU ETS and these were responsible, in 2011, for 39% of total national emissions.

target as early as 2011 when its renewables coverage was already 22% of consumption. In the other two sectors the level achieved is still half way to the requisite target, i.e. 9 and 5% respectively.

— A 20% increase in energy efficiency as compared with the 1990 level. In particular the EU directive 2006/32/CE lays down for each member state a national saving target, by 2016, of 9% of the average consumption for the years 2000-2005; in Italy this was transposed (by the national action plan for energy efficiency adopted in 2007) as a reduction target of 9.6% based on the 2005 level. In 2012 final energy consumption had already fallen by 11.5%.

1.4 The effects of austerity policies on the green economy

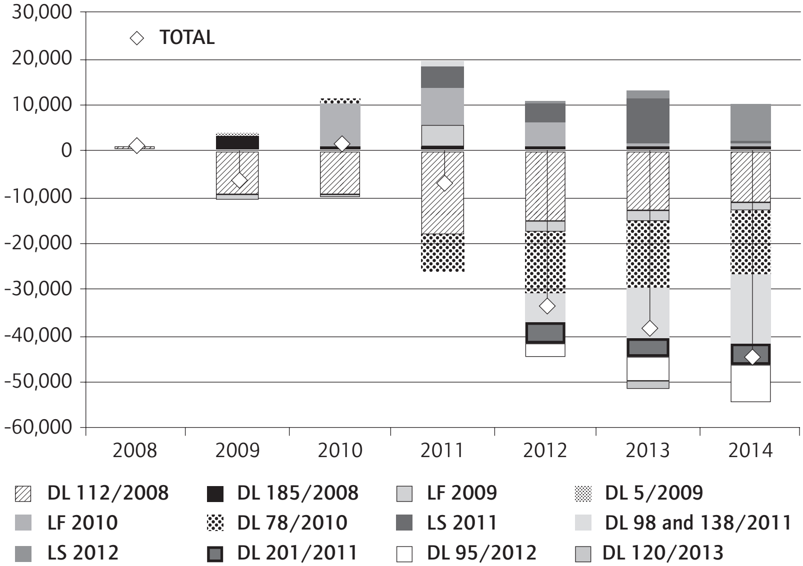
Italy, like several other European countries, has during the last five years experienced a sovereign debt crisis that culminated during the second semester of 2011. During this period Italian governments adopted a stance of austerity which gave rise to a number of different laws and budgetary manoeuvres leading to steady cuts in public spending. The worst effects, however, are still to come. The Economics Ministry has grouped together the effects of all recent laws and decrees and the result indicates that the tougher impact on the Italian budget has in fact only just begun (Figure 7). The effects of the 6 and 7 billion euro cuts in 2009 and 2011 which started Italy's cycle of austerity can hardly be compared with the budgetary cuts of 34, 37 and 45 billion euros announced for the years 2012 to 2014.

Total expenditure increased nominally until 2009 and stabilized afterwards, presenting a small increase of 0.5% over the 2009-2012 period. Its share in GDP, which had dropped to 46% at the beginning of the century, grew again to over 50% during the crisis, fundamentally because of the fall of the denominator and the increased interest payable on the national debt.

In real terms, however, state expenditure dropped by 3% between 2009 and 2012, and, while current spending remained virtually stable (net of interest, expenditure dropped by 2.2%), the capital account components fell by more than 30%.

Public investment was reduced by one quarter during the crisis.

Figure 7 **Principal measures affecting the state budget since 2008 (million €)**



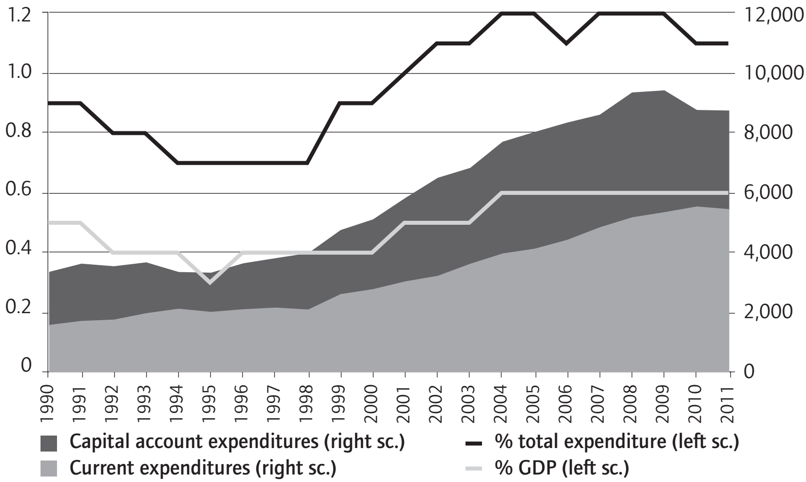
Source: Ministry of Economy and Finance (2013a).
Note: The measures included are the following decrees (decreti legge, DL), stability laws (leggi di stabilità, LS), and financial laws (leggi finanziarie, LF): DL 112/2008; DL 185/2008; LF 2009; DL 5/2009; LF 2010; DL 78/2010; LS 2011; DL 98/2011; DL 138/2011; LS 2012; DL 201/2011; DL 95/2012; DL 120/2013.

During these years the composition of public expenditure also changed. Social protection expenditure has increased by 40 billion euros since 2007, the share of pensions and unemployment benefits having risen from 37.6 to 40.4% of total expenditure. Defence and public law and order also increased their share, while the other areas lost ground with economic affairs, cultural activities and education being the hardest hit.

During the crisis expenditure on environmental protection saw a drop of 7.2% (from 9.4 to 8.7 billion euros between 2009 and 2011), entirely attributable to the drop in investment. Capital account expenditure fell by over 20% in three years, while current expenditure continued to increase, apart from a drop of 1.6% between 2010 and 2011.

Expenditure on environmental protection reached its peak in 2008-2009, not in absolute values alone but also as a percentage of total expenditure, rising from 0.7 to 1.2%. In 2011 it had again decreased to 1.1% (Figure 8).

Figure 8 **Expenditures on environmental protection (% and million €)**



Source: Eurostat, COFOG.

Austerity policies impacted heavily on the Ministry for Environment which saw its budget drop between 2008 and 2013 from 1.6 billion to 470 million euros, a cut of over 70 per cent, focused on 'sustainable development and environmental protection' which has been cut by 76 per cent[5].

