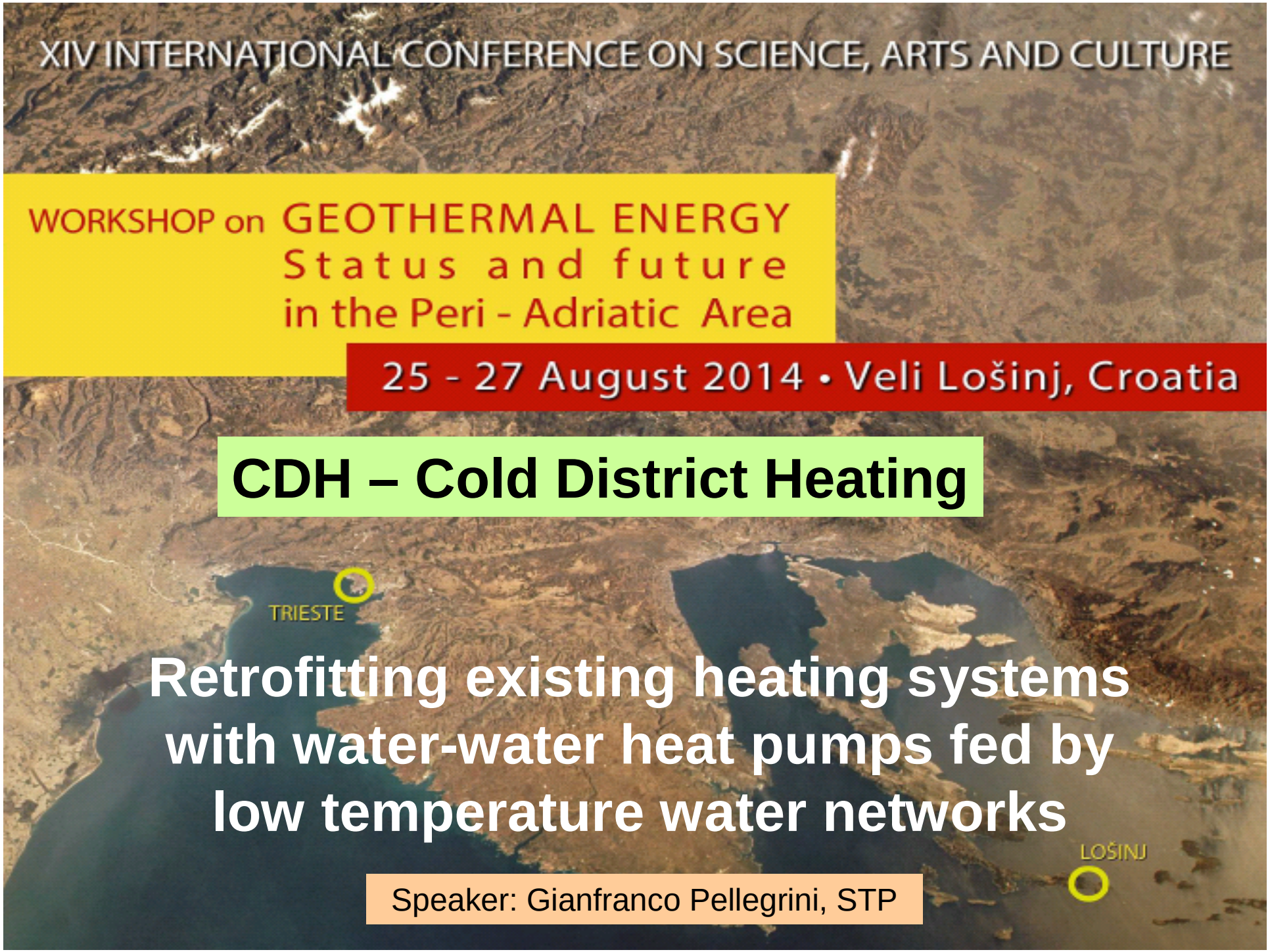
