Call for paper WOC 5 - 5C

ENERGY SAVING BY HIGH EFFICIENCY CHP – A NEW NATURAL GAS VALUE
Eni'S EXPERIENCE

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BACKGROUND

In Italy the energy vector demand is a very critical topic because of the lack of primary energy sources and the increase in energy needs.
The Government keeps lot of attention on this matter promoting initiatives to improve energy efficiency and to reduce energy consumption.

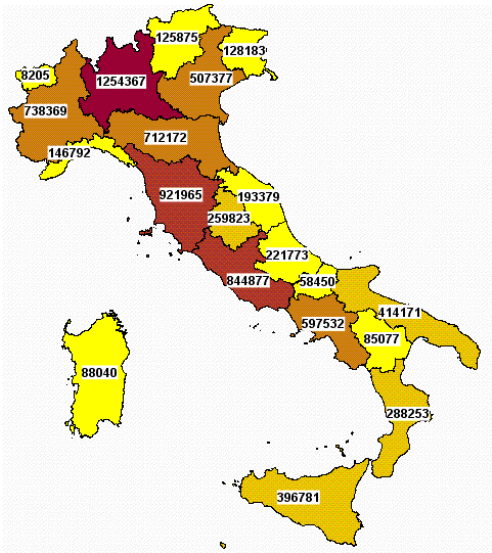
"White Certificate" or "Energy Efficiency Certificates" (TEE) Mechanism is one of the most effective instruments to promote energy efficiency in Italy; it is a market mechanism, built up in 2004 by specific Ministerial Decrees, to support energy efficiency in customers' final uses in homes, the service sector and the industrial sector. It is regulated and managed by the Energy Regulatory Authority (AEEG).
These Ministerial Decrees fix the annual energy saving targets that main Italian electricity and natural gas distributors have to reach in different kind of final uses.
The TEE are the instruments by which AEEG certifies the required achievement of saving target by electricity and natural gas distributors.
Energy savings eligible for TEE can be obtained through projects developed by the distributors themselves, Energy Managers or Energy Service Companies (ESCo).
AEEG certifies the achieved energy savings and authorises the Italian Electricity Market Operator to issue "White Certificates" in favour of distributors, their subsidiaries or Energy Service Companies (ESCOs).
Certificates are marketable and are used by distributors to reach their obligations.

The total initial objective of TEE system was to save 2.9 Million TOE from 2005 to 2009 years; then: [MTOE]: 2.2 (2008); 3.2 (2009); 4.3 (2010); 5.3 (2011); 6.0 (2012).

The energy savings certified in Italy until 31/12/2010 are 9.66 MToe, or:

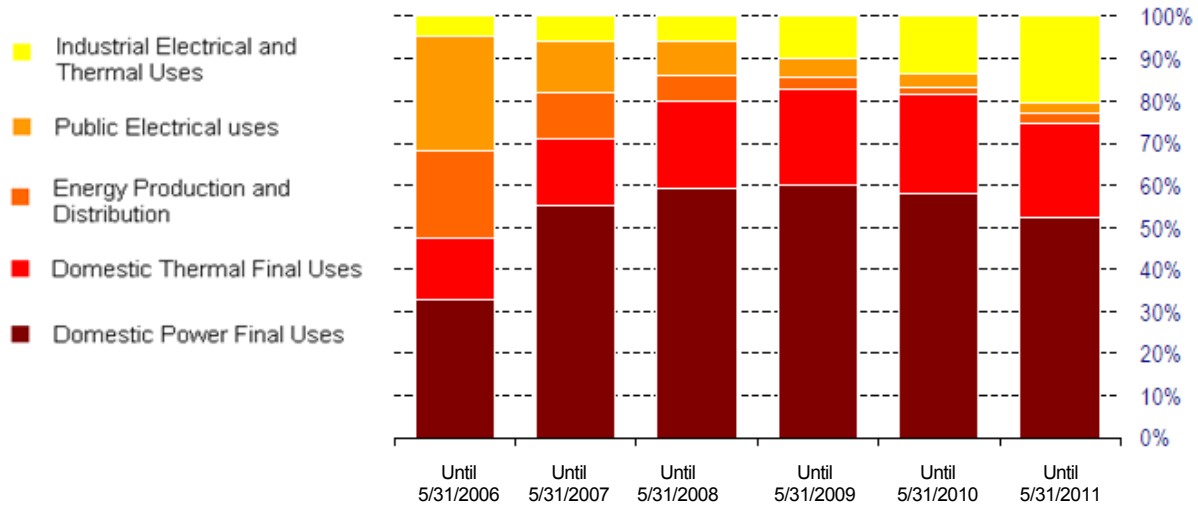
- electricity: 35 TWh
- natural gas: 2.800 M m^3
- gasoil 906.000 m^3

The distribution at 5/31/2009 in different regions are shown in picture n.1 (source: AEEG).



