ENERGY AND EMISSIONS BALANCES OF LARGE COGENERATIVE DISTRICT HEATING SYSTEMS

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THE L.E.A.P. LABORATORY

WHO WE ARE

L.E.A.P. acronimous for - Laboratorio Energia & Ambiente Piacenza - founded in Piacenza in May 2005 following an initiative of Politecnico of Milano Piacenza campus.

Members of the consortium are:

- Politecnico of Milano - (CSPP) Piacenza campus
- Politecnico of Milano Department of Energy Engineering
- Politecnico of Milano Department of Chemical Engineering
- Politecnico of Milano Department of Information Technology Engineering
- Politecnico of Milano Department of Electrical Engineering
- Politecnico of Milano Department of Environmental and Land Planning Engineering
- Fondazione di Piacenza e Vigevano (bank)
- A2A S.p.A.
- Enìa S.p.A.
- Municipality of Piacenza
- Provincial Administration of Piacenza
- R & D Groppalli s.r.l.
- Unical AG

Comune di Piacenza

Provincia di Piacenza

FONDAZIONE DI PIACENZA E VIGEVANO

GROPPALLI

enìa

Più grande, più vicina.

a2a

energie in comune

Unical

THE L.E.A.P. LABORATORY

WHAT WE DO

1. Heat Generation
   - Thermal energy generation through the development of prototypes and component certification of thermal energy generators, including those running on de-carbonated fossil fuels
   - Technical-Economical analysis of Solid Waste and biomass power plants
   - Fine particles measurement

2. Energy from Renewable Sources
   - Biomass
   - Wind Energy
   - Solar Energy

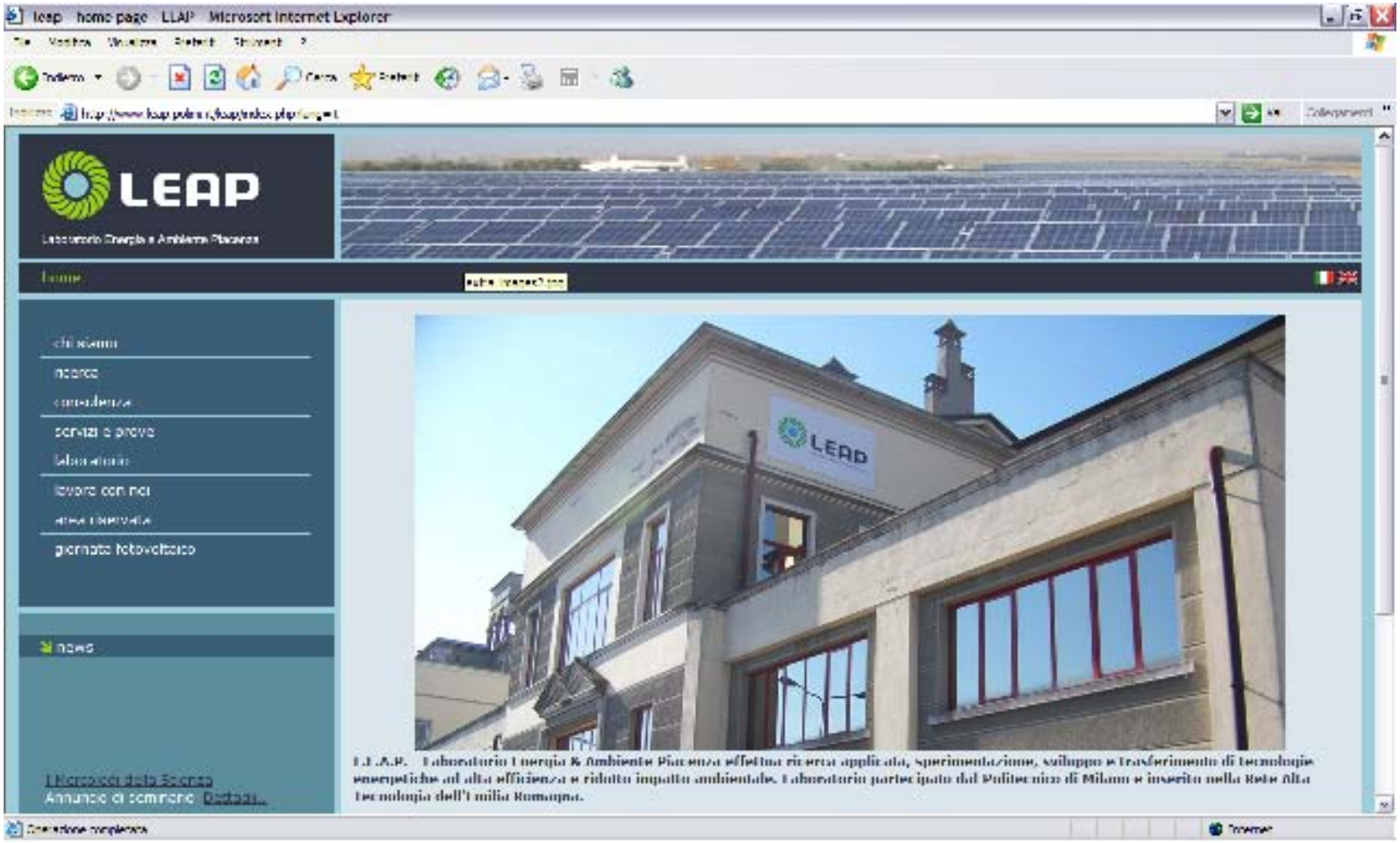
3. Thermo hydraulics experimental activities of new components for new generation nuclear power plants (mainly focused on the I.R.I.S. project)