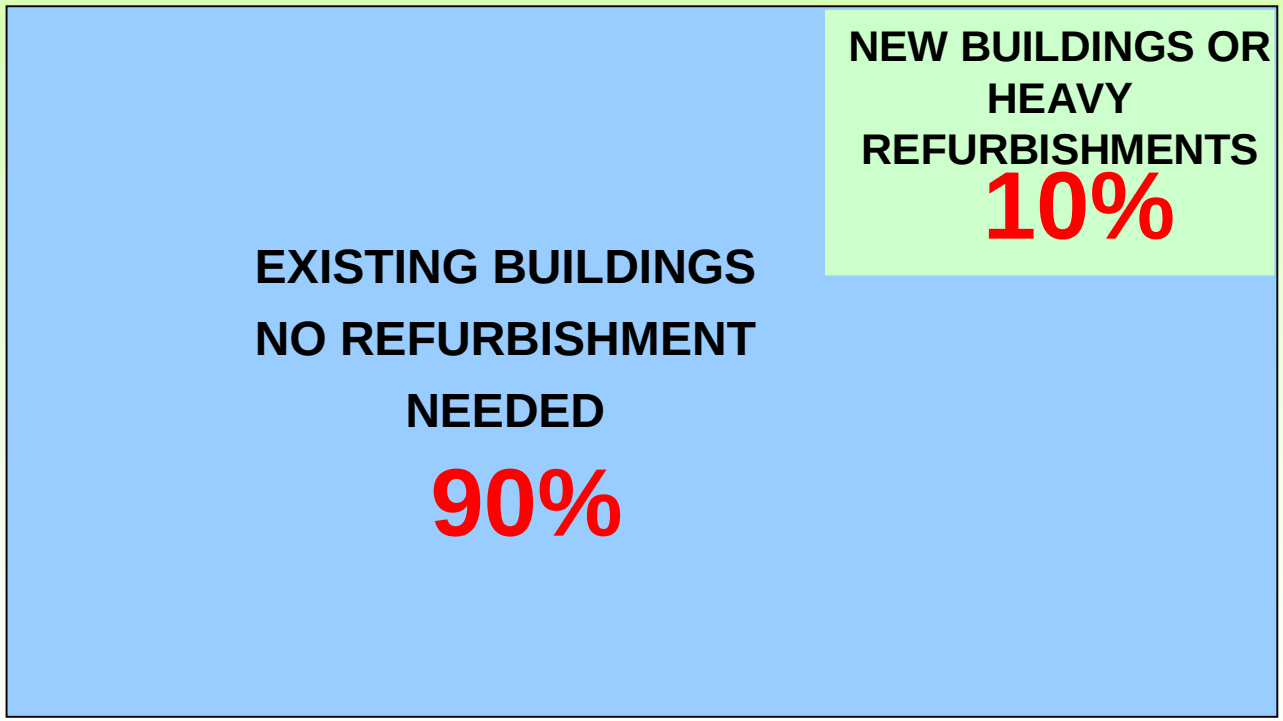

