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Renewable energy: economic instruments between needs and risks

Abstract

The environmental damages caused by global warming and the rising problems of energy security call for a strong revolution in the energy sector. In this field, renewable energy is expected to play a major role. Renewable production is promoted in several ways making use of different kinds of subsidies like green certificates or feed-in tariff systems.

In this perspective, Italy represents a special case since it applies a diversified package of market based instruments (MBIs) for the development of a more sustainable energy system. The purpose of this paper is to investigate the theory behind MBIs and how they have been implemented in reality. Attention will be paid to pitfalls and problems encountered in the national experience in order to suggest potential transformations so as to improve their effectiveness and efficiency.

Keywords: renewable energy, green certificates, feed-in tariffs, subsidies.
JEL Classification: H23, Q42, Q48, Q58.

Introduction

The energy sector has increasingly acquired a critical role in economic growth and development. The current rate of consumption, in fact, is not sustainable either in terms of security of supply or the environmental impacts it generates. Both items – secure energy supply and environmentally sustainable energy – together with the enhancement of competitiveness in the internal energy market have become central goals of the European energy agenda since the White Paper of 1995[1]. The same objectives have been strongly reaffirmed by the more recent Green Paper of 2006[2] and by the Climate-Energy Packages of 2007[3] and 2008[4].

This paper is meant to investigate energy sustainability, keeping in mind that influences among the three dimensions of sustainability are strong and that, more often than not, policies aiming at their attainment are hardly separable. Measures directed at curbing energy consumption or reducing the environmental impact of energy production through renewable sources can in fact bring about a reduction in fossil fuel import, hence improving the security of supply. A stronger concern and political commitment toward energy self-sufficiency and security can modify the socio-economic evaluations of investment opportunities in non-fossil fuels or energy saving, making a large gamut of interventions profitable.

The competition and completion of the internal market can decrease final energy prices, sustain economic development, favour the achievement of social policy objectives (such as alleviating energy poverty) and free resources for investments in clean energy production. However, an efficient energy market can push up consumption levels (without any other accompanying measure) and cause major problems in terms of environmental sustainability.

The question of the environmental sustainability of energy consumption has been raised because of different issues: the depletion of natural resources; the abatement of greenhouse gas emissions and the attainment of exogenous emission reduction commitments; the reduction of local and regional pollution sources and the improvement of air quality.

In terms of policy options, public intervention in this field is based on two major pillars: energy efficiency and renewable energy (Bertoldi et al., 2005). An effective energy efficiency policy on the demand side and the promotion of renewable energy sources (RES) on the supply side are currently considered the key components of the EU approach to sustainable energy.

The analysis carried out in this paper is mainly devoted to the Italian case study, since Italy presents a wide range of economic instruments and regulations aimed at increasing the amount of energy produced by renewable sources. An analysis of the problems and difficulties that have been encountered with respect to the acquired benefits can provide interesting insights on how better to rule these mechanisms in other countries or in a European perspective.

The paper is organized as follows. After a general review of the renewable energy policies and their targets in Section 1, Section 2 discusses the way

[1] European Commission, White Paper: an energy policy for the European Union (COM, 1995, 682).

[2] European Commission, Green Paper: a European strategy for sustainable, competitive and secure energy (COM, 2006, 105).

[3] European Commission: an energy policy for Europe (COM, 2007, 1).

[4] European Commission: Europe's climate change opportunity (COM, 2008, 30). The Climate-Energy Package (20-20) has been finally adopted by the Council of the European Union in April 2009 and includes: a new directive for the promotion of energy from renewable sources (Directive 2009/28/EC); a new directive revising the emission trading system (ETS) (Directive 2009/29/EC); a new decision setting binding emission targets for EU member states in sectors not covered by the EU's ETS (Decision 2009/406/EC).

the taxation of energy products has been implemented in Italy with respect to the main EU countries. Section 3 is devoted to an in-depth analysis of the economic instruments, such as feed-in tariffs or tradable certificates, adopted in Italy to prompt the diffusion of renewable energy (Section 3).The last Section presents some preliminary conclusions and provides some suggestions on how to better manage these incentives.

1. Quantitative renewable energy targets: steps-forward and remaining challenges

The EU approach to renewable energy sources is in general target based. Quantitative objectives are set at the Community level (Tab. 1) and afterwards have to be met both at an aggregate level and by each Member State according to the agreed effort sharing.

