# CODE2

**Cogeneration Observatory and Dissemination Europe**


# D2.3 First draft of final CHP roadmap

# ITALY

**May 2013**

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# 1. Where are we now? Background and situation of cogeneration in the member state

## 1.1. 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.

High efficiency cogeneration (here directly recalled as cogeneration) is widely used in Italy. The table 1.1 shows the status of cogeneration based on the status of applications for cogeneration received and approved each year by the Energy Regulatory Agency (GSE).

| | electric energy | | heat | fuel | CHP/tot electric energy | savings | savings | industry | district heating |
|---|---|---|---|---|---|---|---|---|---|
| | power | production | | | | | | | |
| | MW | 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 1.1 – High Efficiency Cogeneration in Italy 2004-2010

The first seven columns chart the general progress made in cogeneration 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 economic crisis. This tends to support the projections in the Italian Energy Efficiency Action Plan 2011[1] , which estimates 2020 electricity production from cogeneration plants using fossil fuels at 72 TWh.

Fuel consumption increased by25%, less than electricity production. This is proof 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 cogeneration statistics, as these are recorded separately. Such renewable fuel based plants, which in fact are cogenerative, are not be included in the table.

[1] Ministry of Economic Development, 'Italian Energy Efficiency Action Plan 2011'

The last two columns go into greater detail, describing the 'composition' 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 or to be more exact of urban heating) has increased during the period, from 8% (2004) 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.
Largely as a result of this policy more than half of Italy's potential cogeneration output, which the member state potential report of 2009 estimated to be at least 17.000 MW in 2020, has been effectively reached by 2013.
The increase, particularly evident in 2009, was mainly due to the effectiveness of the legislation (see section 1 above) granting to cogeneration plants both White Certificates and also Green Certificates in case of connection with District Heating.

## 1.2. The Italian Energy and Climate Strategy

### 1.2.1. 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".[2]
The energy starting status in 2011 shows a rather low general competitive picture

- actual cost competitiveness is low: electricity and spot gas prices higher than other European counties hinder a fair competition
- Imported primary energy was equal to 82% of total primary energy in 2010.
- the energy intensity of GDP is 22% less than the European average

### 1.2.2. New National Energy Strategy: Main Points [3 4]

- 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,

[2] The SEN was to be converted into a Decree before end of 2012 but because of the change of Government its progress at the time of writing has stopped.
[3] Italy's National Energy Strategy: for a more competitive and sustainable energy
www.sviluppoeconomico.gov.it/images/stories/documenti/20121115-SEN-EN.pdf
[4] Nuova Strategia Energetica Nazionale e la promozione dell'innovazione nel settore energetico - MISE - Marcello Capra

development of renewable sources (regarding electricity, heat and transport), domestic hydrocarbons production, electricity market and networks, fuel distillation and distribution network.

- 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 1.2 - SEN goals

- There is a commitment for Italy to place Energy Efficiency at the centre of the national energy strategy including :
  - specific actions:
    - reinforce standards and regulations;
    - use of White Certificates;
    - heat accounts and direct incentives;
    - fiscal deductions.
  - following drivers factors identified:
    - 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 to 2020, can stimulate 50-60 billion euro total investments, with an important impact on industry.

### 1.2.3. Action Plan for Energy Efficiency (PAEE) [5] [6]

Unlike SEN, the Italian Action Plan for Energy Efficiency (PAEE) relating to the specific topic of Energy Efficiency has been formally issued.

The Directive 32/2006/CE on energy efficiency of end-use and energy services, Italy has adopted a national indicative 9% energy savings targets for 2016 (ninth year of 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.

[5] PAEE *Piano d'Azione Italiano per l'Efficienza Energetica*
www.efficienzaenergetica.enea.it/doc/paee2011/paee2011luglio.pdf
[6] *Il nuovo Piano di Azione per l'Efficienza Energetica - MISE - Marcello Capra*

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 1.3[7].

| Sector | Total energy saving at 21.12.2011 | Energy saving expected 2016 (PAEE 2011) | Percentage of achieved objective at 31.12.2011 |
|---|---|---|---|
| | GWh/y | GWh/y | % |
| 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 1.3 - 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 31.12.2011 with respect to the 2016 target and highlights the difficulty of obtaining the objectives set in the tertiary and transport sectors. The issues of the recent decrees "Heat Account"[8] and "White Certificates"[9] provide the means to overcome the above difficulties.

The Fig. 1.1 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 to 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 (white certificates) for 43% of which approx. 50% come from cogeneration 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.

[7] RAEE 2011 Yearly Report on Energy Efficiency - Executive Summary - 2013 ENEA
[8] Fifth Heat Account - www.gse.it/it/Conto%20Energia/Fotovoltaico/QuintoContoEnergia/Pagine/default.aspx/
[9] *Decreto 28.12.2012 "Certificati Bianchi"*
www.sviluppoeconomico.gov.it/images/stories/normativa/DM_Certificati_bianchi_28_dicembre_2012.pdf