When the state budget is broken down into items of expenditure, the heading 'Energy and energy sources diversification' saw a peak in 2008 and 2009 due to already scheduled major investment to the tune of more than 100 million, which was subsequently reduced to 88 million and then cut to just 8 million in 2010 and 6 million in 2012. Six million is still the current expenditure under this heading, since energy direct incentives are covered by electricity bills and tax incentives are not accounted as expenditure[6].

The European Union estimates at 15% the domestic rate of return on energy R&D investments from 2010 to 2030 (IEA 2013). Energy R&D expenditure in OECD countries has been displaying a falling trend during

5. Ministry of Economy and Finance – LB Bilancio provisionale delle spese per Amministrazione, Missione e Programma.
6. Ibidem.

recent years, as the financial and economic crisis has hardly encouraged investment in this direction. And yet Italy's R&D expenditure actually grew in several energy sectors between 2007 and 2011 compared to the previous years, with only non-PV solar and nuclear technologies showing a negative trend (IEA 2013). The higher expenditure applies to nuclear power, together with hydrogen and fuel cells, as well as power and storage technologies. Fossil fuels too show an increasing trend. R&D for renewables showed a drop just after the 2008 crisis but a further increase subsequently: the overall level remains, however, very low. It is also worth remarking upon the path of R&D investment channelled towards energy efficiency: Italy actually possesses a rather efficient energy system, thanks precisely to the major investments made in this field, especially in the past, which by 2011 had in fact slightly decreased (MIKE programme 2013).

If we look at public R&D spending aimed at environment, transport and energy, funds between 2008 and 2013 dropped respectively by 28.5, 90.3 and 72.1 percent. Overall, R&D dropped by 42.2 percent over the same period.

Moving from the expenditure to the revenue side, we see that total environmental tax[7] revenue amounted to 43,881 million euros in 2011, Italy having one of the highest shares of environmental tax revenues in GDP in the European Union (2.8% as compared with a EU27 average of 2.4%). Yet the percentage of environmental taxes in GDP was decreasing, almost constantly, from 1995 to 2008 (from 3.6 to 2.5% of GDP); it then rose again over the last three years.

Energy taxes, accounting for three quarters of total environmental taxes, decreased – as a percentage of GDP – from 3.1 to 2.1%, while transport taxes, representing nearly a quarter of total environmental taxes, increased from 0.5 to 0.7% of GDP. Pollution and resource taxes, accounting for only 1.1% of the total in 2011, rose from 0.01% of GDP to 0.03%. Both transport and pollution taxes, even though they have provided increasing revenue over the past 20 years, are quite low compared with the European average: their weight within GDP is half the EU average, while the weight of pollution taxes is a quarter.

7. Environmental taxes comprise energy taxes (taxes on energy products like petrol and diesel, fuel oils, natural gas, coal and electricity, and CO_2 taxes), transport taxes (ownership and use of motor vehicles), pollution (emissions to air – except CO_2 taxes – and water, on the management of waste and on noise) and resource taxes (extraction of raw materials, with the exceptions of oil and gas).

2. The system of energy transformation incentives

The energy strategy devised by the Italian government (SEN 2013) has a two-stage time horizon for action (2020 and 2050). Its aims are to achieve the European 20-20-20 objectives, increase the country's energy security, and reduce energy costs in order to overcome the curbs on competitiveness suffered by Italian businesses, as well as the excessive burden on households. The focus is on the improvement of energy efficiency and the development of renewable energy sources, but also the promotion of a competitive gas market and the interconnection with the EU electricity market. The refining industry and fuel distribution network are to be restructured and a national hydrocarbons production promoted.

Actions are grouped into seven areas: energy efficiency, renewable energy, gas market, electricity market, oil refining and fuel distribution, national production of hydrocarbons, and energy governance. All this should be supported, in the longer term, by R&D activities.

Should economic growth be in line with the EC spring 2013 forecast (which is unfortunately already not the case), the SEN counts on ambitious results from its adoption:

1. Reduction of energy costs will lead to around 9 billion a year in savings on the electricity bill.

2. Fulfilment of all EU 2020 sustainable development targets which include: a 21% reduction in greenhouse gasses; a reduction of primary energy consumption by 24%; and achievement of a share of 19-20% of renewable sources in gross energy consumption. Renewables should become the first source for electric energy production with a share of 35%.

3. A reduction of energy imports by 14 billion euros (on the current 62 billion) with foreign dependency dropping from 84 to 67% which would make the trade balance positive.

4. 170-180 billion euros of investment in the whole energy sector between 2013 and 2020.

National projections indicate that implementation of currently planned (additional) measures could bring emissions in 2020 down below target levels.

Table 1 **Planned policies and measures for CO_2 reduction in Italy (projected annual reduction in Mt CO_2)**

Policies	Mt CO_2
National Action Plan for Renewable Energy 2010 and National Action Plan for Energy Efficiency 2011	10.6
New measure of promoting and supporting RES-E	10.0
National Action Plan for Renewable Energy 2010 – Legislative decree 28/2001 – Kyoto fund	6.3
Legislative decree 28/2011	4.7
Directive 2010/31/EC – New standards of efficiency in buildings	4.0

Source: EEA 2013.

The greening of the Italian economy is limited, however, by all the direct and indirect subsidies that are channeled into fossil sources. Efforts to identify all these subsidies, for 2011, have been carried out by Legambiente (2013). The direct subsidies include:

1. Fossil fuel incentives to fuel plants amounted to 2.34 billion euros in 2011 (down from 3.4 billion in 2001). In one decade the subsidies to 'assimilated sources' cost about 38 billion. These incentives were actually paid for directly by consumers within the A3 component of electricity bills;

2. Subsidies amounting to 1.6 billion euros will be made available to energy-consuming industries for use in the event of sudden energy interruption in case of need or emergency. These industries are paid 100-150 thousand euros each year for every Megawatt foreseen by the contract with the energy supplier;

3. Subsidies to road transport amount to about 500 million every year including direct transfer, reduced highway tariffs and reduced insurance premiums;

4. Incentives for old fuel oil power plants to be activated in case of emergency need without any environmental constraints. They may receive in 2013 around 250 million euros, an amount directly covered by bills.

