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The Italian energy policy: changing priorities

A.D'Orazio, C. Poletti

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THE ITALIAN ENERGY POLICY: CHANGING PRIORITIES

A. D'Orazio[*], C. Poletti[*]

[*] *Istituto di economia delle fonti di energia e dell'ambiente*, Università Bocconi di Milano

Via Roentgen, 20136 Milano (Italy)

ABSTRACT

In the 90s, when the liberalization of Italian energy markets started, short-term efficiency issues were driving the economic debate. Over time, the focus of energy policies has progressively shifted towards a multilayered set of interrelated long-term objectives, ranging from climate change, to security of supply and industrial development. Within this changing environment, the article focuses on two crucial issues for the Italian energy policy: the environmental sustainability of economic growth and the security of national energy supply. To this aim the article analyses the Italian environmental performance of the energy sector, past trends and future scenarios, and reviews the so-called "gas emergency" experienced by Italy on 2005/2006. The article shows that over the last fifteen years Italy has not been able to decouple its economic growth from GHG emissions: a necessary condition to meet the Kyoto target. Even the deployment of renewable sources (RES) has been slow, despite the numerous support schemes implemented since the beginning of the 1990s. RES share on gross final energy consumption was less than 6% on 2006 and, according to the business as usual scenario (BAU) estimated by the EC, it should increase up to 8.2% by 2020. Far below the proposed 17% target. The article discusses this BAU scenario and suggests that, if all the new policies and actions approved or put in the agenda by the Italian government during the years 2007 and 2008 were actually implemented, the gap between EC targets and actual performance could be much lower. Namely, Italy could reach a GHG emissions' reduction of 4.8% from 2005 to 2020 and a 9.3% share of renewable sources in gross final consumption by 2020. As for security of supply issues, the article claims that the basis of the 2006 "gas emergency" were not cuts in international gas supplies. Two were the main reasons of the "gas emergency": the inadequacy of the intertemporal flexibility tools, such as storage capacity and the bad functioning of the gas markets whose prices were not allowed to adjust to signal the gas scarcity.

Keywords: Italian energy balance, Italian energy policy, renewable sources, GHG emissions, gas emergency

JEL Classification: Q480; Q580

Corresponding author: Clara Poletti, clara.poletti@unibocconi.it, tel. +39 02 5836 3820

1. Introduction

A shift from command and control to market based mechanisms has led to a deep restructuring of the Italian energy sectors over the last fifteen years, alongside with substantial changes in decision-making processes. Namely, the removal of important levers of control from public decision-makers has deeply affected both the content and the set of tools available to the policy maker. The restructuring process is still in progress and the energy policy finds itself in a transition phase. Not all market mechanisms are functioning at a proper level, and new regulations are under constant development in the attempt to adjust to the changing environment. On the other hand, the increasing space given to competition, even where it was not traditionally present, raised questions on the effectiveness of market instruments to pursue long-term objectives.

Environmental objectives and the need to reconcile a strong policy with the flexibility of market mechanisms on both a national and international level are gaining in importance. Within this framework Italy has taken a proactive stand in the international debate, supporting actions and policies aimed at mitigating the impacts of global warming.

Even at the European level priorities are changing. In 2002 the European Union, and all its Member States, ratified the Kyoto Protocol[1], the international and legally binding agreement to reduce greenhouse gas (GHG) emissions worldwide and to achieve their stabilisation in the atmosphere at a level preventing dangerous anthropogenic interference with the climate system. The European Union committed to reduce its total GHG emissions by 8% in the period 2008-2012, compared to the baseline year 1990. The Italian target for Kyoto is 1.5% lower than the EU one: 6.5% GHG emissions' reduction over the same period. At the same time the EU set up the regulatory framework for a European market for CO2 emissions allowances called European Trading Scheme (ETS)[2], taking into account CDM and JI[3] credits. This market commenced operation in January 2005.

The European legislation has intervened as well in the promotion of renewable sources for electricity production and in the support of biofuels or other renewable fuels for transport. The two European Directives on these issues[4,5] date back to 2001 and 2003. According to these Directives, Italy should reach an indicative target of 25% of renewable sources in electricity generation and 5,75% of biofules introduced into the market by 2010.

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[1] Law 120 of 21 June 2002.
[2] Directive 2003/87/EC of 25 October 2003.
[3] Directive 2003/87/EC of 13 October 2003.
[4] Directive 2001/77/EC (OJ L 283, 27.10.2001)
5 Directive 2003/30/EC (OJ L 123, 17.5.2003)

After this start-up period, in March 2007 the European Union moved a further step towards a fully integrated climate and energy policy. The European Council endorsed an action plan, envisaging new and binding targets on energy efficiency, renewables and emissions' reduction. Following the Council's decision, in January 2008 the European Commission put forward a very ambitious and comprehensive *Package of implementation measures for the EU's objectives on climate change and renewable energy for 2020* (EC Green Package)[6]. There are two key targets set by the European Council for the whole European Union: a reduction of at least 20% in GHG emissions by 2020 with respect to the year 1990[7], and a 20% share of renewable sources in gross final energy consumption by 2020.

As far as Italy is concerned, according to the EC proposal by 2020 there should be:

- a 14% reduction of GHG emissions with respect to year 2005. This overall target on GHG emissions is shared between sectors covered by the EU - ETS and sectors not covered by EU ETS. The proposal[8] sets a 21% reduction for the EU ETS sectors and a 13% reduction for all other sectors;
- a 17% share of renewable energy in final energy consumption.

These targets are really challenging. The needs to tackle the issue of environmental sustainability within a coherent framework, where security of supply and system adequacy can be assessed, as well as GHG emissions is therefore strong. However, a comprehensive set of measures to reach the targets and to guarantee security of supply is still missing. Instead of a coordinated climate change and energy policy, Italy has a range of different measures that need to be translated in a coherent action plan.

