“THE INTEGRATED FERRARAR PLANT”
(50% Geothermal)

Workshop on GEOTHERMAL ENERGY

STATUS AND FUTURE IN THE Peri – Adriatic Area

Lussino, 24 - 27 Agosto 2014

Contents:

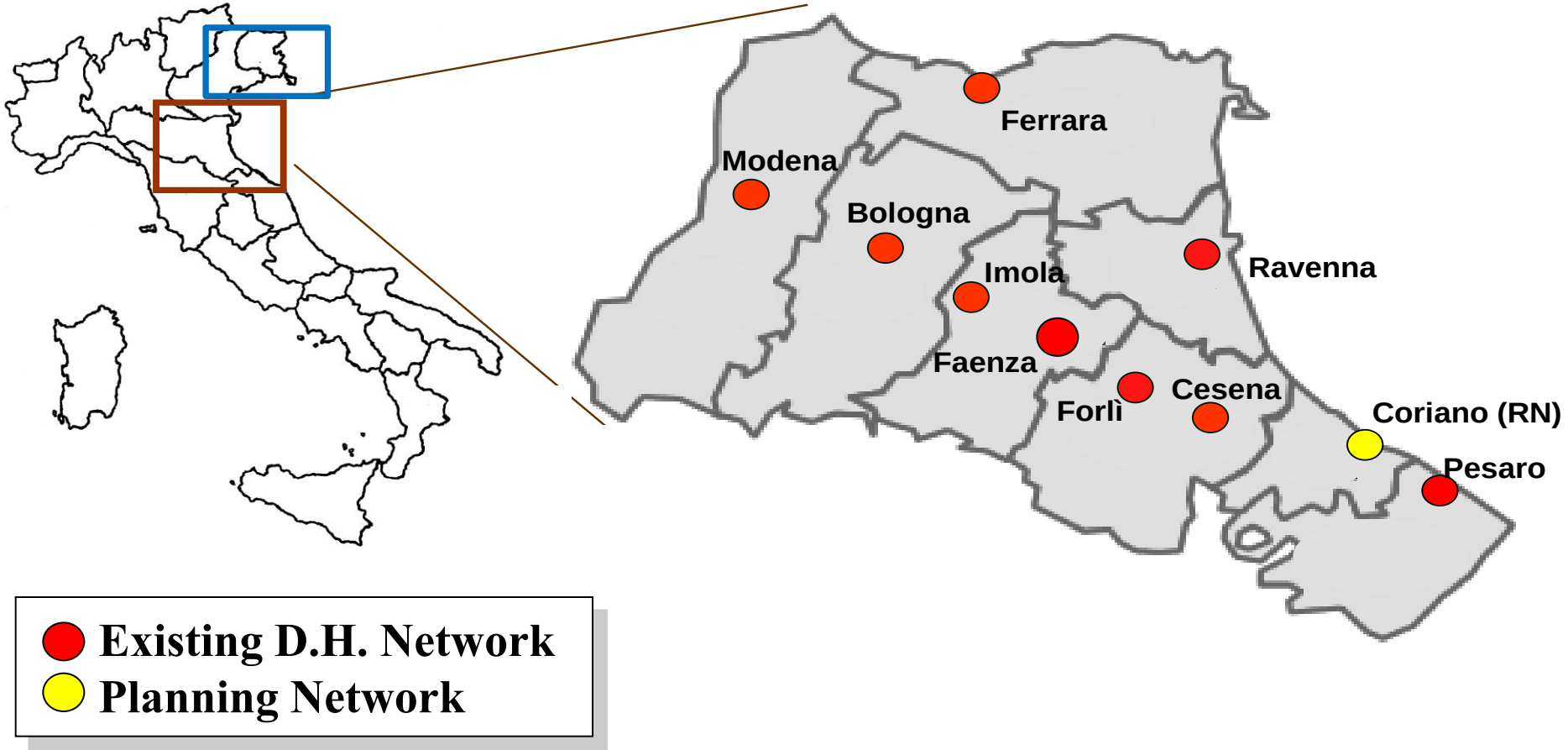
- HERA Group and the District Heating
- Integrated Energy System
- The District Heating System of the City of Ferrara
  - ✓ Existing Scheme
  - ✓ Future Development

HERA Group

HERA (Energy Resources Environment Holding) is now holding a leading position on the Italian Multiutility market, mainly in the Energy sector, Water treatment, Environment and District Heating.

- It was established on 1st November 2002 by the **merger of 12 Public Service Companies** of Emilia Romagna Region;
- **It operates in more than 250 towns**, in several provinces (Bologna, Ravenna, Rimini, Forlì – Cesena, Modena, Ferrara, Firenze, Pesaro – Urbino, Padova, Trieste, Gorizia);
- At the end of 2013, it has around 3,6 mln Customers;