XIV INTERNATIONAL CONFERENCE ON SCIENCE, ARTS AND CULTURE
WORKSHOP on GEOTHERMAL ENERGY
Status and future
in the Peri - Adriatic Area
25 - 27 August 2014 • Veli Lošinj, Croatia
CDH – Cold District Heating
TRIESTE
Retrofitting existing heating systems with water-water heat pumps fed by low temperature water networks
LOŠINJ
Speaker: Gianfranco Pellegrini, STP

MARKETING HEAT PUMPS

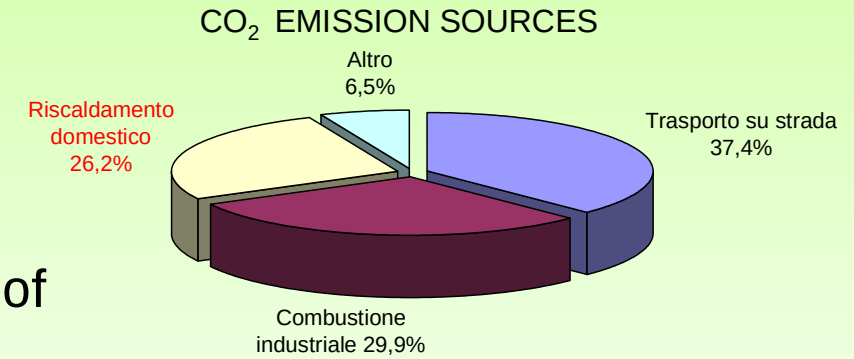
Focus on potential market

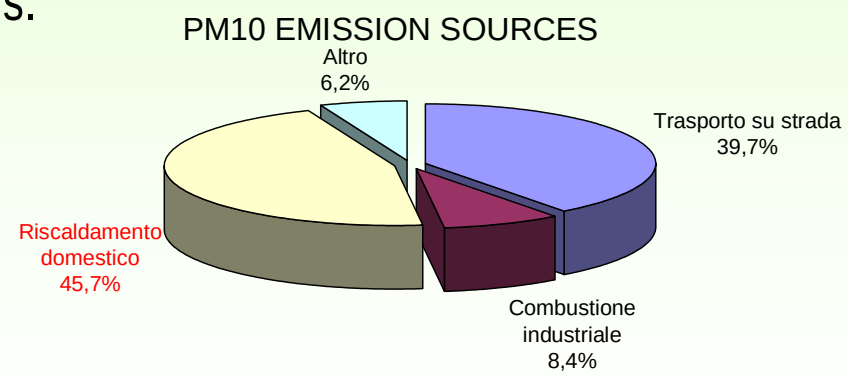


TINA - HIGH TEMPERATURE HEAT PUMP

The starting point

The high temperature heat pump (Tina)
The Non Polluting Boiler
Resolves in the towns the pollution problem due to space heating
just replacing the boilers (plug & play) of traditional radiator systems. There is no need of difficult, expensive and often unrealizable refurbishment of buildings and heating-systems.





TINA - HIGH TEMPERATURE HEAT PUMP

Target market

The first target market are the **existing urban buildings** (apartment blocks, historical buildings, schools, hospitals, etc..) and the industrial/commercial sites.
However, Tina provides significant advantages also on new installations when a low-inertial heating system is needed.

TRADITIONAL HEAT PUMPS

Limits of the traditional heat pumps

Both the traditional heat pumps and the innovative high-temperature heat pump ensure NO POLLUTING EMISSIONS due to building-heating. However, the supply temperature (out) with traditional heat pumps reach a maximum of about 50 °C and therefore they are inadequate for traditional high-temperature systems, i.e. radiators (required temperature: 70-80 °C).
In the towns, where the pollution problem is becoming more and more serious, most of the existing buildings have a high temperature radiator system.

HIGH TEMPERATURE HEAT PUMPS

TINA is a

Heat pump at high temperature

hydrothermal, two stages that can

produce heat at temperatures > 80°C

with COP > 3

(very high value for these ΔT).

These performances are obtained

on behalf particolar technological

patented solutions.

TINA - HIGH TEMPERATURE HEAT PUMP

Advantages - Economical

Economical
The greater initial investment, compared to traditional boilers, is compensated in the time by the cost savings on energy production (35-45%). In this comparison we consider both fuel and management costs (ordinary and extraordinary maintenance, system management, etc.)

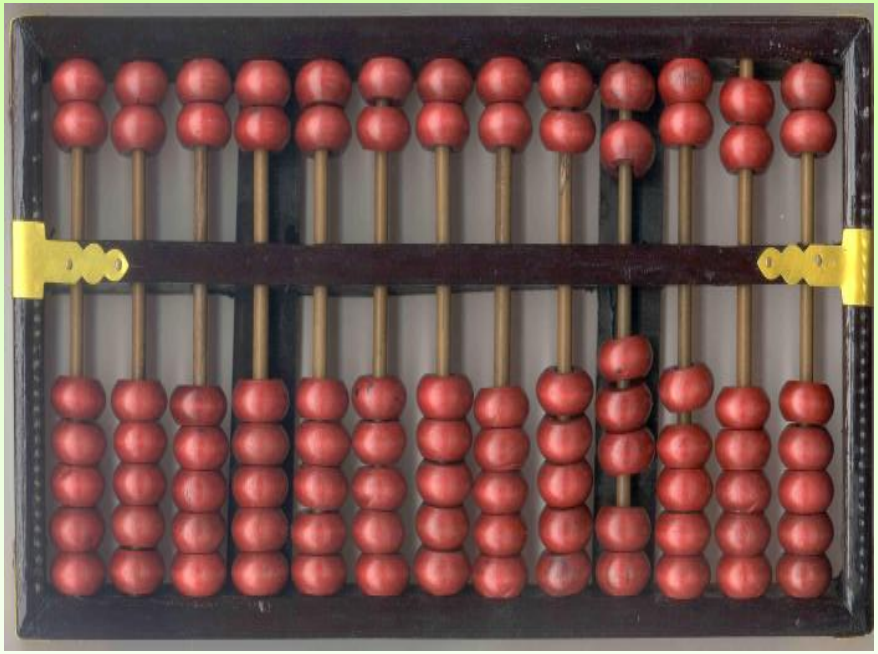
In Italy
The comparison with market costs of natural gas and electricity leads to a **payback of 3÷5 years**

TINA - HIGH TEMPERATURE HEAT PUMP

Advantages - Maintainance

Management

Due to low management requirements, you can save up to 35-45% of the heating-system operative costs (maintenance, tests, law requirements, etc.)