The aim of this article is twofold: the analysis the Italian environmental performance, past trends and future scenarios (with a focus on the energy sector[9]), and the review of the so-called "gas emergency" recently experienced by Italy. As for the environmental performance, the article shows that over the last fifteen years Italy has not been able to decouple its economic growth from GHG emissions: a necessary condition to meet the Kyoto target (par. 2 and 3). As a matter of fact, since 1990 the Italian carbon intensity has decreased, but the amount of total GHG emissions has increased significantly (+12.1 from 1990 to 2005). Even the deployment of renewable sources has been slow, despite the numerous support schemes implemented since the beginning of the 1990s (par. 4): on 2006 their share on gross final energy consumption was less than 6%. According to the business as usual (BAU) scenario

[6] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions - 20 20 by 2020 and four legislative proposals, , {COM(2008) 16 final}, {COM(2008) 17 final}, {COM(2008) 18 final}, {COM(2008) 19 final}.

[7] This is equal to reaching a reduction of 14% with respect to the GHG emissions in the year 2005.

[8] COM(2008) 16 and COM(2008) 17.

[9] In terms of CO2, the energy sector accounts for 86% of the total carbon dioxide emissions.

estimated by the European Commission[10] this share should reach 8.2% by 2020, far below the 17% target. We discuss this BAU scenario and suggest that, if all the new policies and actions approved or put in the agenda by the Italian government and not accounted for in the EC BAU scenario were actually implemented, the gap between EC targets and actual performance could be much lower. Namely, Italy could reach a GHG emissions' reduction of 4.8% from 2005 to 2020 and a 9.3% share of renewable sources in gross final consumption by 2020 (par. 5).

Alongside with the primary objective of GHG emissions reduction, the new European climate and energy policy aims at improving energy security. In the last few years, the issue of energy security of supply to Europe has been sharpened by economic and political contingencies outside the European borders. On one side severe pressures have arisen on oil and gas prices, on the other, there has been a decrease in the geopolitical climate. Within this critical framework particularly serious events have occurred in Italy, such as the interruption of power supplies in 2003 and November 2006, and the shortage of natural gas supply in the 2005/06 winter. These events have focused massive attention on security of supply: energy mix diversification and infrastructures' adequacy in particular. Having limited domestic energy sources with respect to consumption, Italy is highly dependent on imports, especially of gas and oil, and its dependence has been increasing over time. Moreover, the Italian energy portfolio has a low degree of diversification: Italy has no nuclear power and very few carbon power stations. This article shows that the basis of the 2006 "gas emergency" were not cuts in international gas supplies, but rather structural problems, worsened by an exceptional climatic conjuncture and other negative contingencies. Italian gas infrastructures did not adjust to cope with the rapidly changing demand and supply conditions (par. 6). The article ends with some considerations about national energy policies and measures towards a low carbon economy (par. 7).

2. The Italian GHG and CO2 emissions

The Italian Government has been taking actions in the energy sector to address national GHG emissions' reduction since the early 1990s. However, if we look at past trends we see a clear misalignment of Italian emissions with respect to the Kyoto target (-6.5% in the period 2008-2012, with respect to 1990). Italy is not on track to fulfil its obligations: in 2005 total GHG emissions accounted for 580 million metric tonnes of CO2 equivalent (or MtCO2eq), 12.1% higher than 1990.

In order to meet the Kyoto target, Italy should realize structural changes in its energy system, so as to break the long term positive relationship between GHG emissions and economic growth. This is

[10] "European Energy and Transport. Trends To 2030- Update 2007", published on 8 April 2008 by the Directorate General for Energy and Transport.

usually called "decoupling". Decoupling is said to occur when GHG emissions grow at a (possibly negative) lower rate than the rate of growth of the economy, usually measured by GDP at real prices. Decoupling can therefore be analysed by looking at the elasticity of GHG emissions with respect to income ($\frac{\Delta\%GHG}{\Delta\%GDP}$). Three types of interrelations between GHG emissions and economic growth can be identified:

1. *No decoupling or close coupling*

   The elasticity is positive and greater than or equal to 1. In this situation GHG emissions are directly coupled with income growth.

2. *Relative decoupling*

   The elasticity is positive and less than 1. With relative decoupling GHG emissions grow at a slower rate than economy.

3. *Absolute decoupling*

   The elasticity is zero or negative. As income grows, GHG emissions can either stay at the same level or even decline. In the second case (negative elasticity) we have a close decoupling and only in this case GHG emissions decrease whilst the economy grows.

The third case represents the reference point for a future sustainable low carbon economy. It is worth noting that a decrease in the Country's carbon intensity, defined as emissions per unit of GDP, is not a sufficient condition to ensure absolute decoupling. If the economy grows more than the rate at which the carbon intensity decreases, total emissions go up. This is what happened in Italy over the last twenty years. The Italian carbon intensity has decreased and the amount of GHG emissions has increased, but at a lower rate than the (real) GDP. If we look, for example, at the ratio between total GHG emissions and GDP at 1995 prices and we compare it to the GDP's growth rate from 1990 to 2006, we see that the total GHG intensity has decreased by 13% and real GDP has grown by 26%. Absolute decoupling has not been realised. The table below highlights Italian past trends with respect to these elements.

Table 1: Italian decoupling indicators

	1990	1995	2005	2006	Change 2006/1990 %
Gross domestic product (GDP) (000 M€ 1995)	798,637	839,042	997,842	1,006,242	26%
Total primary energy supply or gross inland consumption (TPES) (ktoe)	153,098	161,262	186,766	185,900	21%
Population (000 inhabitants)	56,778	56,844	59,131	59,619	5%
GHG emissions: energy category (C) (MCO2 equ)	419.4	432.5	480.1	469.0	12%
GHG emissions: other categories (OC) (MCO2 equ)	97.4	97.8	99.4	99.5	2%
GHG emissions (total GHG) (MCO2 equ)	516.8	530.3	579.5	568.5	10%
Carbon intensity of the energy system (C/E)	2.74	2.68	2.57	2.52	-8%
Energy intensity of the energy system (TPES/GDP)	1.92	1.92	1.87	1.85	-4%
Carbon intensity of the economy 1 (C/GDP)*	0.53	0.52	0.48	0.47	-11%
Carbon intensity of the economy 2 (total GHG/GDP)**	0.65	0.63	0.58	0.56	-13%

* GHG emissions of energy category per unit of GDP
**GHG emissions of all categories per unit of GDP
Source: UNFCC, ISTAT, Ministry for Economic Development (MED)

Absolute decoupling of GHG emissions from economic growth is a very ambitious target and requires:

- a reduction of energy consumption per unit of GDP, that is a decrease of the energy intensity;
- a reduction of GHG emissions per unit of energy consumption, that is a decrease of the carbon intensity in the energy system;
- a rate of reduction of GHG emissions per unit of GDP larger than the GDP's rate of growth.