Table 1. Renewable energy targets in Italy and the EU: a survey

White Paper 1997[a]	Member states have to double the contribution of RES from 6% to 12% of gross national energy consumption by 2010.	Indicative target. Not binding.	National initiatives.
Directive 2001/77[b]	EU: 21% green electricity of gross electricity consumption by 2010. Italy: 22% by 2010.	Targets are not binding and only "indicative". Planning, reporting and assessment are required.	National initiatives.
Directive 2003/30[c]	EU: 2% of the community fuel market for transport to be covered with biofuels by 2005 and 5.75% by 2010. Italy: 1% by 2005 and 5% by 2010.	Infringements procedures can be applied for a lacking or partial implementation of the procedural contents of the directive.	National initiatives.
Climate and Energy Package: Directive 2009/28[d]	EU target: 20% renewable sources of the final energy consumption and 10% renewable sources of the final energy consumption for transport. Italy: 17% and 10%, respectively.	Voluntary commitment. Mandatory national targets. Planning, reporting and assessment are required. No penalties established.	National initiatives.

Notes: [a] European Commission, energy for the future: renewable sources of energy – White Paper for a community strategy and action plan COM (97)599; [b] Directive 2001/77/CE on the promotion of electricity produced from renewable energy sources in the internal electricity market (2001) OJ L 283/33; [c] Directive 2003/30/CE on the promotion of the use of biofuels or other renewable fuels for transport (2003) OJ L123/42; [d] Directive 2009/28/EC on the promotion of the use of energy from renewable sources (2009) OJ L140/16.

Given the intentions set out in the EU's energy strategy and the general goal of the absolute decoupling between energy demand (and related externalities) and economic growth, the most recent reports (Table 2) highlight the patchy progress made and the likely failure in reaching several of the expected targets.

Table 2. Energy demand indicators by fuel (%) in Italy and the EU

		Gross inland consumption (%)				Final energy demand (%)			Internal RES-E in electricity gross inland consumption (%)[1]			Transport (biofuels)		
		1990	2005	2010*	2020*	2000	2005	2020*	1990	2007	2010	2005	2010*	2020*
Italy	Solid fuels	9.6	8.8	8.6	9.4									
	Oil	58.7	44.5	42.3	40									
	Gas	22.5	37.8	39.8	40.2									
	Nuclear	-	-	-	-									
	Renewables	4.2	6.6	7.5	7.5	5.1	5.3	8.2		13.7	16.1	0.4	3.8	7.3
	Other	2	2.3	1.8	2.9									
EU-15	Solid fuels	22.9	14.8	13.8	14.5									
	Oil	41.2	40.4	38.1	37.3									
	Gas	16.9	23.3	25.3	26.1									
	Nuclear	13.9	15.3	14.3	11.8									
	Renewables	5	6	8.2	10.1	7.8	8.3	12.6		13	15.9	1.2	4	7.6
	Other	0.3.	0.2	0.3.	0.2									
EU-27	Solid fuels	27.3	17.7	17.2	17.4									
	Oil	37.9	36.7	36.4	35.6									
	Gas	17.9	24.6	24.9	25.7									
	Nuclear	12.3	14.2	13.2	11.3									
	Renewables	4.5	6.8	8.2	10	7.9	8.6	12.7		14.6		1.1	3.9	7.4
	Other	0.1	0.0	0.1	0.0									

Notes: Scenarios calculated incorporating existing policies and measures. [1]RES-E –Renewable energy source-energy.
Source: Elaborations on European Comissions (2008a) and GSE (2008c).

As far as the energy mix is concerned, despite renewable energy[1] experiencing the highest growth rate between 1990 and 2005[2], the current shares are hardly consistent with the indicative targets included in the White Paper of 1997[3], Directive 2001/77[4] and Directive 2003/3[5]. In Italy renewable energy accounted for 6.6% of total primary energy consumption in 2005 and is projected to amount to 7.5% at the end of 2010: 4.5 percentage points below the target established by the White Paper (European commission, 2008a).

Without the contribution of imported green electricity, renewable energy is going to be characterized by falling short of the target, even in the electricity and transport sectors (Table 2).

With respect to the new targets for 2020[6], trends suggest Italy will increase its renewable energy by 3-5% by 2020, accounting for 8-10% of final energy consumption. This will leave Italy at least 7% short of the 17% target established in the EU renewable directive for 2020. The same gap is going to characterize the whole EU-27.

2. The taxation of energy products

The main impact of a tax on energy products, aimed at internalizing an externality, is an increase in the energy price and a consequent decrease in its demand. Given that a firms' aim is to maximize profits, in the long run the willingness to avoid the tax would induce the affected producers to invest in R&D, bringing positive effects to the whole system thanks to the so-called dynamic efficiency effect (OECD, 2007).

The taxation of energy products, therefore, is an efficient instrument in a broad sense: on the one side, it minimizes the costs for achieving a given level of pollution control (economic efficiency); on the other side, it provides incentives for technological innovations in the field of renewable energies and further reduction in pollution (dynamic efficiency)[7].

Environmental taxes on energy products are influenced by the EU Directive 2003/96/EC[8] that sets minimum levels of energy taxation[9]. The main aim of the energy taxation directive was to better harmonize tax rates all over Europe in order to reduce competitive issues.

Notwithstanding the effort to reach a certain balance at the EU level (given the differences in tax levels and structures, subsidies and tradable certificates schemes), current energy prices vary significantly among the EU member states[10].