TINA - HIGH TEMPERATURE HEAT PUMP

Advantages - Energetical

At least the 70% of the energy used to heat the building is renewable and comes for free from the nature.

TINA - HIGH TEMPERATURE HEAT PUMP

Advantages - Environmental

Zero emissions on site,
Contribute to resolve
the pollution problem
of the towns.

TINA - HIGH TEMPERATURE HEAT PUMP

ATTIVITA' UNA TANTUM ALL'ATTO DELL'INSTALLAZIONE				
PROGETTAZIONE/PRATICHE				
	Caldaia Metano	PDC HT	Note	
Progettazione	x	x		
Pratiche ISPELS	x			
Richiesta collaudo ISPESL	x			
Esame progetto VVF	x			
Richiesta CPI	x			
Direzione lavori (obbligatoria)	x			
Legge 311 (Ex Legge 10) per mera sostituzione	x	x		
Pratiche autorizzative geotermia		x		
INSTALLAZIONE E COLLAUDI				
	Caldaia Metano	PDC HT	Note	
Video ispezione canna fumo	x			
Pulizia canna fumo	x		Alternativa alla voce seguente	
Sostituzione canna e raccordo fumari	x		Alternativa alla voce precedente	
Manodopera complessiva	x	x		
Adeguamento locale CT a normative VVF	x		Alternativa alla voce seguente	
Rifacimento completo CT	x		Alternativa alla voce precedente	
Collaudi e messa in funzione	x	x		
ATTIVITA' DI GESTIONE ORDINARIA ANNUALE				
COSTO ANNUO DI GESTIONE				
	Caldaia Metano	PDC HT	Note	
Terzo responsabile	x			
Manutenzione ordinaria	x	x		
Manutenzione straordinaria (solo generatore)	x	x		
Analisi prodotti di combustione	x			
Costo metano / elettrricità	x	x		

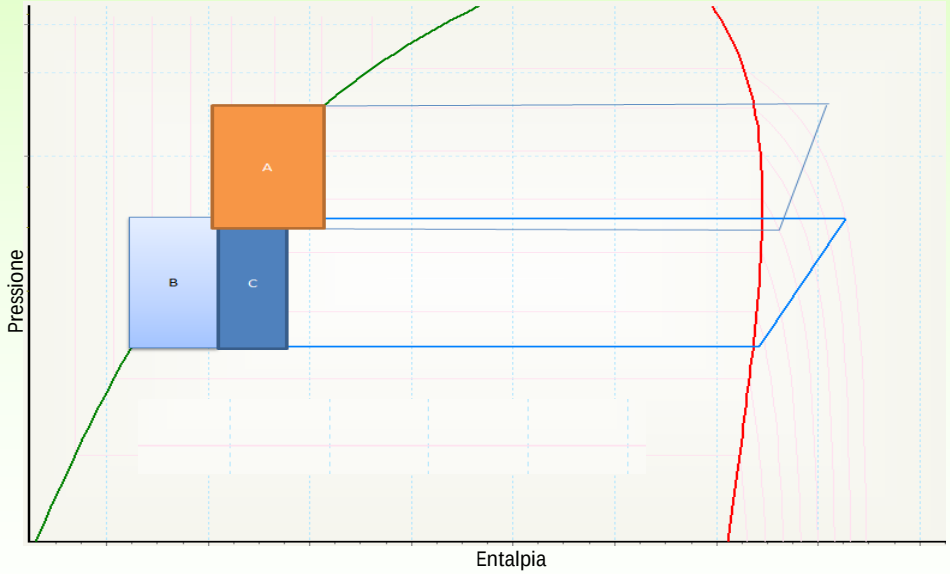
HT HP vs boiler: design, installation, test and management activities comparison.

TINA - HIGH TEMPERATURE HEAT PUMP

Working principles

Tina is a geothermal two-stage heat pump, specifically designed to heat the water up to 80°C with a COP ~ 3 (excellent value for such a temperature)

These performances, never obtained before, are due to particular technical and scientific solutions, covered by international patents.