To reach the Kyoto target, Italy should first move to an absolute decoupling stage, then stabilise GHG emissions on a long term horizon.

If we focus on emissions from the energy sector, we see that Italy has realized a reduction of both energy intensity and carbon intensity of energy uses: between 1990 and 2006 total primary energy consumption per unit of GDP has decreased by 4% and GHG emissions per unit of gross inland consumption has decreased by 8%. However, these improvements have not been enough to compensate for the total emissions increase driven by economic growth: in the same period gross domestic product at 1995 prices raised by 26%. Overall, GHG emissions of the energy system have grown by 12% over the same period.

The emissions' growth has been largely driven by the energy industry, whose GHG emissions increased by 18% between 1990 and 2006, moving from 135 MtCO2eq to 159 MtCO2eq (see tab. 3). The energy industry represents the largest emitter among energy users and covers electricity generation, the use of

fossil fuels for petroleum refining and the production of coke and smokeless fuels (in Italy mainly delivered to the power sector). The rapid GHG emissions' increase is explained by two elements. The first one is the growth of energy consumption for electricity generation. The increased use of fuels that are less carbon intensive, mainly switching fuel from oil to natural gas, has not been sufficient to compensate for the greatest growth of total fuels consumption. As a consequence, despite a 5.5% decrease of GHG emissions per unit of energy consumed, emissions from power generation have grown by 13% since 1990, reaching 134 MtCO2eq in 2006. Further on in the article we will call the ratio between GHG emissions and energy consumption "energy carbon intensity", as opposed to the abovementioned "carbon intensity", defined as emissions per unit of GDP. The second element is the really bad performance of the other activities included in the energy industry and in particular petroleum refining. For this activity the statistics show rapid increases of energy consumptions (+13%) and GHG emissions (+62%), and a consequent growth of its carbon intensity (+36%).

Another sizable emitter with a very bad performance is transport, the largest source of carbon dioxide among final users in Italy for the past 16 years[11]. GHG emissions from transport include emissions from aviation, railways, road transport and shipping. Road transport is by far the largest contributor to transport emissions. Here again the increase has been driven by the rapid expansion of this sector over the period. In fact, from 1990 to 2006 energy consumption for transports grew by almost 33%. Given the small improvements in the energy carbon intensity (-6,7%), in 2006 emissions reached 128.6 MtCO2eq, 24% higher than the 1990 level.

Finally, among the energy final uses it is worth noticing the service sector. This sector accounts only for the 5% of GHG emissions (see tab. 2). However, its emissions have been growing at a remarkable fast pace: +45% from 1990 to 2006. The main reason has been the high growth of energy intensity, due to change in the structure of the economy during the last decade.

Table 2: GHG emissions by sector - % shares on year 2006

	%
Energy industry	34.8
Transports	28.1
Industry	18.0
Households	11.9
Service sector	5.2
Others	2.0
Total	**100**

Source: UNFCC

[11] It accounted for 32% of final energy consumption in 2006

Table 3: Energy consumption (E), GHG emissions and energy carbon intensity (GHG/E) by sector - % growth rates between 1990 and 2006

	%GHG	%E	%GHG/E
Energy industry	18.0	15.2	2.5
Transports	23.7	32.6	-6.7
Industry	-9.4	12.2	-19.2
Households	2.9	19.2	-13.6
Service sector	44.5	62.2	-10.9
Others	-10.1	0.9	-11.0
Total	**11.8**	**21.4**	**-7.9**

Source: UNFCC, MED

The only energy sector that has decreased its emissions since 1990 is the manufacturing industry: from 1990 to 2006 its GHG emissions have fallen by 9.4%, moving from 90.69 MtCO2eq to 82.1 MtCO2eq. The decrease resulted from switching fuel from liquid (petroleum and derived) to gaseous fuels and from changes in the structure of Italian industry (de-industrialisation, de-materialisation) during the last decade.

3. The environmental performance of the Italian industrial categories included in the European ETS

Under the European ETS, Member States set limits on GHG emissions from energy-intensive installations and issue a number of allowances equal to the amount of CO2 equivalent these installations are allowed to emit. The National Allocation Plans sets out the number of allowances, called European Unit Allowances (EUA), to be issued to each installation. EUAs can be traded. The idea is to encourage those who can cut back on emissions cheaply to do so and those who find it more expensive, to use an allowance. Only big energy users are subject to this "cap and trade" scheme. Inside the energy sector: power plants and oil refineries. Inside the industry sector: steel factories, paper mills, and glass and cement installations.

The table below shows ETS activities and GHG emissions sourced from these activities in Italy in 1990 and 2005.

Table 4: GHG emissions by ETS sectors - ktCO2 equivalent

	1990	2005	Change %
Power and heat production	107,544	121,024	12.5%
Petroleum refining	16,498	26,719	62.0%
Other energy industries	10,749	12,849	19.5%
Iron, steel and non ferrous metals	21,662	15,900	-26.6%
Pulp, paper and print	3,098	4,665	50.6%
Glass, pottery and building materials	42,049	44,832	6.6%
Total	**201,600**	**225,989**	**12.1%**

Source: UNFCCC, European Environment Agency

In 2005 the ETS covered 943 Italian installations (996 in 2006 and 1,009 in 2007), in the energy and industrial sectors. These sectors are responsible for 50% of the Italian carbon dioxide emissions and 40% of its total GHG emissions. In the period 2005-2007 the Italian National Allocation Plan (NAP) allocated an annual average of 223.1 MtCO2eq.