HERA Reference Territory and the District Heating



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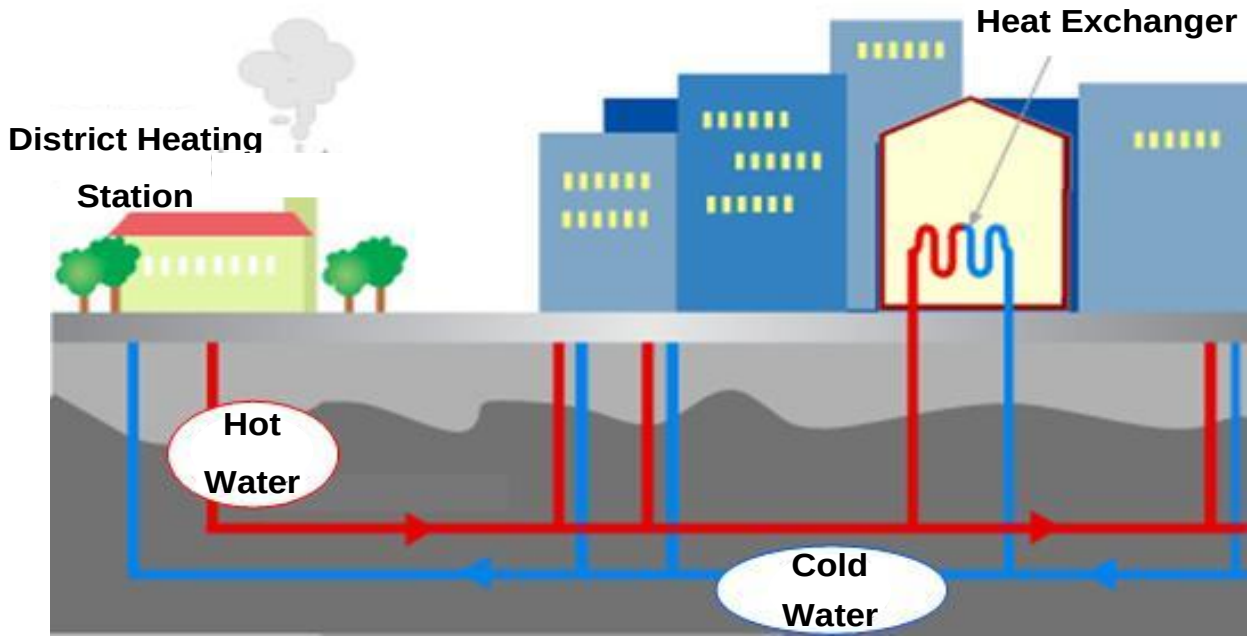
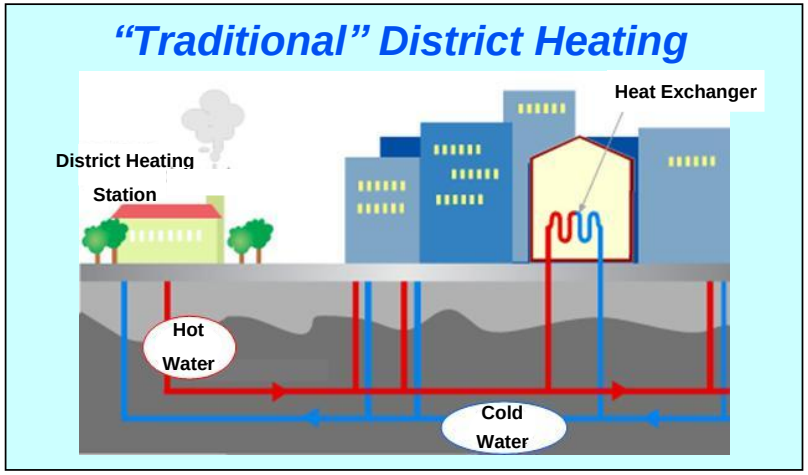
"District Heating"

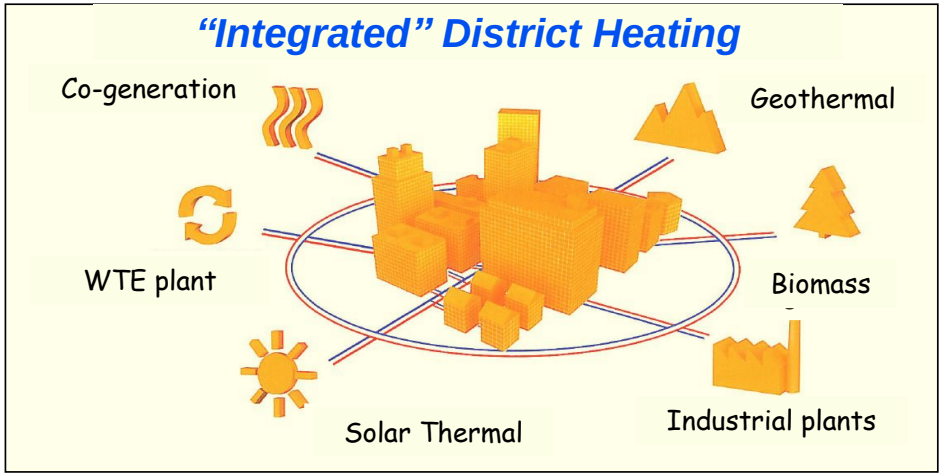
The District Heating is a remote heating system that, with a network of underground pipes, distributes heat generated in a centralized production plant (or more…) and brings the energy directly to the Customers.



Integrated Energy System



In a modern vision, D.H. should become an instrument of Territorial Planning, according to Public Administration, in order to exploit the available energy sources.



INTEGRATED ENERGY SYSTEMS

Integrated Energy System

District Heating may use many types of renewable (or recovery) sources such as:

- Biomass;
- Geothermal;
- Waste Treatment Plants,
- Industrial Thermal Process Plants;
- Solar Thermal.

District Heating "Integrated System Design" needs efforts in order to use the renewable thermal energy sources, located in the surroundings.