Indirect subsidies may be represented by the following:

5. A total of 3 billion euros were spent on investment in new roads and highways; and

6. the very low royalties for oil drilling of only 10% (while in the rest of the world they vary between 20 and 80%). Had royalties of 50% been applied, they would have generated revenue amounting to 1.3 billion euros.

2.1 Photovoltaic incentives

The renewable energies sector is generally characterized by still not having reached so-called grid parity: the full cost of energy production, inclusive of the returns on invested capital, remains higher than for conventional sources. This means that the development of the sector needs some kind of public incentive in order to motivate private action and make investment profitable.

Incentives can be classified in two major categories: market regimes and administered regimes. Italy has adopted both types of category during recent decades.

Market regimes, based on quantities, for which the calculation method is based on obtaining a so-called 'green certificate' and the guarantee that the energy produced will be sold either to traditional producers (who are obliged to include in their production and import a minimum share of energy from renewable sources) or to the body responsible for the management of energy services (Table 2).

— Green certificates were the system foreseen under the Kyoto Protocol trading system mechanism. They referred to all renewable energies with the exception of photovoltaic sources and were active for 15 years for those plants established before 2013. The charges deriving from Green certificates increased three times between 2008 and 2011, from 600 million to 2.1 billion in 2011 when they were abolished.

— Green certificates have been replaced by the auctioning system for larger plants, as foreseen by the EU ETS and by an ‘all-inclusive’ tariff for smaller plants. Italy held its first auction in 2012. A capacity of 1.7GW was up for bid for larger wind, hydro, geothermal and biomass projects while 368MW was made available for smaller projects through a registration system. The auction did not attract a full quota of bids. Only one offshore wind project (30MW) came forward when 650MW in contracts was potentially available. Onshore wind did better with 18 projects securing 442MW out of a possible 500MW.

Administered regimes are based on guaranteed prices, such as Feed-in Tariffs, Feed-in Premium (an additional incentive to the selling of electricity at market prices), capital account incentives and tax incentives. In particular, in Italy three different tools have been applied for fostering renewable sources:

— The CIP6 is a resolution approved in 1992 by the Inter-ministerial Prices Committee (CIP) giving private producers the right to sell energy produced from both renewable and assimilated sources to a public company (called GSE) 6-7% over the market price (assimilated sources are combined-cycle gas, gas recovery from refineries and waste-to-energy incinerators). CIP6, which represented one of the major tools active during the 1990s, is now in its last phase and is applicable to plants activated before 1999 for a period of 15 years, the first eight of them with additional incentives. This system was therefore almost extinct by 2013, its total cost having decreased from nearly 1 billion in 2008 to 430 million in 2012.

— The Energy account is a tool rewarding photovoltaic solar power with a feed-in premium tariff for a period of 20 years. It saw a huge increase from 100 million euros in 2008 to 6.7 billion euros in 2012 when, in its fifth round, it was practically eliminated. Its very generous incentives led to huge investments in photovoltaic energy in recent years, producing positive effects but also important imbalances which will be broadly addressed in the next section. The incentives were gradually reduced over the years: by way of example, during the five Energy accounts (the first in 2006) a small plant of 3kW could receive a subsidy over 20 years of 445 euros for each produced MWh if activated in 2006, the amount being gradually lowered to 126 euros/MWh if activated in 2012. A big plant of 1000MW received subsidies of between 490 and 44 euros/MWh. Incentives will decrease by 15% every semester. In 2012, on average, each MWh produced was paid 333 euros.

— The ‘All-in’ tariff (*tariffa onnicomprensiva*) is the system of incentives that in some respects replaced the Green certificates to finance small plants (less than 1 MW, or 200kW for wind) of all renewable sources except photovoltaic ones. These too are to be gradually reduced over time (-15% each semester). They currently represent a smaller share of the total incentives.

Table 2 **Produced energy and costs of the system of incentives for renewable sources of electric energy in Italy (years 2008-2012)**

Incentive regime	Cost (mill. €)				
	2008	2009	2010	2011	2012
CIP 6 (only renewables)	948	810	780	880	747
Green certificates	615	1296	1580	2049	1359
Fixed ‘all-in’ tariff	36	112	212	652	1056
Energy account (photovoltaic)	110	303	826	3883	6036
Total	**1709**	**2521**	**3398**	**7464**	**9198**
Of which in electricity bill (A3 component)	948	1872	2758	6632	9163
	Energy (TWh)				
CIP 6 (only renewables)	7.8	6.9	6.3	4.8	4.1
Green certificates	10.5	17.4	21.2	27.4	16.9
Fixed ‘all-in’ tariff	0.2	0.7	1.2	2.5	4.1
Energy account (photovoltaic)	0.2	0.7	2.0	10.9	18.1
Total	**18.7**	**25.7**	**30.7**	**45.6**	**43.2**

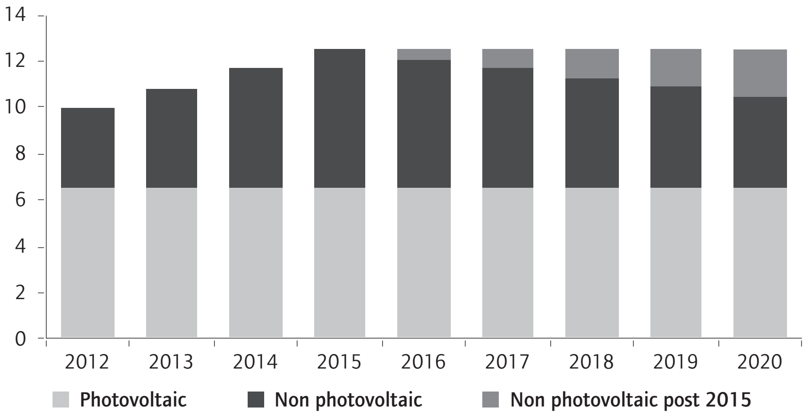
Source: Elaborations on GSE and AEEG data and reports.

As Table 2 shows, the total cost of RES incentives (excluding assimilated incentives and those aimed at fulfilling the other aims of energy efficiency and emission reductions) totalled 3.4 billion euros in 2010. These incentives had exceeded 7 billion euros by the end of 2011 and reached an annual total of 10.1 billion euros in 2012. Ninety percent of the sums in question is passed on to final consumers, being charged to them in the so-called A3 component of the energy bill.

