



# D5.1 Final Cogeneration Roadmap

## Pilot Member State: **ITALY**

**July 2014**

Leading CODE2 Partner: **FAST – Federazione delle associazioni scientifiche e tecniche**

*Italy is part of non-pilot Member States of the South-West CODE2 Region.  
The CODE2 Region 'South-West' comprises the following Member States:  
France, Italy, Malta, Portugal, Spain*



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## Introduction

### **The CODE2 project<sup>1</sup>**

This roadmap has been developed in the frame of the CODE2 project, which is co-funded by the European Commission (Intelligent Energy Europe – IEE) and is part of an important market consultation for developing 27 National Cogeneration Roadmaps and one European Cogeneration Roadmap. These roadmaps are built on the experience of the previous CODE project ([www.code-project.eu](http://www.code-project.eu)) and in close interaction with the policy-makers, industry and civil society through research and workshops.

The input of all experts has informed these roadmaps. The content of the roadmaps and opinions expressed reflect the conclusions of the CODE2 project only.

The project aims to provide a better understanding of key markets, policy interactions around cogeneration and acceleration of cogeneration penetration into industry. By adding a bio-energy CHP and micro-CHP analysis to the Member State projections for cogeneration to 2020, the project consortium is proposing a concrete route to realise Europe's cogeneration potential.

### **Roadmap methodology**

This roadmap for CHP in Italy is written by CODE2 partner FAST – Federazione delle associazioni scientifiche e tecniche, based on a range of studies and consultation.

It has been developed through a process of discussion and exchange with experts.

### **Acknowledgement**

FAST and the CODE2 team would like to thank all experts and policy-makers who on different level have been asked to give their valuable contribution to this roadmap.

It has to be stressed anyway that the statements and proposals in this paper do not necessarily reflect those of the consulted experts.

### **N.B.**

The roadmap was written over the period February 2013 – May 2014. The national policy framework around CHP has continued to evolve in Italy and this should be taken into account when using the material in the roadmap.

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<sup>1</sup> For more details and other outcomes of the CODE2 project see: <http://www.code2-project.eu/>

<b>Introduction .....</b>	<b>1</b>
<b>1. Executive Summary .....</b>	<b>3</b>
<b>2. Where are we now? Background and situation of cogeneration in Italy .....</b>	<b>4</b>
2.1. Current status: Summary of currently installed cogeneration .....	4
2.2. The Italian Energy and Climate Strategy .....	7
2.2.1. Overall Energy background .....	7
2.2.2. National Energy Strategy 2013: Main Points .....	7
2.2.3. Action Plan for Energy Efficiency (PAEE 2011) .....	8
2.3. Policy development .....	13
2.3.1. Regulatory Framework for High-Efficiency Cogeneration .....	13
2.3.2. Efficiency measures for heating and cooling .....	14
2.4. Awareness .....	16
2.4.1. Key role of awareness and know-how on CHP .....	16
2.4.2. Cogeneration Awareness assessment in pilot Member States: Method .....	16
2.4.3. Role of key actors in Italy .....	16
2.5. The economics of CHP .....	18
2.6. Barriers to CHP .....	20
2.6.1. Policy Barriers .....	20
2.6.2. Economic barriers .....	21
2.6.3. Technical barriers .....	22
2.6.4. Awareness barriers .....	22
<b>3. What is possible? Cogeneration potential and market opportunities .....</b>	<b>23</b>
3.1. Potentials and market opportunities .....	23
3.2. CHP at 2020 .....	24
3.2.1. Industry .....	25
3.2.2. Residential .....	26
3.2.3. Tertiary .....	26
3.3. CHP Potential market summary updated to 2020 .....	27
3.4. EED 2012/27/EU implementation impact .....	28
<b>4. How do we arrive there? The Roadmap .....</b>	<b>30</b>
4.1. Preliminary remarks .....	30
4.2. Proposed measures .....	32
4.2.1. Setting up global vision of CHP within energy challenge .....	32
4.2.2. Stakeholders Coalition .....	33
4.2.3. Policy .....	33
4.2.4. Industrial and Tertiary sector .....	33
4.2.5. District Heating CHP .....	35
4.2.6. Micro-CHP .....	35
4.2.7. References to EED .....	36
4.3. Primary Energy Saving Potential and CO2 emissions reduction by the CHP roadmap .....	37
4.3.1. EED methodology .....	37
4.3.2. Substitution mix methodology .....	39
4.4. Overview of the roadmap .....	41
<b>Annexes .....</b>	<b>43</b>
<b>ANNEX 1 STAKEHOLDER GROUPS AWARENESS ASSESSMENT .....</b>	<b>44</b>
<b>ANNEX 2 MICRO-CHP POTENTIAL ASSESSMENT .....</b>	<b>47</b>
<b>ANNEX 3 BIO CHP POTENTIAL ASSESSMENT .....</b>	<b>48</b>
<b>ANNEX 4 CHP POTENTIAL ASSESSMENT .....</b>	<b>51</b>
<b>ANNEX 5 SOURCES AND CONTACTS .....</b>	<b>53</b>

## 1. Executive Summary

In 2012 the Cogeneration in Italy recorded a generation capacity of 13.986 MW, of which over 85% referring to large size combined cycle gas plants. To date, however, on a production of 63.070 GWh (equivalent to 27.320 GWh of electrical energy and to 33.281 GWh of useful heat) only 43,4% is attributable to high-efficiency cogeneration. The production of useful heat in cogeneration has not changed significantly during the period 2004-2012, even over time there has been a reduction in production due to a variety of factors, as legal authorization, incentives scheme, general economy environment.

Legislative aspects refer primarily to a heavier acknowledge procedures for HE CHP following the DM 04.08.2011, as well as an erosion of the real benefits of cogeneration, mainly including the ability to self-produce and a taxation of fuels always in line with that of thermal power plants. The authorization aspects mainly concern the difficulties regarding micro-cogeneration and biomass plants because of, for the former, bureaucratic tasks and taxes in line with other cogeneration plants that hinder their application and spread in small and medium-sized industrial businesses, for the latter, the introduction of quotas for the construction of production biomass plants according their size.

The "energy-intensive large-scale plants" have seen, due to the economic crisis, the decrease of the demand of useful heat, with a consequent difficulty of maintaining cogeneration plants according to the definition of high efficiency and meantime there has been a reduction of electric energy costs through a partial and modular exemption from general system burdens in favor to energy intensive industries.

This legislation has slowed down the energy efficiency process, given that the benefits are proportional to consumption, in contrast with recent European directives, like 2012/27 / EU directive, favoring a real improvement of the energy production costs.

Finally, thanks to the development of non-programmable renewable resources, in particular solar and wind, the main electric providers who had renovated the thermoelectric plants stocks with efficient combined cycle power plants, meeting a decreased electric power demand, were pushed to reduce production.

Nevertheless, thanks to the mechanism of White Certificate, the High Efficiency Cogeneration plants operations can be considered still viable and the concern regards the opportunity of investments on new plants and on remaking the older ones.

This document intends to establish an action line, that is a Roadmap technically and economically feasible, starting from the situation hereinafter described and highlighting opportunities for improving the Italian cogeneration stock in terms of plant renewal and energy efficiency.

According this plan, it is considered possible that cogenerated power production in Italy could increase by 23 TWh/a equivalent to 67,5 % up to 2030 compared to 2010 and cover the 16 % of total gross power production. It is crucial for achieving these results, that the EU-Energy Efficiency Directive is used as an inducement for reviewing the current rather defensive CHP policy. The most important drivers of CHP electricity increase up to 2030 are: higher efficiency CHP, introduction of biomass and biogas technologies and a develop of high efficient district heating. Considering the likely implementation path of such a roadmap 143 TWh/in PES and 37 million tons of CO<sub>2</sub> reductions are achievable, according EED methodology.

## 2. Where are we now? Background and situation of cogeneration in Italy

### 2.1. Current status: Summary of currently installed cogeneration

Cogeneration enables Italy, each year, to save 27-28% of fuel compared to the corresponding separate production, equalling an annual saving of around 4,5 Mtoe of primary energy.

The cogeneration is widely used in Italy. The table 1 shows the status of CHP based on the data received and approved each year by the Energy Service Agency (GSE)<sup>2</sup> and communicated to European Commission on 19.10.2011<sup>3</sup>

	electric energy		heat	fuel	CHP/tot electric energy	primary energy savings	equal to	industry	district heating
	power MW	production TWh	TWh	TWh	%	%	Mtoe	MW	MW
2004	6900	36	39	110	12	24	n.a.	6392	508
2005	7700	39	39	110	13	28	3,7	6704	996
2006	8600	49	39	130	16	28	4,5	7603	997
2007	9900	54	41	145	18	27	4,6	8744	1156
2008	9900	50	39	135	16	27	4,2	8906	994
2009	9960	48	36	127	17	27	4,1	8563	1397
2010	9852	53	37	138	18	28	4,5	8464	1388

Table 1 Cogeneration in Italy 2004-2010

The first seven columns chart the general progress made by CHP in Italy between 2004 and 2010. The marked increase of around 3.000 MW (40%) in total cogeneration output in this period reflects the policy measures taken by government in its support.

The increase in electricity production, by 47%, was also significant, in spite of a slight drop in 2008 and 2009 reflecting the beginning of the economic crisis. This tends to support the projections in the Italian Energy Efficiency Action Plan 2011<sup>4</sup>, which estimates by 2020 electricity production equal to TWh.

Fuel consumption increased by 25%, less than electricity production. This indicates that plants' average efficiency has improved. Natural gas is the most common fuel used in cogeneration in Italy, and represents at least 70% of total consumption. Renewable sources are completely missing from the CHP statistics, as these are recorded separately. Such renewable fuel based plants, which in fact are cogenerative, are not included in the table.

The last two columns go into greater detail, describing the share of Italy's cogeneration with regard to two macroeconomic activity sectors, i.e. industrial and civil. The share of the civil sector (which in reality coincides with the sector of district heating) has increased during the period, from 8% (2004) up to 16% (2010).

The table shows that the policy of providing incentives for cogeneration was effective, even though the legislative procedure was still under development during much of the period under consideration.

<sup>2</sup> Data shown in this table refer to the definition of Cogeneration before the Directive 2004/08/CE implemented in 2011

<sup>3</sup> <http://www.sviluppoeconomico.gov.it/images/stories/documenti/Relazione-cogenerazione-2011.pdf>

<sup>4</sup> Ministry of Economic Development, 'Italian Energy Efficiency Action Plan 2011

Largely as a result of this policy, more than half of Italy's cogeneration power potential, including low and high efficiency, which was estimated to be at least 17.000 MW in 2020<sup>5</sup>, has been effectively reached by 2013.

The increase, particularly evident in 2009, was mainly due to the effectiveness of the legislation granting to cogeneration plants both White Certificates and also Green Certificates in case of connection with District Heating.

Table 2 shows the technologies applied to CHP

	2007	2008	2009	2010
C.C.	5424	5386	5437	5417
G.T.	2577	2547	2553	2575
S.T.bp	821	838	646	507
S.T.fc	433	446	451	489
I.C.E.	527	636	794	789
other	118	47	79	75
total	9900	9900	9960-	9852

Table 2 Technologies applied to CHP in 2007-2010 in terms of installed MW

where the cogeneration technologies taken into account for the purposes of this report, as referred in Annex I of Directive 2012/27/UE, are as follows:

- combined cycle gas turbine with heat recovery (C.C.);
- backpressure steam turbine (S.T.bp);
- full condensing steam turbine (S.T.fc);
- gas turbine with heat recovery (G.T.);
- internal combustion engine (I.C.E.);

The following table shows the total primary energy consumed in 2011 for CHP production, according fuel type.

	2007	2008	2009	2010
Natural gas	103,0	94,7	95,0	103,0
Oil - LPG	22,5	21,1	14,5	21,9
Hard Coal - Coke	1,2	0,9	0,56	0,4
RES	0,4	0,5	0,48	0,5
Other (incl. waste)	17,9	17,8	16,46	12,2
Total	145,0	135,0	127,0	138,0

Table 3 Primary energy per fuel type in 2011 in CHP production in TWh

The Fig. 1 shows the average energy performance of each of cogeneration technology, in particular highlighting the electrical and heat performance and the first principle achieved on the field recorded for the year 2011.

<sup>5</sup> <http://www.sviluppoeconomico.gov.it/images/stories/documenti/Relazione-cogenerazione-2011.pdf>

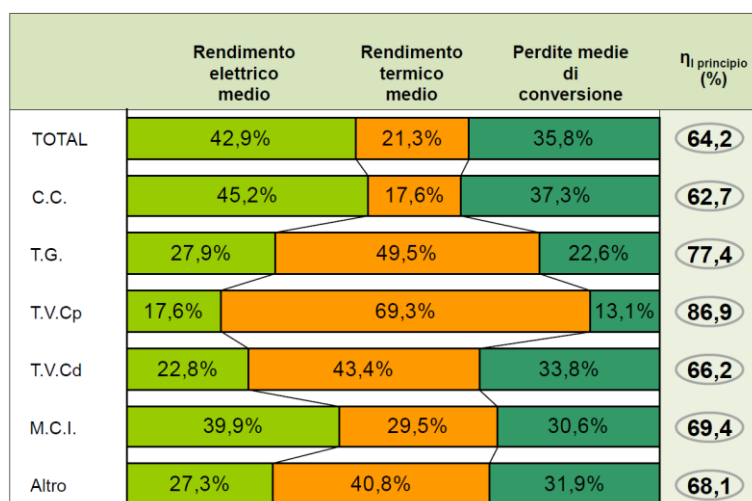


Fig. 1 Power and Heat yield according per CHP technology in 2011

### Updated and normalized values of cogeneration power and production

After 2011, following the implementation of Directive 2004/08/CE, the electricity produced under CHP has been classified as:

- "Gross" electric power: the total electricity produced in cogeneration;
- "High efficiency" electricity: cogenerated electricity that meets the criteria of Annex II of Directive 2004/8/EC;
- "Low efficiency" electricity: cogenerated electricity equal to the difference between the "Gross" and "High efficiency" electricity, in practice the electricity (electricity generated by units that do not comply with Annex II of Directive 2004 / 8/EC).

The new values are consistent with those reported in Eurostat statistics and will be adopted in in this document from here ahead.

The following table 4 shows the status of the cogeneration in the years 2010-2011-2012 with the values referring to High Efficiency Cogeneration (HE CHP) calculated according the new Directive in order to establish a link with the values in Table 1.

	CHP electricity generation, TWh	Share of CHP in total electricity generation %	CHP Electrical capacity, GW	CHP Heat production, PJ
2010	34,71	11,5	7,35	202,5
2011*	34,71	11,5	7,35	202,5
2012	35,82	12,0	7,61	203,2

Table 4 High Efficiency cogeneration in 2010-2012 period

\* in 2011 there was no data collection with the new parameters

In Italy in 2012<sup>6</sup> was registered a generation capacity from HE CHP plants equal to 7.609 MW, of which over 85% due to large size combined-cycle gas plants.

The combined-cycle gas turbines with heat recovery, in terms of electricity generation capacity installed, are in fact the most widely used technology. Confirming this, the primary energy used for the production is attributable to gas for 88,7%. By contrast, the internal combustion engines of

<sup>6</sup> [http://www.sviluppoeconomico.gov.it/images/stories/documenti/PAEE2014\\_ENEA\\_4giu\\_vers2003.pdf](http://www.sviluppoeconomico.gov.it/images/stories/documenti/PAEE2014_ENEA_4giu_vers2003.pdf)

small size, in terms of number, are the most used technology. The reduced number of steam turbines (backpressure or condensing steam) not coupled to gas turbines shows that operators are typically oriented towards cogeneration units in combined modality.

Gross production of electricity amounted to 35.817 GWh of which 43,4% of HE, while the useful heat was 203,2 PJ. Gas turbine combined cycle with heat recovery, in terms of production of electrical energy and useful thermal energy, is the most used technology and the ratio of gross electricity and useful heat for gas turbines heat recovery and steam turbines in simple structure, is significantly lower than the combined cycle gas turbine with heat recovery. The high impact of combined cycles, in terms of production of electricity and useful heat, results in an overall low value of the HE electricity over the total value.