TINA - HIGH TEMPERATURE HEAT PUMP

Technical features of TINA 115kW

Heating power:	115 kW
Range of working temperatures:	60 ÷ 80°C
COP	3,9 ÷ 3,0
Temperature of geothermal water	≥ 7°C
Geothermal water flow needed	1,7 ÷ 6,0 l/s
Electrical power consumption	≤ 40 kWe

High Temperature Heat Pump

Caracteristics

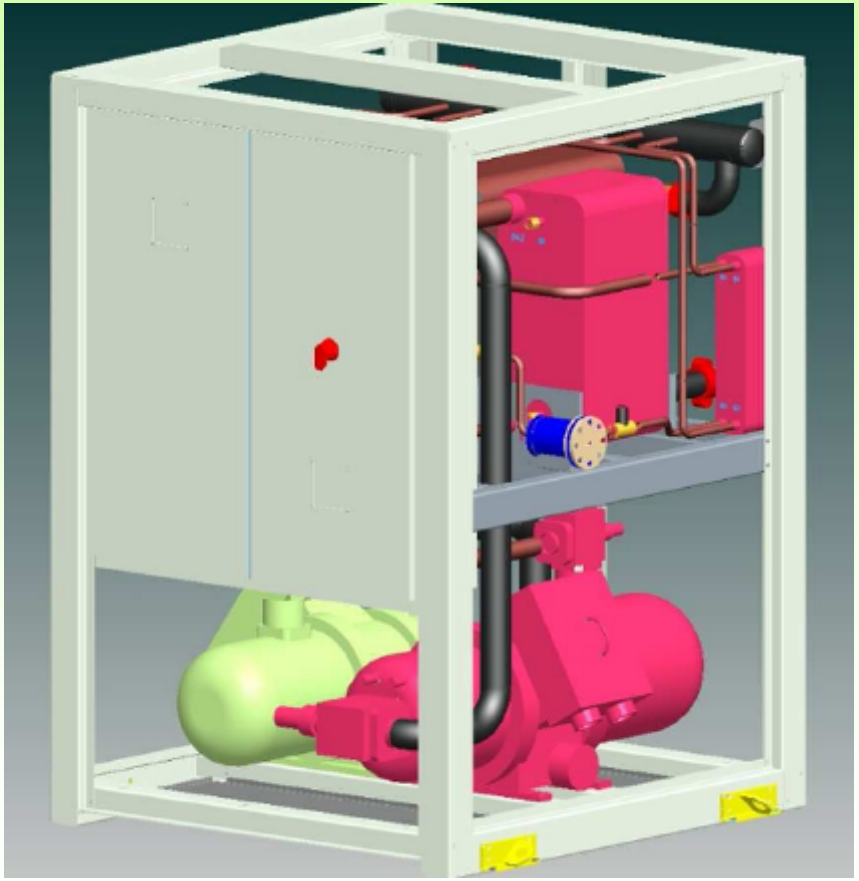
- Two stage vapor compression cycle
- Working fluid → R 600 (n-Butane)
- Hot water for space heating → up to 80°C
- COP_{min} → 3,05