The compulsoriness of energy taxation relies on the idea of shifting the tax burden from labor towards the use of natural resources and environmentally harmful products and activities. The main reason for this choice was the realization of the so-called "double dividend", that is the double benefit coming from the reduction of the externality related to a certain polluting activity and the contextual tax burden reduction on labor and income.

Despite the expected benefits it could generate, environmental taxation on energy products has not been growing in recent years at the average EU level. Worries about the competitiveness of the energy sector and the burden on final consumers prevented energy taxation from increasing over and above the minimum set by the EU Directive.

All over the EU energy taxes account for about 77% of total environmentally related taxes and around one twentieth of total taxes and social contributions. However, they have been employed mainly for revenue reasons and their link to environmental goals has been weak or even absent.

Table 3 shows energy tax revenues in relation to final energy consumption for the main European countries. This rate, also known as implicit tax rate for environmental taxation (ITR)[11], can straightforwardly represent the priority given to environmental protection more than other indicators such as the

[1] Renewable energy includes energy generated from renewable non-fossil sources: namely wind, solar, aero thermal, geothermal, hydrothermal and ocean energy, hydro power, biomass, landfill gas, sewage treatment plant gas and biogas (Directive 2009/28/CE Art. 2).

[2] The annual average growth rate of renewable energy in total primary energy consumption has been 3.4% in the EU-27.

[3] European Commission, energy for the future: renewable sources of energy-white paper for a community strategy and action plan COM (97)599. According to the White paper, Member States have to at least double their contribution of renewable energy sources with respect to gross national energy consumption by 2010.

[4] Directive 2001/77/CE on the promotion of electricity produced from renewable energy sources in the internal electricity market (2001) OJ L283/33. According to this Directive, the EU has an indicative target of 21% green electricity of gross electricity consumption by 2010 (the same target for Italy is 22%).

[5] Directive 2003/30/CE on the promotion of the use of biofuels for transport (2003) OJ L123/42. With respect to this Directive, 2% of the EU fuel market for transport has to be supplied by biofuels by 2005 (1% in the case of Italy) and 5.75% by 2010 (5% in the case of Italy).

[6] The new targets have been set in the framework of the Climate-Energy Package 2009.

[7] Given that in the field of energy the responsiveness of the demand to price changes is very low in the short run, a leading role is assumed by the dynamic efficiency effect of a tax which, in the long run, could induce consumers to shift towards more energy saving technologies and a consequent greater decrease in energy demand.

[8] Council Directive 2003/96/EC of October 27, 2003 restructuring the community framework for the taxation of energy products and electricity (2003) O.J. L 283, P. 0051- 0070.

[9] Each member state is free to set its national rates above the minimum.

[10] In this perspective, including all the relevant externalities to establish the true costs of energy use, as suggested by the EU Directive itself, would help provide the correct price signals all over Europe.

[11] The ITR is in real terms, meaning that tax revenues have been deflated by the deflator of final demand.

rate of revenues on GDP or on total taxes and social contributions.

Table 3. Energy tax revenues in relation to final energy consumption[1] (real ITR on energy)

Euro per ton of oil equivalent, deflated with cumulative percentage change in final demand deflator (2000 = 100)

	1995	2000	2006	1995/2006	2000/2006
Austria	128.8	142.6	144.5	15.7	1.9
Belgium	102.0	92.5	102.8	0.7	10.2
Denmark	221.9	313.7	259.2	73.3	-18.5
Finland	103.4	108.7	105.3	1.9	-3.4
France	176.4	173.0	161.9	-14.6	-11.1
Germany	172.4	192.7	200.7	28.3	7.9
Greece	206.1	117.3	96.0	-110.1	-21.3
Ireland	134.1	140.5	146.9	12.8	6.3
Italy	270.5	248.7	210.4	-60.1	-38.3
Luxemburg	167.8	164.3	167.8	0.0	3.5
Netherlands	122.9	154.4	193.6	70.7	39.2
Portugal	35.0	59.2	87.5	52.5	28.3
Spain	147.5	137.8	119.2	-28.2	-18.6
Sweden	144.7	182.0	199.3	54.7	17.4
UK	152.3	249.5	211.1	58.8	-38.3

Source: Eurostat, 2009.

The ITR experienced on average a decrease all over the EU-27 in the period of 2000-2006 (-13.4%). This average value involves different situations. Several old member states, such as Italy, France, the UK and Spain had energy taxation declines of several percentage points. Most new member states and a few old ones, who traditionally are more sensitive to environmental problems, such as Germany, the Netherlands and Sweden, recorded an increase which has not been sufficient to offset the negative results of the other part of Europe.