4. CO_2 Capture and Sequestration
   - Experimental characterization of carbon dioxide based mixtures for oxy-combustion applications
   - Software development for complex power plants simulation

THE L.E.A.P. LABORATORY

For more detailed information about our research activities please take a look at the site

www.leap.polimi.it



FORMER COGENERATION ACTIVITIES

THE DCOGEN CODE

The DCOGEN code is a software developed by the Group of Energy Conversion Systems of the Energy Department of Politecnico di Milano.

It can perform the energetic-environmental-economical analysis of complex cogenerative systems (combined heat, power and cooling) from really small scale applications (micro-cogeneration) such as domestic applications to large scales combined cycles matched with district heating.

POWER PLANTS

- Alternative Internal Combustion Engines;
- Gas Turbines;
- Fuel Cells;
- Steam Cycle Power Plants;
- Combined Cycle Power Plants.

POLLUTANTS

- CO2;
- CO;
- NOx;
- SOx;

ECONOMICS

- NPV;
- PBT;

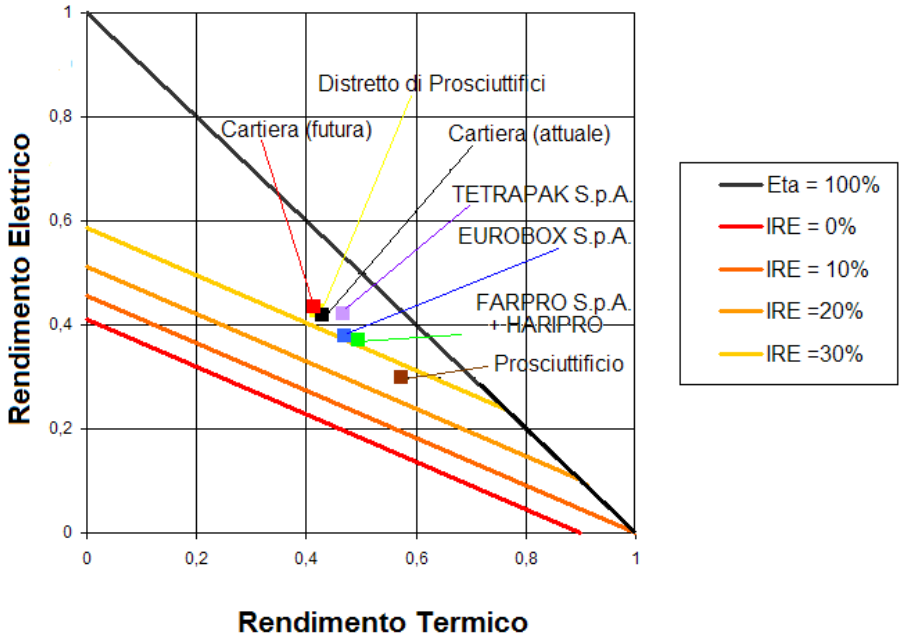
FORMER COGENERATION ACTIVITIES

COGENERATION IN THE REGION EMILIA-ROMAGNA

This project carried out in co-operation with the Energy department of the Bologna University had the goal to evaluate the potentialities in the use of cogeneration systems in industrial power plants.