The first EU ETS trading period which started on January 2005 expired in December 2007. Data on actual emissions have therefore just become available. From 2005 to 2007 verified emissions[12] in Italy increased by 0.2%, moving from 225.9 MtCO2eq in 2005, 227.4 MtCO2eq in 2006 and 226.4 MtCO2eq in 2007. Moreover, in each year CO2 emissions have been higher than the NAP annual average allocation.

Therefore, the evidence is that our NAP did not act as a binding commitment to reduce emissions. In order to make sure that effective trading emerges – and consequently CO2 emissions are reduced – the Italian government should make sure that the total amount of allowances issued is less than the emissions that would have been verified under a business as usual scenario. The first reference level to set the cap could be the Kyoto target, that is a 6.5% reduction by 2012 with respect to 1990. In fact, the EC proposal aims at fully exploiting the EU ETS potential to contribute to the GHG's reduction.

4. Italian renewable sources

There are different ways to reduce our emissions: improving energy efficiency; increasing the use of fuels with a lower CO2 content or introducing renewable sources in energy consumptions; changing the structure of the energy intensive sectors, for example through a modal change in the transport sector. Italian policies have mainly focused on the deployment of renewable sources.

In 2006 renewable energy sources (RES) represented 7.0% of the Italian total primary energy. Most of the renewable sources are used for electricity generation (RES_E). In 2006 RES_E accounted for

[12] Community Independent Transaction Log – CITL.

14,6% of gross inland consumption[13], 52.3 TWh comparing to the 41.6 TWh of 1995. We are therefore at a distance from the non-binding target indicated by the Directive 2001/77/EC on the promotion of renewable sources for electricity generation (RES-E). According to the RES-E Directive, by 2010 the Italian share of renewable sources on gross inland electricity consumption should increase up to 22%.

Table 5: Italian electricity production from renewable sources 1998-2006 (GWh)

	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Hydro	41,213.6	45,358.0	44,204.9	46,810.3	39,519.4	36,674.3	42,744.4	36,066.7	36,994.3
Geothermal	4,213.7	4,402.7	4,705.2	4,506.6	4,662.3	5,340.5	5,437.3	5,324.5	5,527.4
Wind on shore	231.7	402.5	563.1	1,178.6	1,404.2	1,458.4	1,846.5	2,343.4	2,970.7
Biomass	1,228.8	1,822.3	1,906.2	2,587.3	3,422.6	4,493.0	5,637.2	6,154.9	6,744.6
Solar	14.5	15.1	15.6	16.5	18.5	22.6	27.3	31.0	35.0
Total	**46,902.3**	**52,000.6**	**51,395.0**	**55,099.3**	**49,027.0**	**47,988.8**	**55,692.7**	**49,920.5**	**52,272.0**

Source: Gestore dei servizi elettrici S.P.A.

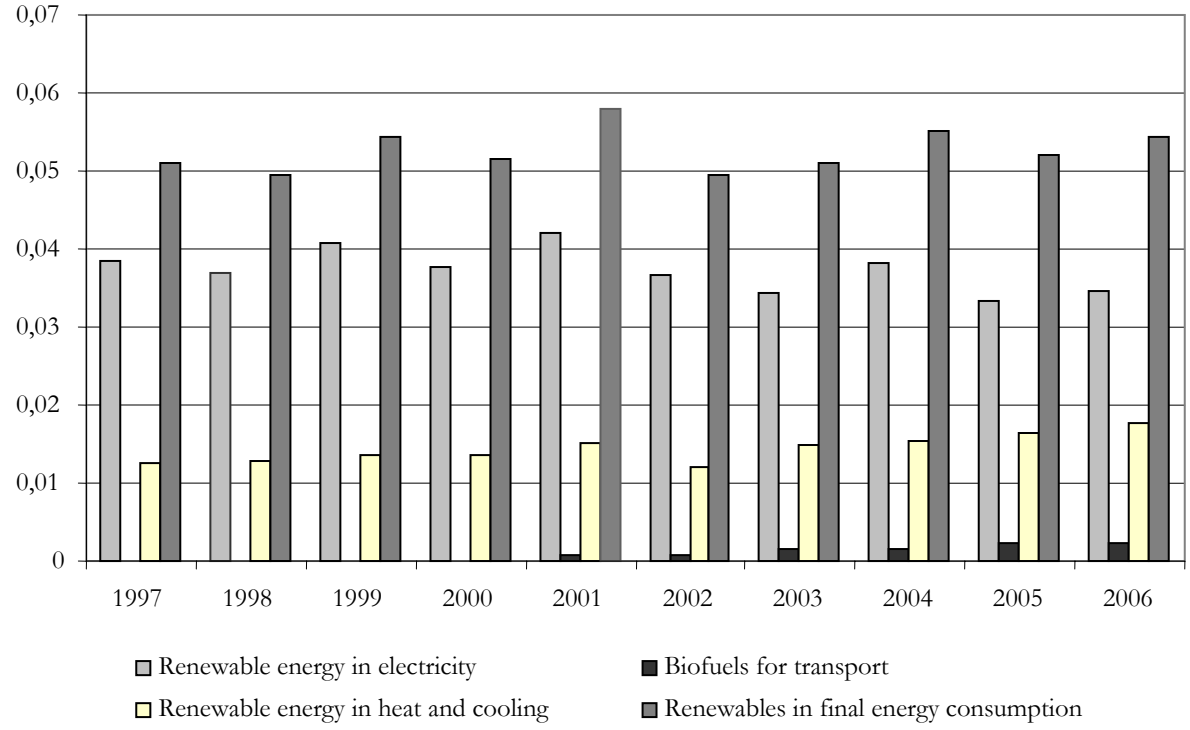
A high percentage of electricity generation from renewables in Italy is produced by hydro plants (71% in 2006). Unfortunately actual production from hydro plants depends on the level of rainfall and over the last few years Italy has had decreased water flows. As a consequence, electricity production from hydro has decreased over time: the three year moving average of annual hydro production moved from 43.6 TWh (1998-2000) to 38.6 TWh (2004-2006). Other RES_E, such as wind and biomass, have been growing at fast pace, but their share on RES_E total RES_E production is still below 30%. Their growth has been supported by numerous incentive schemes since 1992, when a feed in tariff scheme differentiated by technology was introduced (CIP 6/92). Since 1999, Italy has been moving away from this type of support scheme, towards a marked oriented fixed quantity obligation scheme with tradable certificates.