The negative trend has been particularly strong for Italy[2], which experienced a 38.3% decrease in the ITR in the period of 2000-2006, the worst performance all over the EU together with the UK. This kind of circumstance supports the idea of the existence of a silent implicit "fiscal counter-reform". In fact, it seems that in the last ten years pollution and consumption have been favored at the expense of labor and firms, while EU regulations and prescriptions were, and continue to, point to the increase of environmental taxation.

3. Market based instruments and renewable energy

The production of renewable energy is commonly more expensive than the conventional one. Without any incentive or support from the regulatory authority, the market alone would not be able to promote the effective development of a market for renewables.

So far, the main economic instruments implemented to boost the use of renewable energy have been: feed-in tariffs and tradable green certificates (TGCs)[3].

With these instruments, the price received by the electricity suppliers varies according to the type of energy source the electricity is produced with. In fact, while the price paid by final consumers is always the same, whatever the nature of the electricity acquired is (conventional or renewable), the price received by producers differs. Those producing energy from renewable energy sources benefit from two kinds of earnings: one coming from the sale of electricity to the market (at a price set equal to the one established by the conventional producers) and the premium price renewable producers are rewarded with. TGCs and feed-in tariffs differ from one another in the way the premium paid to renewable producers is collected. While in the TGCs system it is the market establishing the correct level of the premium that must be offered to implement new renewable capacity; in the case of feed-in tariff systems this premium price is set autonomously and exogenously by the regulatory authority.

In the last two decades Italy has heavily relied on both feed-in tariffs and TGCs for the deployment of RES-E (renewable energy sources-energy). They have shown pros and cons and their coexistence has sometimes created problems of overlapping policy.

3.1. From feed-in tariffs to tradable green certificates. In Italy, as well as in many other European countries, the production of renewable energy has been prompted firstly through the development of a differentiated system of feed-in tariffs. The Resolution #6/92 of the Interdepartmental Committee on Prices (hereinafter CIP/6) established a scheme of subsidized prices – differentiated by source – for new power plants that had become operative after January 30, 1991.

[1] This includes energy consumed in the transport, industrial, commercial, agricultural, public and household sectors and excludes the energy transformation sector and energy industries.

[2] In 1995 Italy was characterized by one of the highest levels of ITR all over the EU; however, it experienced a dramatic decline in the following years recording a -60.1%.

[3] Together with TGCs and feed-in tariffs, it must be mentioned about direct grants, low interest loans or tax delivered subsidies (in the form of deductions or credits), which have been largely exploited at the level of final energy demand. In Italy a capped national tax credit of up to 55% of investments costs exists for passive solar panels and photovoltaic cells in the field of the energy renovation of buildings. Moreover, regional governments as well as local authorities are free to provide incentives for renewable sources such as solar power or geothermal energy.

The feed-in tariff system was meant to reward those producing renewable energy with an extra premium exogenously set by the regulatory authority. The reasoning was to provide renewable producers with the earnings that would let them increase their production without bearing an excessive burden.

The net cost used to cover the regulated price for RES and "equivalent sources"[1] was put directly into a specific entry (A3) of the electricity bill.

The feed-in tariff system implemented with CIP/6 proved to be extremely appealing but costly, resulting in the suspension of the program at the beginning of 1997. However, eligibility for subsides was granted to plants already built or under construction and for applications accepted up to November 1995. Those on the list were scheduled to come on line within a few years, but postponements and derogations were continuously allowed so that new construction was expected until 2009[2] and, consequently, regulated tariffs until 2021.

The overall effects of the CIP/6 have been significant (AEEG, 2009).

The stability and long-term commitment of the program promoted about 7.7 GW of new nominal capacity (Table 4) in a period of capacity shortage. The system favoured the deployment of new RES such as biomass, wind and wastes which had been largely unexploited until that time. As a positive side effect, new independent producers emerged in the energy market and paved the way to success for energy liberalization.

Table 4. Application of the CIP/6 feed-in tariff in Italy (2007)

		Renewables		Equivalent		Total
Conventions signed until Dec. 31, 2007	Number	336	88.2%	45	11.8%	381
Nominal capacity until Dec. 31, 2007	MW	2669	34.7%	5028	65.3%	7 697
Energy purchased (2007)	TWh €/MWh (average)	8.2 179.89	17.7%	38.2 97.74	82.3%	46.4 112.28
Costs of purchased energy	Billion €	1.48	28.5%	3.74	71.5%	5.22
Revenues from energy sold on the market		0.50	17.7%	2.32	82.3%	2.82
Net costs		0.98	40.8%	1.42	59.2%	2.40

Source: Calculations on AEEG (2009).

Still, some relevant pitfalls clearly emerged.

First, the program started without an upper limit to the energy allowed to benefit from the support. Therefore, it turned out to be expensive, with costs not easily quantifiable in advance. This caused a clear lack of transparency for consumers and of predictability for public authorities. Only considering the net costs, in 2007 the CIP/6 supporting scheme entailed a net cost of €2.4 billion (Table 4) and an additional burden for electricity consumers of about 7 €/MWh (nearly €3 for renewables and €4 for the so-called "equivalent sources")[3]. Up to the expiration date of existing conventions (within about 12 years), the CIP/6 scheme is estimated to entail about €16 billion of net costs for energy consumers.