It has been estimated for the year 2012 a total saving of primary energy equal to 1,46 Mtoe (-10.3%) due to the combined generation of electricity and heat generation compared to the separate one.

The district heating combined with CHP is present almost exclusively in the north regions, with the exception of significant plants networks installed in the regions of Tuscany and Puglia.

The analysis shows, however, that the percentage values of primary energy savings, achieved in different geographical areas, are in line with the spatial distribution of installed generation capacity.

## 2.2. The Italian Energy and Climate Strategy

### 2.2.1. Overall Energy background

In August 2012 for the first time in 24 years the MISE (Ministry of Economic Development) together with the Ministry of Environment issued a new National Energy Strategy (SEN).

The National Energy Strategy has taken into account the new EU directive 2012/17 on Energy Efficiency and recognizes the energy sector as "a key element for sustainable growth of the country".

SEN has been issued and implemented by Ital government with M.D. on 8 March .2014<sup>7</sup>

### 2.2.2. National Energy Strategy 2013: Main Points<sup>8 9</sup>

The Objectives are

- alignment with the average European price/cost of energy boosting competitiveness
- security and independence of supply
- sustainable economic growth of the energy sector and industrial services
- maintenance of standards in environment and quality

The strategy is divided into three areas of intervention identified as electrical energy, gas and oil sectors and foresees priorities encompassing energy efficiency, South-European gas hub, development of renewable sources (regarding electricity, heat and transport), domestic hydrocarbons production, electricity market and networks, fuel distillation and distribution network.

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<sup>7</sup> <http://www.sviluppoeconomico.gov.it/images/stories/normativa/decreto-8marzo2013-sen.pdf>

<sup>8</sup> Italy's National Energy Strategy: for a more competitive and sustainable energy  
[www.sviluppoeconomico.gov.it/images/stories/documenti/20121115-SEN-EN.pdf](http://www.sviluppoeconomico.gov.it/images/stories/documenti/20121115-SEN-EN.pdf)

<sup>9</sup> Marcello Capra – MISE – Nuova Strategia Energetica Nazionale

The goals for the strategy ( table 1.2) are to exceed the European target accepted for 2020

GHG reduction Mton CO2/yr			Renewable/total consumption %			Energy efficiency Primary energy consumptions Mtoe		
2005	EU target 2020	SEN target 2020	2010	EU target 2020	SEN target 2020	Inertial 2020	EU target 2020	SEN target 2020
575	472	466	10	17	20	209	167	158
	-18%	-19%		+70%	+100%		-20%	-24%

Table 5 - National Energy Strategy goals

There is a commitment for Italy to place Energy Efficiency at the core of the national energy strategy

- including specific actions:
  - reinforce standards and regulations;
  - use of White Certificates;
  - heat accounts and direct incentives;
  - fiscal deductions
- identifying the following drivers factors:
  - reinforce ESCOs (qualification process, guarantee funds and innovative contract models);
  - reinforce controls and penalties to enforce standards and regulations.
  - wide program of awareness and dissemination.

All the above measures, estimated at about 15-20 billion euro of public support cumulative up to 2020, can stimulate 50-60 billion euro total investments, with an important impact on industry.

### 2.2.3. Action Plan for Energy Efficiency (PAEE 2011)<sup>10 11</sup>

The Italian Action Plan for Energy Efficiency (PAEE) relating to the specific topic of Energy Efficiency was issued on 2011.

According the Directive 32/2006/CE on end-use energy efficiency and energy services, Italy has adopted a national indicative energy savings target of 9% for 2016 (ninth year after application of the Directive itself) as required.

The PAEE 2011 provides an assessment of the status achieved according to proposed targets, the actions to correct negative gaps and measures for improvement.

In this document all the sectors previously identified as capable of increasing Energy Efficiency have been checked and verified against the 2016 targets.

The energy savings achieved at 31.12.2011 and the indicative national targets proposed in PAEE 2011 document for 2016 are shown in Table 6.<sup>12</sup>

<sup>10</sup> PAEE Piano d'Azione Italiano per l'Efficienza Energetica

[www.efficientaenergetica.enea.it/doc/paee2011/paee2011luglio.pdf](http://www.efficientaenergetica.enea.it/doc/paee2011/paee2011luglio.pdf)

<sup>11</sup> Marcello Capra - Mise - Il nuovo Piano di Azione per l'Efficienza Energetica

<sup>12</sup> RAEE 2011 Yearly Report on Energy Efficiency - Executive Summary - 2013 ENEA

Sector	Total energy saving at 21.12.2011 GWh/y	Energy saving expected 2016 (PAEE 2011) GWh/y	Percentage of achieved objective at 31.12.2011 %
Residential	40.065	60.027	67
Tertiary	1.987	24.590	8
Industry	10.143	20.140	50
Transport	5.400	21.783	25
Total	57.595	126.540	46

Table 6. Annual energy saving, achieved in 2011 and expected at 2016

The second column of the table lists the overall energy savings at 31.12.2011. The fourth column shows the percentage achieved at 31.12.2011 with respect to the 2016 target and highlights the difficulties of obtaining the objectives set in the tertiary and transport sectors. The issues of the recent decrees "Heat Account"<sup>13</sup> and "White Certificates"<sup>14</sup> provide the means to overcome the above difficulties.

The Fig. 2 shows the effectiveness of the main instruments now in force expressed as a ratio between the value of the energy savings obtained (2007-2011) and the overall savings target of 2016 according to the interventions promoted by each measure. The effectiveness quantifies the real effect of a policy instrument and represents the difference between the situation achieved with the implementation of the measure and the case without intervention.

About 80% of the total savings is achieved by means of two measures, namely: Leg. Decree 192/05 (minimum standards of buildings energy performance) for 37% and the energy efficiency certificates also called White Certificates (WhC) for 43%, of which approx. 50% come from CHP applications.

Furthermore the measures identified to reach the 2016 targets were analysed through extrapolation to 2020, business as usual, in order to assess their contributions with respect to 20-20-20 directives.

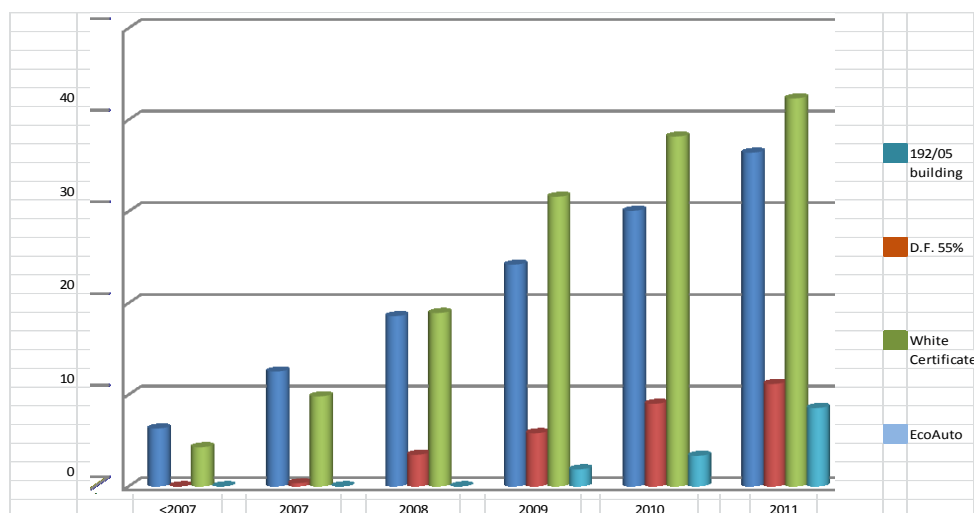


Fig. 2 Effectiveness of measures for the period 2007-2011

<sup>13</sup> Fifth Heat Account -

[www.gse.it/it/Conto%20Energia/Fotovoltaico/QuintoContoEnergia/Pagine/default.aspx/](http://www.gse.it/it/Conto%20Energia/Fotovoltaico/QuintoContoEnergia/Pagine/default.aspx/)

<sup>14</sup> Decreto 28.12.2012 "Certificati Bianchi"

[www.sviluppoeconomico.gov.it/images/stories/normativa/DM\\_Certificati\\_bianchi\\_28\\_dicembre\\_2012.pdf](http://www.sviluppoeconomico.gov.it/images/stories/normativa/DM_Certificati_bianchi_28_dicembre_2012.pdf)

The extrapolation of PAEE 2011 data to 2020 entails a final energy reduction equal to 15,9 Mtoe/y (table 7).

sector	Expected savings in 2020		CO2 reduction in
	GWh/year	Mtoe/year	Mton
Residential	77.121	6,63	18,0
Tertiary	29.698	2,55	9,45
Industry	28.678	2,47	7,20
of which from CHP	8.890	0,77	2,23
Transport	49.175	4,23	10,35
<b>total</b>	<b>184.672</b>	<b>15,88</b>	<b>45,0</b>
% over 2001-2005	14%		

Table 7 Final energy reduction expected in 2020

The set of measures identified by PAEE shows a reduction (2020) in the relative use of primary energy exceeding 15 Mtoe.

Both in the Tertiary sector and even more in the Industry sector the extra final energy reductions compared to 2016 data are a consequence of the higher energy efficiency achieved through the adoption of PAEE measures, amongst which HE cogeneration counts for approximately 23%.

This Plan updates the objectives defined in 2011 by placing PAEE for 2020 on the basis of modified objectives defined in the new National Energy Strategy. The National Energy Strategy (SEN), approved by the Inter-Ministerial Decree of 8 March 2013, directs the efforts of the country to a substantial improvement of the competitiveness of the energy system together with environmental sustainability.

In particular the new SEN aims to achieve by 2020 four main objectives:

- Reduced energy costs with the alignment of prices to European levels (national savings on utility bills for electricity and gas estimated at about € 9 bn per year);
- Overcoming the European objectives set by the European Climate and Energy Package 2020 (reduction of GHG emissions by 21% compared to 2005, 24% reduction in primary consumption with respect to BAU)
- Achievement of 19-20% incidence of renewable energy on gross final consumption);
- Greater supply security with a reduction of foreign energy bill of around € 14 billion a year;
- Boost growth and employment with the launch of investment, both in traditional sectors and in the green economy, for € 170-180 bn within 2020.

The proposed actions in the energy strategy fit the definition of process of decarbonisation by 2050 for Italy according to the scenario analyzed by the DG Energy Roadmap 2050 of the European Commission<sup>15</sup>.

To achieve these objectives, the strategy identifies seven priority areas with specific concrete measures to support. The main point is constituted by the energy efficiency that contributes at the same time to the achievement of all four objectives of the energy policy of SEN.

Energy efficiency is in fact the most economical tool to reduce CO2 emissions, with a positive return on investment for the country, to generate demand in a market where many Italian companies are active, to increase the energy security and reduce the trade deficit.

In terms of quantitative targets, the promotion of energy efficiency program for 2020 aims to:

- Save 15.5 Mtoe of final energy per year (20 Mtoe of primary energy), reaching in 2020 a level of consumption approximately 24% lower compared to the European reference scenario, based on a baseline system (Model Primes 2008);
- Avoid the emission of approximately 55 million tons of CO2 per year;
- Save around € 8 billion a year in imports of fossil fuels.

<sup>15</sup> [http://ec.europa.eu/energy/observatory/trends\\_2030/doc/trends\\_to\\_2050\\_update\\_2013.pdf](http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf)

The table 8 shows the expected savings in 2020 final and primary energy by sector and intervention measures.

Settore	measures foreseen in period 20'11-2020					final energy	primary energy
	norms standard	mobility investments	heat account	tax credit	white certificates	expected saving 2020	expected saving 2020
Housing	1,60		0,54	1,38	0,15	3,67	5,14
Tertiary	0,20		0,93		0,10	1,23	1,72
Public Admin	0,10		0,43		0,04	0,57	0,80
Private	0,10		0,50		0,06	0,66	0,92
Industry					5,10	5,10	7,14
Transport	3,43	1,97			0,10	5,50	6,05
TOTAL	5,23	1,97	1,47	1,38	5,45	15,50	20,05

Table 8 Energy Efficiency Targets at 2020 (final and primary, Mtoe/a)

### 2.2.3.1. Primary energy saving

The National Action Plan for Energy Efficiency 2011 has the target to reduce the consumption of final energy by 10,88 Mtoe/y by 2016, corresponding to a reduction of approximately 9,6% compared to the average consumption recorded in the period 2001-2005 in the non-ETS (Emission Trading Scheme) sectors. To this end, the Plan provides a series of measures and incentive mechanisms which are suitable to achieve energy savings in all areas of energy use.

These measures can be summarized as follows:

- minimum standards of performance of buildings;
- tax deductions for the refurbishment of buildings;
- mechanism Efficiency Certificates ("white certificates");
- incentive to renovate the fleet of cars and trucks up to 3,5 tons.

The savings achieved by means of these measures by 2012 was approximately 6,3 Mtoe/y in terms of final energy, corresponding to about 8,3 Mtoe/y in primary energy sources. The breakdown of savings recorded by each measure and the calculation methodology adopted are listed in the following section.

With regard to the assessment of the savings achieved in primary energy at the sectoral level shown here, the assumptions were:

- for sectors residential, tertiary and industry, it is estimated that the overall saving is for more than 20% electric and for the rest thermal ;
- in the Transport sector it is assumed that the whole saving is achieved in the form of oil products;
- the conversion factors of primary/final energy are equal to about 1,1 for oil and natural gas;
- for electric power the transformation coefficient in 2012 it was put equal to 1,86: the calculation takes into account the average efficiency of national thermoelectric stock (about 46% in 2012) and the share of electricity production from renewable sources (27% in 2012).

Regarding the contribution of the various energy sectors, nearly 60% of the savings recorded up to 2012 is attributable to the residential sector; Industry's contribution is about 30%, while limited is the contribution from transportation and tertiary sector (7% and 3% respectively).

In terms of avoided emissions, it is estimated that the measures described above have helped prevent the emission of around 20 Mt CO<sub>2</sub>/y by 2012 (based on an average emission factor of about 385 grams CO<sub>2</sub>/kWhe).

While in PAEE 2011 the reduction target was identified on the basis of a minimum percentage of savings compared to a reference value of consumption, in SEN the target is calculated as the difference between two possible evolution scenarios of the national energy system:

- The first, called Scenario without measures, represents an evolution of the system in the event of interruption of all measures of support to energy efficiency (such evolution does not recognize any of the expected savings from PAEE after 2011);
- The second scenario SEN, represents the evolution of the system with a package of Energy Efficiency measures (some already included in PAEE).

It should be noted that until 2010 the two scenarios are the same, both reflecting the effects of the measures provided in PAEE until that date.

The new target of expected reduction of fuel consumption by 2020, equal to about 20 Mtoe of primary energy, is based both on strengthening the measures and tools that already exist, and on the introduction of new mechanisms to overcome the difficulties encountered in some areas, as resulted from the monitoring.

The expected contributions of the different application sectors in 2020, in terms of primary energy are 5,14 Mtoe/y from Residential, 1,72 Mtoe/y from Tertiary, 7,14 Mtoe/y Industry and 6,5 Mtoe/y from Transport.

The same assumptions above adopted for 2012 are also valid for the calculation of primary energy savings. Exception is the coefficient of transformation primary/final energy used for electric stock equal to 1,76 (it was in fact suggested an increase in the contribution of renewable sources, 30% in 2020, and a slight increase in the average efficiency of heat power plants).

In terms of CO<sub>2</sub> emissions avoided, it is possible to estimate they amount to 50-55 Mt/y in 2020, due to the effect of the package of measures put in place (considering an average emission factor of the national electric stock of about 350 grams CO<sub>2</sub>/kWh in 2020).

### 2.2.3.2. Final energy saving

The quantitative assessment of the savings achieved in 2012 was carried out with reference to the objectives of PAEE 2011 referring to the period 2007-2016.