The Tradable Green Certificates (TGC) scheme (abbreviated as CV scheme) came into force in January 2002 as part of the electricity liberalization law (Decree 79/99). It requires power producers and importers of thermal energy to have a minimum share of renewables in their portfolio. Renewable generators must apply to a publicly owned company, Gestore Servizi Elettrici S.p.A., to be accreditated with green certificates. Each CV represents 1 MWh of renewable energy generated and can be sold by the renewable generator either with, or separately from, the electricity generated. Producers and importers can meet their renewables obligation by submitting CVs to Gestore Servizi Elettrici S.p.A..

[13] That is 18.5% of total power production.

Feed in tariff schemes still apply to the electricity produced by generators with capacity lower than 1 MW and to some specific technologies, such as solar[14].

Figure 1: Share of RES in final energy consumption



Source: IEFE on Ministry of Economic Development database

As already mentioned, the EC *Green Package* sets a target of 17% renewable sources for Italy by 2020. In analysing the proposal, it is worth noticing that this new target is no longer defined with reference to gross inland consumption, as in the RES-E Directive, but with reference to gross final energy consumption (GFEC). GFEC is defined as the energy consumed by end-use sectors, increased by self consumption of electricity and steam and network losses. On 2006 RES share on GFEC was only 5.9, more than 11 percentage points below the target. Moreover, as shown by fig. 1, despite the numerous incentives schemes, this percentage has remained relatively stable over the last ten years. The target is therefore really challenging: almost all the Italian final energy demand supply is still supplied by non renewable sources, particularly for heat and cooling uses and for transport.

[14] The production of electricity from photovoltaic and other solar technologies have dedicated scheme (Decree 19th February 2007, Decree 15th April 2008).

5. Italian progress towards GHG emissions and renewable energy targets

In this paragraph we discuss the medium term trends of the Italian GHG emissions and renewable energy consumptions. The analysis is grounded on the Business As Usual (BAU) or baseline scenario constructed by the EC through the PRIMES model[15,16]. The baseline scenario does not assume that targets, as set out in the Directives, will necessarily be met and simulates current trends on the ground of actual policies. Numerical values of CO2 emissions with respect to the Kyoto target or renewables' share are outcomes of the model; they reflect implemented policies rather than targets.

The year 2005 is the baseline year, considered by the EC to verify Member States' progress towards the 2020 targets. The table below summarises past and future trends of the Italian GHG and CO2 emissions according to the BAU scenario.

Table 6: GHG emissions in the Business As Usual Scenario for Italy (MtCO2eq)

	1990	2005	2020	Change 2005-2020 %
Total GHG emissions	509.0	580.0	649.6	+12%
Total CO2 emissions	435.0	493.0	565.0	+14.6%
CO2 emissions from ETS sectors	201.6	225.9	266.6	+18.3%
CO2 emissions from energy related non ETS sectors	200.4	237.0	264.6	+11.6%
Other gases (non CO2 GHGs)	74.0	87.0	85.0	-2.3%
Other sectors (non energy sectors)	33.0	30.1	33.4	+11%

Source: "European Energy and Transport. Trends To 2030- Update 2007", 8 April 2008, Directorate General for Energy and Transport

Projections of Italian GHG emissions show the bad performance of our energy system with respect to the environmental goal. The 20% target for emissions' reduction corresponds to a maximum of 407.2 MtCO2eq in 2020, 37% below the BAU emissions in the same year. The total emissions' reduction effort is divided between the ETS and non ETS sectors. The former (excluding aviation) will have to decrease emissions by 178.5 MtCO2eq in 2020 compared to 2005 (corresponding to -47.4 MtCO2eq), that is 88.1 MtCO2eq less than their BAU emissions in 2020. The whole non ETS sector (energy and

[15] PRIMES is a partial equilibrium model focusing on European Union energy markets and as such in very useful in analysing in detail the impact of various forms of carbon emission trading on energy markets. On the other hand it fails to capture some of the impacts which carbon emission trading may induce in the wider economy. PRIMES generates results for each of the 27 Member States separately and has also been used to investigate trends and projections of carbon emissions, under specific assessment of national policy and measures scenarios.

[16] The results of the baseline scenario 2020 are contained in the volume "European Energy and Transport. Trends To 2030- Update 2007", published on 8 April 2008 by the Directorate General for Energy and Transport.

non energy related) will be allowed to emit not more than 308.1 MtCO2eq, which corresponds to an abatement of 22% with respect to the BAU emissions in 2020 (or 13% less emissions from 2005).
The following table shows trends in GHG emissions up to 2020 and the gap with respect to the EU targets for the different sectors.

Table 7: Distance from EU targets (MtCO2eq)

	Baseline 2005	Target % 2020/2005	Target 2020	Projections 2020	Gap
Total GHG emissions	580.0	-14%	499.0	649.6	150.6
CO2 emissions of ETS sectors	225.9	-21%	178.5	266.6	88.1
CO2 emissions of non ETS activities in energy sector	237.0	-13%	206.2	264.6	58.4
Other GHG emissions	117.1	-13%	101.9	118.4	16.5

Source: "European Energy and Transport. Trends To 2030- Update 2007", 8 April 2008, Directorate General for Energy and Transport

The second target requires reaching a 17% of renewable sources on gross final energy consumption, starting from a 5.4% level in 2005. Meeting the RES target will require increasing the use of renewable energy and reducing final energy demand. Also in this case we refer to the BAU scenario 2020 constructed by the EC. Under the EC-BAU assumptions, the share of Italian renewable energy sources in gross final consumption is projected to rise to 8.2% in 2020, almost 9 percentage point below the 17% target.
The table below summarises the renewable energy use in the Italian energy system.