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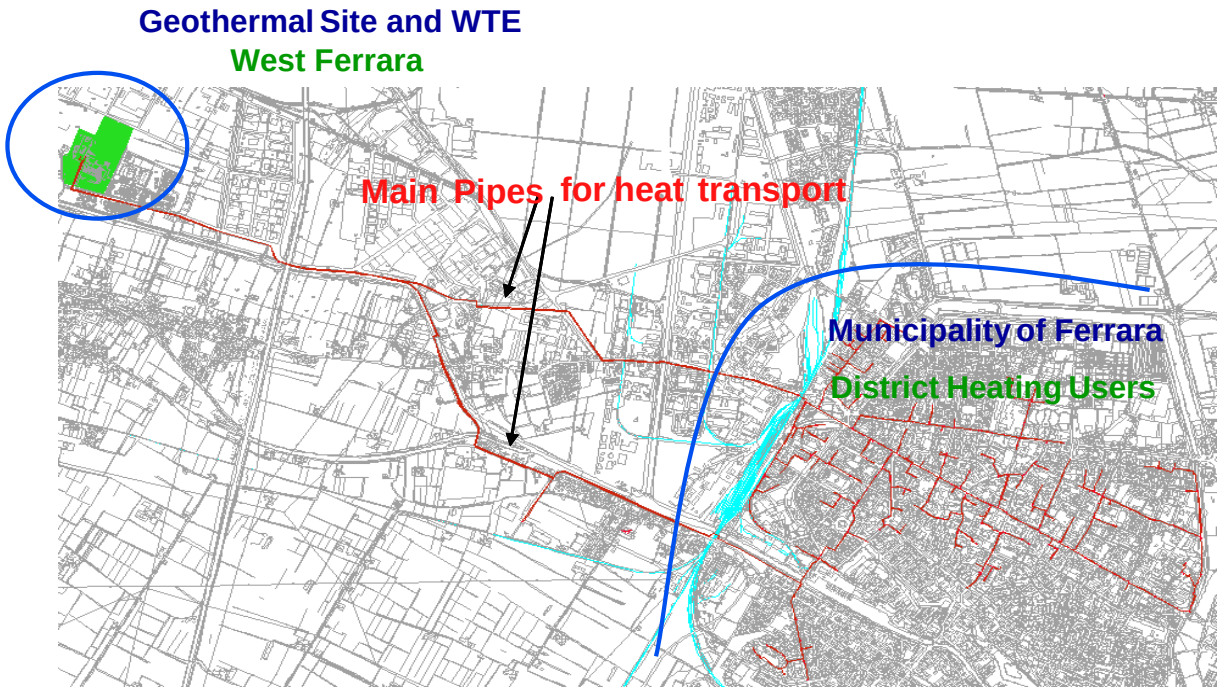
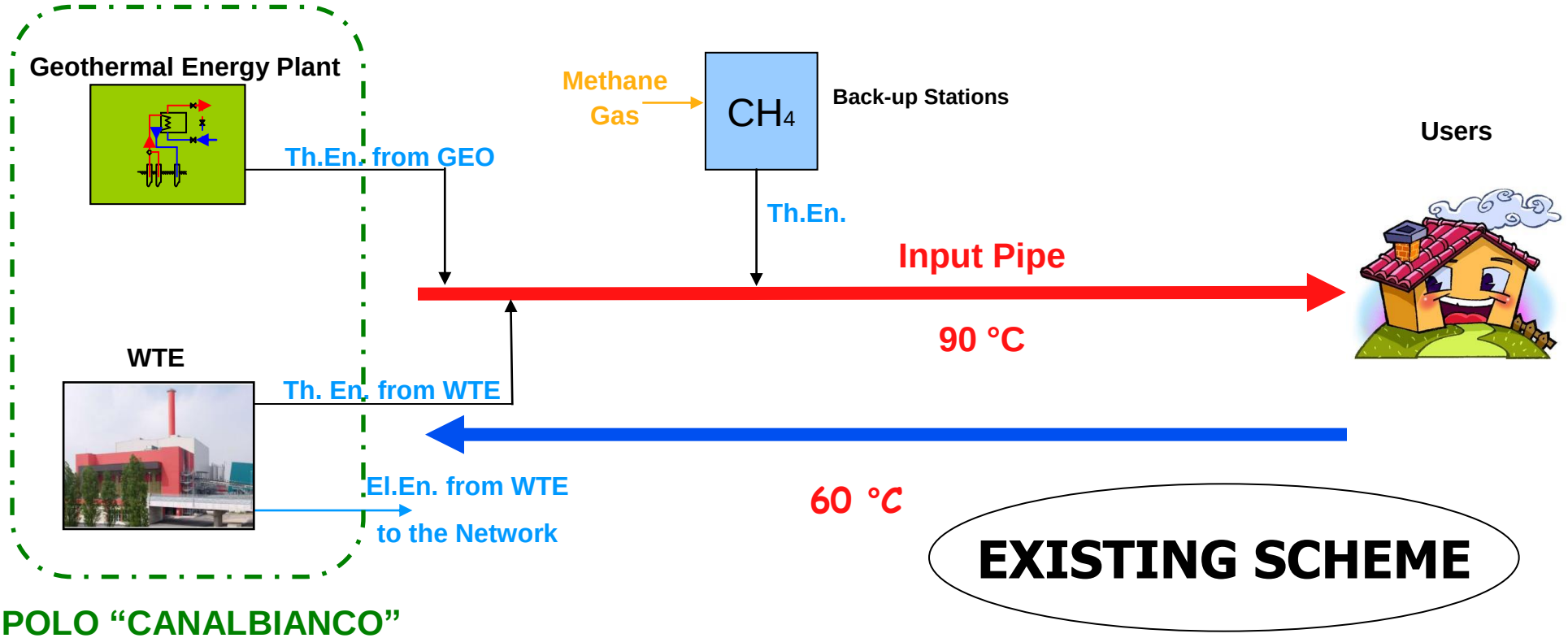
The District Heating in Ferrara - Today



The "Integrated Energy System" in Ferrara makes use of 3 kinds of sources:

- Geothermal source;
- Recovery from WTE (Waste to Energy Plant);
- Back up stations.