Secondly, the broad boundaries established for "equivalent sources" (in particular combined heat and power plants-CHP) to be included in the program, and their lack of continuous updating according to technological developments, caused a major part of the financial support of CIP/6 to be directed to non-RES plants. In the period of 1992-2004, for example, about 55% of the new capacity developed under the CIP/6 scheme (nearly 12.23 MW) was represented by CHP. In 2007 only 18% of the energy financed under the CIP/6 scheme was represented by renewable energy, while 82% came from other sources (Table 4).

Thirdly, public authorities showed clear difficulties in the management of key elements of the program. This was particularly the case for the setting of the extra premium allocated to renewable plants. The correct definition of this value, as well as its continuous indexation, created windfall profits for the involved operators.

Finally, administrative and transaction costs proved to be high, leading to extensions in the evaluation procedures and delays in the time schedule of project implementations. This was partly due to the multiple administrative acts and authorizations required for the construction of new plants and for connection to the grid, but were also caused by the widespread opposition of local communities[4].

Acknowledging the above drawbacks, the supporting mechanism for RES-E was changed in 1999, within the reform of the energy sector introduced by Legislative Decree 79/1999. The main aim was to put into practice a scheme that would be compatible with a competitive market, without creating expensive rents for the owners of existing plants and

[1] The feed-in tariff was granted not only to proper RES, but even to a wide variety of other sources: co-generation, plants exploiting exhaust steam or other forms of wasted energy, plants employing fossil fuels coming from small reservoirs.

[2] Given the garbage emergency recently experienced in the south of Italy, plants which produce energy from garbage have been admitted to benefit from the feed-in tariff system.

[3] Thanks to the recent Law #99/09, plants relying on the "equivalent sources" have the possibility to get compensation in case they opt for the cancellation of their CIP/6 convention. This resolution is expected to bring about a considerable reduction in the tariff burden on final consumers.

[4] This was especially the case for biomass and wind plants.

without the same huge informative requirements of the CIP/6 program. To this end, a TGCs scheme was implemented together with the setting of quantified binding renewable targets.

According to the new decree, importers and producers of electricity from conventional, non-renewable sources must have a certain percentage of their energy coming from renewable energy generation plants[1].

In order to favour the attainment of this target in a cost-effective way, the GSE[2] issued TGCs to previously qualified operators (so-called IAFR, plants powered by renewable sources), with the intention of using them as an instrument to distinguish the sale of electricity from the environmental value of renewable energy. TGCs, in fact, can be sold separately from the electricity they produce. As a result, renewable generators enjoy two revenue flows: one coming from the sale of electricity on the market at a price established by conventional producers, and the other one coming from the sale of TGCs on the green certificates market.

To attain their targets, the obliged operators have three options:

- to directly establish renewable energy plants, earning the corresponding TGCs;
- to buy TGCs from qualified RES-E generators;
- to import renewable energy from countries that jointly or partly coordinate their national supporting schemes with the Italian one.

The costs incurred by electricity producers/importers to attain their target can be passed on to consumers and indirectly influence the final electricity tariffs.

The functioning of the TGCs scheme is strongly influenced by the existing feed-in tariff system and the tasks assumed by the regulatory authority (GSE).

The yearly net average costs paid by the CIP/6 for renewable sources represents the reference price for which the appointed operator (GSE) can sell its own TGCs in the market. Moreover, the GSE plays a major role in the TGCs scheme since:

- it can sell "virtual TGCs", that is TGCs non covered by any real production, in order to satisfy the excess demand;
- it works as a "buyer of last resort" of certificates unsold on the market in order to avoid the excess supply[3];
- it is assigned to the definition and management of the technical rules of the TGCs mechanism.

The part taken by the GSE in the TGCs system and the fact that the premium price identified by the different renewable options is still ruled by the regulatory authority openly conflicts with the idea of creating a certificates market entirely ruled by the market forces.

3.2. Results, critical issues and solutions. The reasoning underpinning a feed-in tariff or a green certificates scheme relies on the awareness of renewable energy being traditionally more expensive than conventional production. Without any incentive or premium, the market alone would not be able to attain the targets that have been set at the European level. Table 5 shows the role played in this field by the incentive mechanisms and the way these have been able to prompt the diffusion of certain technologies such as biomass, biogas and wind, which were previously completely unexploited[4].

