International District Energy Climate Award

District Heating Network – Ferrara, Italy

Name of the System:	"POLO ENERGIE RINNOVABILI"
Location:	Ferrara, Italy
Owner:	HERA S.p.A.
Ownership:	Public-controlled Limited Company
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Summary

Ferrara is an ancient city in North – Eastern Italy, covering an area of about 2.600 km^2 and still maintaining its medieval structure.

Ferrara is located in the flat alluvial Po Valley land and its topography varies between 0 and 20 m. a.s.l. and some metres below the level.

In the 60's, while a research project was investigating new oilfields, an underground source of hot water (approx. 2.000 m deep) was detected in the area.

Following the energy crisis of the 70's, the Municipality of Ferrara started up the *"Geothermal Project",* in order to develop the geothermal resource as a primary source for an urban heating system and reduce the environmental impact created by the traditional energy sources (coke, oil and methane gas, etc…).

Ever since the beginning though, the project involved the use of other energy resources, as additional sources, typical of the area (especially the Waste – To – Energy plant), according to the principles of "Integrated Energy System".

Recent geo – structural and geothermal investigations carried out by HERA Group (Energy Resources Environment Holding) in collaboration with "Consorzio Ferrara Ricerche" (University of Ferrara and Geological Service of Emilia – Romagna Region), confirmed the presence of new particularly interesting geothermal reservoirs in the eastern part of the City.

The extension of the existing district heating network scheme, by increasing the use of renewable energy sources, was eventually decided according to the latest studies and the pursuit of such an environmental policy also led to a strong enhancement of the global city's reputation all over the Country.

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1. INTRODUCTION

1.1. The City of Ferrara

The Province of Ferrara is located in North – Eastern Italy and covers an area of about 2.600 km^2, with an half of it dedicated to agriculture. Ferrara is located in the flat alluvial Po Valley land and its topography varies between 0 and 20 m. a.s.l. and some metres below the sea level, therefore its ground is particularly suitable for agriculture.

As far as the urbanized centre is concerned, Ferrara is an ancient city still conserving its medieval structure, with a population of about 135.000 people.

The whole area can be defined as temperate climate with sub – continental characteristics, cold winters and warm summers, moderate diurnal (10°-12°C) and annual temperature excursions (20°-25°C) and precipitations from modest to moderate (mean of 670 mm/year) but evenly distributed throughout the year. The action of the Adriatic Sea doesn't significantly mitigate the winter's cold, except for the portion of the province close to the coast. (Climatic Zone "E"),

Therefore, the climatic conditions in Ferrara requires the development of a consistent heating system.

1.2. HERA Group

HERA (Energy Resources Environment Holding) was established on 1st November 2002 by the merger of twelve Public Service Companies. The Group is now holding a leading position on the Italian Multiutility market, mainly in the Energy Sector, Water Treatments, Environment and District Heating.

Hera operates in more than 240 towns, in several Provinces (Bologna, Ravenna, Rimini, Forlì – Cesena, Modena, Ferrara, Firenze, Pesaro – Urbino), having today around 2,5 mln Customers.

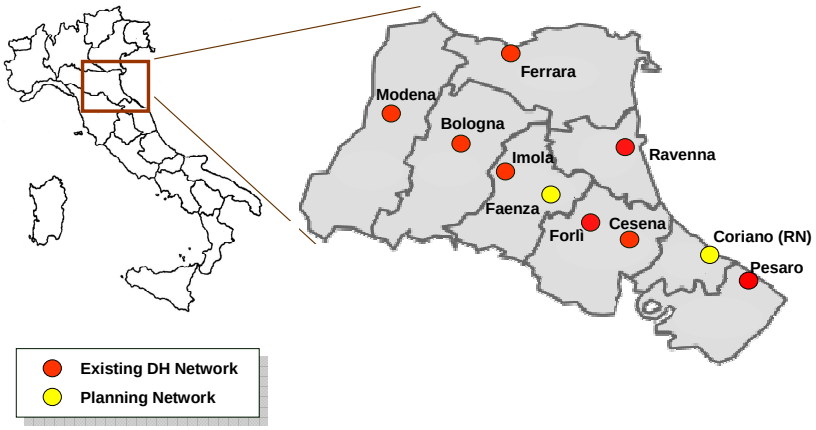


Figure 1: Reference Territory and the District Heating

In the HERA Group, the relationship between customers and territory is carried out following corporate values and principles such as creation of value, social and environmental responsibility, quality, excellence of service, efficiency, innovation and continuous improvement. For these reasons, a "Quality Charter of the District Heating Service" was designed. This Charter constitutes a formal declaration of HERA's Commitment to the Customers, which is a main part of the supply contract, since it identifies the fundamental principles and high quality standards of the service. This document also defines the relationship between HERA and its Customers, in terms of participation and information rights.