In particular, the following measures to improve energy efficiency have been analyzed:

- Implementation of Directive 2002/91/EC and implementation of Legislative Decree no. 192/05 with respect to the prescription of Standard Minimum Energy Performance of Buildings (SMPE): The total saving is about 2,3 Mtoe/y, mainly resulting from the replacement of heating systems in housing.
- Recognition of tax deductions (55%) for rehabilitation of existing buildings: the overall energy saving is approximately 0,8 Mtoe/y.
- Mechanism of Energy Efficiency Certificates or White Certificates: it provides energy savings of approximately 3 Mtoe/y, with an increasing contribution of the projects implemented in the industry.
- Measures to promote sustainable renewal of fleets of cars and trucks up to 3,5 tonnes (realized in 2007-2009) and implementation of the EU Regulation EC 443/2009. The overall energy savings resulting from the two measurements is more than 0,6 Mtoe/y
- Referring to what foreseen in PAEE 2011, the overall energy savings resulting from the measures analysed amounted to approx. 6,4 Mtoe/y, 58% higher than the target set out for 2016. This result comes in particular from the sectors of residential and industry: the latter is four years ahead with respect to the target set (see following table).

Tipologia	Decreto Legislativo 192/05	Certificati Bianchi	Detrazioni fiscali del 55%	Ecoincentivi e Regolamento 443/2009	Risparmio conseguito* 2005-2012	Risparmio atteso al 2016	Obiettivo raggiunto (%)
Residenziale	2,10	1,31	0,71	-	3,79	5,16	73,5%
Terziario	0,06	0,11	0,02	-	0,19	2,11	9,0%
Industria	0,15	1,57	0,04	-	1,76	1,73	101,8%
Trasporti	-	-	-	0,63	0,63	1,87	33,6%
<b>TOTALE</b>	<b>2,32</b>	<b>2,99</b>	<b>0,77</b>	<b>0,63</b>	<b>6,38</b>	<b>10,88</b>	<b>58,6%</b>

Table 9 Final energy savings in 2005-2012 and expected by 2016 according PAEE 2011 (Mtoe/y)

## 2.3. Policy development

### 2.3.1. Regulatory Framework for High-Efficiency Cogeneration

Directive 2004/8/EC of the European Parliament and of the Council the European<sup>16</sup> Parliament recognised that “cogeneration is a major technological opportunity towards fulfilling the Kyoto Protocol, making the progressive spread of high-efficiency cogeneration one of the EU's priorities”.

The Directive laid down the method, based on the total electricity produced by a specific plant, to calculate the relative share of cogeneration production, as well as determining the conditions, the share of cogeneration must meet in order to be defined as 'High-Efficiency Cogeneration' (HE CHP).

The directive, first implemented in Italy in the Legislative Decree No 20 of 8 February 2007<sup>17</sup>, introduced the Guarantee of Origin for CHP. Following this Decree, the conditions for defining CHP apply only from 31 December 2010; electricity produced prior to that date shall, however, be assessed on the basis of the previous rules [Decision No 42/2002 by the Regulatory Authority for Electricity and Gas (AEEG<sup>18</sup>)].

The Directive was implemented by the Ministry for Economic Development's Decree of 4 August 2011, issued in consultation with the Ministry for the Environment, Protection of Natural Resources and the Sea.

Italian legislation grants several benefits regarding CHP electric energy.

The main benefits are:

- Exemption from the obligation to purchase Green Certificates (an obligation imposed, in general, on electricity generated from non-renewable sources)<sup>19</sup>
- The right to priority dispatch of generated electricity
- The right to use the 'on-site exchange service' (for plants with a nominal output of no more than 200 kW)<sup>20</sup>. This service enables producers to feed excess electricity into the public grid and then to withdraw it whenever their requirements exceed their production.
- Ability to obtain energy efficiency certificates (White Certificates) equivalent to the annual primary energy savings.<sup>21</sup>
- Ability to obtain Green Certificates (only for CHP plants which are part of district heating networks and provided they fulfil requirements regarding the date of commissioning, or which are part of farming communities)<sup>22</sup>
- Simplified electricity grid connection procedure to reduce connection costs.<sup>23</sup>

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<sup>16</sup> European Parliament and Council, 2004, Directive 2004/8/EC, 'Promotion of cogeneration based on a useful heat demand in the internal energy market'.

<sup>17</sup> Legislative Decree No 20 of 8 February 2007, 'Implementation of Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC'

<sup>18</sup> Decision No 42/2002 by the Regulatory Authority for Electricity and Gas, 'Conditions for recognising combined electricity and heat production as CHP pursuant to Article 2(8) of Legislative Decree No 79 of 16 March 1999'

<sup>19</sup> Legislative Decree No 79 of 16 March 1999, 'Implementation of Directive 96/92/EC concerning common rules for the internal market in electricity'

<sup>20</sup> Decision of 3 June 2008 - ARG/elt 74/08, 'Integrated text of the modalities and the technical and economic conditions for on-site exchange'

<sup>21</sup> Ministry of Productive Activities, Decree of 20 July 2004, 'A new identification of the quantitative objectives for increasing energy efficiency in final energy use, pursuant to Article 9(1) of Legislative Decree No 79 of 16 March 1999'

<sup>22</sup> Law No 239 of 23 August 2004, 'Reorganisation of the energy sector, delegating power to the Government to rework the provisions in force concerning energy'

- Simplified authorisation procedure (only for plants with an output of less than 1 MWe, provided they are certified).<sup>24</sup>
- Special reduced tariffs regarding the transmission and distribution of the electricity produced and regarding the purchase of back-up or additional electricity.

A specific Law was introduced providing incentives to facilitate cogeneration under the White Certificate system for a minimum period of ten years. This facilitation is based on the primary energy savings associated with the high efficiency cogeneration and using values in line with similar support schemes in Europe. On the basis of these provisions, the Minister for Economic Development on 5 September 2011 issued a decree setting up a support scheme for CHP. This scheme, for plants which meet the appropriate technical and administrative conditions, is based on White Certificates equivalent to the plant's primary energy savings in a given year (calculated according to the Decree of 4 August 2011). Finally, a decree is about to be adopted at the time of writing by the Minister for Economics and Finance, in consultation with the Ministry for Economic Development, which will simplify the installation and introduction of fiscal provisions for high-efficiency micro-cogeneration plants (with an output of up to 50kW). The decree will also simplify the payment of duties and other taxes and fiscal charges.

### **2.3.2. Efficiency measures for heating and cooling**

In order to promote energy efficiency in cogeneration, the Legislative Decree no. 20/2007, issued as implementation of Directive 2004/8/EC, predicted the need for a form of direct financial support to technological interventions that respected the specific requirements in terms of primary energy savings (PES index), which are considered to operate in high efficiency cogeneration.

The Ministerial Decree of 4 August 2011 completed the transposition of the directive establishing the criteria for assessing the condition of HE HCP.

The Ministerial Decree of 5 September 2011, on the basis of the guiding principles of Legislative Decree no. 20/2007, introduced access to the White Certificates type II (CHP WhC) for technological interventions carried out on cogeneration units, according to the following criteria:

- a) for cogeneration units of new construction come into operation after 7 March 2007, the law provided for releasing HE HCP WhC for a period of 10 calendar years, with varying units number, for each reporting year, according to the primary energy savings achieved and a harmonization coefficient "K", between 1 and 1,4 in relation to the average power for electricity generation under the HE HCP. The incentive period is extended to 15 years in case of units combined with district heating network;
- b) for cogeneration units subject, with effect from 7 March 2007, to the intervention of "remake" (replacement of at least two major components with new components, in units in operation for at least 12 years) the law provided for the release of HE HCP WhC for a period of 10 years, in varying units number, for each year of reporting, based on primary energy savings achieved (the harmonization coefficient of "K" is equal to 1). The incentive period is extended to 15 years in the case of units combined with district heating network, when the intervention of reconstruction has also provided an additional transport capacity of the network, expressed in terms of toe/y, not less than 30% of the nominal transport capacity existing before the operation;
- c) for cogeneration units entered in service between 1 April 1999 and 6 March 2007, if recognized as cogeneration units under the rules applicable at the time of entry into service, incorporating the provisions of the Legislative Decree no. 28/2011, was provided

<sup>23</sup> Regulatory Authority for Electricity and Gas, Decision ARG/elt 99/08, 'Integrated text of the technical and economic conditions for connection to electricity grids with a third-party access requirement for electricity production plants

<sup>24</sup> Law No 99 of 23 July 2009, 'Provisions for the development and internationalisation of businesses, also in the field of energy

the right to issue HE CHP WhC's for a period of 5 years in a number equal to 30% of the amount recognized to the units previously mentioned .

Furthermore the DM 8 August 2012 has integrated the definition of "remake" intervention:

- 1) for works carried out from 7 March 2007, involving the installation of components of types not present in the unit prior to intervention and which alter the plant configuration, achieving a combined cycle where there was a simple cycle (consisting in a steam turbine or a gas turbine with adjoined recovery boiler) in operation for at least 12 years;
- 2) for interventions with effect from 7 March 2007 on cogeneration production units, in operation for at least 12 years, comprising a plurality of components of the same type operating in the same factory, even if installed in delocalized position with respect to the central body of the unit dedicated to the production of electricity. This provides a replacement of one or more components of gas turbine types or steam turbine with new components, provided that the power of the new components is equal to or greater than 45% of the power unit before the intervention.

White Certificates can be used to fulfil the obligation referred to MD 20 July 2004 or may be subject to exchange and bargaining. Alternatively, the operator may request the withdrawal of the White Certificates of which he is entitled. The withdrawal price shall be that in force at the time of entry into operation of the unit, constant throughout the incentive period. Only for units already in use before the Ministerial Decree of 5 September 2011, the withdrawal price is the one in force at the date of entry into force of the decree. Cogeneration units for which the operation has been recognized as HE CHP, according to Ministerial Decree of 4 August 2011 are entitled to the following additional benefits:

- exemption from the requirement to purchase Green Certificates (GC), for producers and importers of electricity with annual production and imports from non-renewable sources exceeding 100 GWh;
- priority, in the dispatching framework, in dispatching electricity produced from unit "predominantly" HCP (percentage equal to or greater than 50% of the electricity produced in HE CHP on the total electricity generated), compared to that produced by conventional sources;
- ability to access the metering service of electricity produced from HE CHP plants with power up to 200 kW;
- exemption from the payment of the general system expenses, if other requirements of Legislative Decree no. 115/2008 are fulfilled, for the purpose of recognition of "efficient system of users and equivalent systems (SEU). "

It is also provided:

- for the share of network electricity produced in HE CHP and delivered to the grid by power plants fueled with biomass, biogas and sustainable bioliquids, an increase, different according to the fuel, of the basic tariff incentives provided for by the DM 6 July 2012;
- regarding the network electricity produced in HE CHP and fed into the grid by power plants fueled with bio-methane, the acknowledgement, as per Ministerial Decree of 5 December 2013, of the approved rate for the production of electricity from biogas in DM 6 July 2012.

The DM 24 October 2005, pursuant to art. 14 of Legislative Decree no. 20/2007, rules the access to the Green Certificates (GC-DH) for units which have already received the title of "cogeneration plant coupled to the district heating network," CHP recognized as cogeneration units according to the AEEG Resolution 42/02 and subsequent amendments.

The GC-DHs are recognized for a period of 8 solar years, in varying units number for each reporting year, according to the cogenerated heat transferred to the network.

## 2.4. Awareness

**General awareness is rather wide spread but it doesn't correspond to deep knowledge able to take investment nor operations decision or to influence who can decide. Only in great industry, equipment manufacturers, ESCO's and Energy Agencies the awareness level is considered acceptable**

### 2.4.1. Key role of awareness and know-how on CHP

Sales of cogeneration to customers rely on a commercial proposition and a functioning market for the application of cogeneration. The policy intervention of the European Union to support cogeneration and assist the removal of market barriers is an important element of creating a good commercial proposition. However, alone, it will not be sufficient to grow sales of cogeneration if the customers are unaware or misinformed and lacking support within influencing groups and/or if the supply chain of skills and suppliers does not exist.

A final buying decision by a customer is the result of a set of complex interactions, involving the supplier, the supply chain and the customer. External conditions influence the process as do the market structure and the policy structure. A mature market for a product is characterized by a high degree of awareness among all the relevant players in the market and on-going buying and selling activity.

### 2.4.2. Cogeneration Awareness assessment in pilot Member States: Method

An assessment of awareness of cogeneration among key market actors has been developed. Using qualitative interview techniques with experts and market participants four groups of the socio-economic actors for cogeneration were assessed. The four groups and their subsectors are below. The list is not exhaustive but contains all the most relevant players.

- Customers: utilities (& DH), industry, potential users;
- Market and supply chain: installation companies, planners, energy consultants, architects, technology and equipment providers, banks/leasing, energy agencies;
- Policy structure: energy and climate legislators and all levels of government;
- Influencers: media, general public, academics, environment NGOs, associations.

### 2.4.3. Role of key actors in Italy

Fig. 3 lists the possible actors under each of the groups in the socio-economic model. The level of awareness was assessed for each of the and rated 1-5 , (1 poor and 5 Active market) , as below. The detailed comments on each group are described in Appendix 1.

In the **Customers** group, industries of medium and large capacity or presenting an energy intensity character have good sensitivity to energy efficiency problems and cogeneration is an acquired concept having been using CHP systems for 10 or 15 years. The same could be stated for large commercial centres and hospitals even if CHP installations are so numerous . Much less is the knowledge of CHP potential and benefits among utility and even less among households.

It is noticeable that especially within an industry there is a clear difference of awareness between operation level, management and ownership levels<sup>25</sup>.

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<sup>25</sup> Energy Efficiency Report - Novembre 2012 - Efficienza energetica in impresa - Politecnico di Milano . School of Management

Among the **Market** group actors the manufacturers of CHP systems and equipment together with ESCOs show a high level of awareness and are commercially active. Lower awareness levels are shown in order by engineering companies, consultants, grid operators and by free installers and architects. Banks knowledge is poor and where a project has to be assessed the banks make use of external resources.

In the **Influencers** group the awareness level is varied. There is lack of specialized courses in energy efficiency and especially in cogeneration even if some researchers are carrying out significant studies and researches (Universities, Enea, CNR, ISPRA, Fire). NGOs are active but without deep technical knowledge. The general public is informed especially in topics like green energy and energy saving but normally find cogeneration a less immediate concept and the general media don't fill the gap.

Within the **Policy** makers group the concept of cogeneration is well acquired and widespread especially among central and regional officers participating in international debates and congresses and involved in the adoption of the European directives. A lower level of understanding is shown by local administrators and planners. The energy agencies in contrast are out in front in the acknowledgement and adoption of CHP regulations and their integration within the actual set of norms.