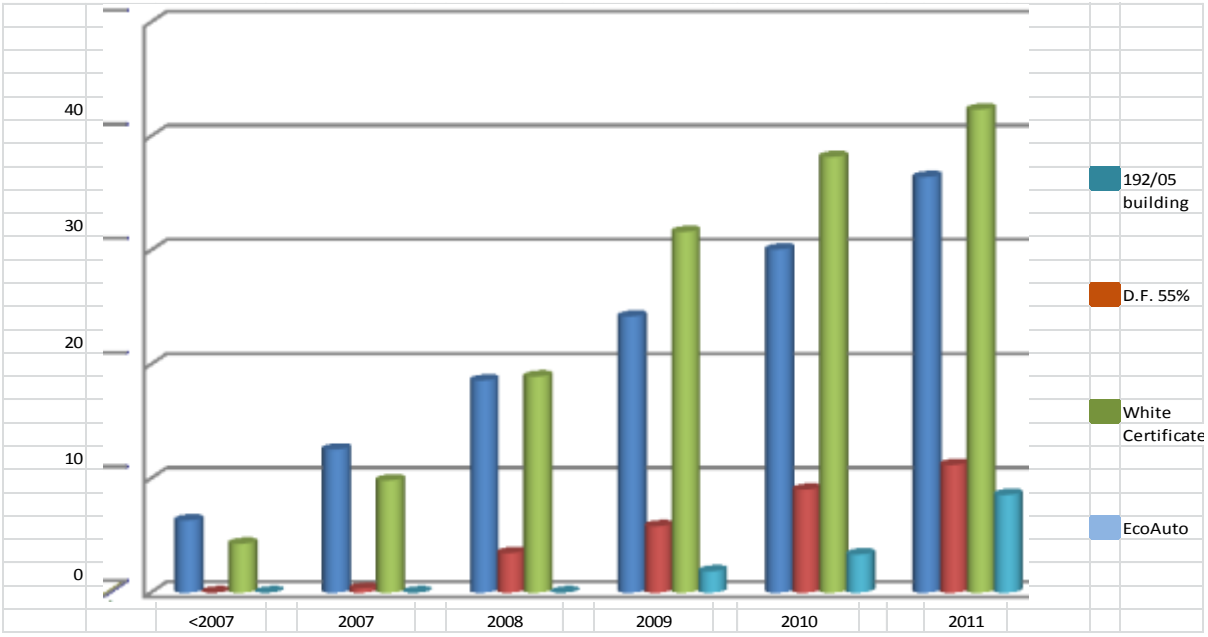



Fig. 1.1 Effectiveness of measures for the period 2007-2011

The extrapolation of PAEE 2011 data to 2020 entails a final energy reduction equal to 15,9 Mtoe/y (table 1.4)

| Sector | Expected savings in 2020 | | CO2 reduction |
|---|---|---|---|
| | 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 |
| **total** | 184.672 | 15,88 | 45,0 |
| % over 2001-2005 | 14% | | |

Table 1.4 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 mainly 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, among which CHP systems which count for approximately 23%.

## 1.3. Policy development

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

Directive 2004/8/EC of the European Parliament and of the Council the European[10] 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 this share of cogeneration must meet in order to be defined as 'High-Efficiency Cogeneration' (CHP).
The directive was first implemented in Italy in the Legislative Decree No 20 of 8 February 2007[11] which among other things brought in the guarantee of origin for CHP. Pursuant to this Decree, the conditions for defining cogeneration laid down in the Directive only apply 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[12])]. The option set out in Article 12(2) of the Directive of using other calculation methods was not used by Italian policy makers.
The Directive was implemented via 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 cogeneration electric energy.
The main benefits are:

- Exemption from the obligation to purchase Green Certificates (an obligation imposed, in general, on electricity from non-renewable sources)[13]
- The right to priority dispatch of electricity generated
- The right to use the 'on-site exchange service' (for plants with a nominal output of no more than 200 kW)[14] . 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.[15]

[10] European Parliament and Council, 2004, Directive 2004/8/EC, 'Promotion of cogeneration based on a useful heat demand in the internal energy market'.
[11] 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'
[12] 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'
[13] Legislative Decree No 79 of 16 March 1999, 'Implementation of Directive 96/92/EC concerning common rules for the internal market in electricity'
[14] Decision of 3 June 2008 - ARG/elt 74/08, 'Integrated text of the modalities and the technical and economic conditions for on-site exchange'
[15] 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'

- Ability to obtain Green Certificates (only for cogeneration 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)[16]
- Simplified electricity grid connection procedure; reduced connection costs.[17]
- Simplified authorisation procedure (only for plants with an output of less than 1 MWe, provided they are certified). [18]
- 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 for and facilitating 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 cogeneration. 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.

[16] 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'

[17] 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

[18] Law No 99 of 23 July 2009, 'Provisions for the development and internationalisation of businesses, also in the field of energy

## 1.4. Awareness

**General awareness is rather wide spread but it doesn't correspond to deep knowledge able to take decision or to influence who can decide. Only in great industry, equipment manufacturers, ESCO, Energy Agencies the awareness level is considered acceptable.**

### 1.4.1. 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 in itself it will not be sufficient to grow sales of cogeneration if the customers are unaware or misinformed and lacking support within influencing groups or, and 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.

### 1.4.2. 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.

### 1.4.3. Role of key actors

Figure 1.2 lists the possible actors under each of the groups in the socio-economic model. The level of awareness was assessed for each of the actors and rated 1-5 (1 being poor and 5 Active market), as below. The detailed comments on each group are described in Appendix 1.