2. DESCRIPTION OF THE EXISTING SCHEME

2.1. History of the System

The history of this plant starts in the 60's when, during a new oilfields search project in the Po Valley, the research group detected an underground source of hot water, 100°C hot and approx. 2.000 m. deep.

By that time, the resource wasn't exploited, due to a lack of appropriate technical-economic conditions and to a different approach to energy-environmental problems. The *"Geothermal Project"* aiming to supply the urban heating system through natural sources, was started up only after the energy crisis of the 70's and with the support of Ferrara Municipality.

The geothermal fluid is pumped to the surface from a depth of 1.000 m through two extraction wells (each of them 14 MW powered) and, after transferring the thermal energy to the network, it is re-introduced in the ground through an intake well, in order to ensure the geotechnical stability.

Since the beginning of the first project, the integration with the Waste Treatment Plant had been taken into consideration, therefore an *"Integrated Energy System"* was realized.

The project of the "Waste - To - Energy Plant" began in 1989 and the plant started working at full capacity 4 years later.

Furthermore, after a considerable improvement in power, in 2007 the new WTE was started up.

2.2. Heat Production Configuration

The Ferrara System is therefore characterized by an Integrated Energy System, working since November 1990, based on:

- Renewable Sources (Geothermal source);
- Recovery from industrial process plants (Waste to energy, *WTE*);
- Back-up thermal stations, supplied with methane gas, satisfying the demand during consumption-peaks.

Four inertial tanks complete the system, by storing the heat produced by the sources in lower demand moments.

The operating data of the plants are reported in the following table:

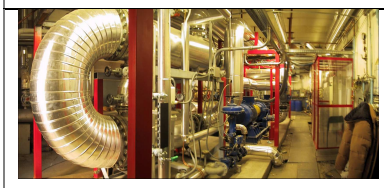
	Total Flow Rate	400 m^3/h
	Temperature of Geothermal Fluid	100 - 105 °C
	Temperature of the fluid in district heating network: - input - output (on the back way)	 90° - 95°C 60° - 65°C
	Thermal Nominal Power	14 MWt
	Thermal Energy Produced	Approx. 75.000 MWht/year
	Authorized Capacity of waste disposal	130.000 tonn
	Electric Power to the system	13 MWe
	Electric Energy to the system	87.000 MWhe
	Max. Thermal Power for heating network	29 MWt
	Total Thermal Energy produced for the district heating system	approx 80.000 MWht/year
	Back-up Station Power	84 MWt
	Energy storages	Approx 1.000 m^3 each

Table 1: Operating data of the plants

The District Heating System in the City of Ferrara, that represents one of most considerable example of Integrated Energy System in Italy and in Europe, will be able to produce about 179 GWh thermal energy in 2011, the 83% of which comes from renewable energy or from Industrial Process Recovery, distributed as follows:

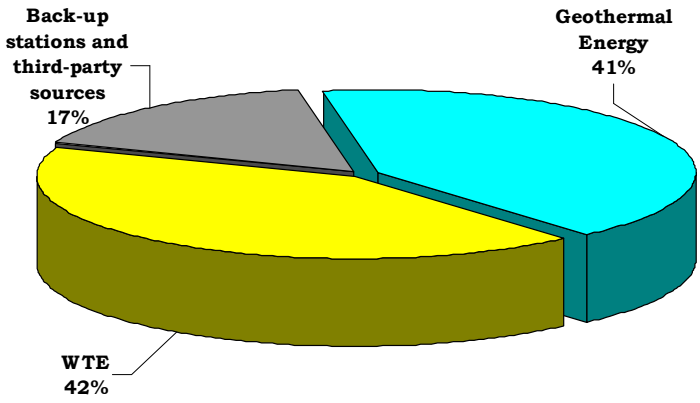


Figure 2: Energy Mix in the System (referring to 2011 forecast).