Table 5. Role of incentives on renewable energy supply (2006)

	Hydro (GWh)	Geothermal (GWh)	Biomass (GWh)	Wind (GWh)	Biogas (GWh)	Solar (GWh)	Total (GWh)
Total gross energy	36994	5527	4 408	2 971	1 336	35	52 275
Energy net of Hydro >10MW	7 875	5 527	5 408	2 971	1 336	35	23 156
Energy with TGCs	2 123	845	447	1 745	439	1	5 602
Energy with CIP/6 tariffs	1 321	1 454	4 367	1 226	897	0	9 265
% with TGCs	5.7%	15.3%	8.3%	58.7%	32.9%	2.9%	10.7%
% with CIP/6 tariff	3.6%	26.3%	80.8%	41.3%	67.1%	0	17.7%

Source: Elaborations on GSE (2008c).

[1] According to the recent Law #99/09 and Law #166/09, since 2012 the obligation is set on electricity vendors. This choice is going to alter the reasoning underpinning the TGCs scheme which is to provide renewable producers with an incentive to invest in new renewable capacity. Moreover, this provision will considerably raise the number of participants, with a consequent increase in the costs of monitoring and control.

[2] The GSE (Gestore Servizi Elettrici) is in charge of promoting the development of renewable energy sources in Italy, by granting support for and organising awareness campaigns on environmentally-sustainable and responsible use of electricity.

[3] With Decree #78/2010 the role of "buyer of last resort" of the GSE has been completely erased. This decision has been driven by the high dimension of the costs incurred to cover the excess supply. In 2009 the expenditures related to the unsold TGCs acquired by the GSE accounted for €1 billion. The expenditures amounted to €630 million, net after what was recovered by the GSE with the sale of TGCs, which were charged on the final electricity tariffs through the tariff component A3. For 2010, the burden on final consumers was expected to amount to €540 million; however, the Decree #78/2010 suspended the possibility of relying on the GSE for situations of excess supply.

[4] Excluding large hydropower plants which were mostly built before 1990, nearly 2/3rds of the existing plants are supported through some extra premium (GSE, 2008c).

With respect to the TGCs system, the attractiveness of the scheme has increased over time during the last decade. Up to the end of 2008 4300 MW of additional supply qualified as renewable became operative, while nearly 9000 MW are planned, but not yet operative.

The results listed in Table 6 provide evidence of the increasing role played by market operators. Because of their expansion, the market share of the GSE that had to compensate the imbalance between supply and demand was progressively lessened to zero.

Table 6. Binding targets in Italy and their attainment

			Renewable energy obligation*						
Year	Energy liable to obligation (TWh)	Renewable quota (%)	Demand (TWh)	Supply covered by traded TGCs (TWh)		Supply covered by self-production (TWh)		Supply covered by GSE (TWh)	
2002	161.6	2	3.23	0.77	23.8%	0.12	3.7%	2.34	72.5%
2003	180.6	2	3.61	1.28	35.4%	0.21	6%	2.05	56.8%
2004	201.1	2	4.02	2.3	57.2%	0.59	14.7%	1.03	25.6%
2005	193.8	2.35	4.48	2.69	60.1%	1.52	33.9%	0.14	3.1%
2006	222.2	2.70	6	3.82	63.6%	1.97	32.8%	0.01	0.2%
2007	189.9	3.05	5,84	2.53	43.4%	3.25	55.7%	0.01	0.2%
2008	190	3.8	7.22	7.22 (100%)				0	0

Notes: *Defaulters not included.
Source: Elaborations on AEEG (2009).

Notwithstanding the growing deployment of renewable sources, the scheme also encountered some troubles.

A mechanism ruled by market forces is traditionally more exposed to price fluctuation compared to a feed-in tariff system, where the premium price is normally established well in advance at the beginning of a certain commitment period. This situation can cause uncertainty for the investors who normally choose certainty over risk.

In order to provide the investors with more certainty, at least with respect to the time frames, targets should be defined in advance with respect to their deadlines. Italy failed to consider these issues, being characterized by the lack of making long-term commitments[1]. The increase in RES-E granted by the scheme turned out not to be coherent with the requirements set by the EU Directive 77/2001. At the same time, the supply of TGCs was higher than the demand, causing a consequent fall in the TGCs price to a minimum level of nearly €60 in July 2008[2].

According to the available estimates (ENEA, 2008), the current targets seem incoherent even if compared to the 2020 objectives and require national authorities to play a big role in carrying out a higher degree of coordination between adopted quantitative targets and instruments developed for their attainment.

Moreover, TGCs pose serious problems because of renewable technologies being at different stages of development and competing on the same market while facing different costs (Agnolucci, 2007; Jacobsson et al., 2007). These issues drove the obliged parties to develop lower-cost solutions to get their certificates, at the expense of the more innovative ones. The data collected by the GSE, in fact, confirm the attractiveness of the mechanism for more mature technologies (mainly hydro, wind, and geothermal), while clearly revealing the residual role of biomass and solar plants (GSE, 2008a).

Furthermore, the establishment of a single TGC's price creates increasing windfall profits for the mature technologies and constitutes an excessive burden on final consumers.