Table 8: Renewable energy sources in Italian energy consumption

	2005	2020	Change %
Renewable primary energy (ktoe)	12,243	19,185	+56.7%
Primary energy consumption (TPES) ktoe	186,766	221,171	+18.4%
RES share on TPES (%)	6.6%	8.7%	+31.8%
Renewable energy consumption (ktoe)	7,301	13,417	+86.6%
Gross Final Energy Consumption (ktoe)	134,080	162,631	+21.3%
RES share on gross final energy consumption (target)	5.4%	8.2%	+55.6%

Source: "European Energy and Transport. Trends To 2030- Update 2007", 8 April 2008, Directorate General for Energy and Transport

The BAU scenario estimated by the EC needs to be updated to take into account new policies recently adopted by the Italian Government. We should consider, in particular:

- the adoption of the Italian energy efficiency action plan on July 2007[17], which sets new measures applied to final energy consumptions to deliver higher energy savings. According to the plan, the national energy savings target is equal to a global reduction of 10,864 ktoe during the period 2008-2016;
- the update, from January 2008, of the Italian "Renewable Obligation" for electricity producers in the context of the green certificates market and the introduction of new support schemes to some specific renewable technologies[18];
- the governmental decision to start a programme for the deployment of nuclear power plants[19];
- the new plan for the investment on new national power lines and on international interconnectors to develop net imports of electricity[20].

The abovementioned measures, if actually implemented, would imply:

- a reduction of gross final energy demand with respect to the EC BAU scenario at 2020, from 162.631 ktoe to 151.764;
- an increase of 5 percentage points of the RES with respect to the baseline, up to 14.100 ktoe;
- a 10% share of nuclear power in fuel inputs to thermal power generation by 2020, which implies an amount of about 6.500 ktoe of nuclear energy sources in gross inland consumption;
- a 30% increase of net imports of electricity with respect to the current value of 4.227 ktoe, up to 5.500 ktoe.

The table below, in the column called alternative scenario, summarises the results of these new policies and measures on Italian emissions and renewables targets by 2020.

[17] "Italian Energy Efficiency Action Plan 2007", under the European Union's Energy End-Use Efficiency and Energy Services Directive 2006/32/EC, Ministry of Economic Development, July 2007.
[18] Article 2, paragraphs 143-174, of the Law 244 of the 24 December 2007.
[19] Artiche 7 of the Law 133 of the 6 August 2008.
[20] "2008-2017 Electricity Grid Development Plan", issued by the Italian TSO and approved by the Ministry for Economic Development on January 2007.

Table 9: GHG emissions and renewable energy consumptions in the Alternative Scenario

	2005	2020 EC-BAU scenario	2020 Alternative scenario	Change % 2005- AS 2020
Gross inland consumption (ktoe)	186,766	221,171	210,304	12.6%
of which				
Solids	16,477	20,743	16,715	-14.2%
Oil	83,169	88,512	71,326	1.5%
Natural gas	70,651	88,874	71,618	6.5%
Nuclear	0	0	6,500	100%
Net imports of electricity	4,227	3,857	5,500	6.5%
Renewable energy	12,243	19,185	20,076	64.0%
GHG emissions (total) (MtCO2eq equ.)	580.0	649.6	552.1	-4.8%
GHG emissions (energy)(MtCO2eq equ.)	480.1	548.4	450.9	-6.1%
GHG emissions (other sectors) (MtCO2eq equ.)	99.9	101.2	101.2	-1.3%
Renewable energy consumption (ktoe)	7,301	13,417	14,100	93.1%
Gross Final Energy Consumption (ktoe)	134,080	162,631	151,764	13.2%
Share of RES in Gross Final Energy Consumption (target)	5.4%	8.2%	9.3%	70.6%

Source: Iefe and "European Energy and Transport. Trends To 2030- Update 2007", 8 April 2008, Directorate General for Energy and Transport

In the alternative scenario, where new energy policies are introduced, GHG emissions are lower than in the baseline. Indeed, the growth of renewable energy, together with increased energy savings, implies a greater share of renewable sources in gross final consumption.

With respect to the EC targets, the alternative scenario has:

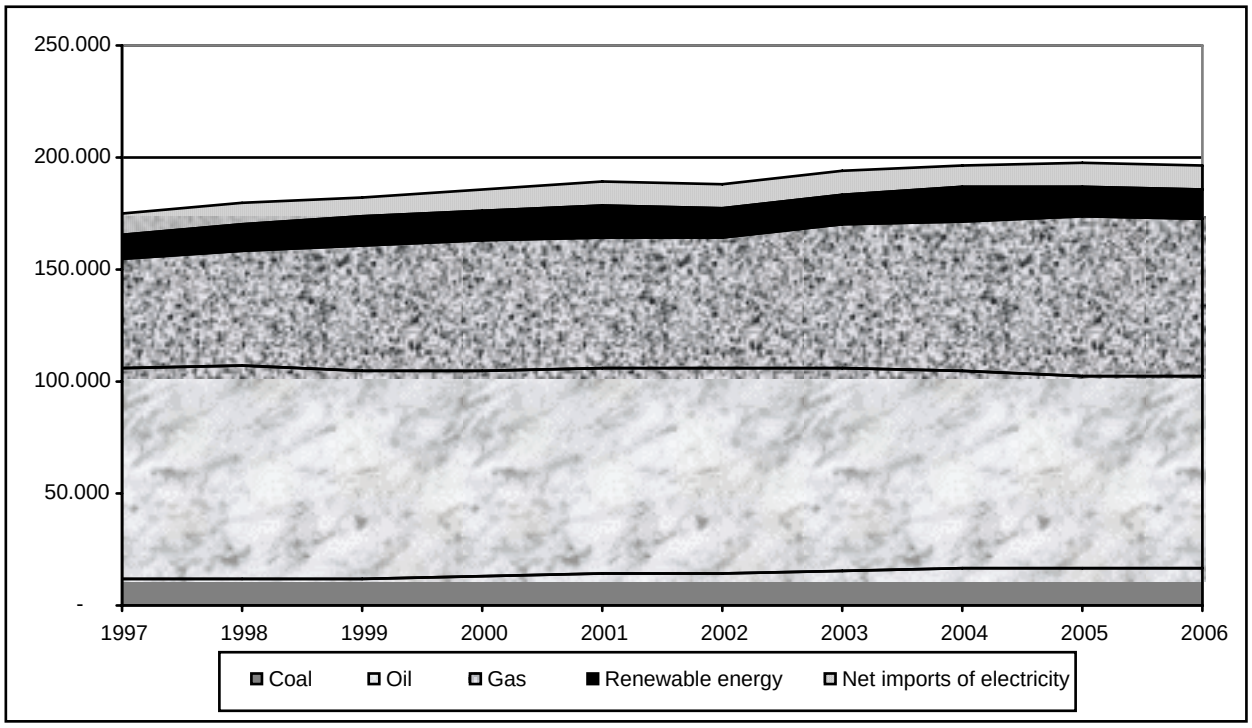
- a GHG emissions' reduction of 4.8% from 2005 to 2020, with a gap of 9.2 percentage points with respect to the EC Green Package target;
- a 9.3% share of renewable sources in gross final consumption by 2020, which implies a gap of 7.7% from EC Green Package target.