Several Types of industrial processes have been considered and among them some have been studied in detail. By using the DCOGEN code, accurate simulations have been carried out to evaluate the energy and emissions savings due to the introduction of cogenerative systems.

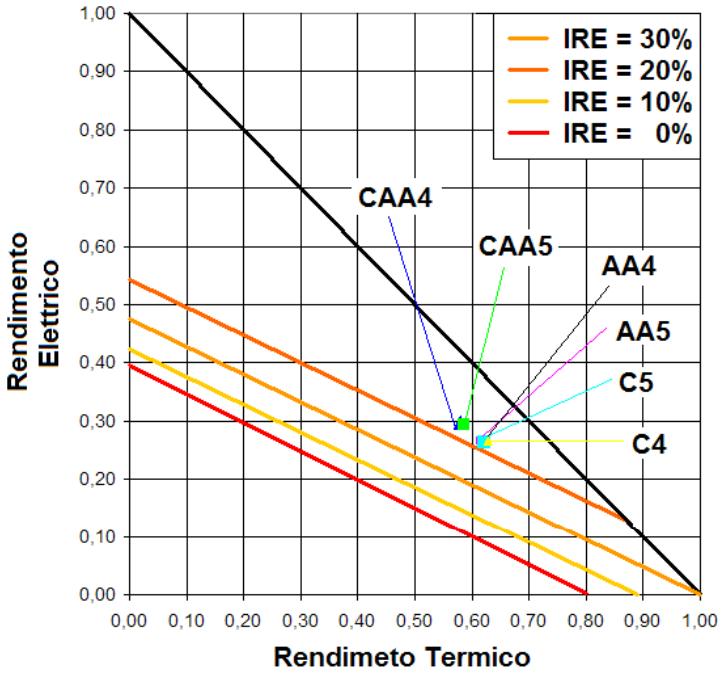
Due to the magnitude of the energy requirements the chosen engine technology was in all cases an alternative internal combustion engine



FORMER COGENERATION ACTIVITIES

COGENERATION IN THE ZENA CASTLE

This project was developed to better understand if the application of cogeneration systems and renewable sources to ancient buildings was possible. Since in the Zena Castle the integration was possible the energy balances were performed to quantify the energy and pollutants emission savings