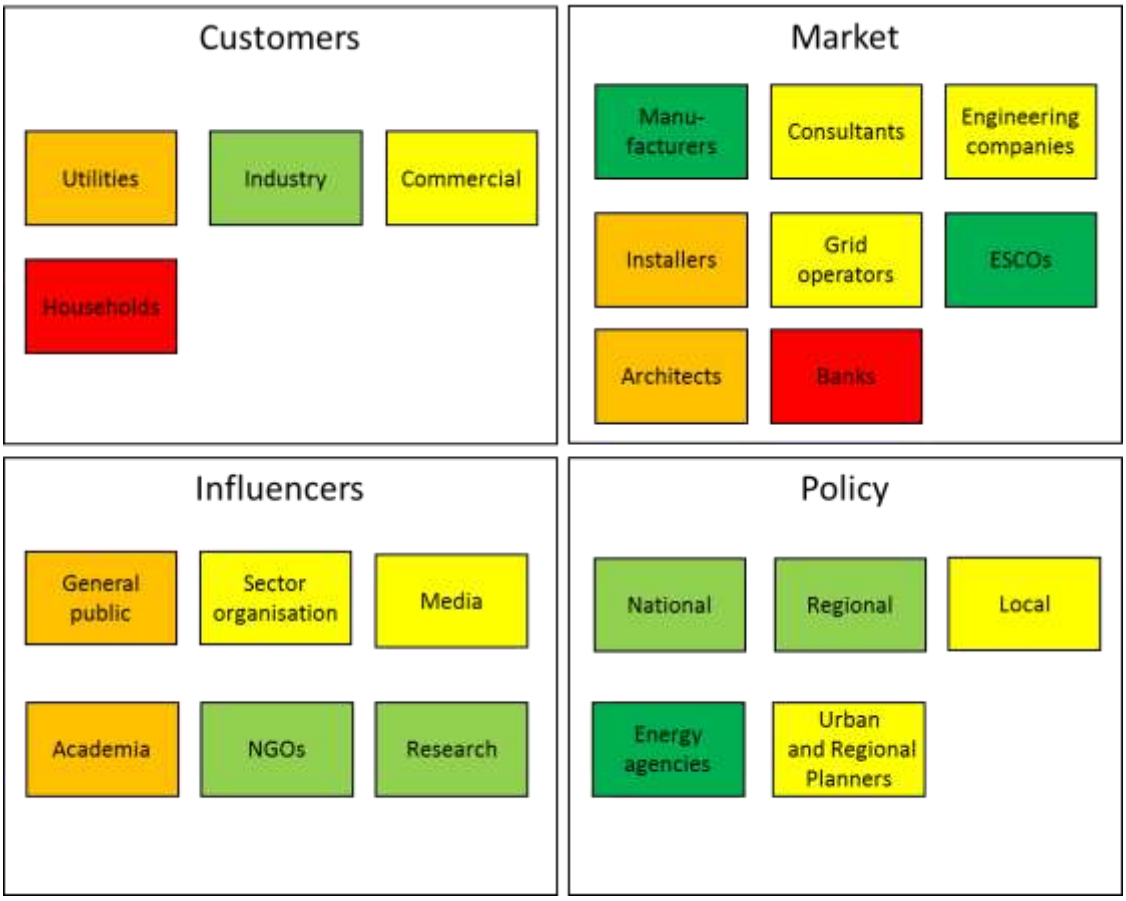



Fig. 1.2 - Level of awareness among key actors under the 4 socio-economic groups

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

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 cogeneration systems for 10 or 15 years. The same could be stated for large commercial centres and hospitals even if cogeneration installations are so numerous. Much less is the knowledge of cogeneration 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[19].

Among the **Market** group actors the manufacturers of cogeneration systems and equipment together with ESCOs show a high level of awareness and are commercially active. Lower awareness level is 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 cogeneration regulations and their integration within the actual set of norms.

## 1.5. 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 cogeneration 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 for some projects a key first condition for any project to proceed is a good economic case.

The trend of the price of electricity and of natural gas shown in the last months of 2012 is continues in the first trimester of 2013 with a decrease of electricity price equal to 1,4% and a

[19] Energy Efficiency Report - Novembre 2012 - Efficienza energetica in impresa - Politecnico di Milano . School of Management

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.

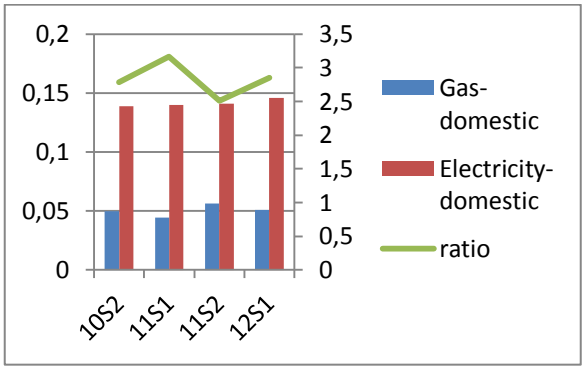



Fig. 1.3 - NG and El prices- domestic plus ratio

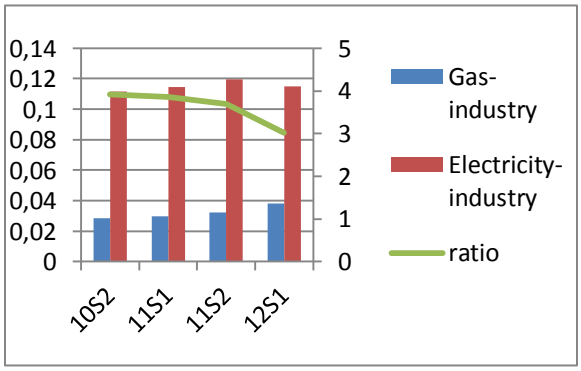



Fig. 1.4 - NG and El prices-industry plus ratio

For the purposes of the roadmap study and with reference to the Policy measures presented in paragraph 1.3, this analysis considers the economic case of incentives/options for a proposed new High Efficiency Cogeneration plant (CHP) in Italy today. (White Certificate price of 100€/WC)

- White Certificates(WC) are worth about 12-15 €/$MWh_e$ for 10 years, for the district heating they can exceed 30 € / $MWh_t$ for 5 years
- Green Certificates, if cogeneration is fuelled by renewable sources, leading to about 80 €/$MWh_e$ for 15 years (rules under revision)
- Fiscal reduction on gas not used for thermal purposes is about 25 €/$MWh_e$ for civil use and 2.5 €/$MWh_e$ for industrial and assimilated
- feed in tariff schemes, available up to 200 $kW_e$, is worth from 10 to 30 €/MWhe, 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.