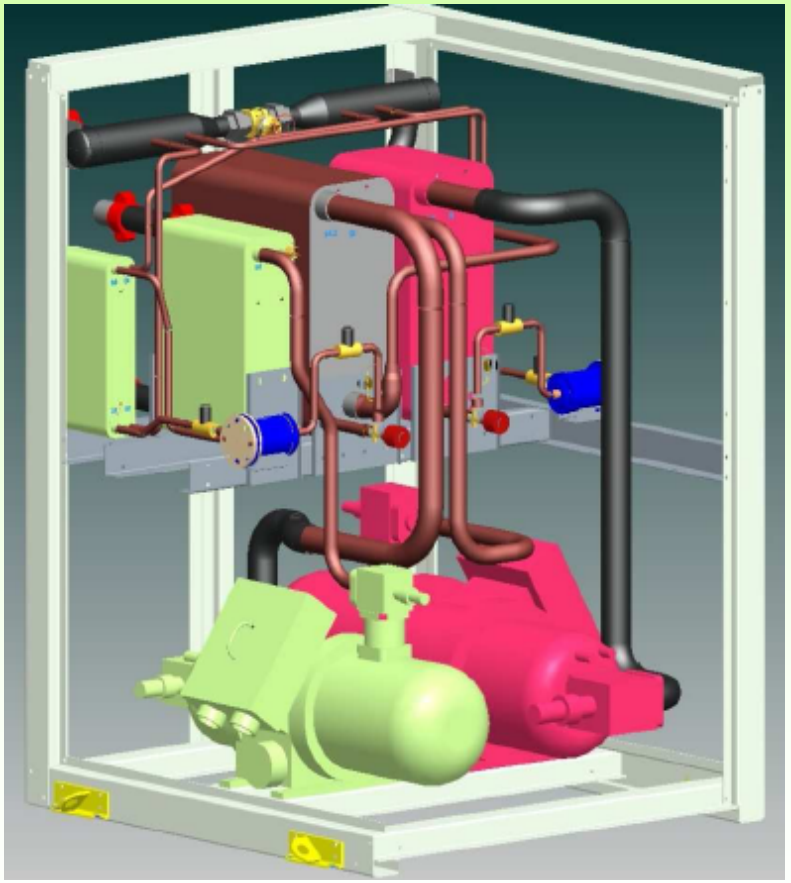
Sizes

Thermal Power [kWt]	Electrical Power [kWe]	Water flow [l/s]	Dimensions [m x m x m]
115	40	2 - 6	1,6m x 1,5m x h 2,2m
250	87	4 - 13	2m x 2m x h 2,3m
365	127	6 - 19	3,6m x 2m x h 2,3m
500	174	9 - 26	4m x 2m x h 2,3m

TINA - HIGH TEMPERATURE HEAT PUMP

Design phase





The High Temperature Heat Pump (TINA)

TINA - HIGH TEMPERATURE HEAT PUMP

First prototype realization

TINA - HIGH TEMPERATURE HEAT PUMP

First installation in Pordenone (Italy)

Tina was hardly tested in laboratory, simulating the operating conditions. The results of the tests were great.

The first pilot-installation heats a public school in Pordenone (Italy).
The **commercialization** phase is currently going on.

TINA - HIGH TEMPERATURE HEAT PUMP

Ideal sites

The ideal sites to replace existing boilers with Tina are all those in which we can find:

wells, aqueducts, sewers, rivers, culverts, lakes, ponds, sea, ground water, waste heat from the condensers of electrical power plants, waste water from industrial processes, etc.., which can be used as **source of geothermal heat**.

COLD DISTRICT HEATING

Traditional district heating can be replaced by a cold water (10-14°C) distribution net which provides geothermal energy to the connected Tina:

- Allocating the Tinas by the end-users enables the circulation of low-temperature water in the net, avoiding the expensive insulation of pipes and ensuring a more simple installation;
- No heavy initial investments for the district power plant are needed;
- Gli interventi sono frazionabili e modulabili nel tempo, anche in funzione delle risorse economiche disponibili;

COLD DISTRICT HEATING

Further advantages

- The cost of the infrastructures and of the net is significantly lower (non insulated pipes)
- Facility management and maintenance costs are very low;
- Any faults and stops do not affect all users;
- No heat-dispersions in the net, in particular for the production of domestic hot water in the summer period;
- At least the 2/3 of the energy comes from renewable resources;

COLD DISTRICT HEATING

Steps of a cold district heating project

The steps of a cold district heating project are:

- Analysis of the potential buildings to be served (location, power need, etc.)
- Technical and economical feasibility study;
- Business plan sharing with the investors;
- Sharing with the Municipality Technicians to eliminate the main risks;
- Presentation to Municipal Council for final approval;
- Start of authorization and design phase

COLD DISTRICT HEATING

Issues of a traditional district heating project

A traditional district heating project provides ecological advantages for the city pollution, potential economical benefits for end-users and potential energetical benefits, particullarly if you re-use heat waste.

Such a project, indeed, can cause also some political and social conflicts due to the heavy impact of the operations to realize the net in the public roads.

Another problem may occur when the heat is not recovered from existing processes (waste) and it must be produced locally with polluting emissions.

COLD DISTRICT HEATING

Advantages of cold district heating

The problems of a traditional district heating are almost resolved by a cold district heating.

It takes less time ti realise the net and this operation is less invasive. This means less inconveniences for citizens.

The cold district heating doesn’t need a big central district power plant. This means that we have **no local pollution coming from the district power plant**. Furthermore **at least the 70% of the energy come from a clean and renewable resourse**.