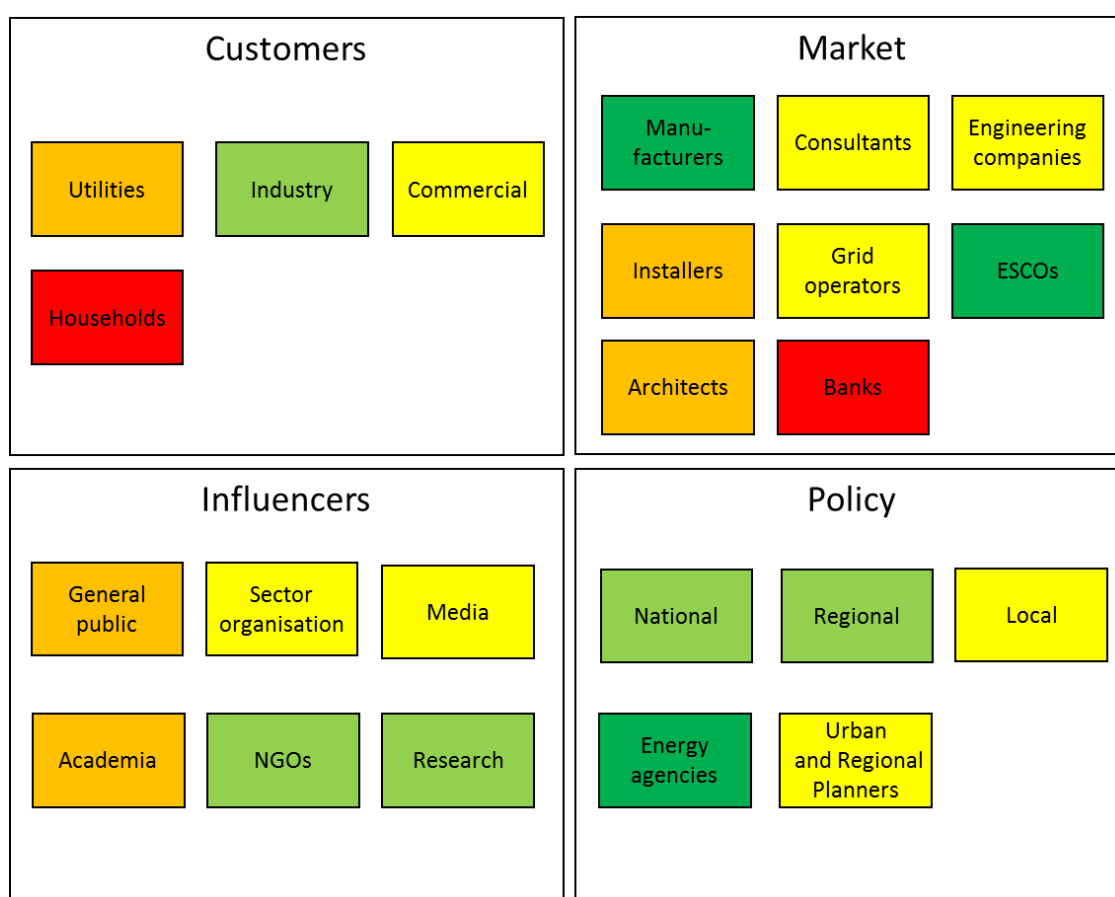


Fig. 3 Level of awareness among key actors under the 4 socio-economic groups

- |   |                 |  |
|---|-----------------|--|
| 1 | Poor            | <span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>        |
| 2 | Low             | <span style="display: inline-block; width: 15px; height: 15px; background-color: orange; border: 1px solid black;"></span>     |
| 3 | Early awareness | <span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span>     |
| 4 | Interest        | <span style="display: inline-block; width: 15px; height: 15px; background-color: lightgreen; border: 1px solid black;"></span> |
| 5 | Active market   | <span style="display: inline-block; width: 15px; height: 15px; background-color: darkgreen; border: 1px solid black;"></span>  |

## 2.5. The economics of CHP

**The actual price of gas and electricity and their ratio, even if higher than the average European level, are considered at the limit for further investments in CHP and this on the assumption that the current state incentives and favourable taxation regimes are maintained in the future.**

In general the principal element effecting the decision to invest in cogeneration is always an economic one. The economic and financial case being always more important than, the combination of other factors such as awareness and knowledge. Acknowledging that there can be other non-economic parameters of uncertainty and bureaucracy which result in unacceptable risk or timescales.

The trend of the price of electricity and of natural gas shown in the last months of 2012 continues in the first trimester of 2013 with a decrease of electricity price equal to 1,4% and a contemporaneous increase of natural gas price equal to 1,7 % (AEEG data). The gas price is affected by greater system costs: distribution, transport and storage. These costs are fixed and can become an issue in times of market contraction (-4% in 2012) on each cubic meter of gas. Prices on the internal market are generally higher by approx. 20% with respect to European price average.

This phenomenon has been hindering new investment in cogeneration in Italy for the last year, even if the ratio of the electricity/gas price is still close to 3, limit considered feasible if all tax reductions and incentives are taken into consideration for electrical energy produced in cogeneration regime.

Fig. 4 - NG and El prices- domestic plus ratio

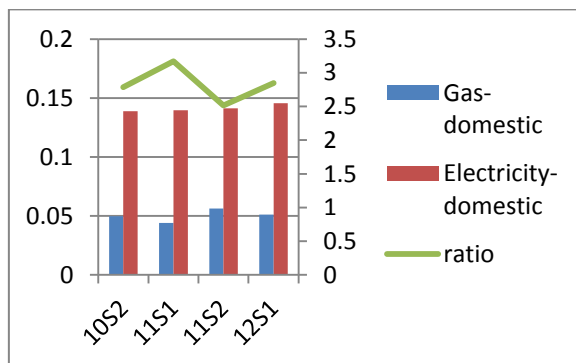
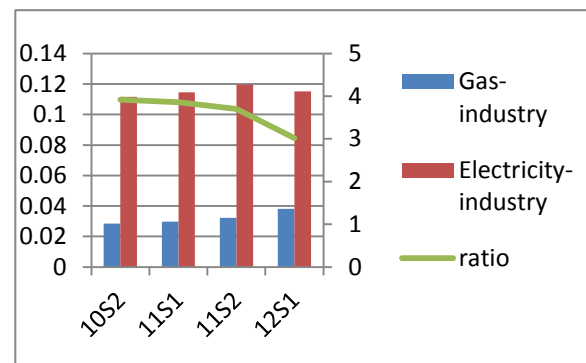


Fig. 5 - NG and El prices-industry plus ratio



For the purposes of the roadmap study and with reference to the Policy measures presented in ch. 2.3, this analysis considers the economic case of incentives/options for a proposed new High Efficiency Cogeneration plant (CHP) in Italy today. (White Certificate price fixed to 100€/WC)

- White Certificates (WhC) are worth about 12-15 €/MWh<sub>e</sub> for 10 years, for the district heating they can exceed 30 €/MWh<sub>t</sub> for 5 years (this is a market price and at time of project closing at the end of 2014 it's much higher)
- Green Certificates, if CHP is fuelled by renewable sources, leading to about 80 €/MWh<sub>e</sub> for 15 years (rules under revision)
- Fiscal reduction on gas not used for thermal purposes is about 25 €/MWh<sub>e</sub> for civil use and 2,5 €/MWh<sub>e</sub> for industrial
- feed in tariff schemes, available up to 200 kW<sub>e</sub>, is worth between 10 and 30 €/MWh<sub>e</sub>, depending on whether it refers to fossil or renewable sources
- authorization procedures made simpler
- dispatching priority

Without state incentives the payback time is 5-6 years for industry and normally investors are looking for 3-4 years of payback, so it's clear that even in the most favourable sector, industry, there is still a need for external support providing that absolute fuel prices will not increase.

With the current government incentive schemes in Italy economic conditions for cogeneration units above reported the industrial sector payback lowers to 4 years according to the fuel market price and it is on the brink of become interesting for investors. Especially if business is intermediated by ESCOs which can be charged with part of risk, projects in this particular sector are close to being economic.

This position is true for industry even for applications up to 10 MW. In contrast to the position for industry, the position for micro/nano CHP for households and the general position for the household market is economically unattractive due to high investment and maintenance costs.


Most of Italy micro/nano CHP is still considered to be at an experimental or demo stage and the installed base is still poor.


The following economic matrix presents the attractiveness of investment in the different segments given the actual incentives, regulations and power/gas prices, but let's keep in mind that a decree is enough to make colors to change toward red or green in a very short time.


Italy	Micro		Small & Medium		Large	
	up to 50kW		up to 10 MW		more than 10 MW	
	NG	RES	NG	RES	NG	RES
Industry						
District Heating						
Services						
Household						


Table 10: CHP economics matrix

**Legend:**

 **"normal"** CHP Investment has good economic benefits, return on investment acceptable for the investors, interest for new investment exists; there are no significant economic barriers for the implementation.

 **"modest"** CHP Investment has modest/limited economic benefits and return on investment, limited interest for new investments.

 **"poor"** CHP Investment has poor or negative return on investment (Z?) or is not possible due to other limitations, no interest/possibilities for new investments.

 Not applicable for the sector

NG Natural Gas or appropriate fossil fuel

RES Renewable energy sources (wood biomass, biogas, etc.)

## 2.6. Barriers to CHP

Since 2007 implementation of the EU Directives 2004/08/EC and CHP implementation of decrees D.M. 4/8/11 and 5/9/11 have strengthened the supporting policy position of CHP in Italy and an incentives framework has been put in place.

Despite this the market, whose characteristics remain substantially the same, is currently in descending phase and several non-economic and economic become relatively more important.

Here a picture is presented of the main barriers affecting the development of cogeneration in Italy.

The barriers are divided into groups according to their effects. This operation, even useful for classification purposes, is rather arbitrary, as the interdependence is everywhere strong and practically all have a legislative reference.

The categories utilized are:

- Policy
- Economic
- Technical
- Awareness

This simplifying scheme is followed both for the barriers and for the indications of the relevant measures, that will find their arrangement in the suggested Roadmap in order to overcome the actual situation.

### 2.6.1. Policy Barriers

#### **Barrier 1: Inertia and complexity of the system of laws and regulations**

The legal framework in Italy is complex and cumbersome. An exemplary case is constituted by the Cogeneration Directive 2004/8/EC which was implanted only in 2011 through various decrees (DM 04/10/11, DM 09/05/11, DM 27/10/11). The Directive 2012/27/EC on Energy Efficiency, of which was recently approved the Law Decree 102/14 of 8 July 2014 is likely to complicate the situation in the short term, making uncertain a market partially and recently stabilized after the previous directive.

Typically, the support frame and the subsidies to energy installations, and moreover in the case of cogeneration, due to its complexity, lack of clearness and contradictory aspects, results in an administrative burden for the company operators that turns to be a deterrent to consider the installation of a cogeneration plant and even any remaking.

#### **Barrier 2: Dispatching priority**

Today's regulation of the Italian electricity market (Authority Resolution No. 111/06) provides that, among the same price bids, the bids relating to renewable energy plants (programmable or not) get priority on those from CHP units (without specifying whether high efficiency or not). The fact that there is no difference between programmable and non-programmable FER is prejudicial against cogeneration that is a constant and available source and this contradicts art. 15 of EED.

### **Barrier 3: Internal consumption not SEU**

The restrictions imposed on the mechanism to be applied on SEU<sup>26</sup> (Efficient User System) provide that the holder of a cogeneration industrial plant not recognized as SEU, should pay the system costs on the entire produced electricity regardless whether self-consumed or dispatched into the network. This improper charge makes practically not economically sustainable the generation from cogeneration, which has in self-consuming one of its most important technical and economic characteristics. The same problem is even worsened by resolution 578/2013 R / EEL AEEGSI in the case of the tertiary sector, where this rule in practice inhibits the spread of cogeneration in the residential premise with multiple owners to whom the power cannot be sold.

### **Barrier 4: Energy intensive Industries**

Another example of counterproductive norm refers to the benefits in terms of taxation laid down by Directive 2003/96/EC Article 17 applied by DM 5/4/2013 on general production unit without prior investment obligation in electrical efficiency, so negating the merit of investing in HE CHP.

## **2.6.2. Economic barriers**

### **Barrier 5: Economy and finance**

The payback time on investments in CHP is often judged as too long compared to the expected returns in 2-3 years. In cogeneration a reliable assessment of savings that could be achieved in the medium term depends primarily on energy production volumes connected at its turn by useful heat demand that is a parameter ruled primarily industrial economy. In a moment when the business is in decreasing phase, like at present and realistically in the next future, it is hazardous to draw up a reliable budget.

As regards to financial resources, the Italian banks show difficulty to finance CHP project as their performance and revenues are connected to the general trend of the economy and as a matter of fact they are rather reluctant with respect to this kind of investment, both when they are directly borne by companies and when they are carried out through ESCOs.

The problem in all cases is to construct a credible model of cost and income for a new CHP project which adequately covers the associated economic and energy risks at a time when markets are changing and prices fluctuating. The involvement of ESCO to obtain the necessary financing for the intervention may not always be sufficient.

### **Barrier 6: Market and Overcapacity**

The average price of electricity has been practically steady since 2006, moving from 74,75 €/MWh to 75,48 €/MWh (+0,98), mainly due to two factors (GME sources)

- The economic crisis started in 2009 brought the consumption in 2011 equal to 334.640 GWh with a variation of – 0,8 % with respect to the reference year 2006 (Terna sources)
- Italy is self-sufficient with an installed power of 118 GW compared with a peak demand 58 GW. This oversize is due to non-proper planning and to the rapid increase of renewable sources that in 2011 counted for 23,8% of the total installed power.

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<sup>26</sup> SEU – Sistema Efficiente di Utensità - Efficient Users System

As defined by D.lgs (Legislative Decree) 30 May 2008 n°115, implementing Directive 2006/32/EC, and afterwards modified by D.lgs 23 March 2010 n°56 (modification in italic)

“Efficient users system»: system in which a power plant with nominal power not exceeding 20 MWe installed on the same site, powered by renewables or in HE cogeneration, even in the ownership of a person other than the end user, is directly connected, via a private line without the obligation to use third parties connection, to the consumption unit of a single end user (either an individual or an entity) and is realized within an area of property or in the availability of the customer”

In the meantime the average natural gas price for protected market passed from 41,71 c€/m3 to 44,73 c€/m3 (+7,24 %).

Over offer of electricity together with gas price increase is determining a severe slowdown in the installation of new cogeneration plants.

### **2.6.3. Technical barriers**

#### **Barrier 7: Complex management of White Certificates**

Although the introduction of WhC has been very decisive for the success of any energy saving intervention and still constitutes a major contribution in the development of energy saving systems towards greater Energy Efficiency, especially in case of cogeneration plants, is often required the presence of external experts to fill the necessary cards, because of the complexity of the mechanism of registration and approval of HE CHP production shares in order to call for WhCs. Furthermore changes to regulations affecting WhC and especially variation in WhC price, which should follow the market, tend to make difficult the assessment of the long-term return for investors.

#### **Barrier 8: Micro-cogeneration barriers**

Two specific difficulties are related to micro-cogeneration applications, beyond the SEU norm that is of extreme damage in this sector. One is connected to their capital costs, their times of operations and specific request of not always synchronized heat and power: this generally implies longer payback times.

The second reason resides once again resides in bad applied norm, so called "Simplifications for HE micro-generation" DM 27/10/2011, which provides a flat excise duty on the share of fuel used to produce electricity, defeating the concept itself of micro-cogeneration in residential or domestic applications and making the micro-cogeneration less competitive than other cogeneration plants, not subject of this duty,

#### **Barrier 9: District heating barrier**

District heating has suffered in recent years growth less than expected. Paradoxically measures allocated in these years to the rehabilitation of buildings has diverted large amounts of funds towards applications, normally passive, directly managed by the recipient, preferring a simple and direct support to more complex District heating projects with long payback times and strong impact infrastructure.

The uncertainty arising from a precise legal classification as a local public service or a private economic activity together with no loan guarantee funds, already provided by the DM 28/2011, are hindering the concrete investors interest.

### **2.6.4. Awareness barriers**

#### **Barrier 10: Lack of awareness and strategic focus**

The National Energy Plan SEN, even if aware of the current available resources and of the constraints of European directives, doesn't seem to be in the position of prioritizing applications and technologies, producing a poor focus on energy efficiency without giving the right importance played by CHP in this regard and hence allocating insufficient financial resources to this sector. This shows a poor awareness of the fundamental role of CHP in energy saving and CO2 reduction problems.

The interventions of policy to support CHP to remove market barriers, although important, are not enough to make CHP to grow if candidate clients don't have the basic knowledge and awareness of costs/benefits related to cogeneration technology or are scarcely informed by experts and suppliers.

### 3. What is possible? Cogeneration potential and market opportunities

The greatest contribution to the development of HE CHP, according to the model scenarios, is provided by the industrial sector (10 TWh of heat, about 68% of the total heat potential), while the residential and tertiary sectors contribute with a reduced rate (5 TWh, accounting for the remaining 32%) mainly due to the limited number of operating hours per year and variable thermal loads in the day and according to the season.

#### Potentials and market opportunities

According to Energy Efficiency Plan 2014 and Energy Efficiency Directive 27/2012, the evaluation of the national potential for high-efficiency cogeneration, district heating and cooling systems, generally "Efficient systems", is divided into two phases:

- identification of the "technical potential", that is the demand of heat and cooling that could be met through "efficient systems." To achieve this goal it is necessary to reconstruct the current and future whole demand of heat and cooling and the potential supply obtainable from "efficient systems" considering appropriate technical and geographical constraints;
- identification of the "economic potential", with the help of cost-benefit analysis that compares the current scenario updated 2011 ("reference"), including its likely evolution, with one or more alternative scenarios taking into account options relating to "efficient systems."