In 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.

| 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 1.5 - 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.)

## 1.6. Barriers to CHP

Since 2007 implementation of the EU Directives 2004/08/EC and cogeneration implementation of decrees D.M. 4/8/11 and 5/9/11 have strengthened the supporting policy position of cogeneration in Italy and a incentives framework has been put in place and revised as necessary. Despite this the market, whose characteristics remain substantially the same, currently is moving only slowly. Despite policy makers attempts to create a level playing field for cogeneration several non-economic and economic barriers remain for cogeneration today.

### 1.6.1. Policy Barriers to the wider deployment of CHP

- There remain elements of the current energy efficiency and cogeneration policy support framework which, through their complexity, add to the administrative cost of a project and deter potential users from adopting cogeneration. This acts as a barrier to potential new cogeneration users moving out of the planning phase
- White Certificates (WC). Even if the introduction of WC has given a very important and essential contribution to develop a system of energy saving regarding all the technologies involved in the field of Energy Efficiency and mainly cogeneration plants (see paragraph 1.2.3. Action Plan for Energy Saving), WC have some aspects that constitute real barriers to cogeneration.
- Exaggerated number of different norms for specific cases together with continuous modifications constitutes a concrete difficulty of interpretation of norms and their applicability. This situation has created a situation which requires the presence of experts to assist cogeneration owners in filling the "cards" to register as HEHCP producers and to correctly calculate and attribute the request for WCs. The modifications, of the regulatory aspects of WC plus the variation of WC prices that follow market demand/offer rule tend to make a long term economic assessment of return very difficult for investors.
- WC is recognized as an innovative system but the present version is too articulated and complex to be normally managed directly by the beneficiaries, especially for SMEs.
- The National Energy Plan SEN, even if aware of the current available resources and of the constraints of European directives, it seems not prioritizing applications and technologies, producing a poor focus on energy efficiency and then insufficient allocations of financial resources to this sector.

### 1.6.2. Market barriers to the wider deployment of CHP

#### 1.6.2.1. Lack of knowledge in the customer decision chain

In the market the competence and knowledge of cogeneration implications at environmental, economic and social level, even if generically rather widely spread, is still unsatisfactory from part of all and each one of the chain components appointed with the analysis and the decisions as regards both the technical point of view, the feasibility and the ability to deal with all the obstacles, including financial and bureaucratic ones. Even with some differences among sectors, this lack constitutes a severe entry barrier for the design and development of cogeneration projects.

#### 1.6.2.2. Energy market prices impedes investments in new CHP plants

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 that 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 count for 23,8% of the total installed power.

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

This over offer of electricity together with gas price increase has determined a severe slowdown in the installation of new cogeneration plants.

#### 1.6.2.3. District Heating (DH) barriers

The DH sector up to 2013 has presented a reduced growth with respect to the figures forecast in 2007. Paradoxically measures allocated in the last years to increase building efficiency brought to move large financial resources toward applications, especially of passive kind, directly managed by end users, as the financing mechanism has been found simpler and direct, drawing resources, funded on the same measure, from other applications, e.g. DH, requiring the participation of public administrations, in the meantime hit by the financial crisis and unavailable to invest in heat networks with long return and requiring strong impacts on urban infrastructures.

### 1.6.3. Industry barriers

#### 1.6.3.1 Economic barriers

- The payback time on investments in cogeneration is often judged as too long compared to the expected returns in 2.3 years.
- Difficulty to carry out a reliable assessment in the medium term of savings that could be achieved in business time decrease where it is hazardous to forecast production volumes connected with energy consumption.

#### 1.6.3.2 Financial resources

As regards financial resources, the operators charge the Italian bank system with the difficulty to financing of cogeneration project and as matters of facts they are rather reluctant with respect to this kind of investment, both when they are directly borne by companies and when they are realized through ESCOs. The problem in all cases is to construct a credible model of cost and income for a new cogeneration project which adequately covers the associated economic and energy risks at a time when markets are changing and prices fluctuating. The involvement of an ESCO to obtain the necessary financing for the intervention may not always be successful.

### 1.6.4. Micro-CHP barriers

#### 1.6.4.1 Residential dwelling

Two different cases are taken into account:

- Single apartments or villas

  the difficulty to deal with the complexity of domestic micro-CHP (purchase, installation, maintenance and first of all regulation, much more complex than for a traditional boiler) in front of unprepared sellers and distributors together with complexity of support scheme and permit procedures have strongly hindered investments from part of private people.

- Condominium

  According a complex legislation regarding the unitary access point to the network, it is not possible to sell the electricity produced by micro-cogenerator to individual users, but it is only possible to use it for common uses (e.g. elevators, lighting, stairs and common utilities), thereby strongly reducing the economic benefits compared to grid connection.

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

## 2.1 Potentials 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.**

The potential assessment here represented is based on the following documents

- *Ipotesi di sviluppo della cogenerazione in Italia al 2020* (Hypothesis of cogeneration development in Italy at 2020), Francesca Bazzocchi, Omar Perego (RSE SpA), Liliana Fracassi, Gabriele Susanna (GSE SpA), AEIT 2011
- Energy Efficiency Report – *L'efficienza energetica in impresa: soluzioni tecnologiche, fattibilità economica e potenziale di mercato* – Nov 2012
- *Atti del convegno* mcTER, Milan, 29.06.2010

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

## 2.2 CHP at 2020[20]

The base hypothesis for the calculation of the potential of growth of cogeneration at 2020 has been to consider that the cogeneration plant follows the heat demand, which has been determined equal to total consumption of 61 Mtoe, 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[21] (agriculture potential has been omitted).

| Sector | $TWh_{th}$ |
|---|---|
| Industry | 306 |
| Residential | 158 |
| Tertiary | 74 |
| Agriculture | 22 |

Table 2.1 - Heat demand allocation at 2020

[20] *Ipotesi di sviluppo della cogenerazione in Italia al 2020* (Hypothesis of cogeneration development in Italy at 2020), Francesca Bazzocchi, Omar Perego (RSE SpA), Liliana Fracassi, Gabriele Susanna (GSE SpA), AEIT 2011

[21] ENEA *Rapporto Energia Ambiente*

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. In this way the economic potential has been calculated in the 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.