Therefore, despite the most recent energy policy, Italy will not be able to meet EU environmental targets. The gap between the results and EC policy targets show the challenges policy makers will be facing in the years to come as well as the need to go one step further for the target to be met.

6. Gas security of supply

Energy security has recently gained importance on the Italian policy agenda, mainly due to the fast growing gas demand and to the lasting bottlenecks in gas infrastructures, such as gas storage and import capacity.

Figure 2: Italian total primary energy supply by source 1997-2006 (Mtoe)



Source: Iefe on Ministry of Economic Development database

Today, Italy depends on foreign supplies for more than 90% of its natural gas consumption and the contribution of the national production is destined to reduce further because of the progressive exhaustion of the national fields.

The first signals of a probable gas shortage emerged in the winter of 2004/05 and they were coped with by reducing the gas supply to some industrial customers, according to the interruptability clauses foreseen in their contracts. The situation worsened the following winter, when Italy experienced both an insufficiency of peak capacity, that is the impossibility to face rapid increases in the demand because of insufficient speed in the withdrawal of gas from the storage fields and a possible volume shortage. The speed in the extraction of gas from the deposits depends on the filling level of the fields: with the progressive emptying, speed is reduced. For this reason, peaks of demand in the second part of winter are particularly important, indicatively from mid February, as the total quantity of gas that is still in the fields in that period is low because of the withdrawals made up until that moment.

The basis of the 2006 "gas emergency" were indeed structural problems, worsened by an exceptional climatic conjuncture and other negative contingencies. Italian gas infrastructures (pipelines, regasification terminals of the liquefied gas and storage capacity) did not adjust to cope with the rapidly changing demand and supply conditions. Structural problems have been worsened by the regulatory constraints on gas prices: in 2006 the exceptionally cold winter led to an increase in the gas prices in Europe. This, in turn, led to a surge in prices on the other European power exchanges. In Italy however, because of the scarce competitiveness and the rigidity of the regulatory mechanisms in the gas sector, gas prices have not responded to the new structural conditions. As a consequence electricity exports, and the related demand for gas, remained high even under gas scarcity[21].

To face the emergency, the Economic Development Ministry has had to activate an emergency plan: the emergency condition had been officially declared on 9th December 2005, with respect to the withdrawals of gas from the storage fields having been significantly higher than the expectations.

The rapid withdrawal from the storage fields was explained by three factors:

1) stresses on the international gas markets which led to a reduction of the gas exports, particularly in Russia because of the Russia-Ukraine crisis;
2) increase in the natural gas demand for heating, due to the particularly rigid temperatures. The winter of 2005-2006 was colder than the average of the winters in the last 20 years;
3) increase in the demand of natural gas for the production of power, due to the setting up of new power production units supplied by gas, for about 2000 MW in the period of November-December 2005 and to scarce hydroelectric production, given the strong drought conditions of the year.

According to the data published by the regulatory authority, on 1st March 2006 the volume of withdrawn gas from the storage was 8.7 billion cubic meters, against the 5.3 billion in an average winter. For this reason, the "withdrawal surplus" on such a date was estimated at 3.4 billion cubic meters, divided as follows: 1.2 billion for higher consumption for the thermoelectric production and 2.3 billion for higher consumption of heating due to low temperatures.

Many measures have been taken to face the emergency. At the end of December 2005, the Emergency Committee activated an obligation upon the operators to maximize the imports of natural gas and national production. In the second half of January, after the reductions in the supplies to Italy from Russia, the Emergency Committee activated phase 3 and 4 of the procedure for gas emergency, arranging the passage to oil of the power plants called "dual fuel", that is to say those power stations

[21] See Provision n. 37/06, Autorità per l'energia elettrica e il gas, "Avvio di istruttorie formali per l'eventuale irrogazione di sanzioni amministrative pecuniarie nei confronti di alcuni esercenti l'attività di vendita per uso improprio delle capacità di stoccaggio conferite per gli anni di stoccaggio 2004-2005 e 2005-2006", www.autorita.energia.it.

that can function both with oil and with gas. In the same days, the Ministry of Economic Development introduced incentive measures for those industrial customers that were willing to interrupt their supply of natural gas.

At the end of January, despite these measures, the situation was still very critical. The passage from gas to oil in power production with dual fuel plants had revealed itself to be scarcely effective because of the violation of the emission limits that such a fuel switch would have meant. Practically, only one power station – Montalto di Castro – had substituted gas with oil. For this reason, it had been necessary to intervene on a legal basis.