The District Heating in Ferrara - Today



POLO "CANALBIANCO"

- Renewable Sources and Recovery from WTE -

Geothermal Source - History

- ***Casaglia, the 60's***

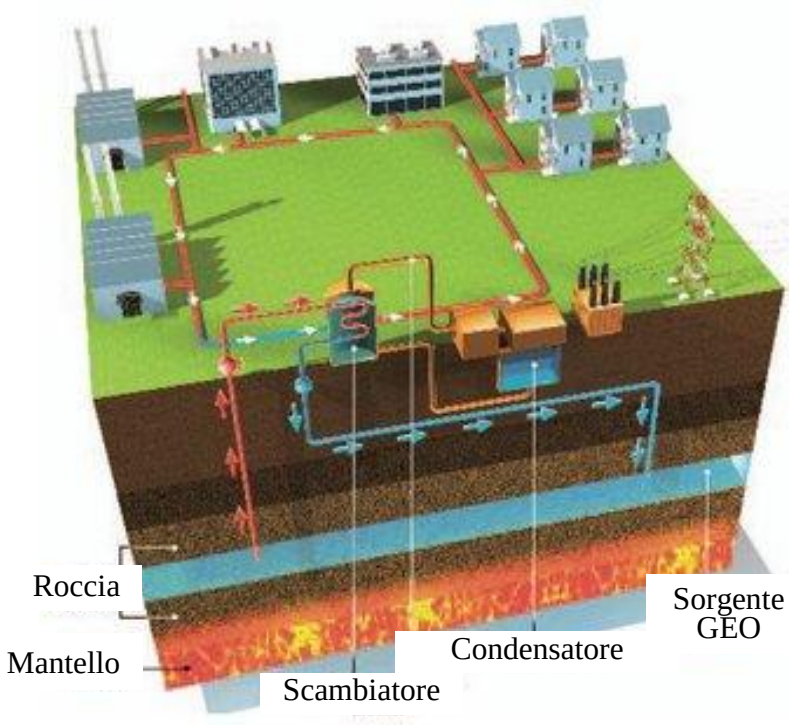
  During new oilfields research, it was detected an **underground source of hot water**, approx 2.000 m deep.

- ***The 70's***

  Energy crisis and exploitation of renewable sources.

- ***1981***

  The Municipality of Ferrara started up the



GEOTHERMAL PROJECT

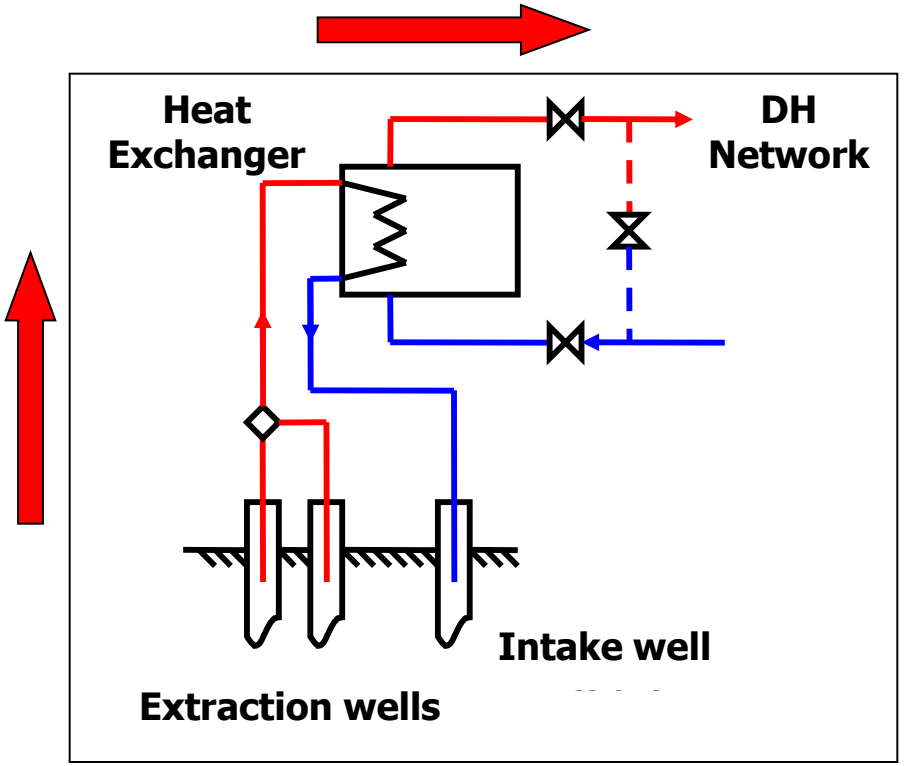
Exploitation of the geothermal resource as a primary source for a D.H. system

Geothermal Source - Characteristichs

The **geothermal fluid** is water with a high salt content at approx. 100°C.

The fluid transfers thermal energy to the network.

The hot water is pumped to the surface from a depth of approx. 1.000 m through two extraction wells.



The fluid is re-introduced in the ground in order to ensure the geotechnical stability.

WTE Source

Since the beginning of the first project, the integration with the Waste Treatment Plant had been taken into consideration:

URBAN WASTE → ENERGY RESOURCE

"INTEGRATED ENERGY SYSTEM"

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.