### 2.1.1. 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 $TWh_{th}$ that can be technically produced by new cogeneration plants.
To the small industry (agro industrial, textile and other manufacturing industries) have been allocated 8 $TWh_{th}$ that can be technically produced by new cogeneration 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 cogeneration system with the conservative one of maintaining a traditional boiler system, using software developed by RSE.[22] The economic evaluation resulted in no opportunity to develop cogeneration in small industries and a good opportunity for medium industry. A further 500 $MW_{el}$ has been added to the total electric power to take into consideration the biomass cogeneration plants. The total energy produced by new cogeneration in 2020 are reported in table 2.2

| | Heat demand 2020 $TWh_{th}$ | CHP 2008 $TWH_{th}$ | Heat Tech potential new CHP 2020 $TWH_{th}$ | Economic potential new CHP 2020 $TW_{el}$ | New bio-energy CHP 2020 $TW_{el}$ | Total installed new CHP 2020 $TW_{el}$ |
|---|---|---|---|---|---|---|
| Large industry | 145 | 21 | 16 | | | |
| Medium industry | 106 | 8 | 22 | 900 | | |
| Small industry | 55 | 2 | 8 | | | |
| Total | 306 | 31 | 46 | 900 | 500 | 1400 |

Table 2.2 - Technical and economical CHP potential for Industry in 2008 and 2020

[22] http://www.rse-web.it/prodotti/prodotto/128

| Industry 2020 | Fossil fuel | Bio-energy | Total |
|---|---|---|---|
| Electrical production $Gwh_{el}$ | 4600 | 2500 | 7100 |
| Useful heat $GWh_{th}$ | 6670 | 3630 | 10300 |
| Installed power $Gw_{el}$ | 900 | 500 | 1400 |

Table 2.3 - Total energy produced by new HEHCP by industry sector in 2020

### 2.1.2. 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 cogeneration 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.

The analysis shows that at present, given the cost of installation of cogeneration, operating costs and maintenance and the values of heat and electricity produced, neither of the two scenarios can get a payback time less than 6 years. However, if an extension up to 10 years could be considered as acceptable range of payback 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 payback time brings to the first scenario a technical-economic potential of 20 $MW_{ei}$ from new cogeneration satisfying 0,07 $TWh_{th}$, and to the second scenario a technical-economic potential of 670 $MW_{ei}$ from new HEHCP DH satisfying 2,6 $TWh_{th}$ of heat demand (see table 2.6)

| Residential 2020 | Scenario 1 | Scenario 2 | Total |
|---|---|---|---|
| New electrical power installed w/o incentives (bau) $MW_{el}$ | 20 | 670 | 690 |
| Heat demand fulfilled by new CHP w/o incentives (bau) $TWh_{th}$ | 0,07 | 2,63 | 2,7 |
| Electricity produced by new CHP (bau) $Twh_{el}$ | 0,05 | 2,33 | 2,38 |

Table 2.4 - CHP potential for residential sector in 2020

### 2.1.3. Tertiary

As regards the tertiary sector the heat demand at 2020 is estimated equal to 72,1 $TWh_{th}$ 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 centres, namely all those sectors characterized by high numbers of operating hours. The results are reported in table 2.6

| Tertiary 2020 | Hotel | Community | Commerce | Offices | Sport | Total |
|---|---|---|---|---|---|---|
| New electrical power installed w/o incentives (bau) $MW_{el}$ | 240 | 110 | 0 | 0 | 40 | 390 |
| Heat demand fulfilled by new CHP w/o incentives (bau) $TWh_{th}$ | 1,41 | 0,65 | 0 | 0 | 0,27 | 2,33 |
| Electricity produced by new CHP (bau) $Twh_{el}$ | 0,94 | 0,43 | 0 | 0 | 0,18 | 1,55 |

Table 2.5 - CHP potential for tertiary sector in 2020

## 2.3 Conclusions

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 2.7 and graphic 2.1 is reported the resulting comparison 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 tot. | % increase |
|---|---|---|---|---|---|---|
| electric power $GW_{el}$ | 10 | 1,4 | 0,69 | 0,39 | 2,48 | 25 |
| heat power $TW_{th}$ | 38 | 10,3 | 2,7 | 2,33 | 15,33 | 40 |
| electric energy $TW_{el}$ | 50 | 7,1 | 2,38 | 1,55 | 11,03 | 22 |