Based on the results of the evaluation of the national potential, measures to be taken in 2020 and 2030 will be identified in order to exploit the possible potential development of the "Efficient systems", according to costs analysis and efficiency criteria.

#### Identification of the "technical potential"

The technical potential will be identified by comparing the assessment of the global demand for heat and cooling and the availability of supply of heat, taking into account the reference scenario. In particular, will be assessed the following contributions:

- demand of heating and cooling that could be served by high-efficiency cogeneration, including residential micro-cogeneration and through district heating and cooling;
- revamping of industrial plant and of power generation plants or other facilities generating waste heat or installations of new plants;
- identification of energy efficiency potentials of district heating and cooling infrastructures.

#### Identification of the "economic potential"

A cost-benefit analysis is performed to identify the portion of the technical potential that is economically viable

The cost-benefit analysis includes the following steps:

- construction of the reference scenario within the defined geographical and system boundaries. The reference scenario describes the current situation and its likely evolution over a prefixed period of time;
- comparison between the reference scenario and alternative scenarios identified in accordance with the NPV evaluation criteria and using a discount rate determined taking into account the guidelines of European and national data provided by the European Central Bank.

The potential assessment here represented is based on the following documents

- Hypothesis of CHP development in Italy at 2020<sup>27</sup>, AEIT 2011
- Energy Efficiency Report – L'efficienza energetica in impresa: soluzioni tecnologiche, fattibilità economica e potenziale di mercato – Nov 2012
- Proceedings of mcTER conference, Milano, 29.06.2010
- EU Energy, Transport and GHG emissions trends to 2050 referee scenario2013, 16 December 2013

with reference to

- Report on Cogeneration in Italy in response to request ENER/PL/jma/pc/S-309427 by the European Commission, DG ENER 19 October 2011
- Request by the Commission for a report in accordance with Article 6(3) and Article 10(2) of Directive 2004/8/EC of the European Parliament and of the Council
- Strategia Energetica Nazionale: per un'energia più competitiva e sostenibile, Marzo 2013

### 3.1. CHP at 2020<sup>28</sup>

The hypothesis for the calculation of the potential of growth of CHP at 2020, based on macro analysis carried out in 2011, considered that the plant cogeneration follows the heat demand, which has been determined equal to total consumption of 61 Mtoe or 698 TWh for 2020. Assuming an average yield of 80% the final heat demand was fixed to 560 TWh, spread over four sectors according historic consumption data<sup>29</sup> (agriculture potential has been omitted).

sector	TWh <sub>th</sub>
Industry	306
Residential	158
Tertiary	74
Agriculture	22

Table 11 Heat demand allocation at 2020

From these data a technical potential for cogeneration has been identified for each sector on the basis of engineering and technical considerations.

An analysis was then carried out to assess the economic feasibility of the investment assuming some case studies, following the methodology above illustrated. In this way the economic potential has been calculated in absence of incentives. This methodology led to the identification of new plant capacity at 2020 as result of both technical and economic-financial considerations for each sector.

<sup>27</sup> Ipotesi di sviluppo della cogenerazione in Italia al 2020, Francesca Bazzocchi, Omar Perego (RSE SpA), Liliana Fracassi, Gabriele Susanna (GSE SpA), AEIT 2011

<sup>28</sup>

[http://www.sviluppoeconomico.gov.it/images/stories/normativa/20130314\\_Strategia\\_Energetica\\_Nazionale.pdf](http://www.sviluppoeconomico.gov.it/images/stories/normativa/20130314_Strategia_Energetica_Nazionale.pdf)

<sup>29</sup> ENEA Rapporto Energia Ambiente

### 3.1.1. Industry

The total heat demand of the industry has been divided into 12 industry sectors, through processing of historical data, later grouped into three main categories, namely small, medium and large industries, and the actual cogeneration potential has been assessed by means of further calculation assumptions.

Large industry, a category which includes chemical and petrochemical industries and part of the steel industry, is associated with no additional cogeneration potential, since it is assumed that the potential is already fully exploited. It is not excluded that some of the existing cogeneration plants can be subject to technical improvement with greater exploitation of useful heat and then some cogeneration plants, now classified as non-high performance, should become HE later.

To the medium industry (paper, glass, ceramics, building material) have been allocated 22 TWh<sub>th</sub> that can be technically produced by new CHP plants.

To the small industry (agro industrial, textile and other manufacturing industries) have been allocated 8 TWh<sub>th</sub> that can be technically produced by new CHP plants. (see table 2.2)

In order to take into account the economic aspect a Return on Investment analysis has been carried out, comparing the hypothesis of buying a new CHP system with the conservative one of maintaining a traditional boiler system, using software developed by RSE<sup>30</sup>.

The economic evaluation resulted in no opportunity to develop CHP in small industries and a good opportunity for medium industry.

A further 500 MW<sub>el</sub> has been added to the total electric power to take into consideration the biomass CHP plants.

The total energy produced by new CHP in 2020 are reported in table 12 while table 13 shows the sources distribution regarding industrial sector.

Table 12 Technical and economical CHP potential for Industry in 2008 and 2020

	heat demand 2020 TWh <sub>th</sub>	CHP 2008 TWh <sub>th</sub>	Heat Tech potential new CHP 2020 TWh <sub>th</sub>	Economic potential new CHP 2020 TW <sub>el</sub>	new bio-energy CHP 2020 TW <sub>el</sub>	total installed new CHP 2020 TW <sub>el</sub>
large industry	145	21	16			
medium industry	106	8	22	900		
small industry	55	2	8			
total	306	31	46	900	500	1400

Table 13 Total energy produced by new HEHCP by industry sector in 2020

INDUSTRY 2020		fossil fuel	bio-energy	total
Electrical production	GWh <sub>el</sub>	4600	2500	7100
Useful heat	GWh <sub>th</sub>	6670	3630	10300
Installed power	Gw <sub>el</sub>	900	500	1400

<sup>30</sup> <http://www.rse-web.it/prodotti/prodotto/128>

### 3.1.2. Residential

Two different scenarios were considered: the first concerns the large condominiums, which can install a cogeneration system to meet the heat demand of the tenants, while in the second instead are also taken into account other types of housing, considered potentially connectable to a large size CHP through a district heating network.

A special case is made by one family users which could be equipped with micro-cogenerators for self-production of electricity and heat. Given the high investment cost of these machines and their low yields, it was verified the lack of prospects in the near future in absence of economic and fiscal incentives.

Furthermore, installations in new buildings have to face the very low energy requirements of well-insulated houses, requiring the industry to develop new solutions and technologies

The analysis shows that at present, given the cost of installation of CHP, operating costs and maintenance and the values of heat and electricity produced, neither of the two scenarios can get a payback time of less than 6 years. However, if an extension up to 10 years could be considered as acceptable range of pay back time, as the investment in a cogeneration plant for community use or in a district heating system is inherently tied to long-term trends.

This change in acceptable pay back time brings to the first scenario a technical-economic potential of 20 MW<sub>el</sub> from new CHP satisfying 0,07 TWh<sub>th</sub>, and to the second scenario a technical-economic potential of 670 MW<sub>el</sub> from new HEHCP DH satisfying 2,6 TWh<sub>th</sub> of heat demand (see table 14)

RESIDENTIAL 2020	scenario 1	scenario 2	total
new electrical power installed w/o incentives (bau) MW <sub>el</sub>	20	670	690
heat demand fulfilled by new CHPHP w/o incentives (bau) TWh <sub>th</sub>	0,07	2,63	2,7
electricity produced by new CHPHP (bau) TWh <sub>el</sub>	0,05	2,33	2,38

Table 14 CHP potential for residential sector in 2020

### 3.1.3. Tertiary

With regards to the tertiary sector the heat demand at 2020 is estimated equal to 72,1 TWh<sub>th</sub>. This demand is shared among 5 sectors (hotel, community, commerce, office, sport) according to their different heat demands. The Health sector is excluded from this analysis and included in the small industry sector data as they show installed power greater than 1 MW.

The technical/economic analysis leads to a payback time (less than 9 years, payback time considered acceptable in this sector) for hotels, communities and sports centers, namely all those sectors characterized by high numbers of operating hours.

The results are reported in table 15.

TERTIARY 2020	hotel	community	commerce	offices	sport	total
new electrical power installed w/o incentives (bau) MW <sub>el</sub>	240	110	0	0	40	390
heat demand fulfilled by new CHPHP w/o incentives (bau) TWh <sub>th</sub>	1,41	0,65	0	0	0,27	2,33
electricity produced by new CHPHP (bau) TWh <sub>el</sub>	0,94	0,43	0	0	0,18	1,55

Table 15 CHP potential for tertiary sector in 2020

### 3.2. CHP Potential market summary updated to 2020

The Report Analysis of the Italian potential for the application of HE Cogeneration, transmitted to the Commission in 2009, is based on a previous version of the study above..

In the following table 16 and graphic 6 the resulting comparison is reported between the status of HE CHP in 2009 and the estimated potential in 2020, .

HE CHP		2009	2020 industry	2020 residential	2020 tertiary	2020 New total	% increase
Electric power	GW <sub>el</sub>	10	1,4	0,69	0,39	2,48	25
heat power	TW <sub>th</sub>	38	10,3	2,7	2,33	15,33	40
Electric energy	TW <sub>el</sub>	50	7,1	2,38	1,55	11,03	22

Table 16 Electric power, heat and electric energy in 2009 and 2020

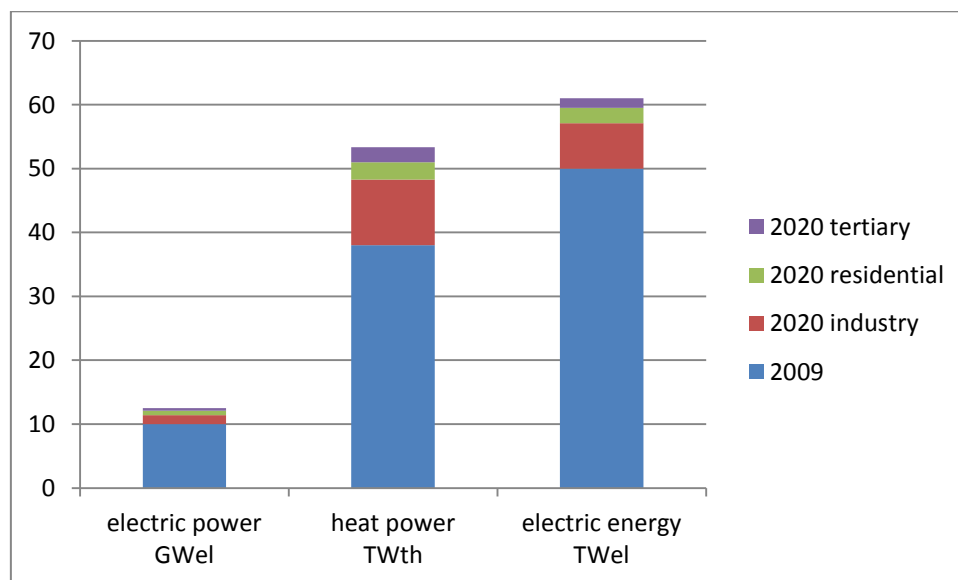


Fig 6 Electric power, heat and electric energy in 2009 and 2020

According to the assumptions, it is possible to observe that, even in the absence of specific incentives, HE CHP presents a significant potential for development, with expected increments of about 25% in terms of installed capacity and 41% of heat.

The implementation of the full CHP potential could produce a reduction in the consumption of primary energy, compared to separate production of the same amount of electricity and heat, of the order of 0,9 Mtoe.

From the figure we see that the greatest contribution to the development of HE CHP in these modelled scenarios is provided by the industrial sector (10 TWh of heat, about 68% of the total heat potential), while the residential and tertiary sectors contribute with a reduced rate (5 TWh, accounting for the remaining 32%) mainly due to the limited number of operating hours per year and variable thermal loads in the day and according to the season.

### **3.3.EED 2012/27/EU implementation impact**

The Law Decree 102/214 of 4 July 2014 implemented the Directive 2012/17/EU.

The aim of the decree is to reduce the EU's dependence on energy imports, using the tool of energy efficiency and implementing actions to provide stimulus to the economy in the current crisis and to tackle climate change. The transition to a more efficient energy will accelerate the spread of innovative technological solutions, enhancing the competitiveness of industry and contributing to boosting economic growth and creating high quality jobs in related areas. It is foreseen in particular: a 20% reduction of primary energy consumption in the EU by 2020, and further improvements in energy efficiency after 2020, through the following instruments:

- development of intervention programs for medium and long term for the rehabilitation of public and private buildings;
- yearly interventions for energy improvement in Public Administration's premises and building, starting from 2014 until 2020;
- requirement for large businesses and enterprises to perform a diagnosis of energy efficiency in sites located throughout the country, to be repeated every four years;
- obligation for operators to measure the activity of providing users with individual meters that accurately measure their actual energy consumption and that provide information on actual time of use ('smart meters');
- preparation of a report that is designed to identify the most efficient solutions to meet the needs of heating and cooling;
- overcoming the progressive structure of the electricity tariff with respect to consumption and adjustment of components to the cost of the actual service;
- three-year program of training and information to promote an efficient use of energy
- Promotion of energy performance contracts, and introduction of simplified measures to promote energy efficiency;
- establishment of a national fund for energy efficiency for the granting of guarantees or the provision of funding in favor of interventions consistent with the achievement of national targets for energy efficiency.

The legislative decree updates the national legal framework on energy efficiency, with the transposition of the directive 2012/27/UE, on the basis of the authorization contained in the law of the European delegation in 2013 (Law 96/2013). The same law (art. 4) expands the content of the legislative mandate for the implementation of the Directive by introducing a specific criterion by which the Government is also required to adopt provisions that give the Authority for Electricity and Gas to adopt one or more measures to eliminate the current progressive structure of electricity tariffs with respect to consumption.

The decree consists of 20 articles, divided into titles:

- Title 1: Aims and objectives
- Title 2: Efficiency in the use of energy
- Title 3: Efficiency in energy provision
- Title 4: Horizontal disposition
- Title 5: Final disposition

The document also consists of eight attachments:

1. Products, services and buildings regulated by communitarian legislation
2. Minimum criteria for energy audits, including those made in the context of energy management systems
3. Potential energy for heat and cooling
4. The cost-benefit analysis
5. Guarantee of origin of electricity produced from high efficiency cogeneration
6. Energy efficiency criteria for the regulation of energy networks and for the tariffs of the electricity grid
7. Energy efficiency requirements for transmission system operators and distribution system operators
8. Minimum elements to be included in energy performance contracts signed with the public sector or in the relevant tender documents

## 4. How do we arrive there? The Roadmap

Almost contemporaneously with the implementation of the Energy Efficiency Directive in Italy, occurred on 4 July 2004 with the Law Decree 102/214, this Roadmap has outlined some actions identified as possible measures to overcome the barriers previously indicated in order to realize as much as possible the cogeneration potentials calculated for 2020 and 2030, indicating also the expected Primary Energy Saving and CO<sub>2</sub> emissions reduction.

### 4.1. Preliminary remarks

This chapter is based on the considerations developed in the previous chapters, mainly those referring to the barriers and market potential, aiming to arrive to propose Roadmap that indicates a possible path to implementing CHP potential and growth in Italy.

As long as possible, a scheme similar to that applied to barriers identification is adopted to suggest the relevant measures indicating, when adaptable, the articles of the EED helping or at least affecting the implantation of the proposed measures.