Operating Data of Geothermal Plant

- Total Flow Rate **400 m³/h**
- Temperature of Geothermal Fluid ca. **100°C**
- Temperature of the fluid in district heating network
  - input 90° - 95°C
  - output 60° - 65°C
- Thermal nominal Power **14 MWt**
- Thermal Energy produced ca. **75 GWh/year**

Operating Data of WTE Plant

- Authorized Capacity of waste disposal
  130.000 tons
- Electric Power to the system
  13 MWe
- Electric Energy to the system
  87 GWhe
- Max thermal power for heating network
  29 MWt
- Total thermal energy produced for the district heating system
  80 GWht/year

Back-up stations

In the "Geothermal Site", in order to handle the daily variability of the demand, there are

2 BACK-UP STATIONS

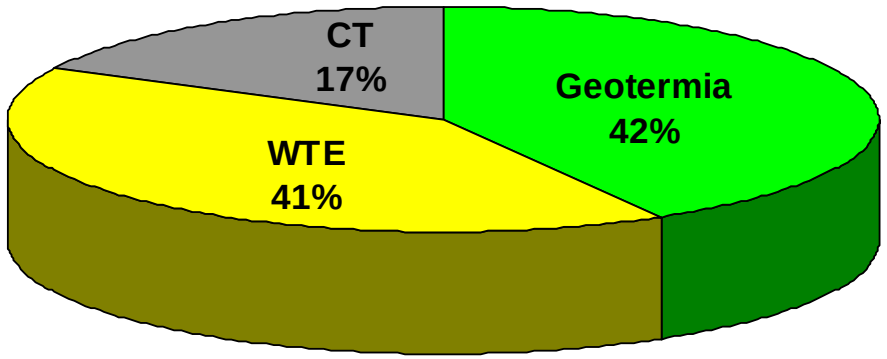
(4+3 gas boilers)

Station Power **84 MWt**

The **Thermal Energy Storage** (approx. 1.000 m^3 each one) are used for reducing the usage of the boilers during the daily consumption-peaks → **Optimization of the exploitation of the renewable and recovery sources** → Decrease of methane use

Benefits

In 2013, further to a total production of thermal energy amounting to 179 GWh, of which the **84% coming from renewable or recovery sources** (Geothermal and WTE), the **avoided emissions** will amount to:



- NO_x ca. 48 ton
- SO_2 ca. 37 ton
- CO_2 39.411 tons

Energy saving: **14.800 TOE saved** (Tons of oil equivalent),

equivalent to approx **55.000** photovoltaic panels installed (1 kW powered).

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Development Suggestion for the System

The District Heating System of Ferrra is now hydraulically satured.

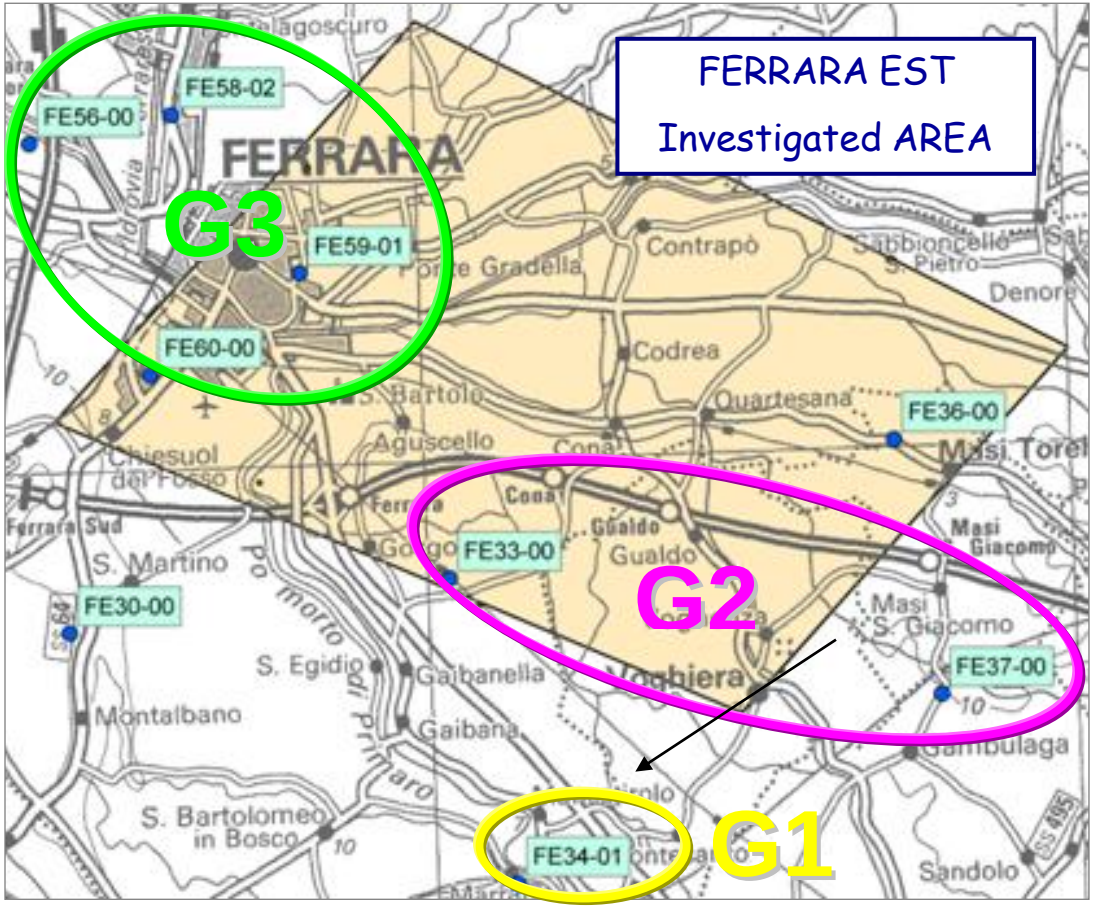
Thanks to geo - structural and geothermal investigation that confirmed the presence in the East of the town of geothermal reservoirs, suitable for a district heating exploitation, it was decided to develop the design of a new plant → "Polo Energie Rinnovabili".