Table 2.6 - Electric power, heat and electric energy in 2009 and 2020

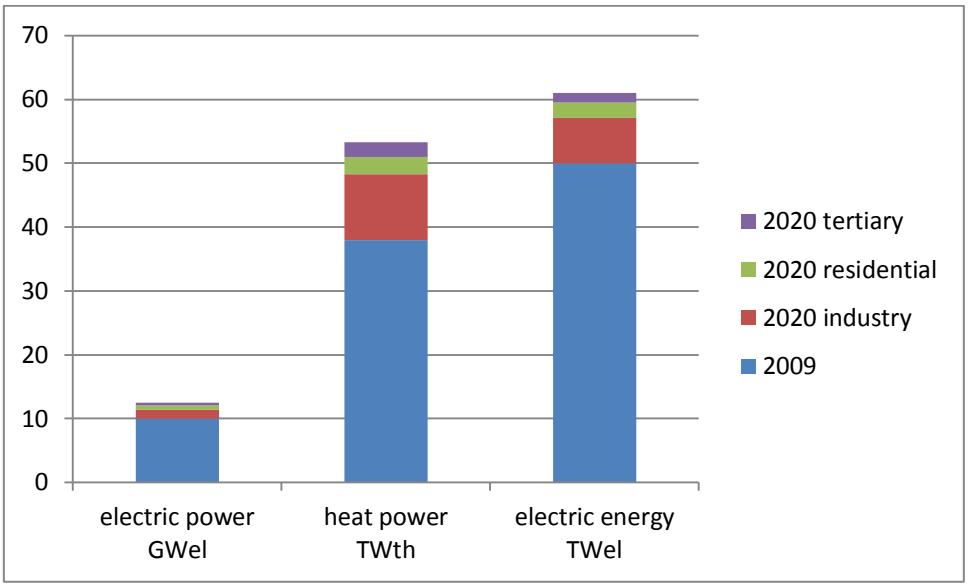



Fig 2.1 - Electric power, heat and electric energy in 2009 and 2020

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 cogeneration 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 is possible to appreciate 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. How do we arrive there? The Roadmap

## 3.1 Preliminary remarks

This chapter builds on the considerations developed in the previous chapters, mainly those referring to the current status, policy, awareness, barriers and market, to arrive at a proposed roadmap that indicates a possible path to implementing growth in cogeneration in Italy.
**Cogeneration is a rather complex technology connected at its turn to other technologies, different fuels, large application varieties moving in the vast area of energy, energy efficiency and renewable energies.**

The roadmap was developed with the following aims for the growth of cogeneration in Italy:

- Overall fuel efficiency measured as primary energy saving in the economy
- Energy supply and stability to be increased
- Positive cost-benefit relation for investments
- Social acceptance and political feasibility of the proposals

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

- Decree of 4.8.2011 implementing the Directive 2004/8/EC (see paragraph 1.3)
- SEN National Energy Strategy (paragraph 1.2.2) and PAEE (paragraph 1.2.3)
- EED Energy Efficiency Directive
- EU Energy roadmap 2050

Using this legislation as the basic framework of action the roadmap will identify actions, actors and timing, some of general nature, some others specific for a certain application or problem.
It is not the aim of this document to present actions devoid of costs. Knowing that cogeneration is only a part of the big puzzle of energy, energy efficiency and decarbonisation that has to be revised and redeveloped as a whole from the point of view both of technical and direct costs.
The roadmap intends to suggest mainly non-structural actions prioritised to create a favourable environment where specific measures, discussed and agreed by all the stakeholders, could occur.
Otherwise, given the present economic crisis in Italy and the reduced availability of resources, the risk is to not receive the right attention at least at this stage of the document development and practically to be rejected.
That means that the present proposals should require mainly marginal expenses and overall a rearrangement of organization and regulatory initiatives.

## 3.2 Overcoming existing barriers and creating a framework for action

### 3.2.1. Global vision of energy challenge

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

The European EED, which shall be adopted by Member State by June, constitutes a good opportunity to carry out the task of relaunching positive action around cogeneration, given its compelling force toward a more efficient way to utilize energy.

Italy is short of natural resources, aside from sun and in some biomass, but does have technology, acceptable infrastructure and an enormous reserve of energy to be saved: implementing EED can be seen as a very good opportunity to translate this resource of saved primary energy into economic growth. CHP has been singles out in the EED as the significant measure for improving transformation efficiency (art. 14).

### 3.2.2. Remove policy barriers and actions

The problem in itself is not simple and requires time, a constant willingness to simplify the intricate jungle of norms and acquired privileges, but there are some measures that policymakers can take with immediate effect.

#### 3.2.1.1 Revision of White Certificates calculation

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 in front of other sources, due at its turn to economic crisis in vicious circle, it is of fundamental importance to facilitate investment that policymakers could design a revision on the mechanism of attribution of WCs to lower the payback time. To this regard it's possible to make reference to a document presented by the "*Autorità per l'energia elettrica e il gas*"[23] where have been proposed correction measures not yet become operative. To exemplify some interesting points these 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

[23] *Proposte per l'aggiornamento della regolazione tecnica ed economica attuativa del meccanismo dei titoli di efficienza energetica* (*certificati bianchi*) 11.01.2011

#### 3.2.1.2 Moving resources

Moving resources from tax reduction, as recently happened with energy intensive industry to help their competitiveness, to active support to 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 policy makers using a large strategic vision on energy market, privileging sectors who present potential characteristic of increase (see paragraph 2.1) and to be also drivers of economy like SMEs and tertiary sectors.

#### 3.2.1.3 Improving permitting procedures

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 a striking case of non-economic barrier that can produce discouragement and even abandon of the installation and of the investment from part of the user and the investor. The measures are of two kinds:

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

It is suggested to not underestimate this aspect that can facilitate the development of micro-CHP in the residential market and of bio-energy utilization.

#### 3.2.1.4 Financial support

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

This action should be directly performed by a 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 and Green Deal, powered up in USA[24] and in UK[25], shortly saying 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 centres retrofitting or micro/nano CHP installations.

[24] Property Assessed Clean Energy Financing (PACE), see e.g. http://www.ase.org/sites/default/files/PACE_factsheet_0.pdf
[25] https://www.gov.uk/green-deal-energy-saving-measures/how-the-green-deal-works

This kind of support is able to revitalize the market and giving 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.