This combined system of incentives has been a constant determining factor of future expenditure for many years. According to the National Energy Strategy, the trend will mean an increase in the costs charged on electricity bills from 10.5 billion euros by the end of 2012 to between 11.5 and 12.5 billion in 2020. However, thanks to the gradual exiting of the first plants set up in the early 2000s (endowed with higher incentives), the SEN foresees that, as from 2016, it would be possible to support further incentives to the tune of 0.5-1.5 billion a year. The National Strategy hopes for partial coverage of these future incentives through the introduction of a carbon tax at European level. Moreover, in the event of an over-performance of national objectives, which is indeed about to happen, it is possible to consider the hypothesis of selling excess production through the mechanism of statistical transfer foreseen by EU directive 2009/28/CE. The economic benefits deriving from such a tool may lead to some reduction of the electricity tariffs. Overall, the system of incentives for renewable forms of energy has entailed high costs for the whole system; these can be estimated at something like 170 billion over the 15-20 years of incentives (SEN 2013).

The development trend of renewable sources depends essentially on two factors: the profitability of the incentives with respect to the costs of renewable technologies and the availability of suitable sites (which restricts the applicability of wind and mini-hydro while presenting no constraint in the case of solar plants which can be installed almost anywhere).

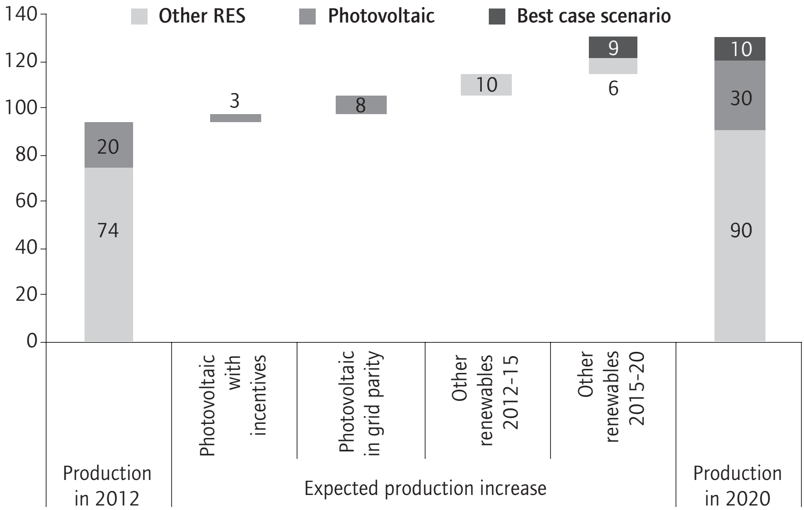
Figure 9 **Expected evolution of the costs for the development of renewable sources of electricity (billions of €)**



Source: SEN 2013.
Notes: 2012 base does not include auctions assigned between 2012 and 2013.

Under this system of incentives, the Ministry of Economic Development foresees still some increase of power from renewable sources which could, by 2020, reach a production level of about 120-130 TWh per year. As shown in Figure 10, this forecast assumes: a further small increase in production under incentives (3 TWh); the installation of 1 GW each year due to the reaching of grid parity[8] which will produce in 2020 a further 8 TWh; and a substitution effect for other renewable technologies which, following the exit of old plants from previous mechanisms of incentives, will increase production by 16 to 19 GWh thanks to more efficient technologies.

Figure 10 **Expected electricity production from renewable sources in 2012 and 2020 (TWh/year) and expected 2012-20 increase by different components (%)**



Source: SEN 2013.

2.2 Energy efficiency incentives

The other relevant set of national incentives are those designed to promote energy-efficiency initiatives for the purpose of achieving the other Europe 2020 target of a 20% increase in energy efficiency from the 1990 level. The national strategy aims at saving 20 MTOE of primary energy and 15 MTOE of final energy every year until 2020. Such a saving

8. This happens when technologies are cheap and efficient enough to guarantee profits without subsidies or incentives, thereby making investment in solar plants competitive with other traditional sources.

Box 1 **Waiting for the grid parity**

Data from the World Energy Council (2011) clearly show the existing differences in prices for electricity production from different sources in Europe. The price for a kilowatt-hour is 6 euro-cents for carbon and 5.7 cents for gas and between 2.5 and 5.5 for nuclear power. Among renewables, wind energy is cheaper, costing from 6 to 9 cents per kilowatt-hour, while the photovoltaic ranges between 11 and 17 cents. Data presented do not include social and environmental costs deriving from the use of different sources, yet for carbon and gas the maximum price includes the taxation on CO2 emissions, even though this is not applied in all European states.

Nevertheless, forecasting the future efficiency of photovoltaic technologies, under the hypothesis of constant progress of the market and including the composition of the building costs of photovoltaic parks, it is possible to foresee a reduction in costs within 20 years of between 56 and 66 percent, without 'quantum leaps' due to technological research which may further improve the effects of cost reductions and further shorten the length of time required to reach grid parity. Production costs of a Kilowatt-hour may shift to 6-10 euro-cents in 2020 and 4-7 cents in 2030. In the best scenario, grid parity might be reached already in 2013, even if the international economic crisis and its consequent contraction of consumption and industrial production is leading to deflationary mechanisms which may slow the path towards grid parity.

Nevertheless, according to different sources (SEN, 2013; PV-Parity project) grid parity is not only very close but is actually a reality in Italian Southern regions where photovoltaic plants are convenient even in the absence of incentives in the case of market prices for self-consumption.

The National Energy Strategy (SEN 2013) identifies a few measures to be put in place to accompany production under grid parity (a further simplification of administrative procedures for small plants or the inclusion of photovoltaic technologies among the works for energy efficiency) but these have not yet been put in place.

would avoid the emission of 55 million tonnes of CO2 every year until 2020 and the import of 8 million euros worth of fossil fuels every year (SEN 2013).

The Italian industrial system is potentially strongly affected by the energy-efficiency strategy because of the many important sectors which are involved in it, such as automotive, electrical appliances, home automation, lighting design, boilers, engines, inverters and smart grids as well as, of course, construction.

In the case of energy-efficiency incentives, results in terms of approaching targets have been less successful than in the case of renewable energies; in the absence of a more sustained effort, the targets will, accordingly, be difficult to achieve. In this case, however, the whole burden does not fall directly upon consumers since a significant portion of the incentives takes the form of tax relief on energy-efficiency investments. Since the measures in question pass through the state budget, they are, at times of austerity, at constant risk of being axed. Yet they survive, perhaps because they represent the only support to the building sector which is the worst affected by the crisis.