2.3. The Distribution Network

The distribution Network, characterized by hot water (90°C), is approx. 52 km long (length of the way in double pipes) and it allows to heat about 5.245.000 m^3 of users, equal to 21.800 standard flats*.

3. BENEFITS

The District Heating Network in Ferrara represents an important opportunity of intelligent energy use and it widely contributes to significantly decrease the environmental pollution.

Environmental benefits that come through such a network can be clearly calculated by comparing the district heating system to a conventional production of thermal and electric energy (methane and oil gas boilers).

In 2011, further to a total production of thermal energy amounting to 179 GWht, the 83% of which coming from renewable or recovery sources (Geothermal source and WTE) , the **avoided emissions** will amount to:

- NO_x : 47.560 kg;
- SO_2 : 36.628 kg;
- CO_2 : 39.411 tons.

The energy saving will amount to 14.800 TOE saved (*Tons of oil equivalent*), which are equivalent to approx. 55.000 photovoltaic panels installed (1 kW powered).

* *We consider, as standard, a flat of 80 m^2 , three-metre high.*

4. DEVELOPMENT OPPORTUNITY

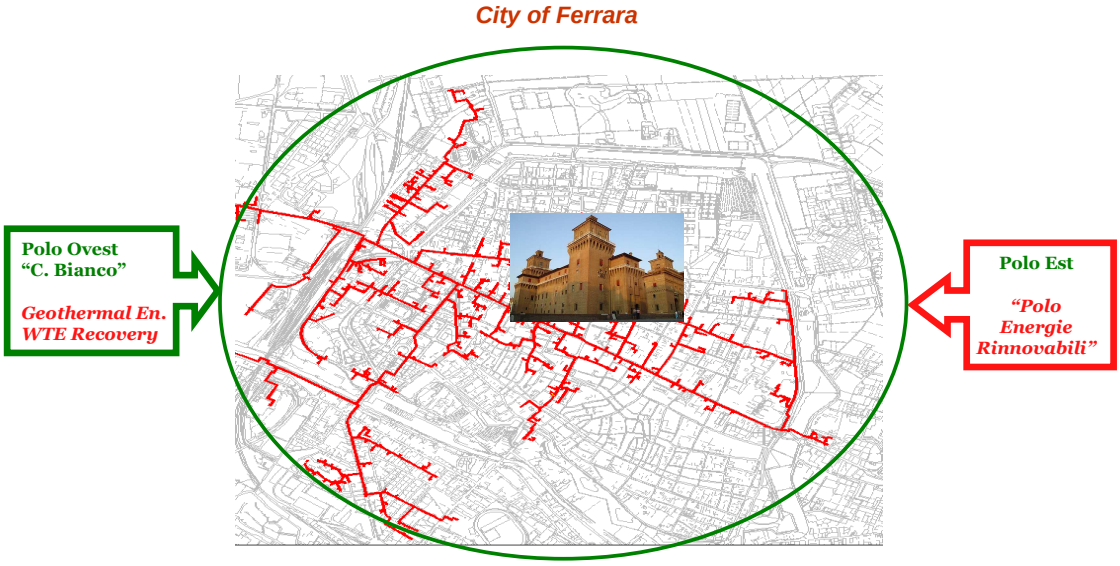


Figure 3: Development Plan

HERA has planned a project, called "Polo Energie Rinnovabili", developing the existing system scheme, increasing the supplied volume up to 9.000.000 m^3 of users, covering at least the 91% of total production with renewable energy or recovery from industrial processes.

That will be possible through the exploitation of further geothermal wells, in the eastern zone of the city.

4.1. Geothermal Development Potential supporting the Development Plan

Recent geo - structural and geothermal investigations carried out by HERA Group in collaboration with "Consorzio Ferrara Ricerche" (University of Ferrara and Geological Service of Emilia - Romagna Region), confirmed the presence of new geothermal reservoirs, in the eastern part of the city.

Three hydrothermal systems have actually been identified: G1 (Early Pliocene Formations), G2 (Late Messinian Formations) and G3 (Early Jurassic Formations). Each reservoir can be considered hydraulically separated from the others by a impermeable layer that prevents significant leakages.

While the system G1 does not show big thermal anomalies, the hydrothermal system G2 is characterized by an average temperature of 45°C-60°C, and the G3 shows temperature between 85°C and 95°C.