### 3.2.3. Development CHP markets

Indirect actions to sustain the market are

- Strengthen the presence of ESCOs, as foreseen in the art. 18 of EED, which constitute a key part to realize the foreseen potentials in industry, DH and commercial or community centres and explicitly welcome and supported even from the normative point. It is suggested that the ESCOs, that operating by offering the contractual guarantee of the energy performance of interventions assume the financial risk involved in the investment, could access to the National Funds for Energy Efficiency (art 20 of EED) through a proper regulation.
- As regards DH, municipalities should prepare heat plans especially for new residential establishment and imposing them as part of the more general urbanization plan for installation greater than 20 MW (cfr. EED art.14), similarly as it happens today with Environmental Impact Assessment.
- A specific measure relevant for buildings could be represented by investing, even though special regulation, by part of the public administration in its own facilities, as suggested in the EED, 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 cogeneration in office buildings, schools, leisure centres, military premises and distributed energy systems.

  This operation could carry out together with ESCOs to facilitate funds rising.

### 3.2.4 Overview of the roadmap

| ACTION | REASON | STEPS | TARGET GROUP | OUTCOME | PLANNING |
|---|---|---|---|---|---|
| Global vision of energy challenge | Lack of global vision on energy and solutions | - build energy maps<br>- find feasible technologies<br>- hybrid solutions | Policy makers<br>Stakeholders | Better define CHP inside energy efficiency and renewable | 2014 |
| Revision of White Certificates calculation | Electricity price is penalizing | - reformulate WC calculation<br>- simulations | Policy makers | Shorten RoI<br>Improve feasibility | 2015 |
| Moving resources | Transform resources in development | - change interventions on tax with active support EE projects<br>- | Policymakers | Focus on energy saving instead on installations only | 2014 |
| Improving permitting procedures | Bureaucratic procedures uncertain | - analyse procedures one by one<br>- identify new ones<br>- make them compelling | Policy makers<br>Stakeholders | Homogenize license procedures | 2020 |
| Financial support | Difficult credit for CHP projects | - study foreign successful cases<br>- adapt to country | Policy makers<br>Stakeholders | Diversify finance | 2018 |
| | | | | | |
| ESCO access to funds for EE | Only capitalized ESCO can afford risks of performance | - study special rules<br>- make a low design | Policy makers<br>Stakeholders (ESCO, banks) | More projects of EE will be financed | 2015 |
| DH | Develop DH potential | - analyse heat and power | Policy makers | Energy plan for new | 2020 |

| | | | | | |
|---|---|---|---|---|---|
| | | requirement<br>- analyse project<br>- release license | | establishments | |
| Energy urbanization | Huge public estate exploitable | - cadastre of candidate building<br>- analysis of energy projects<br>- tender | Policy makers<br>Stakeholders | Public estate as CHP development motor | 2018 |

## Annex 1: Stakeholder group awareness assessment

| **Customers** | |
|---|---|
| Commercial centres, hotels, hospitals, households | Varied degree of awareness on cogeneration technology. The promotion of cogeneration 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.<br>Micro-CHP expectation is high among households |
| Industry (paper, steel, food) and SMEs | Cogeneration 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<br>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 cogeneration and is progressively adapting and cooperating in the networks interface definition |
| Utilities and DH | Depending on local administration that generally is at early stages |
| **Market and supply chain** | |
| Installation companies | Normally installers, except for packaged applications, as could be for micro-cogeneration, 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 cogeneration 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 cogeneration |
| Architects | Cogeneration 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 cogeneration benefits and has the skills to design and propose even integral solutions |
| Banks, leasing institutions | 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 |
| 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 |

| Policy structure | |
|---|---|
| Policy makers | 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.<br>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 |
| **Influencers** | |
| 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<br>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 |
| Associations of supplying industries | The world of Associations in Italy is large and sometimes overlapping but it gives an idea of the interest in cogeneration 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 |

Table 1 - Ratings of CHP awareness of different influential groupings

**Legend:**

- Active CHP market
- Interest in CHP
- Early CHP awareness
- Low CHP awareness
- Poor CHP awareness

## Annex 2: Micro-CHP potential assessment

# micro-CHP potential summary Italy

### Country statistics

Population: 60 700 000 (2010)
Number of households: 27 580 000 (2010)
GDP per capita: € 25 100 (2010)
Primary energy use: 124 800 ktoe/year (2010)
GHG-emissions: 501 Mton $CO_{2,eq}$/year (2010)

### Household systems (±1 kWe)
*Boiler replacement technology*

**Present market (2013)**
Boiler stock: 20 600 000 units
Boiler sales: 1 850 000 units/year

#### Potential estimation

| Indicator | Score |
|---|---|
| Market alternatives | 1 |
| Global CBA | 3 |
| Legislation/support | 3 |
| Awareness | 0 |
| Purchasing power | 2 |
| **Total** | **8 out of 12** |

**Market share in 2030: 42% of boiler sales in Household sector**

#### Yearly sales

Sales in 2020: 13 300 units/year*
**Sales in 2030: 742 000 units/year***

#### Stock

Stock in 2020: 26 200 units*
**Stock in 2030: 3 740 000 units***
Stock in 2040: 7 700 000 units*

#### Potential savings in 2030

**Primary energy savings:**
77 PJ/year*
1 850 ktoe/year*
**GHG-emissions reduction:**
3.2 Mton $CO_{2,eq}$/year*

### SME & Collective systems (±40 kWe)
*Boiler add-on technology*

**Present market (2013)**
Boiler stock: 498 000 units
Boiler sales: 45 000 units/year

#### Potential estimation

| Indicator | Score |
|---|---|
| Market alternatives | 2 |
| Global CBA | 2 |
| Legislation/support | 3 |
| Awareness | 1 |
| **Total** | **6 out of 9** |

**Market share in 2030: 28% of boiler sales in SME & Coll. sector**

#### Yearly sales

Sales in 2020: 390 units/year*
**Sales in 2030: 10 000 units/year***

#### Stock

Stock in 2020: 2 600 units*
**Stock in 2030: 45 000 units***
Stock in 2040: 121 000 units*

#### Potential savings in 2030

**Primary energy savings:**
37 PJ/year*
890 ktoe/year*
**GHG-emissions reduction:**
1.5 Mton $CO_{2,eq}$/year*

*Corresponding to the expected potential scenario.