Energy-efficiency incentives are organized according to the sectors at which they are aimed: tax deductions for both residential and service sectors; incentives in the form of *Conto Termico* for the public administration; white certificates for the industrial sector; and standard regulations for transport. These can be summarized as follows:

— Tax incentives for the achievement of energy efficiency are in force both for service enterprises and for the building sector. Since 2007, they have granted a 55% tax rebate, in both the personal income tax and corporate tax systems, on all energy efficiency measures taken in relation to buildings. Apart from efficient structures and materials, incentives are applicable for the adoption of solar panels for water heating and new generation boilers and heating systems. During the second semester of 2013 the rebate was raised to 65%, but will be lowered to 50% in 2015-16 and to 36% subsequently.

— The industrial sector is able to take advantage of the so-called White certificates (*Titoli di efficienza energetica*, TEE) which in mid-2012 had covered 14.8 Mtoe saved by (mostly) energy service enterprises. Furthermore, a fund for subsidized loans (interest rate at 0.50%) called the ‘Kyoto rotating fund’, has been set up to finance investments totalling 600 million euros.

— Finally, a large number of initiatives have been carried out for sustainable transport, the largest having been a fund for sustainable mobility amounting to 239 million euros between 2007 and 2009.

The combined effect of these measures between 2007 and 2010 enabled an annual saving of about 4 Mtoe of final energy (and about 6 of primary energy) meeting the targets set for that period of approximately 3.5 Mtoe (SEN 2013). These results are net of the reduction in consumption that is attributable to the effects of economic crisis on the country.

Unlike the incentives for photovoltaic schemes, the system of energy-efficiency incentives is based on state budget contributions made either through direct contributions or through smaller revenues after tax benefits and energy saving. The total burden between 2010 and 2020 is estimated by the Government at about 40 billion euros.

The governmental *Agenzia per la diffusione delle tecnologie per l'innovazione* has devised a model to assess the overall economic impact of the incentives for the 2010-2020 period. This is estimated at a 130 billion increase in demand and an approximately 240 billion increase in production. This increased economic activity entails the creation of 1.6 million FTE[9] jobs, as well as major revenue from income, corporate and consumption taxes. The value of this revenue, shown in Table 3, leads to a total negative net impact on the public budget of 15.5 billion. The net burden is nevertheless broadly offset by the positive economic impacts on the energy bill and the CO_2 costs avoided.

Energy efficiency appears to be a very effective means of achieving the environmental sustainability objectives, as it lends itself to fulfilment of many of the Community targets set within the 20-20-20 strategy: reduction of greenhouse gas emissions, energy safety, and technological opportunities for a number of industrial sectors. In 2020, through energy-efficiency policies, Italy will have saved over 200 million tonnes of CO_2 to a value of over 5 billion euros. Even more valuable is the reduction of energy consumption which will lighten Italians' bills by 25 billion euros and significantly increase the energy security of a country which imports more than 80% of the energy it consumes. The simulation leads to the estimate of an annual contribution to GDP growth of over 0.3 percentage points. Of course all these estimated mid-term effects still have to be confirmed but they provide a sketch of the effectiveness of energy-efficiency interventions.

9. Full-time equivalent.

Table 3 **Overall effects of energy-efficiency measures in 2010-2020 (cumulated effects, million euros)**

Effects on state budget	Personal taxes due to increased employment	4,555
	Corporate taxes	2,312
	VAT due to increased consumption	18,302
	Public incentives	-22.817
	VAT and duties due to less energy consumption	-17,781
	TOTAL	-15,492
Economic impact on energy system	Economic value of saved energy*	25,616
	Economic value of saved CO_2**	5,190
	TOTAL	30,806
Overall impact		15,377
Effects on industrial development	Increased demand	130,118
	Increased production	238,427
	Increased employment (thousands of FTE jobs)	1,635

Source: Agenzia per la diffusione delle tecnologie e per l'innovazione 2013.
* considering oil price at USD 0.75 per barrel and USD-euro exchange rate of 1.25
** considering a value of 25 euros per tCO_2

3. The case of photovoltaic incentives

Incentives have definitely accelerated the development of the photovoltaic sector as a whole, but the evaluation of their effectiveness and efficiency is mixed. Such a favourable level of incentives in relation to the costs of the renewable technologies has fostered strong growth in photovoltaic power installations, the generating capacity of which has doubled in four years, while overall expenditure on this form of energy, both private and public, has increased fourfold. This rapid and expensive development, which has enabled achievement of European targets ahead of schedule, has entailed a number of advantages and disadvantages.

The positive effects include:

1. Achievement of 20-20-20 targets;
2. Reduction of CO_2 emissions;
3. Fostering of energy security by reduction in imports of fossil fuels;
4. A high level of investment and generation of tax revenues;
5. Occupational effects;
6. The spreading of a culture of energy sustainability.

Among the negative effects we found:

1. An unfair redistributive effect allowing huge profits for foreign investors;
2. A significant volume of hidden taxation in times of crisis;
3. An inefficient strategy for greenhouse gas reduction;
4. The lack of development of a national industry.

The recent system of photovoltaic incentives was initially accompanied by very generous tariffs in order to move operators away from CIP6 activities, a highly controversial system because of the financing of so-called 'assimilated' sources, which included incinerators and combined-cycle gas. It produced extremely positive results over a very short time scale with an impressive increase in power installations and a significant contribution to achievement of the 2020 targets concerning the share of energy consumption deriving from renewable sources. In the electricity sector the 20-20-20 target has been (practically) already reached nearly eight years ahead of schedule: 93 TWh produced in 2012 from RES when the target for 2020 is 100 TWh. This leap forward is predominantly due to the 13 GW of photovoltaic power installed since 2010, leading to a current total of 16.4 GW, the largest amount of photovoltaic power installed anywhere in the world after Germany.

This progress has contributed greatly to a reduction in CO2 emissions and to energy security (for example, a 2.5 billion euros a year reduction in fossil fuel imports and the flattening of the demand curve on energy wholesale markets to the tune of about 400 million euros a year).