Picture 1: Energy Saving in Italy – White Certificates' Region Distribution (source: AEEG)

The main areas and applications in which energy savings has been certified are indicated in picture n.2 (source: AEEG)



Picture 2: Main Areas and Applications (source: AEEG)

For the first five years of implementing the mechanism (2005-2009), the payment of incentives worth 531 million Euros - through the tariff contribution fixed and updated by the AEEG on electricity and gas bills - contributed to avoid the emission of 22.5 million tonnes of carbon dioxide and save around 8.5 million tons of oil equivalent.

The most significant 'savings' were obtained through the introduction of more efficient technologies in citizens' uses of electricity such as, for instance, low-consumption lamps, water saving kits, power appliances, air conditioners, high-efficiency hot water cylinders and boilers, and further improvements on heating systems, industrial plants and public lighting systems.

Recently, a consultation document made proposals to update the mechanism terms and conditions. At the end, new guidelines were published by AEEG in November 2011.

Moreover, it is important to extend the mechanism duration by defining new national saving targets for the years after 2012.

The energy saving projects eligible for white certificates are that belonging to a defined group of interventions (e.g. substituting electricity or gas appliances with more efficient ones, heat recovery, electric engines, heating, chp, etc.).
They can be defined with reference to various sectors (civil/domestic, industrial), kind of saved energy (electricity savings, natural gas savings, other fuels savings, transportation).

Depending on the type of project, energy savings have to be quantified by measurements (normally in industrial sector) or statistics (e.g. high efficiency lamps).

In industrial sector, the method normally used to calculate the energy saving is specific for the particular application so it could change case by case; it needs special approve by Energy Regulatory Authority and is called “a consuntivo”.

Each project has normally a conventional life of five years . Anyway, since a project can produce savings for more than 5 years, savings are multiplied for a specific factor, t (e.g. for heat recovery: 3,36, equivalent to 20 years).

Certified savings equivalent to white certificates are only “additional” savings, which means savings achieved by a Best Available Technology with reference to normally used technology.

Recently, White Certificates have been used as the method to support High Efficiency Combined Heat and Power (CHP). Basing on PES calculation, savings achieved by CHP system can receive white certificates. These special certificates can access TEE market or paid by public Energy Service operator (GSE).

Eni – as a ESCo – since 2006 has been following a considerable number of energy saving applications for the industrial sector, providing energy saving projects and calculations based on measurement of savings (“a consuntivo”), with tailor-made method to measure and calculate energy savings.

AIMS

In this paper a real case-study on High Efficiency natural gas CHP in the ceramic sector will be presented as a successful case history of the application of White Certificates Mechanism.

METHODS

It will be illustrated:

1. description of a typical energy saving project called “a consuntivo”;
2. a technical description of the specific natural gas cogeneration plant;
3. the main features of the “a consuntivo” program made by **eni**

1. Energy saving evaluation of the “a consuntivo” type, is typically based on the following issues:

- check of the eligibility of the project to White Certificates mechanism;

- clear definition of time sheet (build-in, start time, reference period to calculate savings – e.g. 1 year);
- the algorithm used to calculate energy saving with reference to previous conditions and reference conditions (i.e. baseline)
- baseline, i.e. reference consumption to calculate additional savings;
- parameters to be measured;
- measurement instruments used;
- calculation formulas;
- documents, datasheet and data to be saved