# micro-CHP score card Argumentation

The score card is used to assess the relative position of an EU country based on current regulations, markets and economics. The score itself functions as input to the implementation model to 2030.

## ±1 kWe systems (Households)

**Boiler replacement technology**

### Scorecard

| Indicator | Score |
|---|---|
| Market alternatives | 1 |
| Global CBA | 3 |
| Legislation/support | 3 |
| Awareness | 0 |
| Purchasing power | 2 |
| **Total** | **8 out of 12** |

### Market alternatives

*SPOT:* ***5 years***

### Legislation/support

***Current legislation is favourable to CHP*** *in general and particularly to mCHP in case HEmCHP. The application norms are cumbersome especially for households, treated as bigger ones.*
*In any case FiT, WC and tax incentives are foreseen.*

### Awareness

***Very low awareness as regards households****. Consultants, architects and installers are mainly proposing alternative technologies that don't include cogeneration*

### Purchasing power

*GDP:* ***€ 25 100 per year***

## ±40 kWe systems (SME & Collective systems)

**Boiler add-on technology**

### Scorecard

| Indicator | Score |
|---|---|
| Market alternatives | 2 |
| Global CBA | 2 |
| Legislation/support | 3 |
| Awareness | 1 |
| **Total** | **6 out of 9** |

### Market alternatives

*SPOT:* ***7 years***

### Legislation/support

***Current legislation is favourable*** *to CHP in general and particularly to mCHP in case HEmCHP. The application norms are cumbersome for small installation for households, treated as bigger ones.*
*In any case FiT, WC and tax incentives are foreseen.*

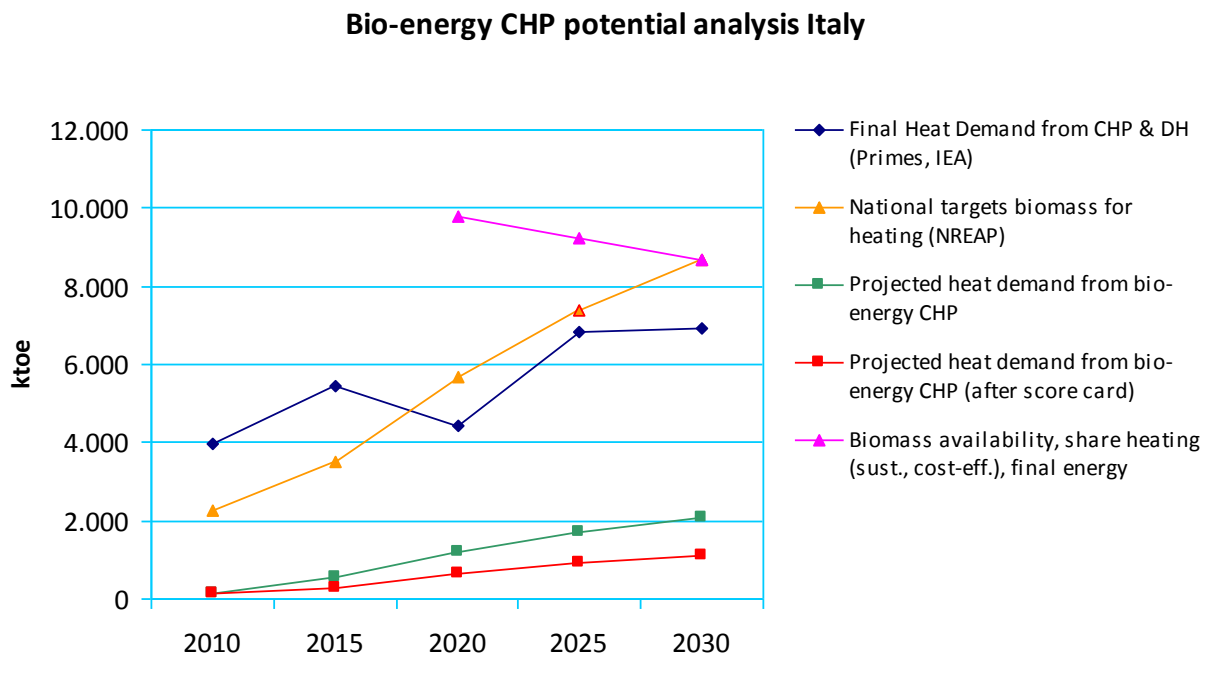
### Awareness

***Low awareness****, supported mainly by ESCO's and manufacturers*

## Annex 3: Bio-CHP potential assessment

### *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 | 629 | 1.109 |
| Bio-energy penetration rate in CHP markets (2009: EEA, Eurostat) | 3,8% (2009) | 14,2% | 16,0% |
| Biomass availability, share heating (sust., cost-eff.), final energy (Biom. Futures), ktoe | | 9.796 | 8.693 |



| *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 |
| Awareness for DH and CHP | + 2 (of 3) | Awareness good among administrative bodies, industries, associations and citizens |