The investment required to install the new photovoltaic panels accounted for about 1.5 percent of Italian GDP in 2011. Such a high level of investment necessarily gives rise to immediately apparent benefits in terms of employment and tax revenues. In 2011 73% of the investment can be associated with the setting up of plants, thus giving rise to immediate effects, while the remaining 27% is associated with the routine operation of the plants, and therefore with a longer-term effect (Testa *et al*. 2013).

The total tax revenue deriving from the activity of photovoltaic plants is estimated at 1.7 billion euros a year, though this cannot be regarded as accruing wholly on top of existing revenue flows insofar as the entrance of the photovoltaic supply to the energy market necessarily eroded the shares of traditional energy sources.

Composition of the total turnover of the photovoltaic sector, in its different components and between national and foreign firms, shows that national enterprises secured 80% of the distribution of components and plant installation. With respect to the production of modules and inverters, national enterprises reaped some 50% of the turnover. However, for the production of the so-called ‘silicon wafers’, one of the basic components of solar panels, the national share dropped to 6%. The value of exports of components in 2011 amounted to 850 million euros for panels and 400 million for inverters.

According to ANIE (2013), the association of electro-technical and electronic producers, in 2011, the golden year of photovoltaic energy, the sector as a whole employed in Italy more than 100,000 people, their average age being below 35. In 2011 18,000 jobs were created in the sector, 7,000 of them in components production and 11,000 in marketing and installation. A further 40-45,000 jobs can be attributed to ancillary industries. These are the outcome of nearly 30 billion euros in investment, the effects of which are concentrated over a very short time span. These estimates should, in any case, be considered together with the probable effects of the rise of photovoltaic energy on the electricity market as a whole which may include significant reductions in power generated by the traditional production plants and hence also in the labour employed by them. While the net effect is thus not clear, it is undoubtedly positive. National budget figures do not, unfortunately, allow this result to be clearly demonstrated.

In 2012, however, because of a 51% reduction in investment, employment in the sector dropped by 24%, and a further drop of 7% was expected in 2013. This means that in 2012 and 2013 more jobs were lost than were created during the boom of 2011.

In cultural terms, the spread of solar energy is also regarded as having a positive impact on current and future generations. According to qualenergia.it, developments of the last few years mean that about 2 million people are currently living or working in premises where electricity is produced from solar power.

3.1 Equity issues

The very generous incentives enabled significant positive returns – much higher than standard market levels – for all parties involved in the investment required for the building of photovoltaic parks.

The investors, the agencies that financed the initiative together with a bank, were, in the good years, able to gain a return on their investments of as much as 20%, with no significant risk. As confirmed by KPMG (2011) through the analysis of a sample of large and small energy actors, the level of incentives permitted major economies of scale which led to very high levels of profitability, with a marginal return of 20% or more. While this is indeed a field enjoying virtually unanimous acceptance, it is nonetheless legitimate to wonder whether the legislator should allow such high profit margins to any economic actor, in particular where the business activities in question entail very limited risk. From the redistributive point of view, the operation has been strongly regressive insofar as it led to a transfer of resources from energy consumers, that is the population as a whole, including poor households, towards banks and big investors. While this is true of investors, it does not seem to apply to the supply chain as a whole. Testa *et al.* (2013) attempted to describe the benefits accruing to different actors along the value chain beginning with the landowners who are gaining up to 20 thousand euros per hectare over 20 years letting out fields, the sale price of which would be 5 to 10 thousand euros. Later, during the boom, permits reached a value of 400 thousand euros per Megawatt so that those who had bought permits for a few thousand euros for a 10MW plant were able to resell it for as much as 4 million. The authors went on to consider the building firms which charged around 20% over their costs, the latter being represented fundamentally by the cost of the panels since the installation and the concrete structure are relatively much cheaper.

With the reduction in the value of incentives, however, revenues along the supply chain shrank. A study from the University of Milan (Politecnico di Milano 2012) shows highly differentiated margins among and within sectors. Producers of silicon and wafers showed, in 2012, margins (ebitda) that varied from negative to over 20%, a gap that broadened over time between small and large producers. The average ebitda fell from 40% in 2008 to 12% in 2012. Even lower margins are experienced by producers of cells (6.5%), modules (1.5% but experiencing also negative margins) and distributors (3%). A better level and trend is found, meanwhile, in the inverters sector (13.5%).

One of the reasons for the widespread consensus which allowed such tremendous use of public money was the idea that it would lead to benefits for the households and businesses that were enabled to green their energy consumption. However, looking at the composition of the different power classes installed, the smaller plants, those up to 20kW which may refer to a domestic plant, amount to a total of about 2.5 GW out of the 16.4 GW installed. The remaining 13.9 GW are plants with higher power which have clearly commercial aims, producing energy only to sell it and benefit from the incentives.

Looking at the number of plants, by the end of 2012 those below 20kW numbered about 422,000, compared with 56,000 with higher generating capacity. This means that 11.7% of producers gained 85% of the incentives. Taking the bigger producers (over 200kW) alone, 2.4% of them gained 77% of the incentives. According to AssoSolare, the capital behind these investments was, in the vast majority of cases, not Italian, an issue which gave rise to further concerns about the overall progressivity of the incentives system.

Table 4 **Distribution of installed plants in different power classes by number, generated power and incentives gained (2012; %)**

	Number	Generated power	Incentives gained
1-20 MW	88.3	15.4	14.9
Over 20 MW	11.7	84.6	85.1
Total (%)	**100.0**	**100.0**	**100.0**
1-200 MW	97.6	36.6	23.3
Over 200 MW	2.4	63.4	76.7
Total (%)	**100.0**	**100.0**	**100.0**
Total (absolute value)	**478,331**	**16.4 GW**	**6.03 bn €**

Source: IEA 2014.

Finally, the bill is paid by 29 million Italian consumers. A possible saving for households was expected to be represented by the flattening of bills resulting from a reduction of prices during hours of high consumption, since these are the very hours during which solar energy is produced. While this did indeed happen, the introduction of incentives served to move the flattened cost curve upwards. Accordingly, even though the cost of natural gas has decreased during recent years, the energy bill has increased because of the steep rise in the component introduced to cover the cost of the incentives. In 2006, when the first Energy account came into force, the incentives cost 2 euro cents for each megawatt-hour consumed. By 2008 the cost was 32 cents and in 2012 the surcharge had increased to over 20 euros, thus putting real pressure on bills (the overall A3 component costs 30 euros for every Megawatt consumed). Households consuming less than 1MWh had seen no increase since 2008 but, as shown above, 2012 saw an average annual increase in electricity prices of 14% when consumers started to pay for the incentives to all the plants installed in in 2011. Assuming general inflation of 3%, the real level of increase is 10.6%. At the beginning of 2013, after seven consecutive years of increase, the electricity price index saw a first reduction.