The basic policy framework around CHP in Italy today sets the scene for the roadmap :

- SEN National Energy Strategy (ch. 1.2.2) and PAEE (ch. 1.2.3)
- EED Energy Efficiency Directive
- EU Energy roadmap 2050

together with the legislation acts and decrees , of which a significant excerpt is presented here:

2002 March 19 – AEEG deliberation n° 42/02
Consolidated text of the additions and changes made by resolution of 11 November 2004, n. 201/04, by resolution 29 December 2005, n. 296/05, and October 2, 2008 by resolution ARG / elt 145/08 Resolution 19 March 2002 Conditions for the approval of the combined production of electricity and heat cogeneration as defined in Article 2, paragraph 8, of the Decree of 16 March 1999, no. 79 (Resolution no. 42/02) "
2007 February 20 – Legislative Decree n° 20
Implementation of Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC "
2011 August 4 – Ministerial Decree
Implementing decree of the Legislative Decree 20/2007 Gives the new definitions of HE CHPCAR
2011 September 5 – Ministerial Decree
Implementing decree of art. 30, paragraph 11 of Law 99/2009 Defines the support mechanism HE CHP
2012 April 26 – Law n° 26
Law 26.4.2012, 44, of 2.3.2012 converting the Decree-Law no 16 on simplification of tax rules. Measures in the field of transport, sea transport, electricity, VAT warehouses, and other sectors. Article 3 bis - Excise duty on fuel used in the combined production of electricity and heat. Amendments to Legislative Decree 504/95 and subsequent amendments
Consultation documents no. 183/2013/R/EEL and 209/2013/R/EEL from AEEG on the completion of the regulatory framework in the field of electrical networks and simple systems of production and consumption
DECREE 28 december 2012 (DM Heat Account)
Incentives for the production of thermal energy from renewable sources and energy efficiency small interventions.
DM 5 April 2013
Definition of the companies energy-intensive. This decree establishes, pursuant to art. 17 of the Directive 2003/96/EC of 27 October 2003, companies with strong power consumption by implementing art. 39, paragraph 1, of Decree-Law of 22 June 2012 no. 83, converted, with amendments, by Law of 7 August 2012, n. 134. Shall be excluded from the application of this

<p>decree production companies in the thermoelectric sector.</p> <p>For the purposes of this Decree is intended:</p> <p>a) reference annuities': the calendar year for which the organization submits the declaration referred to in art. 6, paragraph 2, for inclusion in the list of companies in energy-intensive referred to in that Article. 6;</p> <p>b) PUN: the purchase price of the electricity that forms in the Italian electricity market, defined as the average of the prices determined on the day-ahead market (MGP) pursuant to art. 5, paragraph 1 of the Decree of the Minister of the productive activities 19 December 2003 on the "approval of the integrated text of the Electricity Market Rules. GSE SpA taking responsibility of the Electricity Market.</p> <p>c) energy products: the products of art. 21, paragraph 1, of the consolidated excise tax approved by the legislative decree of 26 October 1995 n. 504, as well as' other products equivalent thereto in connection with the use, in accordance with paragraphs 4 and 5 of the same Article. 21, used as fuel for heating or to power stationary motors, plant and machinery used in construction, civil engineering and public works;</p> <p>d) electricity: electricity, however, generated or acquired by the company, in the reference year to develop its own activities;</p> <p>e) energy other than electricity: energy derived from the use of energy products referred to in subparagraph c) used by the company to develop its activities, expressed in gigawatt-hours;</p> <p>f) enterprise: an economic activity organized in order to produce or exchange goods or services, as defined by art. 11, paragraph 2 of Directive 2003/96/EC; for firms belonging to corporate groups, each firm in the group.</p> <p>In this context industries "energy intensive" enjoy benefits under Art.17 of Directive 2003/96/EC in the absence of investments in energy efficiency.</p>
<p>Deliberation 3 october 2013 437/2013/R/eel</p> <p>Operating modes for the first constitution of the list of companies with high electricity consumption. The measure defines the operating procedures for the establishment and updating of the list of companies "energy-intensive", as well as the first application for gathering annual statements provided by art. 6, paragraph 3 of the Decree of the Minister of Economy and Finance, in consultation with the Minister of Economic Development, the April 5, 2013</p> <p>In this context energy intensive industries enjoy benefits under the Directive 2003/96/EC Art.17</p>
<p>Deliberation 12 December 2013 578/2013/R/EEL</p> <p>The resolution defines the mode to rule the connection services, measurement, transmission, distribution, dispatching and sale in the case of system configurations in the category of simple systems of production and consumption (SSPC), including efficient utility systems (SEU).</p> <p>Cogeneration CAR is one of the conditions to meet SEU requirements.</p>
<p>DECREE-LAW 24 June 2014, n. 91</p> <p>Urgent measures for the agricultural sector, environmental protection and energy efficiency in school and university education centers, the revival and development of enterprises, the containment of costs imposed on electricity tariffs, as well as for the definition of immediate obligations arising from the EU rules.</p> <p>Specifically, the CAR is penalized in</p> <p>ART. 23 (Reduction of electricity bills for customers supplied in medium and low voltage)</p> <p>Article 24 (Provisions relating to exemption from fees and charges of the electrical system for internal networks and efficient systems of production and consumption).</p>
<p>Decree Law 4 Julyo 2014, n. 102</p> <p>Implementation of directive 2012/27/UE energy efficiency, modifying directives 2009/125/CE and 2010/30/UEand repealing directives 2004/8/CE and 2006/32/CE.</p>

Using this legislation as the basic framework of action the Roadmap will identify actions, actors and timing, some of general nature, others specific for a certain application or problem.

The document presents measures and suggestions, well keeping in mind that CHP is only a part of the big puzzle of energy, energy efficiency and decarbonisation that the procedure has to be revised and redeveloped as a whole both technically, economically and considering the social impact.

In particular manner the Roadmap intends to propose concrete and focused measures, discussed and agreed by all the stakeholders, in order to overcome, or at least reduce, the negative effects of some barriers, especially those due to a cumbersome and plethoric legislation.

It is our opinion that, given the present economic crisis in Italy and the reduced availability of resources, any proposal should require and regard organization and regulatory initiatives, in order to get a feasible level of acceptability.

In any case we would like to put as a premise of this Roadmap a general warning regarding the implantation of the EED, based on the fact that Italy experienced a heavy delay in implementing the CHP directive 2004/8/EC. It should be noted that the transposition of the directive occurred three years later issuing the directive (Legislative Decree n°20/2007) and the implementing decree has been published only on 2011 (Ministerial Decree 4 Aug 2011).

The new Directive is coming in a just settled, complex and farraginous framework and though it brings new opportunities, there is a concrete risk that it will introduce further confusion in the sector, unless well managed taking into account a general overview on the present status of decarbonisation, energy saving and market in Italy.

The hope is that this Roadmap document will be a concrete basis to follow the right steps.

## **4.2. Proposed measures**

### **4.2.1. Setting up global vision of CHP within energy challenge**

(EED art. 3, 14, 18, 19)

In crisis periods like the present one, started in 2009, it's even more compelling, especially for policy makers, not only to have a global theory vision of the energy challenge in the country, but to put down this vision into the current situation. It must stay inside the frame of energy efficiency and renewable sources, while being able to prioritize interventions and to carry out selections focusing resources in few sectors where the possibility to maximize the results is seen, even if this operation is not free of risks.

To this regard policymakers need to recognize the importance of the role of cogeneration, beyond the main energy efficiency intrinsic characteristic, in network balancing and in obtaining emission reductions.

it is of the utmost importance, when measures are designed and supports allocated, that the advantages and impacts of the different technologies (wind, photovoltaic, cogeneration, etc.) be analyzed and compared and that the objective results from test sites be the basis of any decision.

HECHP has been clearly identified in the EED as the significant measure for improving transformation efficiency .

The European EED, that shall be adopted by Member State by June 2014, constitutes a good opportunity to carry out the task of re-launching positive actions around CHP, given its compelling force toward a more efficient way to utilize energy, provided that the switching from the former 2004/8 directive will be carried out gradually.

Italy is short of natural resources, aside from sun and in some extent biomass, but does have technology, acceptable infrastructure and an enormous reserve of energy to be recovered and saved: implementing EED can be seen as a very good opportunity to translate this resource of saved primary energy into economic growth.

As cogeneration is an important part of the EED, a global vision should be taken over in 2013/2014 on how cogeneration will contribute to energy efficiency targets where EED should be used to establish a consistent framework to achieve these targets.

#### **4.2.2. Stakeholders Coalition**

Following the global vision required to deal with the energy saving complexity using the available means indicated by the EED, CODE2 Project identifies as priority that the CHP stakeholders join their effort to constitute a Coalition, which will be entitled, thanks to its capability to represent the interests of energy organizations, manufacturers, users and services, to interact and support in primary role the appointed governmental and institutional bodies during the implementation phases of the new EED.

Tasks of the Coalition should be to:

- increase awareness on HECHP, promote dissemination and training
- assure constant information flow and form a unique feeling on common obstacles and solutions
- become a privileged channel in of discussion in front of policymakers and institutional agencies providing data, information and suggestions
- be a lobby force searching for regulations, finance and tax rules favorable to CHP expansion
- support and implement Project Roadmap to make this document to reflect members instances

#### **4.2.3. Policy**

(EED art 14, 18,19)

Despite the fact that practically all measures that could be proposed have an aspect connected with policy and recognizing that the problem is intrinsically complex as it requires time, constant political directions, constant and real will to simplify the intricate jungle of norms and acquired privileges, our opinion is that there are some organization and structural measures that policymakers can take with immediate effect.

##### **4.2.3.1. Improving permitting procedures**

(EED art. 7,12, 17, 19)

Policymakers, in strict co-operation with stakeholder representatives, should define the measures to homogenize the permitting procedures followed by different bodies (administrative, health, safety, fire) improving the certainty of the outcomes regarding applications for new energy plant installation and for restructuring works. This action shall deal with this striking case of non-economic barrier that has proven its effectiveness in discouragement and even abandon of the installation projects and investment from part of the user and the investor.

The measures are of two kinds:

- promote a standardization of procedures across the country eliminating discretionary decisions and facilitating the bureaucratic process simplifying the installation requests
- institute a unique office to apply projects and licenses.

It is important to not underestimate the importance of this point especially in the case of the development of micro-CHP in the residential market and of bio-energy utilization, where simplification is a determinant factor.

#### **4.2.4. Industrial and Tertiary sector**

##### **4.2.4.1. Revision of White Certificates calculation**

(EED art. 3, 7)

With reference to EED articles 3 and 7, it has to be mentioned that Italy created, first of all others, the White Certificates support scheme.

The mechanism has been improved introducing the “theta coefficient” that compresses the span of time in which incentives are delivered in the first years of the technical life of a plant. This helps reducing the payback time of the investment (AEEG Deliberation EEN 9/11)

As it is clear that payback time is a key parameter for investors to decide and that this parameter is becoming ever longer due to the relative decrease of electricity price compared to other sources, due at its turn to economic crisis in a vicious circle, it is of fundamental importance to facilitate investment that policymakers could start up a revision on the mechanism of attribution of WCs allowing to lower the payback time. To this regard it’s possible to make reference to a document<sup>31</sup> presented by AEEG (Autorità per l’energia elettrica e il gas) where have been proposed correction measures not yet become operative.

To exemplify, some interesting points of the document are recalled:

- raise the structural level of interventions, increasing the contribution regarding the investment
- eliminate regulation aspects that hinder projects submission
- improve the feature of WC to be a monitoring tool of the progress toward the saving targets

Though valid for small and large CHP, the White Certificates lacks of effectiveness for micro CHP because the incentives have been demonstrated insufficient to cover the investments.

#### **4.2.4.2. Free SEU identification**

(EED art 7, 15)

Actions should be taken to avoid AEEG circumscribes the “SEU” identification only to industrial users, as per consultation document 183/2013/R/EEL and 209/2013/R/EEL.

Furthermore, the one-to-others configuration should be allowed for SEU, eliminating the bond of selling power to a single end user.

#### **4.2.4.3. Strengthen the role of ESCO’s**

(EED art 18)

Important indirect action to sustain the market is definitively to strengthen the presence of ESCOs, as foreseen in the art. 18 of EED, that constitutes a key part to realize the foreseen potentials in industry, DH and commercial or community centers and explicitly welcome and supported even at normative level.

Due to the fact that ESCOs, offering the contractual guarantee of the energy performance of interventions, assume the financial risk involved in the investment, they could access to the National Funds for Energy Efficiency ( art 20 of EED) through a specific regulation.

#### **4.2.4.4. Moving resources**

(EED art 14, 20)

Moving resources from tax reduction, as recently happened with energy intensive industry (DM 5 April 2013 “Definition of energy intensive industries”) to help their competitiveness, constitutes a kind of active support to promote energy efficiency interventions, that can solve the problem in a structural way lasting in the years with positive repercussions onto economy.

This action should be taken directly by policymakers using a large strategic vision on energy market, privileging sectors who present potential characteristic of growth (see chp. 2.1) and could be also drivers of economy like in SMEs and tertiary sectors.

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<sup>31</sup> Proposte per l'aggiornamento della regolazione tecnica ed economica attuativa del meccanismo dei titoli di efficienza energetica 11.01.2011 (White Certificates updates)

#### **4.2.4.5. Financial support**

(EED art 20)

When investments are dealt with, it is very important that the attention is not uniquely pointed toward public incentive regulations, often cumbersome and slow (sometimes in Italy this sounds euphemistic) to react to the dynamics of the market.

This action could be directly performed by the Coalition of stakeholders together with Public Administration, whose utility has always to be recalled, to find out different and innovative financing support tools, like PACE<sup>32</sup> and Green Deal<sup>33</sup>, powered up in USA and in UK respectively, in practice tools which permit the intervention of private bodies and public funds for energy efficiency operations where the costs are directly recovered along the saving. Such tools are normally used for residential building and commercial centers retrofitting or micro/nanoCHP installations.

This kind of support is able to revitalize the market and give impulse to employment in much less time than governmental incentives.

A coalition of stakeholders should examine a programme like the suggested ones, adapt it to the Italian market, identify the fields and procedures more appropriate and effective, co-operate with financial institutions and find a formal support through a legal basis and a law regulation.

#### **4.2.4.6. Intervention on Public Estate**

(EED art 4, 5, 14, 20)

A specific measure relevant for buildings could be represented by investing, even through special regulation, from part of the public administration in its own facilities, as explicitly suggested in the EED (art 4, 5), also in a progressive form.

Given the enormous public estate this will

- strongly boost the market and facilitate the creation of new specialist jobs
- bring high saving figures
- become a model for other installations and become the real “case study” for its intrinsic characteristic to constitute a microcosm of the entire economy in that there is a complete range of opportunities to use CHP in office buildings, schools, leisure centers, military premises and distributed energy systems.

This operation could be carried out together with ESCOs and international financial institutions to facilitate funds raising.

#### **4.2.5. District Heating CHP**

(EED art 14)

As regards DH, municipalities should prepare heat plans especially for new residential establishment and impose them as part of the more general urbanization plan for installations greater than 20 MW, similarly as it happens today with Environmental Impact Assessment.

#### **4.2.6. Micro-CHP**

(EED art. 14, 9)

These measures should be taken:

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<sup>32</sup> Property Assessed Clean Energy Financing (PACE), see e.g.  
[http://www.ase.org/sites/default/files/PACE\\_factsheet\\_0.pdf](http://www.ase.org/sites/default/files/PACE_factsheet_0.pdf)

<sup>33</sup> <https://www.gov.uk/green-deal-energy-saving-measures/how-the-green-deal-works>

- SEU configuration must be modified to allow one-to-others connections .  
In this way power could be produced in a condominium and sold to all the tenants, allowing the micro CHP installations to develop
- DM 27 Oct 2011 should be eliminated/modified because it conflicts with Law 44/2013. The DM foresees a reduced tax allowance for the fuel share used on power generation, whereas Law 44/2012 allows all the cogeneration (included micro CHP) for a greater tax allowance (in reason of 0,22 m<sup>3</sup> for each self-produced kWh<sub>e</sub>).  
In other words, DM 27 Oct. 2012 complicated the situation for micro CHP instead of simplifying it!