Driller data collected during oil and gas detections in the Po area, indicate a geothermal gradient of 1°C/100 m; however, the gradient is not linear and the studies carried out by HERA suggest gradients from 2°C to 6,5°C/100 m in the deepest reservoir G3. This one, therefore, has turned out to be the most appropriate area for a district heating exploitation.

4.2. Innovative Solutions

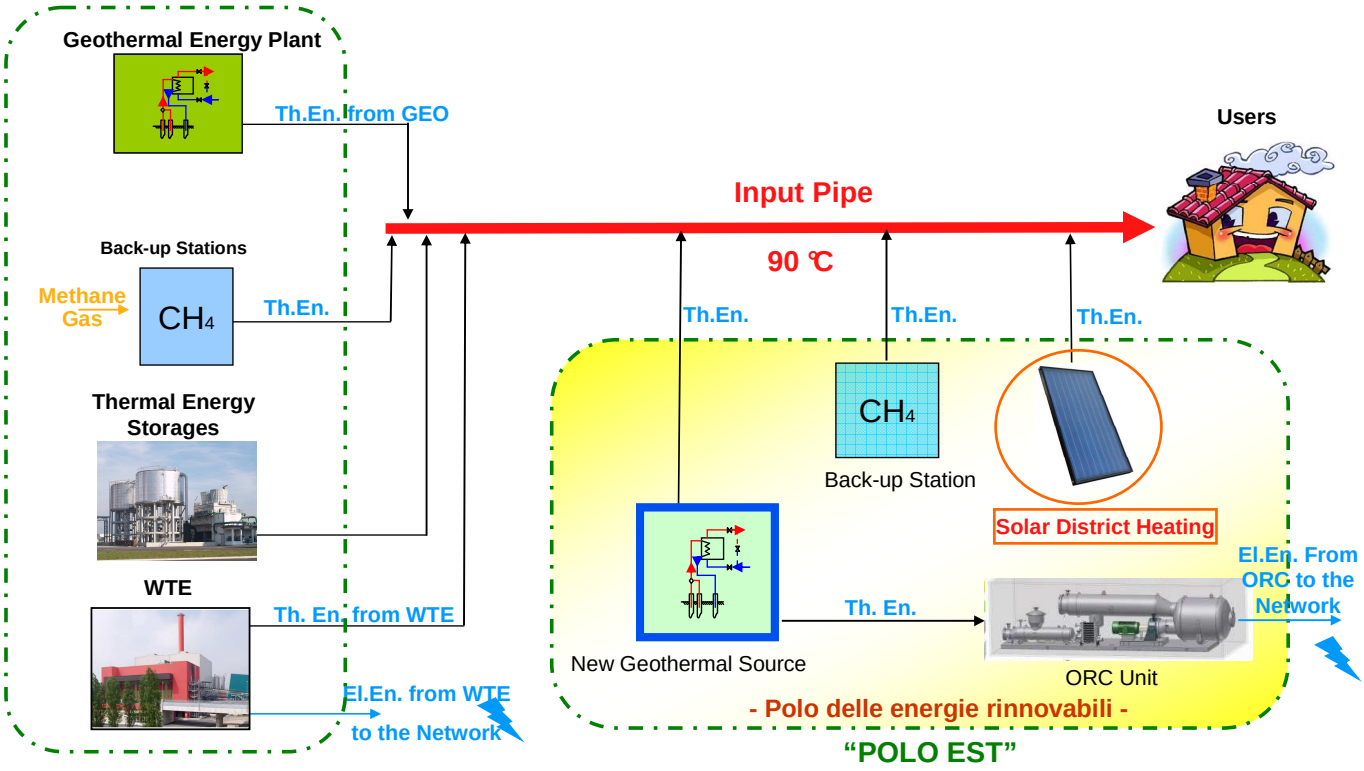


Figure 4: City of Ferrara District Heating Development Project

The development project, in addition to geothermal source, shows other innovative solutions such as Solar Thermal Plant, 1 MW installed power, as primary thermal energy source (base load).

The project will ensure about 1.000 MWht total annual thermal production by a 1.220 m^2 surface of solar panels: due to the great extension of the area, panels will be installed on the technological buildings embankments, consistently designed to reduce the plant environmental and architectural impact and allow a fair integration with the surrounding landscape.

This application will represent the first example in Italy of Solar Thermal applied to District Heating, which has already well started up in Northern Europe, where SDH plants exist since beginning of the 80's at competitive costs.