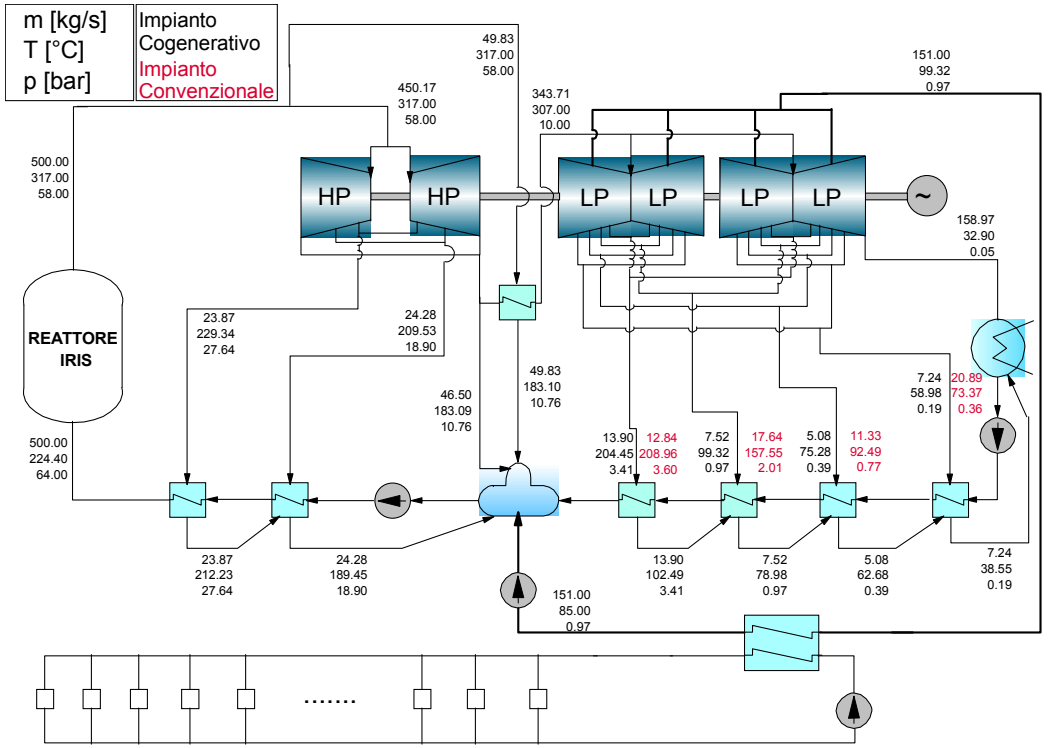
FORMER COGENERATION ACTIVITIES

COGENERATIVE NUCLEAR POWER

This project carried out in co-operation with S.I.E.T. S.p.A. was a preliminary evaluation of the potentialities of a cogenerative application of an I.R.I.S. nuclear reactor based power plant.

In particular for different sizes of the network and for different supply temperatures were evaluated:

- Energy and mass balances of the power plant;
- CO_2 emissions savings due to the use of cogenerations;
- Preliminary cost analysis of the whole system including the district heating;



THE A2A-BRESCIA PROJECT

THE BRESCIA COGENERATIVE DISTRICT

The Brescia district heating is one of the largest examples in Italy. It started in 1971 as a centralized heat distribution. It was converted into a cogenerative district heating when in 1978 , 1981 and 1987 were the three groups of the Lamarmora power plant were progressively introduced. They are mainly fed by coal and fuel oil.

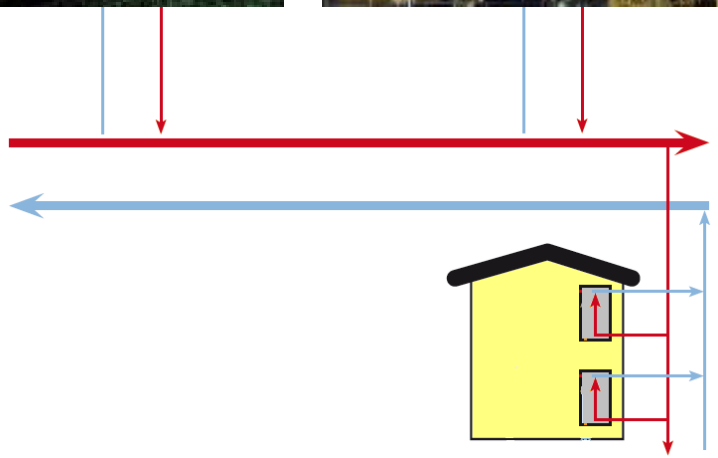
Another very important step in the development of the Brescia cogenerative district heating was the introduction in 1998 of the waste to energy plant that at that time was solid waste fed. Since 2006 the waste to energy plant has been modified and can be partially fed with biomass.

THE A2A-BRESCIA PROJECT

THE BRESCIA COGENERATIVE DISTRICT

Electrical Power : 139 MW
Thermal Power : 300 MW
Fuels : Coal
Fuel Oil
Natural Gas

Electrical Power : 70 MW
Thermal Power : 150 MW
Fuels : Solid Waste
Biomass



Final Users : 17,500
Heated Volume : 39.6 Mm³

THE A2A-BRESCIA PROJECT

ENERGY AND ENVIRONMENTAL BALANCES OF THE ACTUAL SYSTEM

The first phase of the project consists in the evaluation of the most important energy fluxes and pollutants emissions of the actual configuration of the Brescia's district heating system. The actual energy consumption and pollutants emission will then be compared with the non cogenerative case (natural gas fired domestic boilers and electricity acquisition by the national electric network).

The evaluation will be carried out by analysing the historic data supplied by A2A about the heating network, the Lamarmora Power plant and the waste to energy plant .