The Geothermal analysis was managed with the collaboration of **Consorzio Ferrara Ricerche**, that is:

- **University of Ferrara**;
- Geologic Service of **Emilia – Romagna Region.**

The analysis discovered 2 Reservoir:

- ***RESERVOIR "G2"***
  - Deep: **ca. 650-800 m**;
  - Degree: **ca. 50-60°C**.
- ***RESERVOIR "G3"***
  - Deep: **ca. 1600-1800 m**;
  - Degree: **ca. 90°C**.



Development Suggestion for the System

Volume served

5.500.000 m^3

+

Connectable Volume

3.000.000 m^3

Heating to 8.500.000 m^3

Equal to 37.500 standard flats*

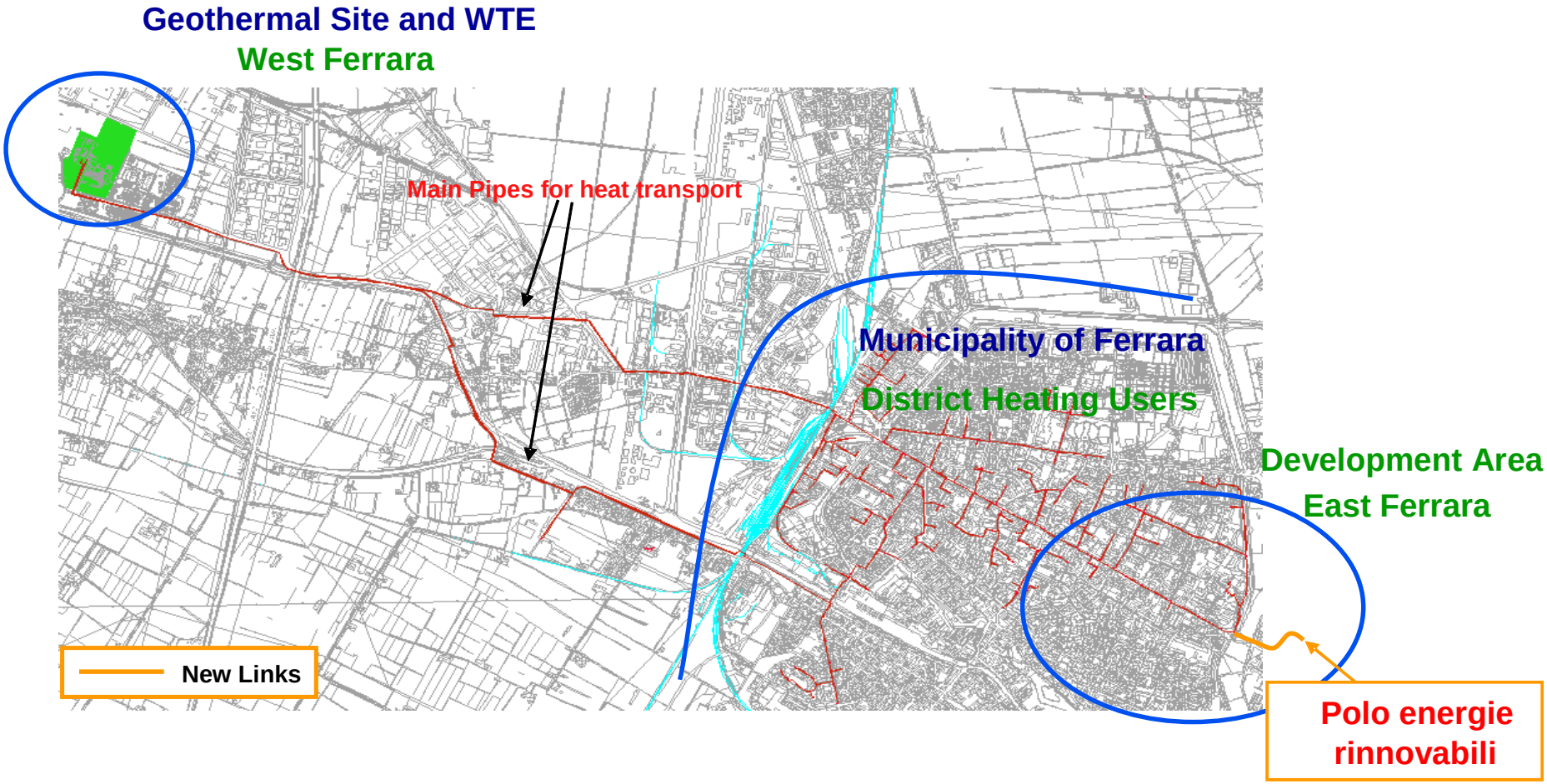
(approx. the 40% of the flats of the whole city)

In order to improve the exploitation of the resources of the country, according to "Integrated Energy System", it has been planned a new Project.