Furthermore an ORC (Organic Rankine Cycle) turbine will be installed. The geothermal source will supply thermal energy to the turbine and produce electricity while D.H. has been turned off. The ORC will produce 1 MW net active electric power.

Due to the uniqueness of the system in terms of innovative solutions in Italy, the project "Polo Energie Rinnovabili" has been included among the "Best Practices" of:

- *GEOPOWER*: a two years project financed by the "Programma Interreg IV C" based on the exchange of fair practices about low enthalpy geothermal sources;
- *SDH Take-off*: a project in the context of "Intelligent Energy Europe (IEE)" that foresees collaborations of Associations, Manifacturing and Management Companies, operating in the

fields of D.H. and Solar Thermal; the acts of this project are directed to analyze and to improve the applications of the solar thermal district heating and to transfer know-how and cooperation among the stakeholders in the European renewable energy market.

4.3. Expected Goals

By the realization of the new "Polo Energie Rinnovabili", together with the development of an Integrated Energy System in the whole urban area, a total thermal energy production of 289 GWht is foreseen, of which the 91% from renewable and recovery source (163 GWht from geo-source and 100 GWht from WTE).

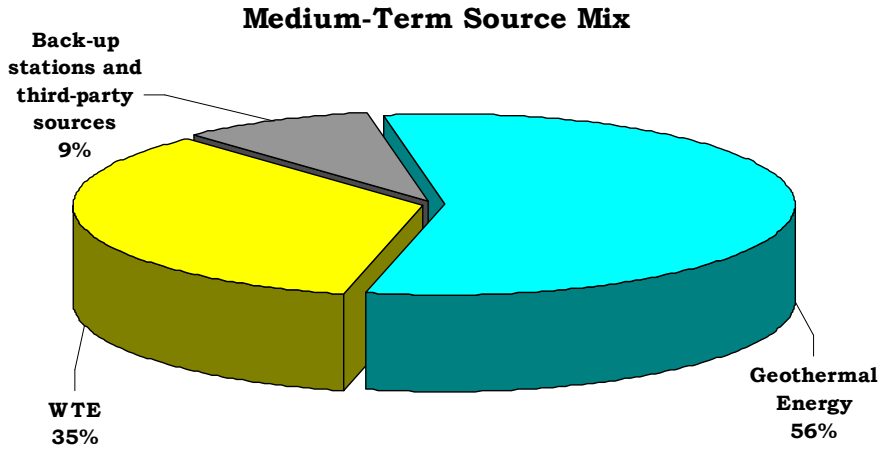


Figure 5: Medium-Term Source Mix used by Ferrara District heating System

As far as gas emissions from D.H. plants are concerned, a reduction of 11% is expected by the realization of this project, comparing to 2011 emissions amount, mainly due to a wider use of renewable sources and consequent reduction of methane gas burned into integration boilers.

EMISSIONS PRODUCED BY THE SYSTEM

Pollutant	*[u.m.]*	*2011*	*Medium-Term*
NO_x	[kg]	8.690	7.708
CO_2	[tons]	6.908	6.126
TOE requested		2.966	2.631