3.2 Efficiency issues

The profitability produced by the incentives was of course largely predictable. Moving backward from the incentives fixed by the law, the total turnover can easily be calculated since both efficiency of the solar panels and number of hours of sun in the different zones of the country are known. The prices of panels, land, permits and bank loans were also known. Panel efficiency, what is more, is usually guaranteed by the producer for 20-25 years. All the actors knew the level of incentives and were therefore able to use their bargaining power to obtain high profit margins. Even the price of solar panels was kept artificially high by suppliers. In fact, when incentives began to fall, the cost fell accordingly until it was half the initial level (Testa *et al.* 2013) The only real risk incurred would be the partial or total loss of efficiency of panels bought from a supplier who went bankrupt after the Italian incentives were discontinued, an event that actually occurred in the case of a number of Chinese producers. A lower level of incentives would have motivated investors anyhow, though possibly in lesser numbers, but it would have reduced (even halved) the expenditure per KWh produced. Such predictable profitability highlights errors on the part of policy makers. The same happened in the case of wind power plants. A simulation carried out by KPMG (2011) on the level of incentives shows that, in order to obtain a return on equity of more than 7.5%, the minimum incentive should be about 70 euro/MWh, more than 20% less than the incentives actually offered which paid 89.7 euro/MWh.

This is a burden on the system which seems hardly compatible with the circumstances of a country in deep recession and with stringent austerity policies already severely affecting households and enterprises.

The rush provoked by the huge revenues led also to the installation of a photovoltaic national park that was non-optimized with respect to the possible technologies and to the relative costs of the capital outlays, which are foreseen to fall significantly in the coming years. The result is a disproportionately high level of expenditure per Kilowatt-hour for the renewable energy produced. Moreover, photovoltaic energy production is one of the less efficient technologies for achieving the environmental targets put in place at European level. Considering that today the Italian energy system emits about 450 grams of CO2 for each Kilowatt hour of energy produced, Testa *et al.* (2013) estimate the cost, including the input in terms of incentives, of the emission of a ton of CO2 using the most common carbon-free technologies (Photovoltaic, wind and hydropower).

Early photovoltaic incentives were the most expensive ones, costing between 450 and 800 euros per avoided tonne of CO2, followed by small wind and hydro plants which benefit from the 'all-in tariff'. High power wind and hydro plants foresee costs of about 100-140 euros/tCO2, similar to what can be obtained with white certificates[10] at least during an initial phase (as energy efficiency increases, obtaining further savings becomes increasingly expensive).

3.3 Industrial development and jobs

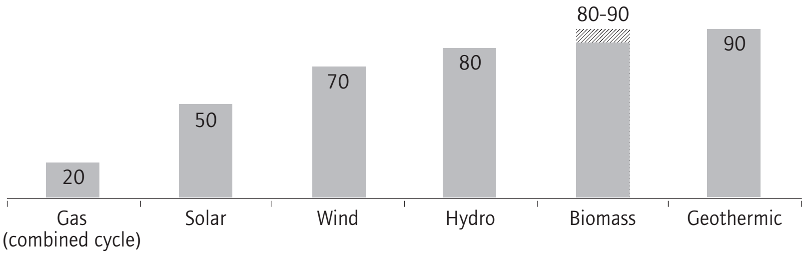
The energy incentives, insofar as the focus was not on fostering innovations or industrial production, led to no significant technological innovation for Italian firms. In Italy there are no firms producing better or more convenient solar panels than the Chinese or the German ones. Only in the production of inverters, a component which accounts for about 10% of the total value of the plant, are a couple of firms gaining market shares (KPMG, 2012). Here Italian firms do appear competitive,

10. If the 6.5 billion euros earmarked for photovoltaic incentives were to be invested in the promotion of energy saving through White certificates and '*titoli di efficienza energetica* (TEE)', the emission reduction would be potentially huge. TEE currently cost about 92 euros and are granted after the saving of 1 TOE (tonne oil equivalent) in the energy final use. With 6.5 billion euros it should be possible to finance savings amounting to some 70 million TOE, representing nearly 40% of Italian annual primary energy demand (185 million TOE/year). Subject to the hypothesis that the exchange value of TEEs is able to cover one third of the cost of the intervention which allows for energy savings, a 6.5 billion public intervention would lead to savings of about 20 million TOE of primary energy (11% of the total primary energy consumed). Such saving corresponds to about 50 million CO2 tonnes, 5 times the emission saving due to the photovoltaic plants currently installed. These benefits are purely hypothetical and would be valid only during an initial phase (Testa *et al.* 2013).

with the value of exports having jumped by over 60% between 2009 and 2010 and remaining high thereafter.

As shown in Figure 11, the contribution of national industry to the total activity is around 50% in the case of photovoltaic plants, a very low share when compared with other renewable sources (albeit much higher than natural-gas-related activities).

Figure 11 **Contribution of national industry on whole-life cost: investments, operating costs and fuel (2012 estimates)**



Source: SEN2013.

According to Istat, there has been a huge shift in the trade balance deficit for energy products, industrial and immaterial goods for the purchasing of panels, and royalties on the patents. The trade deficit due to the photovoltaic boom amounted to 8.4 billion in 2010 (it was only 2 billion in 2009), mostly concentrated towards Germany and China from which Italy imports the photovoltaic cells.

Lower but longer-term incentives, together with related R&D, could have fostered the birth of a national industry in a sector with secure future development.

Yet without the development of a photovoltaic-related industrial sector, the jobs created through the system of incentives were most probably fundamentally limited to the bricklayers who built the concrete structures (if any) on which to lay panels, the workmen who assembled them, and the electricians who made the connections. Subsequent maintenance is limited to cleaning the panels and cutting the grass in the dedicated area. In the absence of investment in a national industry, incentives of this kind support only the demand side and not the supply side, thereby never really creating green jobs.