In order to avoid or at least lessen this problem and introduce a certain degree of flexibility, the regulatory authority intervened in the field of technology specification and technology banding.

Separate premium schemes have been introduced to support more costly technologies.

In the case of photovoltaic plants, since 2005 a feed-in premium (Conto energia) has been in place. The premium is granted for the period of 20 years and applies to both self-consumed energy (valued through a net metering system) and energy put on the grid. Under the premium scheme:

- the subsidized energy has a ceiling, i.e., a national maximum power of 1200 MW that may be supported;
- the rate increases with the level of architectural integration of the plants into the building and with the joint adoption of energy efficiency measures;
- the costs incurred are recorded on the same specific entry (A3) of the electricity bill used for the CIP/6 scheme[3];

[1] From this point of view, a first (even if tardy and unsatisfactory) adjustment has been furnished by the Budget Law 2008 (Law #244/07) which provided for an annual increase in the obligation of 0.75% for the period of 2008-2012.

[2] To solve the problem of the excess supply, the government assigned the GSE the role of "buyer of last resort" (Law #244/07). With Decree 78/2010 this possibility has been definitively erased.

[3] At present the A3 entry accounts for a percentage of nearly 8-9% of the final pre-tax electricity price.

- benefits cannot be cumulated with other grants or supporting schemes introduced by public authorities[1].

Since 2005, the *Conto energia* has encouraged the installation of 350 MW of new capacity, bringing the total supply capacity to 420 MW for the end of 2008.

A similar premium scheme was introduced in 2008 for thermodynamic solar plants with the aim of supporting electricity generated from the solar source for 25 years. The rates range from 0.28 to 0.22 € cent/kWh, depending on the proportion of electricity generated from non-renewable sources.

A general reform based on technology banding has been carried out at the end of 2007 for plants commissioned after January 1, 2009. The new framework was meant to overcome the problems of renewable technologies that are in different stages of development. In the field of TGCs, corrective factors are granted to less developed technologies to provide more certificates for each unit of RES-E produced. Small plants (less than 1 MW) are given the opportunity to opt for a feed-in tariff in substitution of TGCs. In both cases the duration of the supporting mechanism has been extended to 15 years and is not cumulative with other national or local incentives.

Administrative, physical and social costs are another critical issue for the development of renewable energy sources. The administrative process for obtaining an authorization revealed to be particularly costly in time and resources, generally requiring the involvement of several authorities and procedures. Even access to the grid represents a notable obstacle, because of the congestion of the existing capacity and the lack of transmission infrastructures for plants situated far away from the city centres. The most relevant non-cost barrier is probably represented by community opposition to new plants (mainly in the case of wind, biomass, and wastes). This entailed the development of new prescriptions and bargaining requirements for operators, producing further delays and, in some cases, the cancellation of infrastructural projects[2].

To reduce the administrative and political hurdles (and costs) involved in commissioning new or re-powered plants, the general reform of 2007 established:

- the introduction of a single integrated authorization under the responsibility of the regional government for the construction and commissioning of new plants;
- the establishment of a minimum generation capacity under which plants can be built simply through a notification to the local municipality;
- the outlining of more precise deadlines for the construction and commissioning of qualified renewable plants;
- in the case of delays in the connection to the grid, the provision of automatic refunds under the *Conto energia* and halved connection costs for plants fed by renewables.

The streamlining of the decision-making process and a significant improvement of its efficiency are decisive to bringing about the definitive diffusion of renewables.

Conclusions

The analysis carried out in the paper has been meant to investigate the issue of renewable energy sources and the way it has been dealt with by public authorities. In terms of policy options, public intervention in this field has been based on market based instruments (MBIs). MBIs represent the new frontier of public policy given the various benefits they entail with respect to traditional forms of regulations[3]. MBIs have the advantage of guaranteeing effectiveness, cost efficiency and dynamic efficiency at the same time.

The focus of the analysis has been the Italian case study, since it presents a quite long-asting and differentiated use of MBIs, so that it can furnish relevant insights on the possibility of extending their application to the European scale and, concurrently, the need to find better internal functioning and coherence. The analysis has pointed out the likely failure to reach several of the expected targets, so that, notwithstanding the recent employment of tradable certificates and feed-in tariffs, Italy is expected to rely on a wide package and mixture of different instruments to attain its objectives.

[1] The subsidy is not granted if a plant has already received an initial public investment greater than 20% of its capital costs, and it is not compatible with TGCs.

[2] By June 2008, 40% of the plants qualified under the TGCs scheme were not operative, with a much higher share (60%) if estimated productivity is taken into account (GSE, 2008c).