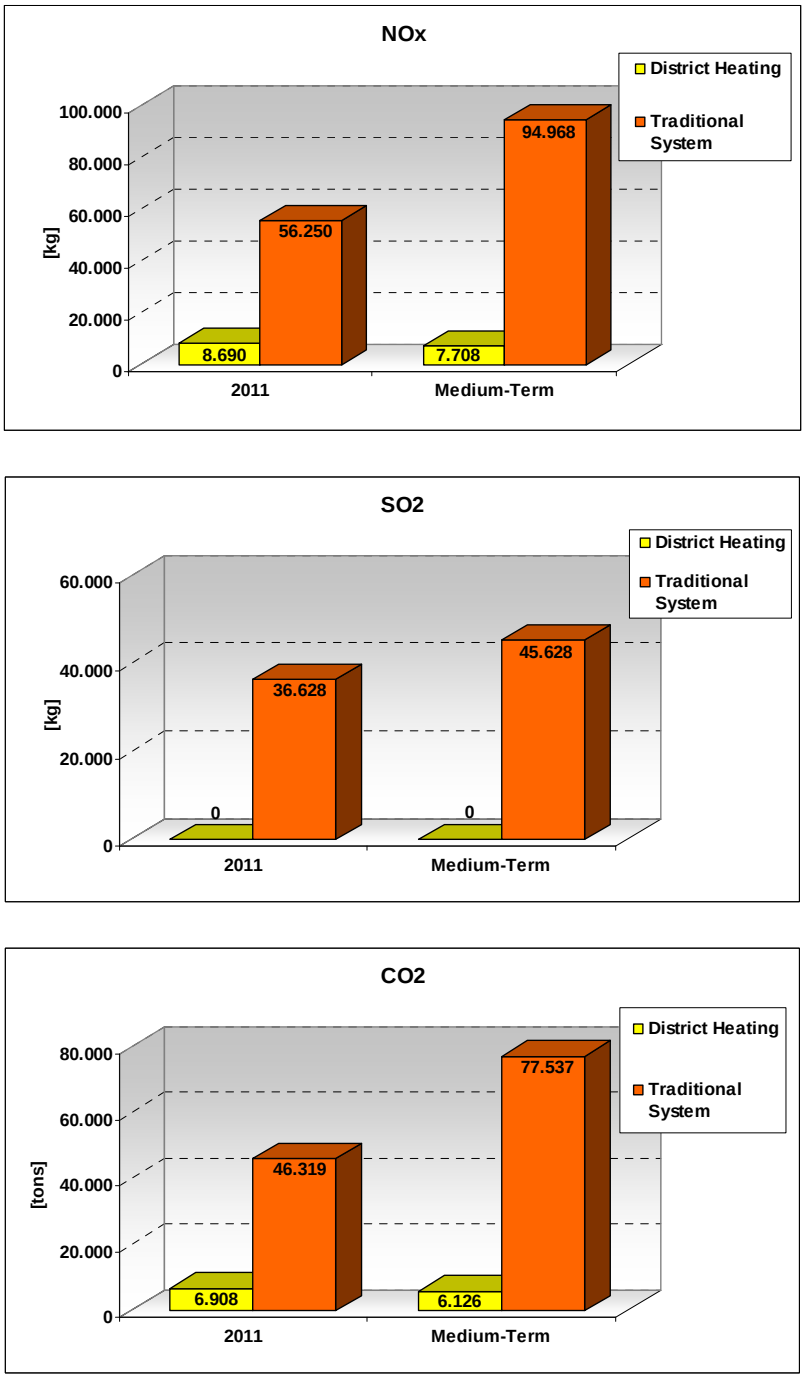


Figure 6: Emissions produced by the District Heating System compared to a Traditional System (methane gas and oil boilers), producing the same amount of energy.

The policy of substitution of the fossil fuels with renewable energy sources will lead the city of Ferrara to the achievement of further energy-environmental improvement.

AVOIDED EMISSIONS

Pollutant	*[u.m.]*	*Forecast 2011*	*Medium-Term*
NO_x	[kg]	47.560	87.260
SO_2	[kg]	36.627	45.628
CO_2	[tons]	39.411	71.411

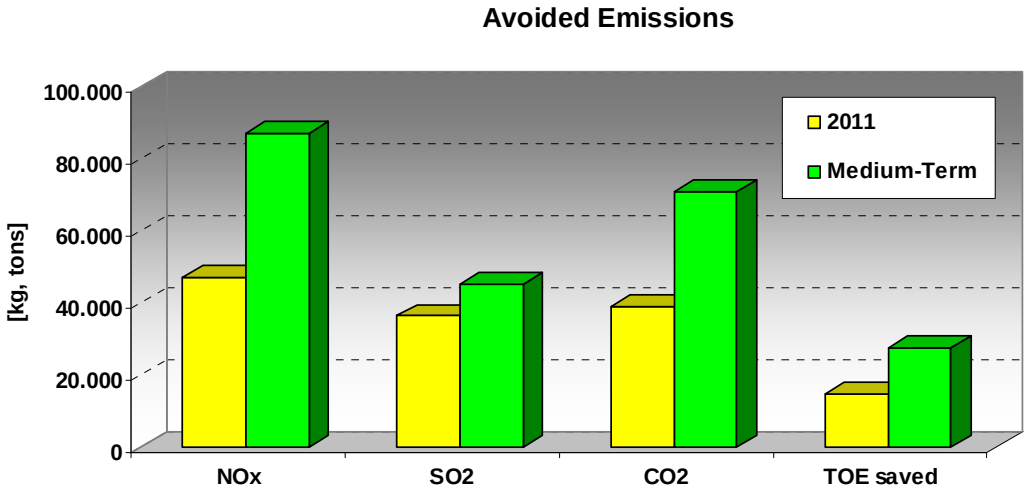


Figure 7: Avoided Emissions Synthesis, considering, for the same energy need, thermal energy produced by D.H. in substitution to a traditional heating system with gas and oil boilers.