The law decree n. 19, 26th January 2006 introduced "Urgent measures to guarantee the supplying of natural gas", only for the necessary period of time to face the emergency. Such measures concerned:

a) the assignation of the production planning of the power stations supplied by combustible oil to Terna Spa – responsible for the management of the transmission net and balancing between demand and supply – with the aim of obtaining the increase of the contribution of such power stations to the coverage of the national requirements and the consequent reduction of production for the power stations supplied by gas;
b) the assignation to the Economic Development Ministry to issue environmental decrees, to increase the commitment of the power stations supplied by combustible oil, by urgently authorizing the raising of the levels of gas emission limits;
c) the possibility to make the oil supplied power stations productive again, which were stopped because of the lack of authorization, but that were potentially functioning.

The interventions described above allowed Italy to supersede the emergency winter period. The Economic Development Ministry declared its termination on 22nd March 2006.

Despite the corrective measures, in the winter of 2005/06, it was necessary to use about 1.2 billion cubic meters of the "strategic reserves" of natural gas. According to the estimates given by the Economic Development Ministry, without such corrective measures the use of the strategic supplies would have been significantly elevated, reaching 3.3 billion cubic meters.

The stable resolution of the criticality in the natural gas supply requires the realization of structural investments, such as the implementation of interconnection with foreign Countries and the realization of new regasification terminals. For these reasons it could not be organized in a short period of time. As a matter of fact, the winter 2006/07 projections indicated again a critical situation, with a possible early exhaustion of the gas storage before the end of the winter period. Not being able to intervene quickly on the structural problems, once the emergency of 2005/06 ended, in August 2006 the Ministry

for the Economic Development adopted contingency measures, aimed at the containment of the demand and the increase of the gas availability[22].

Thanks to the particularly mild temperatures of the last two winters (2006/07 and 2007/08) there were no problems to supply the gas demand. However, the structural problems described above were and still are present: their resolution is a necessary condition to safely face the years to come.

Since the year 2000, only the Greenstream pipeline from Libia to Italy has become operational, with an increase of the import capacity of 8 Bcm. Development of the TAG pipeline from Russia (+6.4 Bmc - nominal) and of the TRANSMED pipeline from Algeria (+6.5 Bcm - nominal) are on the agenda. The deployment of the new import capacity is expected for the end of 2008, with additional 3.3 Bcm from the TAG and 5.5 Bcm from the TRANSMED. By 2009 even the Rovigo LNG terminal should become operational. Its regasification capacity should gradually reach the total nominal capacity of 8,2 Bcm by 2011. We can therefore estimate for 2008 a total potential supply on a winter peak day of around 490 Mmc/day. This estimate assumes 170 Mmc/day of withdrawal from storage[23] and national production of 22 Mmc/day. This has to be compared to peak demand. In February 2006 demand was just above 440 Mmc/day. If we assume that demand at the peak remains stable at the 2006 levels, the margin for the next winter appears to be fair. The situation should improve further in the following years, thanks to the full deployment of the new infrastructure.

7. Conclusions

In this paper we analyze the set of measures today operational in the Italian energy supply sector to reduce GHG emissions, with particular reference to renewable energy sources and describe the security of supply worries that have arisen since 2005 because of a potential shortage of natural gas.

With reference to the climate change issue, the article puts in evidence that Italian current efforts to cut emissions and to promote renewable energy consumption do not allow it to reach the EC Green Package targets. The most recent energy policy measures are steps in the right direction to reduce the gap between projections and targets. Namely, the Italian energy efficiency action plan approved on July 2007, sets a new energy savings target equal to a global reduction of 10,864 ktoe during the period 2008-2016. Moreover, the higher "Renewable Obligation" set by the Law n. 244/2007 for electricity producers in the context of the green certificates market and the new support scheme introduced for

[22] The Ministry introduced the compulsory full use of the import capacity of natural gas to optimize the filling procedures of the storage fields in the summer. Secondly, he foresaw the obligation to insert in all the supply contracts a clause that guaranteed, starting from January, an interruptability equal to at least 90% of the quantities supplied in the previous thirty days.

[23] This withdrawal capacity is in line with what was actually recorded during the gas emergency in January 2006.

some specific renewable technologies, should increase the amount of RES at 2020 with respect to the baseline, up to 14.100 ktoe. Moreover, the Italian government has introduced in its political agenda deployment of nuclear power plants for electricity generation. We estimate that a 10% share of nuclear power in fuel inputs to thermal power generation by 2020 would implies about 6.500 ktoe of nuclear energy sources in gross inland consumption. Finally, the new plan for the investment on new national power lines and on international interconnectors would increase net imports of electricity by 30% with respect to the current value of 4.227 ktoe, up to 5.500 ktoe. Nuclear power and imports are GHG free energy sources.

Taking the impact of all abovementioned measures into account, we estimate a GHG emissions' reduction of 4.8% from 2005 to 2020 and a 9.3% share of renewable sources in gross final consumption by 2020. Only by implementing all existing and planned national and European policy measures Italian emissions can be brought down with respect to 1990.

We have observed how there are many energy policies and instruments already implemented by Italy to limit GHG emissions, but a comprehensive and integrated set of measures to reach the 2020 targets is still missing. Existing policy and measures need to be translated in a coherent action plan where all the targets are simultaneously taken into account as well as other goals of energy policy, mainly to maintain the reliability of energy supplies and to promote competitive markets. Furthermore, in a recessive phase of the national economy (which favours an economy with lower carbon emissions anyway), it is desirable to reduce the additional costs needed for meeting the emission reduction and the renewable energy sources deployment targets. First of all, the cost of action must be socially acceptable.

As for security of supply, this article shows that, unlike the general assumption, gas supply problems recently experienced by Italy did not come from cuts in international supplies but from a shortage of intertemporal flexibility tools, such as storage capacity. National bottlenecks in infrastructure development had been the main cause of the 2005/2006 gas emergency. Structural problems have been worsened by the inefficacy of the gas market to give a reasonable price signal. As a matter of fact, Italy is not well equipped to cope with sudden spikes of international gas prices because market mechanisms are not working properly and domestic prices are not allowed to adjust. During the crisis the Italian gas prices did not adjust to the new structural conditions. Given the sharp price surge in foreign markets, particularly in France, Switzerland and Germany, Italy increased its power exports and, consequently, the related demand of natural gas. The low reactivity of the domestic gas price had therefore worsened the security problem.

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