PER - POLO ENERGIE RINNOVABILI

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

Development Suggestion for the System



Development Suggestion for the System

The New Polo will:

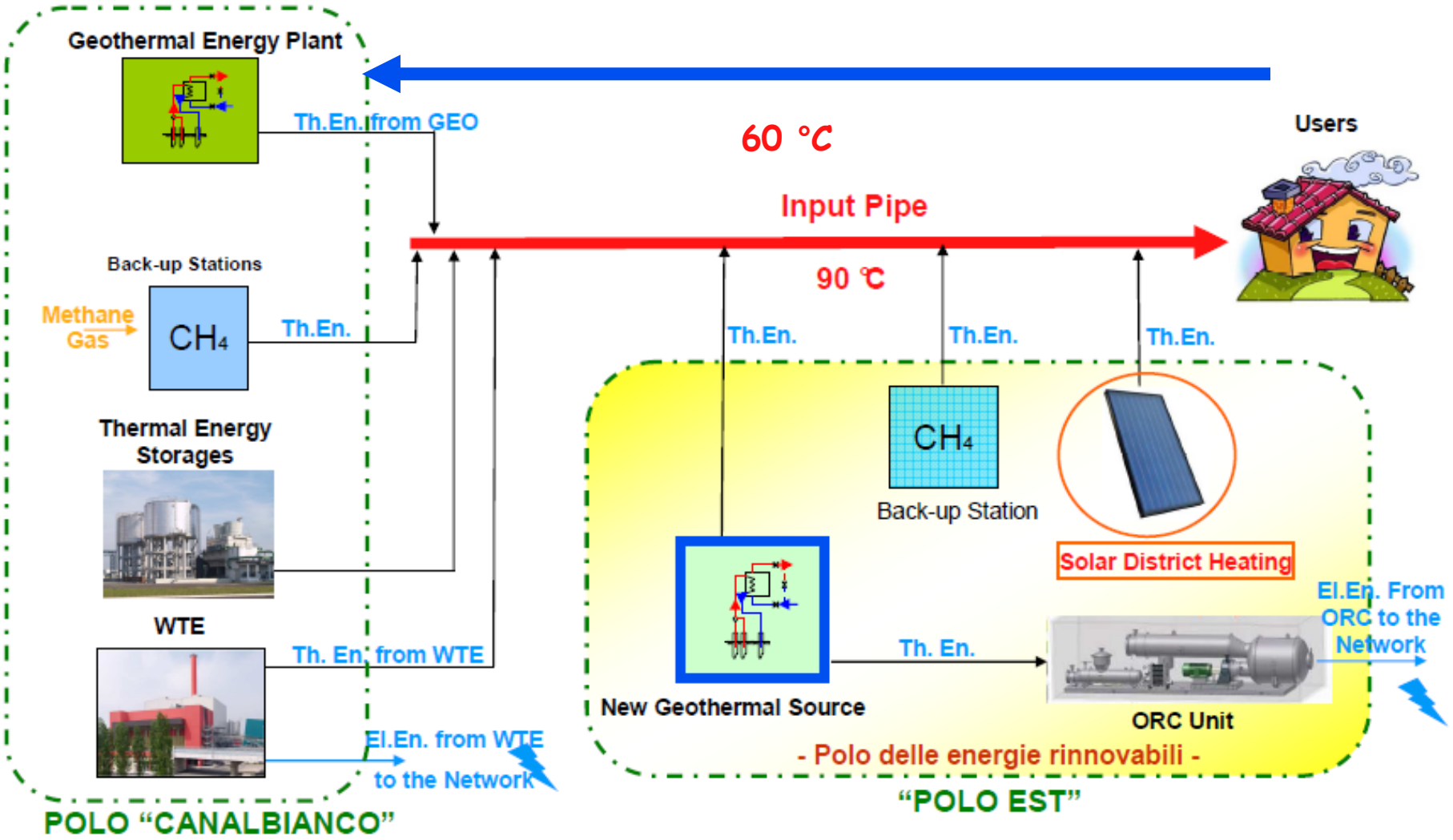
- allow to ***extend the district heating*** to more users;
- guarantee the ***hydraulic equilibrium*** of the system → it will be located in the opposite side of city, towards the existing "Geothermal Site";
- give the chance of better exploiting the ***new geothermal reservoirs***.

Project Outline

The general plan of the new production area, working with renewable sources (so-called *"Polo Energie Rinnovabili*, is:

- ***Solar District Heating (SDH)***
  about 1 MWt as a primary source of thermal energy (base-load) for the D.H. network
- ***New Geothermal Source (→ research project "Metageo")***
  2 Extraction Wells + 1 for re-introducing the fluid in the ground (total 14 MWt). The deep of new Wells is among 3.000 m
- ***ORC System for electric power production***
  1 MWe generator
- ***2+2 thermal energy storages***
- ***1 Back-up Thermal Station***
  3 boilers (each of them of 14 MWt)