The promotion of a national industry could also have stemmed from public investment for the so-called ‘smart grids’. The increasing production from intermittent sources needs an efficient system of distribution which passes though the building of such smart grids. These are particularly urgent in southern regions where the power installed is already higher than the peak demand (25 GW vs. 21 GW – SEN, 2013). Moreover, with the progressive achievement of grid parity, these infrastructures are increasingly needed for the efficient exploitation of renewable sources.

In 2010 a number of pilot projects for the introduction of innovative technologies were launched but their implementation today appears subject to delay (AEEG 2013). They are intended to improve the current standards developed in 2011 for the promotion of smart grids[11] and to enhance the returns on capital invested in distribution services. What actually happened is a rapid increase along traditional lines, with the national park rising from 45 thousand to 64 thousand kilometres between 2008 and 2009. In other words, even if the grids have not become smarter, they have been widely extended.

Conclusions

During the last five years, Italy has seen the worst economic recession since World War II. As in the rest of Europe, the initially financial crisis turned into an economic crisis, with a loss of trust in Italy’s ability to repay its debt. In 2013, the social effects of the crisis are at their peak, and the situation is not yet improving.

It is common knowledge that the response to the crisis in Europe has been characterized, especially for peripheral countries, by austerity measures aimed at reducing fiscal deficits and sovereign debt with a view to correcting the so-called ‘macroeconomic imbalances’. In Italy, the measures in question have taken a regressive toll on the economy as a whole with tough effects for production and employment. As a result of the crisis, Italy lost 25% of its industrial capacity and level of investment, as well as over one million jobs.

11. D.lgs 3 march 2011, n. 28 and AEEG, Delibera ARG/elt 199/11.

The principal economic policy measures since 2008 led to major budgetary cuts in almost all sectors (with the exception of social protection to cope with unemployment) with a cumulative effect for 2012, 2013 and 2014 of over 2% of GDP.

Green sectors did not prove immune to austerity: from 2008 onwards, environmental expenditure, as classified by Eurostat, was reduced; in 2011 it fell by 7%. By 2012 the Ministry of Environment had reduced its total budget by 70%, with support for energy transformation having dropped from 58 million euros to 6 million euros. Public research and development for environmental, transport and energy purpose was reduced by two thirds.

In spite of all this, the overall results of the Italian green economy are not totally negative, given the reduction in energy consumption and GHG emissions, as well as the increased energy efficiency in most sectors.

In particular, during all these years Italy saw an impressive boost of renewable energy sources thanks to a series of very generous incentives. The incentives were able to remain in existence because they were financed directly by consumers in the context of their energy bills without passing through the state budget. This has applied particularly to photovoltaic power, but all renewable sources incentives have been financed in the same way. The approach gained political acceptance because the measures were seen as environmentally necessary, because the positive effects on energy security and possibly on the aggregated demand enabled it to be viewed as a sort of green new deal.

However, the growing economic difficulties suffered by households and businesses served to draw attention to the fact that incentives were being financed through consumers' energy bills, the steady increase in which was a matter of so much concern that the legislator was compelled to put to an end to the incentives.

At the same time, tax incentives (that impact directly on the deficit) have been used to encourage energy-efficiency investments made by households and enterprises. To date these incentives have managed to resist the austerity axe but they are bound to be radically reduced in 2016.

In this chapter we have tried to offer a general picture of energy transformation policies in Italy and to assess the pros and cons of a strategy which allowed Italy to reach European energy targets on renewable sources ahead of schedule, while at the same time imposing an annual hidden tax burden of over 10 billion euros until 2020, set to fall steadily thereafter.

We focused on the case of photovoltaic incentives which in Italy represented the biggest and most controversial experiment. In just a few years the country has become much greener and is today one of the largest producers of renewable energies, with a photovoltaic park of 19GW, second only to the German one. Thousands of families and businesses have in this way started to 'live with' renewable energy, a development that is considered to have a significant cultural significance, over and above its economic impact.

Yet a number of other drawbacks emerged from such a generous system and we analyzed these under the headings of 'equity', 'efficiency' and 'industrial issues'.

From a distributional point of view, returns on investments are disproportionate. Italian tariffs were twice or three times higher than French or German ones in the case of photovoltaic power and 50% higher for wind plants. Moreover, they are concentrated among a limited number of big investors, in most cases foreign private equity firms.

No attention has been paid to the rapid reduction in the cost of photovoltaic technologies and to the increasing efficiency of cells. A longer-term policy should have led to less generous tariffs and would have offered incentives for more efficient panels. In 2013 in many Italian southern regions the grid parity is already a reality, but the Government actually paid out incentives amounting to billions of euros for plants which, two years later, would have needed no – or at least only minimal - incentives.

Finally, no mechanism has been devised or put in place for the support of a national industry. In such a short time it was not possible to achieve any medium-term effect on industry and employment. Cells have been bought from abroad creating a balance-of-trade deficit under that single product heading of around 8 billion euros in 2010 and 2011 (the deficit from oil being meanwhile around 30 billion). Employment was generated for setting up the plants, but this job-creation potential is now over and what remains is limited to the maintenance of the plants. Italy's presence on international markets, meanwhile, was enhanced solely by the production of inverters.

The system of incentives for energy efficiency, though it may have produced less impressive results, turned out to be more cost-effective in both environmental and economic terms. It is important that such a system should not now be abandoned, indeed that it be expanded to include also small residential photovoltaic plants.

In general terms, the whole system of energy transformation in Italy suffered from a lack of clarity and huge volatility. Rules and tariffs have been changing at least every year, undermining the ability of different involved parties to plan their investments efficiently. But Italy is today less dependent on oil imports and has reduced its CO_2 emissions – over and above the reduction attributable to economic recession – with the associated benefits in terms of avoided CO_2 costs.

Though greater improvements could have been achieved, Italy is now on course to meet the targets set by the European green package 20/20/20 (though not the Kyoto ones).

Energy transformation sectors were able to circumvent austerity by incorporating the costs of incentives into consumers' energy bills. This approach has now run out of steam: households are impecunious after five years of recession and businesses cannot stand increasing energy costs. The way forward must be through public spending: by maintaining incentives for energy efficiency and selected energy sources, by gradually redirecting incentives for fossil fuels towards the greening of the economy, and by investing in a national system of smart grids able to guarantee full use of the energy produced by renewables now that grid parity is gradually being reached.

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