Pollutants that will be considered are:

- CO
- NOx
- SOx
- HC
- Particles
- CO_2

THE A2A-BRESCIA PROJECT

POSSIBLE IMPROVEMENTS OF THE SYSTEM

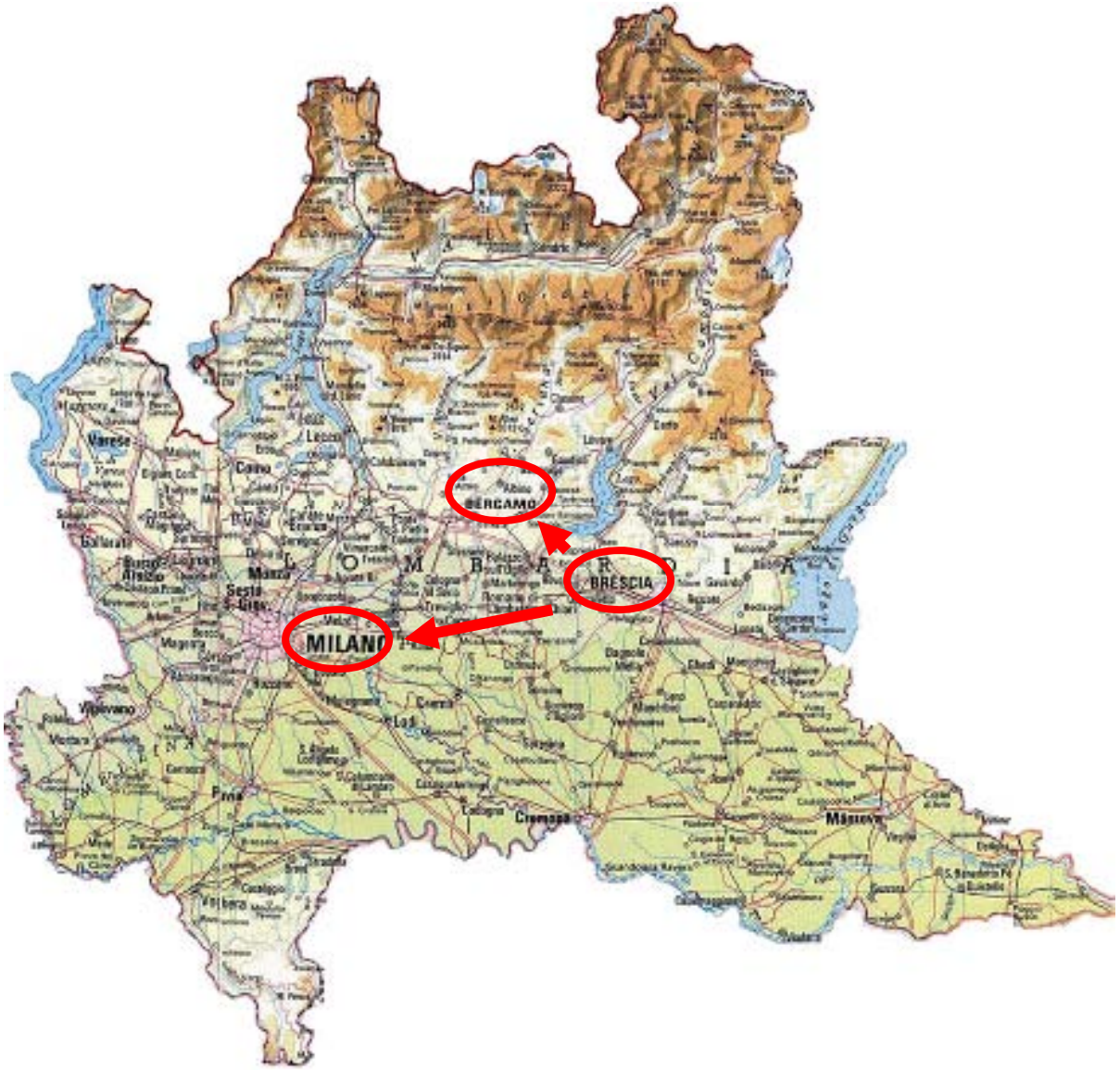
Since the Lamarmora power plant is not representative of the state of the art of modern cogeneration power plants, a new scenario will be considered. A modern combined cycle power plant will be chosen as an alternative to the Lamarmora steam cycle power plant.

Depending on the district's energy requirements the correct size of the power plant will be chosen and the new energy and pollutants emissions will be compared to the actual system layout and to the non cogenerative case.

THE A2A-BRESCIA PROJECT

EXTENSION TO OTHER SIMILAR CITIES IN NORTHERN ITALY

The results obtained for the configuration representative of the state of the art of modern heating districts (cogenerative combined cycle + cogenerative waste to energy plant) will then be extended to two other major cities located in northern Italy, Milan and Bergamo to evaluate the potential energetic and environmental benefits related to the introduction of district heating.



THANK YOU FOR YOUR ATTENTION