Development Suggestion for the System



Solar District Heating

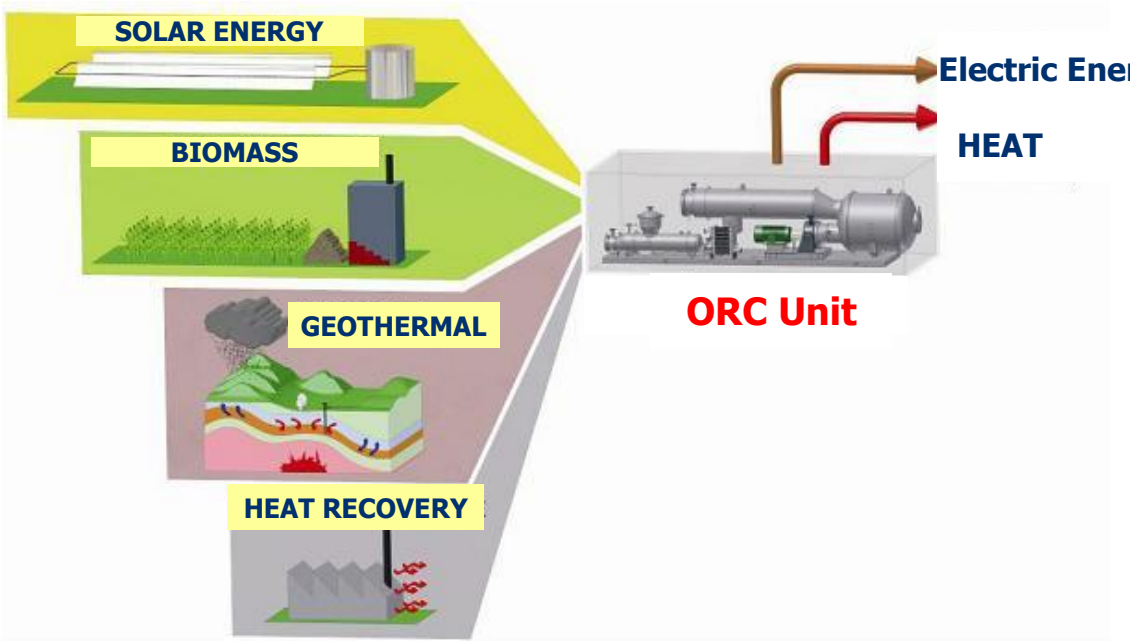
The development project shows several innovative solutions, such as **Solar thermal Plant** (1 MW powered) as primary thermal energy source (base-load).

The Solar thermal Plant will ensure about 1 GWh total annual thermal production.

This application will represent one of the **first examples** in Italy of Solar Thermal applied to District Heating, which has already well started up in Northern Europe.

Organic Rankine Cycle (ORC)

A generator works such as a steam turbine, in order to turn thermal energy into eletric energy.



When the District heating isn't active, the ORC unit can be powered by the geothermal source.

Expected Goals

Polo Ovest “C. Bianco”

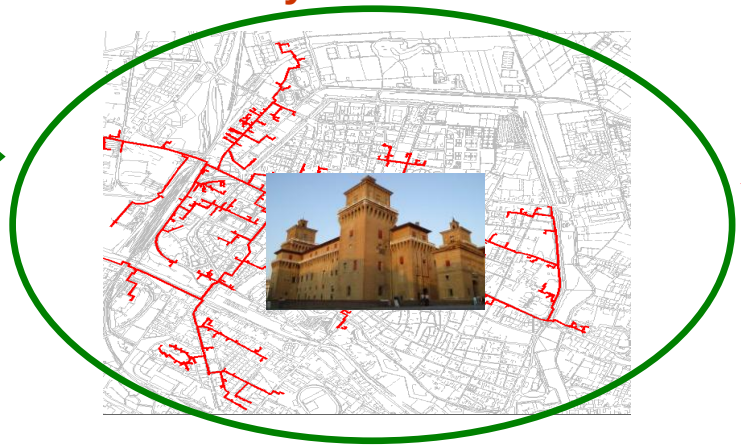
Geothermal Energy

WTE recovery

Served Volume

8,5 mln mc

City of Ferrara



Polo Est

Polo Energie Rinnovabili

With the development of an *Integrated Energy System in the whole city*, is forecast:

- ✓ **Thermal Energy from Solar Plant: 1 GWh**
- ✓ **Thermal Energy from Geothermal Plant: 163 GWh**
- ✓ **Thermal Energy from WTE: 99 GWh**

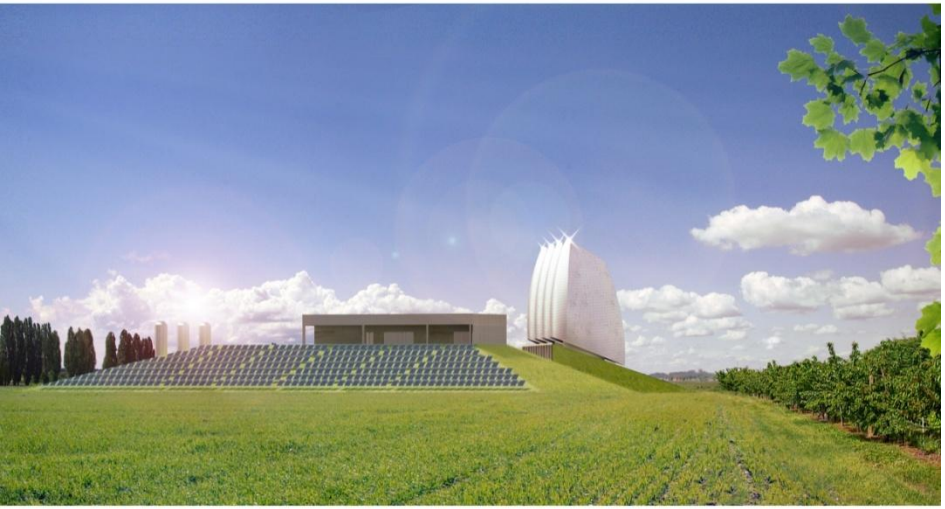
Energy from Renewable or Recovery Sources

91%

Polo Energie Rinnovabili

1.

2.



Polo Energie Rinnovabili

3.

4.

State of the art

At the present time, the applications of authorizations are in stand - by, in order to wait the definitive conclusions on the studies of "**I**nternational **C**ommission on **H**idrocarbon **E**xploration **A**nd **S**eismicity in the **E**milia Region" (ICHESE).

This Commission was founded by Emilia Region after the may 2012 seismic events.

Thank you for your attention!