[3] In the past renewable energy policies were mainly based on command and control measures in the form of uniform technology standards. In order to comply with the standards, the obliged participants had to rely on certain technologies, without having any incentive to go over and above the regulation. Market based instruments have the advantage of guaranteeing effectiveness, cost efficiency and dynamic efficiency at the same time. Economic instruments based on price signals are, in fact, able to create flexibility and incentives that result in the least cost pattern of development, and in the long run, they have the potential to boost technological innovation because of the continuous pressure they exert on firms to look for the cheapest solution. However, the way these instruments have been implemented in reality has sometimes hampered the concrete realization of their expected benefits. Their effectiveness in delivering the expected results crucially depends on a number of factors such as: the actual technical-economic potential, the number of actors involved in the market, their variety in terms of technological options as well as costs, the degree of complexity of the rules shaping the mechanism, and last but not least, the effective functioning of a genuine market in the case of tradable certificates.

A critical part could be played by energy taxation. As suggested by the EU Directive 2003/96/EC[1], energy taxation should be higher than the EU minimum and more importantly, more related to the environmental damage involved with energy production and consumption. The inclusion of all the relevant externalities to establish the true costs of energy use would help provide the correct price signals all over Europe and prompt the adoption of renewable alternatives.

In Italy feed-in tariffs have been used together with TGCs. With feed-in tariff systems, the premium price recognized for different technologies proved to be higher than what was necessary, creating extra profits for the involved actors and an excessive burden for final consumers. In order to overcome these problems, the regulatory authority should continuously adjust the level of the premium according to the costs of implementation of the different technologies. Feed-in tariffs should be limited in time or at least related to some level of maturity or market penetration of a certain technology, as it is currently done in Germany.

In the case of CIP/6 a major problem regards the role taken by the so-called "equivalent sources". Their inclusion into the scheme created a situation, where most of the incentives were devoted to non-RES plants. Thanks to the recent Law #99/09, the plants relying on "equivalent sources" can opt for the cancellation of their CIP/6 convention[2]; this resolution is expected to bring about a considerable reduction in the tariff burden on final consumers[3].

Feed-in tariffs create equity problems. The costs used to cover the regulated price for RES are put on a specific entry of the bills for final consumers creating a price increase. The energy consumption is not always proportional to the level of income, but the tariff component is set at the same level for all the consumers irrespective of their income or welfare condition. This weakness has sometimes supported the idea that it could be better to relate the incentive (or at least part of it) for renewable energy to the general fiscal policy, delinking its value from the energy bill.

TGCs have been introduced with the aim of developing an instrument able to guarantee effectiveness, efficiency and flexibility, and overcome the pitfalls encountered with feed-in tariff systems. However, TGCs schemes are not free of limitations. A mechanism ruled by market forces is traditionally more exposed to price fluctuation compared to a feed-in tariff system, where the premium price is normally established well in advance at the beginning of a certain commitment period.

In order to provide the investors with more certainty, at least with respect to the time frames, targets should be defined in advance with respect to their deadlines. Italy instead failed in the attainment of this objective by continuously changing its targets and the rules shaping the entire mechanism.

The TGCs system is still far from being based on a correct market platform. The role played by the GSE and the link between TGCs and CIP/6 feed-in tariffs creates an implicit ceiling to the TGC's price. Renewable technologies are at different stages of development and this situation, coupled with the price fluctuation typical of market mechanisms, induced the investors to prefer technologies with higher margins of profitability and short-run investments returns. The general reform carried out in 2007 tried to contain these negative effects by introducing corrective factors for the less developed technologies and a mechanism of price indexation to reduce the price volatility. However, concrete actions still have to be taken to prompt the diffusion of renewable technologies such as wind[4] or biomass that represent the renewable sources with the highest potential of clean production.

Given the quite recent adoption of economic instruments such as TGCs and feed-in tariffs, it is difficult to infer the relative effectiveness of the various supporting mechanisms. They have pros and cons and the success of each supporting mechanism crucially depends on the political and economic context and on the ability of the actors involved (Ringel, 2006). As a general remark, feed-in tariffs give the investors more certainty about their returns, and, therefore, should be employed in the case of renewable technologies applied at the level of final consumption. This is in fact the strategy adopted in Italy in the case of photovoltaic cells and thermodynamic solar plants. TGCs, instead, are much more sensitive to price variability and for this reason more suitable for big investors that can easily benefit from a mechanism based on market forces.

In the near future the environmental and economic results of the implemented market mechanisms will provide evidence on the effectiveness of the policy mix implemented. The experience gained in these first years of implementation already suggests improvements and amendments that could better solve climate change problems.

[1] Council Directive 2003/96/EC of October 27, 2003 restructuring the Community framework for the taxation of energy products and electricity (2003) O.J. L 283, P. 0051-0070.

[2] In this case, the so-called "equivalent sources" would benefit from a reimbursement, whose value would be inferior to what they would earn otherwise.

[3] There is, nevertheless, the possibility for the tariff burden to rise given that plants producing energy from garbage but not yet operative have been admitted to the scheme to face the garbage emergency in the South of Italy.

[4] Its potential would cover about 50% of the whole target for 2020 (GSE, 2009).

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