#### **4.2.7. References to EED**

For sake of clarity are here recalled the headings of articles of the Energy Efficiency Directive 2012/27/EU of 25th October 2012, cited in the above proposed measures

- Article 3 states that each member state has to set indicative energy efficiency targets.
- Articles 4 & 5 promote renovation of public estate buildings not complying with minimum energy requirements
- Article 7 sets an Energy Efficiency Obligation Scheme (1.5% per year) on energy suppliers. In addition article 7 mentions training and education, including energy advisory programs, that lead to the application of energy- efficient technology or techniques.
- Article 8 require auditing and empowerment of customers.
- Article 14 and annexes require the making of heating-and-cooling plans and the requirement to build cogeneration plants above 20 MW<sub>e</sub> and a cost-benefit analysis is required as well.
- In Article 15 Demand Side Management provisions and balancing potential of HE CHP are clearly mentioned (with penalties for those hampering the development of those markets). This shall provide incentives to transmission and distribution system operators to improve the network infrastructure and to simplify and shorten authorization procedures.
- In Article 17 online tools to raise awareness on energy efficiency solutions are mentioned..
  - ESCo development is encouraged through Article 18.

### 4.3. Primary Energy Saving Potential and CO<sub>2</sub> emissions reduction by the CHP roadmap

The calculation of the Primary Energy saving (PES) and CO<sub>2</sub> emission reduction, taking into account the EED scenario and the PRIMES data referring to 2030 (where the country main indicators are reported in the reference scenario at 2013, as indicated in the DG Energy<sup>34</sup> report), has been carried out following two methodologies:

- EED methodology with reference to 2013 scenario, as indicated in the DG Energy<sup>35</sup> report and according to Annexes I and II of EED;
- Substitution methodology according the CHP Roadmap outputs (see Annex 4)

These represent two different analytic considerations which bring to not so different results. For calculation details see Annex 4.

#### 4.3.1. EED methodology

The PRIMES model is a modelling system that simulates a market equilibrium solution for energy supply and demand in the EU28 and its Member States. The model determines the equilibrium by finding the prices of each energy form such that the quantity producers find best to supply matches the quantity consumers wish to use. The market equilibrium is achieved for each time period and the simulation is dynamic over time.

The model is behavioral but also represents in an explicit and detailed way the available energy demand and supply technologies and pollution abatement technologies. This method is used at a member state level today for national reporting to the European Commission and at project level for determining if a specific CHP plant is high efficient. The system reflects considerations about market economics, industry structure, energy/environmental policies and regulation, which are conceived so as to influence market behavior of energy system agents. The modular structure of PRIMES reflects a distribution of decision making among agents that act individually about their supply, demand, combined supply and demand, and prices. The market integrating part of PRIMES subsequently simulates market clearing.

This model takes into account the following indicators:

Year	2010	2030
Main Energy System Indicators		
Population (Million)	60,34	64,49
GDP (in 000 M€10)	1.553,20	1.964,20
Gross Inl. Cons./GDP (toe/M€10)	113,00	83,60
Carbon intensity (t of CO <sub>2</sub> /toe of GIC)	2,31	1,99
Import Dependency %	83,80	70,30
Total energy-rel. and other mitigation costs (B) (in 000 M€10)	191,50	280,80
as % of GDP	12,30	14,30

Tab. 17: main compared indicators of Primes model

<sup>34</sup> [http://ec.europa.eu/energy/observatory/trends\\_2030/doc/trends\\_to\\_2050\\_update\\_2013.pdf](http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf)

<sup>35</sup> [http://ec.europa.eu/energy/observatory/trends\\_2030/doc/trends\\_to\\_2050\\_update\\_2013.pdf](http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf)

The model foresees the decoupling of the economic development from the energy consumption.

According to the model, the following gross electric energy production is derived:

Year	2010	2030
<b>Gross Electricity generation by source (in GWh) (E)</b>	298.772,00	350.221,00
Nuclear energy	-	-
Solids	39.734,00	60.029,00
Oil (including refinery gas)	21.713,00	4.896,00
Gas (including derived gases)	158.215,00	115.587,00
Biomass-waste	11.586,00	22.864,00
Hydro (pumping excluded)	51.116,00	50.983,00
Wind	9.126,00	44.223,00
Solar	1.905,00	44.408,00
Geothermal and other renewables	5.377,00	7.232,00
Other fuels (hydrogen, methanol)	-	-

Tab. 18 Electric energy production according source

An increase of electric energy production is noted mainly due to renewable sources (biomass, wind, solar) and a strong decrease of oil and gas. From these indicators a depressing effect is expected on the production from CHP plants.

In terms of installed power the thermoelectric plants are so divided:

Year	2010	2030
<b>Thermal power (MW)</b>	77.255,00	69.275,00
of which cogeneration units	8.435,00	9.915,00
of which CCS units	-	706,00
Solids fired	8.676,00	7.733,00
Gas fired	54.126,00	54.695,00
Oil fired	10.546,00	2.394,00
Biomass-waste fired	3.217,00	3.667,00
Hydrogen plants	-	-
Geothermal heat	689,00	787,00
Avg. Load factor of net power capacity (F) (%)	31,50	27,70

Tab. 19 Installation power by thermoelectric plants types

Here is noted an absolute decrease of installed power with an increase of cogeneration plants (HECHP) with respect to 2010 plants, a slight increase of power from biomass plants of about 450 MW (10% lower than data elaborated with 2011 reference scenario) and a strong decrease of oil plants. It's possible to deduct that the increase in power of HECHP is mainly connected to the substitution of gas plants and to the increase of biomass plants, that, given the actual regulations, must be of HE cogeneration type.

The main technological indicators for electric energy production indicate the following figures:

Year	2010	2030
Efficiency of gross thermal power generation (%)	37,70	42,50
% of gross electricity from CHP	11,50	16,60
% of electricity from CCS	-	2,00
Carbon free gross electricity generation (%)	26,50	48,50
nuclear	-	-
renewable energy forms	26,50	48,50

Tab. 20 Technological indicators

Under these conditions the fuels used in electric energy production are:

Year	2010	2030
<b>Gross Electricity Generation in GWhe</b>	298.718,00	350.221,00
Self-consumption and grid losses	33.042,00	36.712,00
<b>Fuel Inputs to Thermal Power Generation (ktoe)</b>	53.965,00	42.588,00
Solids	9.484,00	11.796,00
Oil (including refinery gas)	7.365,00	870,00
Gas (including derived gases)	28.966,00	18.889,00
Biomass & Waste	3.527,00	5.103,00
Geothermal heat	4.622,00	5.929,00
Hydrogen - Methanol	-	-

Tab. 21 Fuel consumption used for electric energy production

Resuming the results of the application of the calculation methodology, according to the substitution mix methodology exposed in Annex 4, the following figures of Primary Energy Saving and of CO<sub>2</sub> are obtained:

<b>Total CO2 reduction, Mio. t/a</b>	<b>-36</b>
<b>Share in total energy-related CO2 emissions</b>	<b>9%</b>
<b>Share in energy sector CO2 emissions</b>	<b>11%</b>
<b>Primary Energy Saving, TWh/a</b>	<b>-140</b>
<b>Decrease of PE, %</b>	<b>7%</b>
<b>Bio Energy Share in CHP Fuels 2030</b>	<b>24%</b>
<b>Share of modernised and replaced CHP plants in CHP power growth up to 2030</b>	<b>72%</b>

Tab. 22 PES and CO<sub>2</sub> emission reduction according EED methodology

#### 4.3.2. Substitution mix methodology

This method has been developed within the project and estimates the amount of electricity, heat and fuel which are actually replaced by additional new CHP, based on a projection of the supply base changes in the member state supply over the period.

The situation in 2030 is compared to the current status. The actual saving is particularly dependent on the efficiency increase due to upgrading both current power plants and CHP technology efficiencies. The final share of bio-energy in additional CHP has a major impact on the CO<sub>2</sub> savings. The CO<sub>2</sub> reduction achieved is due to both higher energy efficiency and fuel switching towards low carbon (switch off oil plants and switch off non high efficiency natural gas CHP plants) and non-fossil fuels (bio-fuels).

The CHP replacement and fuel switching are anticipated to be an integrated process driven by policy objectives

Resuming the results of the application of the substitution mix calculation methodology, the following figures of Primary Energy Saving and of CO<sub>2</sub> emission reduction are obtained:

<b>Total CO2 reduction, Mio. t/a</b>	<b>-37</b>
Share in total energy-related CO2 emissions	9%
Share in energy sector CO2 emissions	11%
<b>Primary Energy Saving, TWh/a</b>	<b>-143</b>
<b>Decrease of PE, %</b>	<b>7%</b>
Bio Energy Share in CHP Fuels 2030	24%
Share of modernised and replaced CHP plants in CHP power growth up to 2030	83%

Tab. 23 PES and CO2 emission reduction according substitutionmix methodology

#### 4.4. Overview of the roadmap

ACTION	REASON	STEPS	TARGET GROUP	OUTCOME	PLANNING
Setting up global vision of CHP within energy challenge	Lack of global vision on energy efficiency problems with respect to CHP role	<ul style="list-style-type: none"> <li>- Find feasible technologies</li> <li>- Compare</li> </ul>	<ul style="list-style-type: none"> <li>-policy makers</li> <li>- stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>-improve awareness of CHP</li> <li>- placement of CHP within EE panorama</li> </ul>	2014
Coalition establishment	Lack of synergy of stakeholders and low representative level	<ul style="list-style-type: none"> <li>- organize members</li> <li>- coordinate actions</li> <li>- interact with legislative bodies</li> <li>- carry out pressing actions</li> </ul>	<ul style="list-style-type: none"> <li>- stakeholders</li> </ul>	-establishment of privileged channel of discussion and comparison	2014
Improving permitting procedures	Bureaucratic procedures uncertain	<ul style="list-style-type: none"> <li>- analyse procedures one by one</li> <li>- identify new ones</li> <li>- make them compelling</li> </ul>	Policy makers Stakeholders	Homogenizing licence procedures	2015
Revision of White Certificates calculation	Electricity price is penalizing	<ul style="list-style-type: none"> <li>- reformulate WC calculation</li> <li>- simulations</li> </ul>	Policy makers	Shorten Rol Improve feasibility	2015
Free SEU identification	Remove restriction to non industrial	<ul style="list-style-type: none"> <li>- reformulate SEU</li> <li>- revise one-to others rule</li> </ul>	Policy makers	Development of market	2015
Role of ESCO	Only capitalized ESCO can afford risks of performance	<ul style="list-style-type: none"> <li>- study special rules</li> <li>- make a low design</li> </ul>	Policy makers Stakeholders (ESCO, banks)	More projects of EE will be financed	2015
Moving resources	Transform resources in development	<ul style="list-style-type: none"> <li>- change interventions on tax with active support EE projects</li> </ul>	Policymakers	Focus on energy saving instead	2015

Financial support	Difficult credit for CHP projects	<ul style="list-style-type: none"> <li>- study foreign successful cases</li> <li>- adapt to country</li> </ul>	Policy makers Stakeholders	Diversify finance	2016
Public Estate operation	Huge public estate exploitable	<ul style="list-style-type: none"> <li>- cadastre of candidate building</li> <li>- analysis of energy projects</li> <li>- tender</li> </ul>	Administrations, Esco's, banks	Develop CHP and market potential	2016
DH	Develop DH potential	<ul style="list-style-type: none"> <li>- analyse heat and power requirement</li> <li>- analyse projects</li> <li>- release licences</li> </ul>	Policy makers	Energy plan for new DH establishment	Develop DH potential
Elimination DM 27 Oct 2011	Odd treatment of Micro-CHP taxation	<ul style="list-style-type: none"> <li>- study special rules</li> <li>- make a low design</li> </ul>	Policy makers , Stake holders (ESCO, banks)	More projects of EE will be financed	2015

## **Annexes**

**Annex 1: Stakeholder group awareness assessment**






**Annex 2: Micro-CHP potential assessment**

**Annex 3: Bio-CHP potential assessment**

**Annex 4: CHP potential assessment**

**Annex 1: Sources and contacts**

## ANNEX 1 STAKEHOLDER GROUPS AWARENESS ASSESSMENT

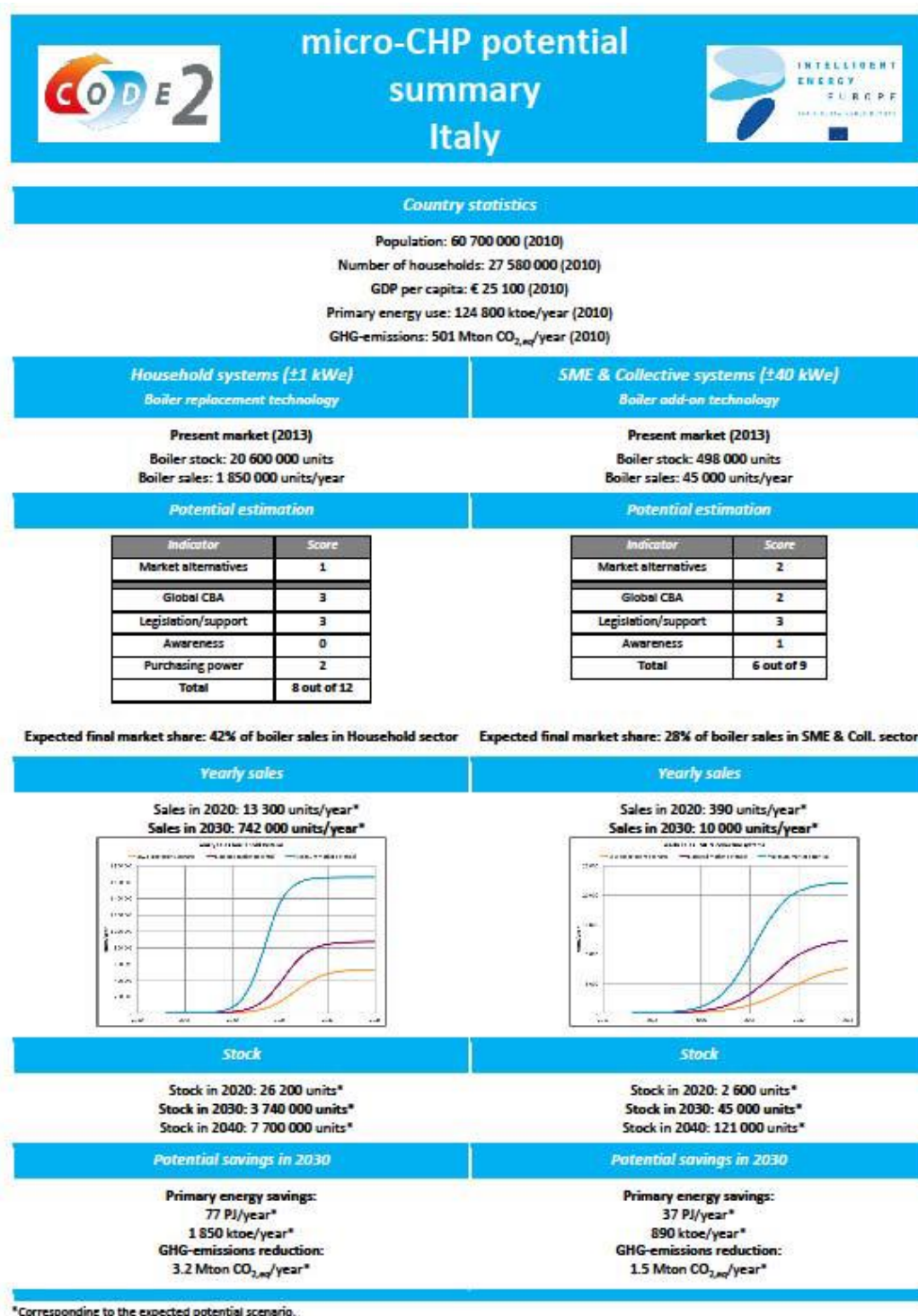
1	Poor	
2	Low	
3	Early awareness	
4	Interest	
5	Active market	