A coefficient indicating the quantity of renewable versus not-renewable energy produced or used by a system has been defined by EU organization. This coefficient, as everybody knows, is the Primary Resource Factor (P.R.F.).

If this coefficient is greater than 1, it means that the use of fossil fuels prevails; otherwise, in case of PRF smaller than 1, the use of renewable source prevails. Lower values of PRF mean a low use of fossil fuel in producing/consuming energy, and a consequent lower environmental impact.

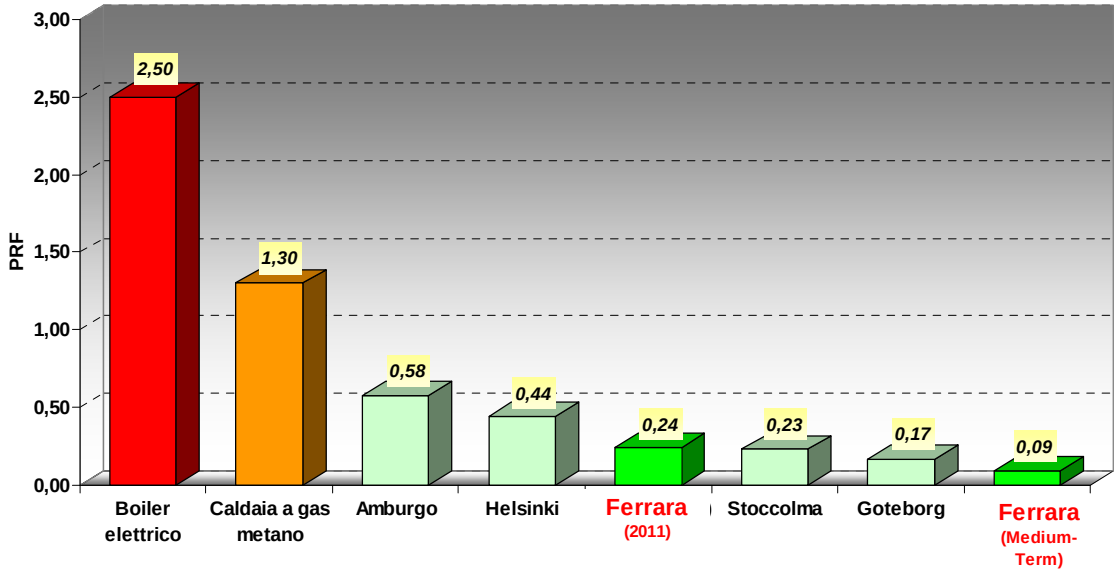


Figure 8: Primary Resource Factor

In present configuration, the PRF value of Ferrara D.H. system is already lower than 1; in long term configuration (New "Polo" realized), thanks to an intensive utilization of renewable sources, the PRF will be < 0,1, placing Ferrara system at an excellent level throughout European ones.

5. RELATIONSHIP WITH CUSTOMERS

For its customers' convenience, five different communication means have been provided by Gruppo Hera, such as:

1) Call Centre for residential customers
2) Call Centre for business customers
3) Web
4) Mail
5) Customer service office

An important evidence of Hera high quality communication system came from the second place earned on the 2010 "Webranking" award: this yearly analysis carried out by Hallvarsson & Hallvarsson is one of the most accurate European research on the "on line communication means and strategies" of the first hundred most capitalized Italian Companies.

Furthermore, according to Article 57 of its Ethic Code, Hera "gives its full attention to requests coming from its reference communities, through advisory boards, information and participation initiatives". This continuous effort for improvement, based on frequent meetings and boards with local communities, guided visits to Hera plants and cooperation with local schools, also this year led to a positive increase of the customer satisfaction index. As far as the D.H. service is concerned, from the last year a three point increase in customers' satisfaction was highlighted, thanks to a higher advantage rating, together with a very good service reliability and, most important, an increased sensibility toward renewable energy sources use.