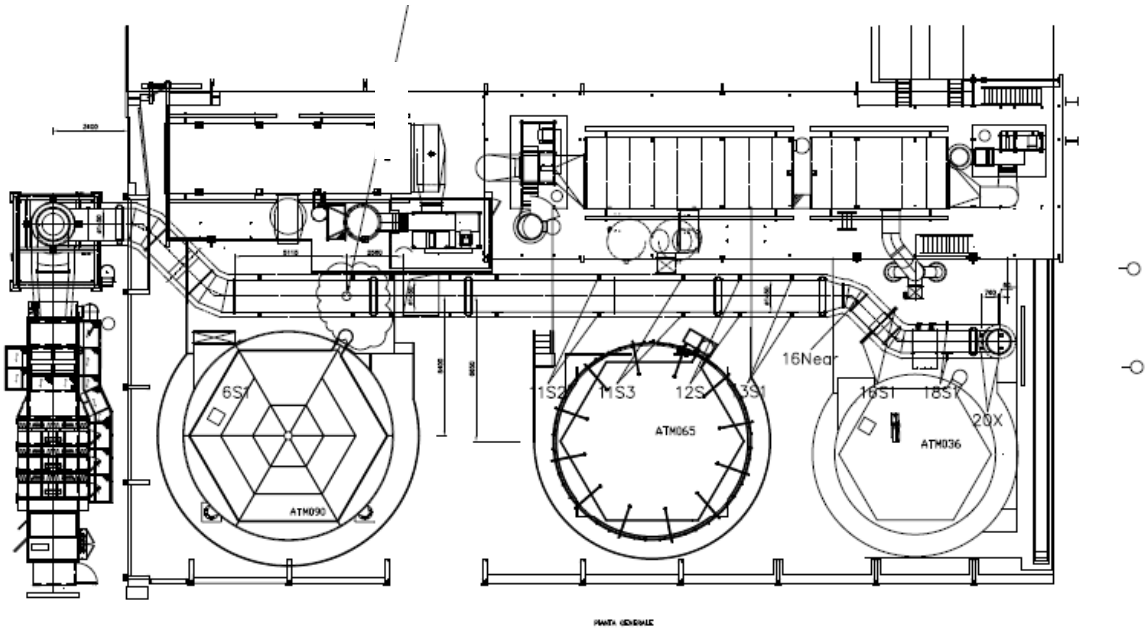
2. The Energy saving project is based on a High Efficiency natural gas CHP plant. It is based on a 6 MWe gas turbine (GT), installed in 2009 in a ceramic factory (Casalgrande Padana Spa, Italy).

Data sheet:
Electric Power: 5.580 MWe
Thermal Power available: 9.884 MWt
Gas consumption: 1.864 Sm^3/h

This plant produces the electricity needed by the factory, with heat recovery from exhaust gas of GT. Thermal energy produced by GT (hot exhaust gas at 550 °C) is completely used to dry basic product of ceramic tiles (a water- clay mixture with 30% water, called "barbottina"), which flows in 3 counter flow spray-driers. Normally, natural gas burners are used to produce hot gases, in this case hot gases come from GT and they can eventually be post-fired by burners. Thanks to high heat exchange, water evaporates suddenly, so generating fine powder products.

The final product obtained is used to prepare tiles. See picture below.

Heat recovery generates high energy savings in gas consumption for burners.



Basing on technical and operating parameters of spray-dryers, almost all hot exhaust gas are recovered, thus resulting in high efficiency of this CHP plant.

Anyway, specific diverter can exhaust exceeding hot gases to atmosphere.

In the feasibility study, this plant was estimated to be a high efficiency one, according to Italian law and European directive 2004/8/EC.

Estimated Energy savings were:
- 1050 TOE/y in terms of electricity saving
- 750 TOE/y in terms of natural gas savings.

This plant was installed in 2009 and first running year was 2010.

CHP plants permit to optimize energy efficiency through the simultaneous utilisation of fuel energy to produce electricity and heat. Thus needs specific algorithm to evaluate global efficiency with reference to separate electricity and heat production using traditional technology: boiler or burners to generate hot gases and traditional power plant to generate electricity. Each traditional technology has a specific efficiency; for power production we need to take into account also electricity distribution efficiency.

In this case, reference values are that of resolution 42/02 of AEEG.

Energy measurement is undertaken as follows. With specific reference to exhaust gas, mass flow and temperature are measured, in order to calculate thermal energy once we know specific enthalpy.

The instrumentation of measurement of exhaust gas flow is placed along the conveying pipe exhaust gas to the spray-dryers, in such a way to avoid measurement error due to curves and turbulences. Data recording has a sampling period of 60 minutes.

All data are collected and managed by PLC system normally used for plant management.

RESULTS

Technical and energy results after the first year running have been:

Year	Electricity produced	Heat recovery	Gas consumption	Energy saving
-	MWh	MWh	MWh	TOE
2010	29.515	49.505	90.612	1.917

This case history is an example of how **eni**, according to its customers' needs, has found specific applications to improve the efficient use of natural gas on its costumer's sites. This intervention is obtaining significant primary energy saving, over 1.800 Toe/year, and thanks to incentive program it is gaining a real extra value.

SUMMARY CONCLUSIONS

White Certificates Mechanism, developed in Italy since 2004, is an effective way to promote energy efficiency basing on a market process.

At the end of 2011, specific rules have been introduced to support CHP in Italy with specific Ministerial decrees, based on white certificates. For this reason, AEEG is going to modify the mechanism in coherence with the new decrees.

Eni supports the exchange of experiences of the energy saving schemes based on market mechanisms (e.g. White Certificates) as a way to achieve energy efficiency reducing at the same time countries overall costs.

High efficiency natural gas cogeneration, based on heat recovery, is one of the best solutions to improve energy savings. If well applied, it accesses incentive mechanism, as shown in this paper.