<b>Customers</b>	
Commercial centres, hotels, hospitals, households	Varied degree of awareness on CHP technology. The promotion of CHP plants is left to equipment manufacturers and ESCOs. In any case good levels of awareness are found in big concentrations, residential and touristic, commercial and hospitals. Micro-CHP expectation is high among households
Industry (paper, steel, food) and SMEs	CHP is a well-known concept in term of its potential applications. Depending on the size of the enterprise and the type of possible installation, the internal resources very rarely are in the position to translate their needs into a project without external support Industries of medium and large capacity or presenting an energy intensity character have good sensitivity to energy efficiency problems and cogeneration and normally have prepared personnel to deal with that. On the other hand SME's show minor degree of capacity to recognize problems and show minor awareness on cogeneration technology and what it can offer
Energy industry	The energy industry has understood the role and the importance of CHP and is progressively adapting and cooperating in the networks interface definition
Public administration	Low awareness on cogeneration used for heating and cooling public buildings of the central and local government due to a regulatory framework for assigning public tenders that doesn't foresee medium/long term rewards
Utilities and DH	Depending on local administration that generally is at early stages
<b>Market and supply chain</b>	
Installation companies	Normally installers, except for packaged applications, as could be for micro-CHP, are not consulted directly by clients. Clients seeking energy solutions tend to be referred by ESCOs or Engineering companies
Planners	In the presented Case Studies the role of the Planners of the Technical Office of the local Administrations has been very

	important and the relations were profitable. In general it can be stated that for works integrated into the territory the cooperation with territorial planning is fundamental while their understanding of CHP is normally functional
Energy consultants	Engineering companies or even Engineering offices dedicated to thermo-mechanic engineering project design are not very frequent but some can be found with good knowledge of CHP
Architects	CHP solutions are known only from the functional and authorization points of view
Technology and equipment providers	This category is the most aware of the importance of CHP benefits and has the skills to design and propose even integral solutions
Banks, leasing institutions	<p>The market is not yet very open to external financing cogeneration projects both for incompetent analysts and for the intrinsic difficulty, greater than in other alternative energy projects, to assess the risk and the economic profile of the investment</p> <p>Banks currently lack of structured guarantees tools from part of specific funds, including revolving, ensuring the invested capital or at least the depreciation missing in case of customers that have a medium / high profile risk.</p>
ESCOs	The involvement of ESCO's in all the aspects relating to cogeneration investments in Italy is very high. Starting from the phase of dissemination and raising of awareness during commercial contacts, to the phases of assessment of feasibility studies, design, construction, commissioning and maintenance. This relationship for many clients is a necessary condition for a positive decision on cogeneration projects. In general ESCO's are closer to clients than pure financial institutions due to fact that they offer a global vision on the job and assume part of the risk
<b>Policy structure</b>	
Policy makers	<p>The legislative activities on national and regional parliaments have been subject of strong increase in recent years as well as the presence of policy makers to public debates and congresses. In these senses there is increasing policy awareness driven by the decision to streamline and speed up the adoption process of all the European directives.</p> <p>There are several bodies and agencies, directly or indirectly related to the State, charged with operative tasks of energy market as well as gathering data for monitoring purposes, that deploy an important role concerning awareness</p>
<b>Influencers</b>	

General public	The broad public is ever more informed on topics relating to energy and, in descending order from the most popular, green energy, energy saving, energy efficiency, distributed generation, cogeneration. The last item often appears too technical and less immediate. However in the last two years it is becoming more common and particularly micro-cogeneration appears in newspaper articles, radio-television programs, web sites even non-specialized ones, felt closer to the public interests
Media	The attention paid by media on cogeneration is growing fast but always from the perspective of the wider energy efficiency frame. The focus is anyway on micro-cogeneration leaving larger cogeneration applications to the most professional magazines and media
Academia	Energy efficiency and cogeneration matters are normally included within Facility Management courses in many technical schools or within Energetics faculty in the Polytechnic universities, but it doesn't result at the moment in any specialized degree course The co-participation of the industrial and academic worlds in financed European or national projects has turned out a key factor in awareness raising
Environment NGOs	Awareness in cogeneration is good but technical knowledge is lacking. The limits imposed on local level does not help either differentiated development of skills and applications at the local level
Associations of supplying industries	The world of Associations in Italy is large and sometimes overlapping but it gives an idea of the interest in CHP and of the industrial Associations and of their level of awareness and the capability of dissemination and training they provide to their associated and to the entire community

## ANNEX 2 MICRO-CHP POTENTIAL ASSESSMENT



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## ANNEX 3 BIO CHP POTENTIAL ASSESSMENT<sup>36</sup>

In the context of the CODE2 project, a potential analysis for bio-CHP was elaborated for the EU-27 countries in aggregate and per member state.

The national bio-CHP potential analysis is based on figures from the PRIMES database, Eurostat, the National Renewable Energy Action Plan (NREAP), and the project Biomass Futures. The analysis has been discussed and, where necessary, refined in consultations with national energy experts.

The complete EU-27 analysis is found at

<http://www.code2-project.eu/wp-content/uploads/CODE2-D2.6-European-report-on-potential-of-bio-energy-CHP.pdf>

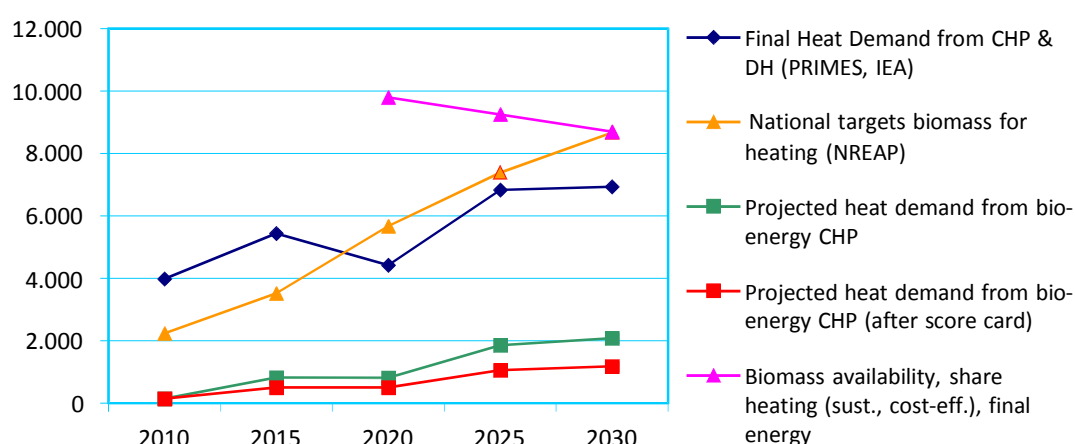


### Bio-energy CHP potential analysis Italy



Figures (projections)	2010	2020	2030
Final heat demand from CHP and DH (PRIMES, IEA), ktoe	3.984	4.424	6.930
(Projected) heat demand from bio-energy CHP and DH (after score card), ktoe	150	501	1.179
Bio-energy penetration rate in CHP markets (2009: EEA, Eurostat)	3,8% (2009)	11,3%	17,0%
Biomass availability, share heating (sust., cost-eff.), final energy (Biom. Futures), ktoe		9.796	8.693

### Bio-energy CHP potential analysis Italy



<sup>36</sup> The national bio-CHP potential analysis is based on figures from the PRIMES database, Eurostat, the National Renewable Energy Action Plan (NREAP), and the project Biomass Futures. The analysis has been discussed and, where necessary, refined in consultations with national energy experts (see Annex for the detailed bio-CHP potential analysis).



Framework Assessment (Score card)	Score	Short analysis
Legislative environment	+ 2 (of 3)	Legislation is active and decrees issued; sometimes ambiguous as approving body
Suitability of heat market for switch to bio-energy CHP	+ 2 (of 3)	Heat market increased in last years; Unknown from prices and crisis
Share of Citizens served by DH	o 1 (of 3)	Penetration poor respect to potential
National supply chain for biomass for energy	o 1 (of 3)	Availability is expected to decrease

## ANNEX 4 CHP POTENTIAL ASSESSMENT

The assessment of the potential of cogeneration is carried out according to the model developed by DG Energy "EU ENERGY, TRANSPORT AND GHG EMISSIONS TRENDS TO 2050 REFERENCE SCENARIO 2013." The scenarios are available for the EU and each of its 28 Member States simulating the energy balances and GHG emission trends for future years under current trends and policies as adopted in the Member States by spring 2012, also including those being presently implemented, as the Directive 2012/27/UE.

The basis of the model is PRIMES, that is a general purpose energy model and is conceived for designing projections to the future, scenarios building and policy impact analysis. It covers a medium to long-term horizon. Its modular structure allows for either integrating model use or for partial use. The modular structure of PRIMES reflects a distribution of decision making among agents that act individually about their supply, demand, combined supply and demand, and prices. The market integrating part of PRIMES subsequently simulates market clearing. The same model is used by the Italian Government for the evaluation of SEN (National Energy Strategy).

The Reference 2013 scenario includes all binding targets set out in EU legislation regarding development of renewable energies and reductions of greenhouse gas (GHG) emissions, as well as the latest legislation promoting energy efficiency. These assumptions together with the current statistical situation derived from the EUROSTAT energy balances represent the starting point for projections which are presented from 2015 onwards in 5 years steps until 2050.

Taking into account the technology portfolio available, energy efficiency gains in the scenarios are driven by microeconomic decisions, reflecting the market agents' aim of minimizing costs and maximizing economic benefits operating in the context of public policies that promote energy efficiency. Similarly, renewables and CHP development are driven by private economic considerations also taking into account supportive policies which are assumed to continue in the Reference scenario and gradually decrease in the longer term.

Energy efficiency improvements also occur on the energy supply side, through the promotion of investments in CHP and in distributed steam and heat networks. These investments are combined with incentives on the consumer side to shift towards heating through district heating, both in the residential and the tertiary sectors. This incurs some rebound effects, e.g. houses connected to district heating generally consume more heat than houses which use individual (non-central) heating equipment, as district heating is more cost efficient; such features are automatically integrated in this price responsive energy modeling.

In Italy the Cogeneration developed significantly in the Reference 2013 scenario, driven by the corresponding provisions of the EED. The share of gross electricity produced by CHP plants attains a level around 16,4 % throughout the period from 2025 until 2035, significantly up from 11,5% in 2010.

By 2030 the fuels used by cogeneration are distributed as follows

- Average Thermal Power Generation with CHP Fuel	Year	2030 (*)	2.010
Nuclear energy	Ktoe	0,0	0,0
Solids	Ktoe	54,1	54,1
Oil (including refinery gas)	Ktoe	870,0	4.006,8
Gas (including derived gases)	Ktoe	6.906,0	16.931,0
Biomass-waste	Ktoe	2.601,2	1.025,2
Hydro (pumping excluded)	Ktoe	0,0	0,0
Wind	Ktoe	0,0	0,0
Solar	Ktoe	0,0	0,0
Geothermal and other renewables	Ktoe	0,0	0,0
Other fuels (hydrogen, methanol)	Ktoe	431,2	1.986,1
Total	Ktoe	10.862,5	24.003,2

Can be noted the following aspects:

- there is a significant reduction in consumption, linked on one hand to the improvement of the installed generation and on the other hand to the increase in production of electricity from non-programmable renewable sources
- there is a change in the mix of technology
- the gross efficiency of CHP stock switches from 40.47% to 48.70%
- the production of the refineries is greatly reduced with the consequent abandonment of plants associated
- "Other fuels" maintain their market share.

This distribution in percentage looks like

- Average Thermal Power Generation with CHP Fuel	Year	2030 (*)	2.010
Nuclear energy	%	0,0%	0,0%
Solids	%	0,5%	0,2%
Oil (including refinery gas)	%	8,0%	16,7%
Gas (including derived gases)	%	63,6%	70,5%
Biomass-waste	%	23,9%	4,3%
Hydro (pumping excluded)	%	0,0%	0,0%
Wind	%	0,0%	0,0%
Solar	%	0,0%	0,0%
Geothermal and other renewables	%	0,0%	0,0%
Other fuels (hydrogen, methanol)	%	4,0%	8,3%
Total	%	100,0%	100,0%

It's possible to note a sharp increase in the share of CHP production using biomass passing from 4,3% to 23,9% corresponding to an absolute increase of about 1,575 ktoe.

## ANNEX 5 SOURCES AND CONTACTS

### Associations

ITALCOGEN: <http://www.anima.it/ass/italcogen>  
ASSOESCO: <http://www.assoesco.org/>  
ASSISTAL: <http://www.assistal.it/>  
CONFINDUSTRIA: <http://www.confindustria.it/>  
COGENA: <http://cogena.ascomac.it/home/home.aspx>  
CONSORZIO ITALIANO BIOGAS: <http://www.consorziobiogas.it/>  
ASSORINNOVABILI: <http://www.assorinnovabili.it/>  
ASSOELETTRICA: <http://www.assoelettrica.it/>  
FEDEUTILITY: <http://www.federutility.it/>  
AIRU: <http://www.airu.it/>  
FIRE: <http://www.fire-italia.it/>  
AIGET: <http://www.aiget.org/>  
ASSOCARTA: <http://www.assocarta.it/>  
FEDERCHIMICA: <http://www.federchimica.it/Index.aspx>  
ASSOCERAMICA: <http://www.confindustriaceramica.it/site/home.html>

### Ministries:

MINISTERO DELLO SVILUPPO ECONOMICO: <http://www.sviluppoeconomico.gov.it/>  
MINISTERO DELL'AMBIENTE: <http://www.minambiente.it/>  
MINISTERO POLITICHE AGRICOLE: <http://www.politicheagricole.it/>  
MINISTERO DELL'ECONOMIA E DELLE FINANZE: <http://www.mef.gov.it/>

### Institutions:

AUTORITA' PER L'ENERGIA: <http://www.autorita.energia.it/it/index.htm>  
GESTORE DEI SERVIZI ENERGETICI: <http://www.gse.it/it/Pages/default.aspx>  
GESTORE MERCATI ENERGETICI: <https://www.mercatoelettrico.org/it/>  
AUTORITA' PER LA CONCORRENZA: <http://www.agcm.it/>  
CTI: <http://www.cti2000.it/>  
CEI: <http://www.ceiweb.it/it/>  
UNI: <http://www.uni.com/>

### Research:

ENEA: <http://www.enea.it/it>  
RSE: <http://www.rse-web.it/home.page>  
CNR: <http://www.cnr.it/sitocnr/home.html>  
POLITECNICO DI MILANO: <http://www.polimi.it/>  
POLITECNICO DI TORINO: <http://www.polito.it/>  
UNIVERSITA' DI PADOVA: <http://www.unipd.it/>  
UNIVERSITA' DI BOLOGNA: <http://www.unibo.it/it>  
UNIVERSITA' LA SAPIENZA: <http://www.uniroma1.it/>  
UNIVERSITA' DI TOR VERGATA: <http://web.uniroma2.it/>  
POLITECNICO DI BARI: <http://www.poliba.it/it/>  
UNIVERSITA' DI NAPOLI: <http://www.unina.it/index.jsp>

## **Cogeneration manufacturing enterprises:**

AB ENERGY: <http://www.gruppoab.it/>

TURBODEN: <http://www.turboden.eu/it/home/index.php>

GENERAL ELECTRIC: <http://www.ge-energy.com/about/index.jsp>

CATERPILLAR: <http://www.caterpillar.com/en/company/corp-overview/global-issues.html>

2G ENERGY: <http://www.2-g.com/en/>

ENER-G: <http://www.energ-group.com/>

HEAT AND POWER: <http://www.heat-and-power.com/>

EDF FENICE: <http://www.edf-fenice.com/>

COFELY GDF SUEZ: <http://www.cofely-gdfsuez.it/it/chi-siamo/la-societa/cofely/cofely-italia/cofely-italia/>

SIRAM: <http://www.siram.it/>

HERA: <http://www.gruppohera.it/>

A2A: <http://www.a2a.eu/it/index.html>

BERICA IMPIANTI: <http://www.bericaimpianti.it/jspbericaimpianti/index.html>

ASJA: <http://www.asja.biz/>

ANSALDO ENERGIA: <http://www.ansaldoenergia.com/>

WARTSILA: <http://www.wartsila.com/en/Home>