Site: Piazza Unità d'Italia - Trieste

The purpose of this study is to demonstrate the technical feasibility of a CDH for all existing urban buildings around "Piazza Unità d'Italia – Trieste".

The low temperaure heat source is the seawater close to the place.

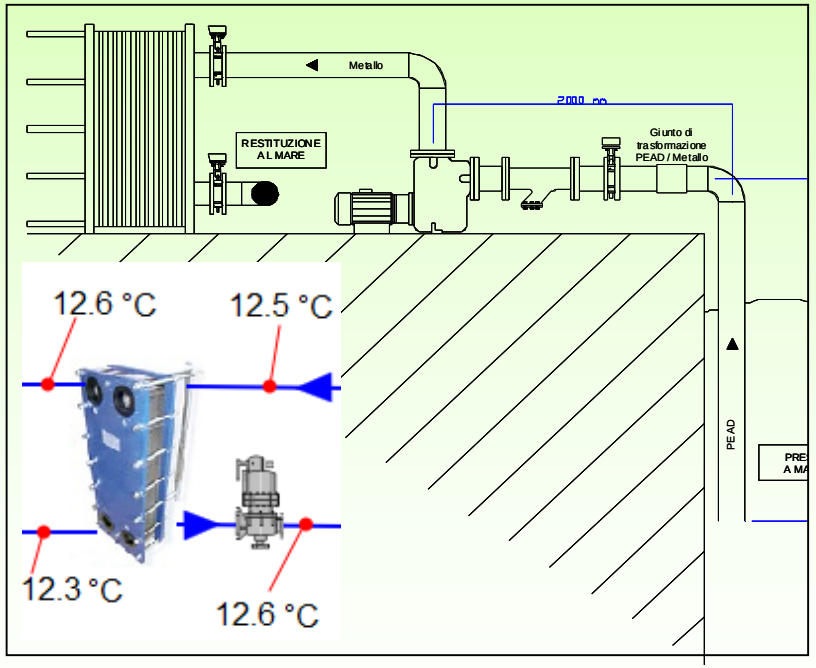
Heat exchangers separates the seawater from the softwater cyrculating in a double-pipe PEAD pipework.

Heat-exchangers installed in the buildings connects the pipework to the evaporators of High Temperauture Heat Pumps (HT HP).

The HT HP condensers produces hot water up to 80°C for space heating.

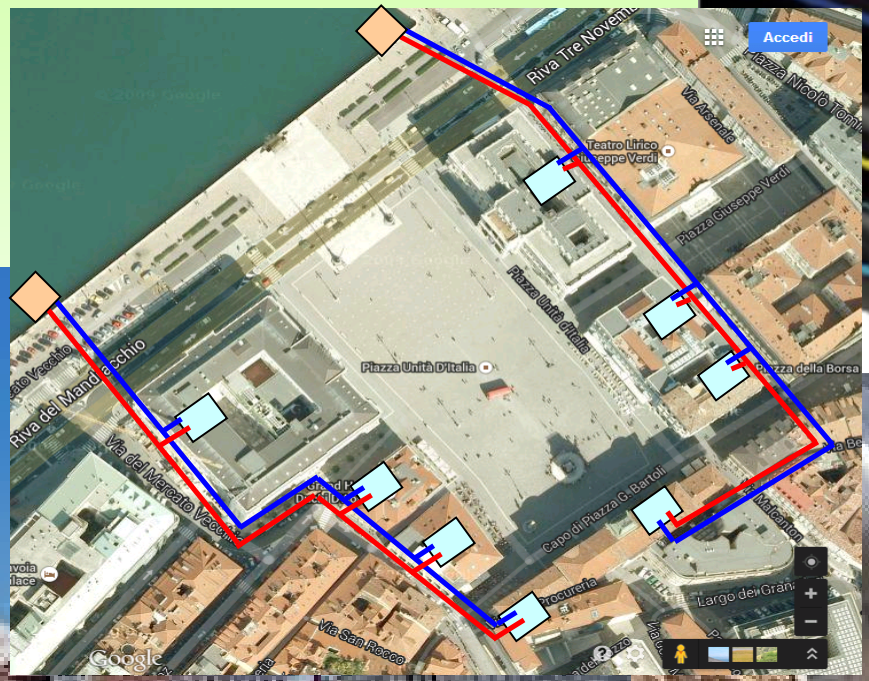
Low temperature heat source

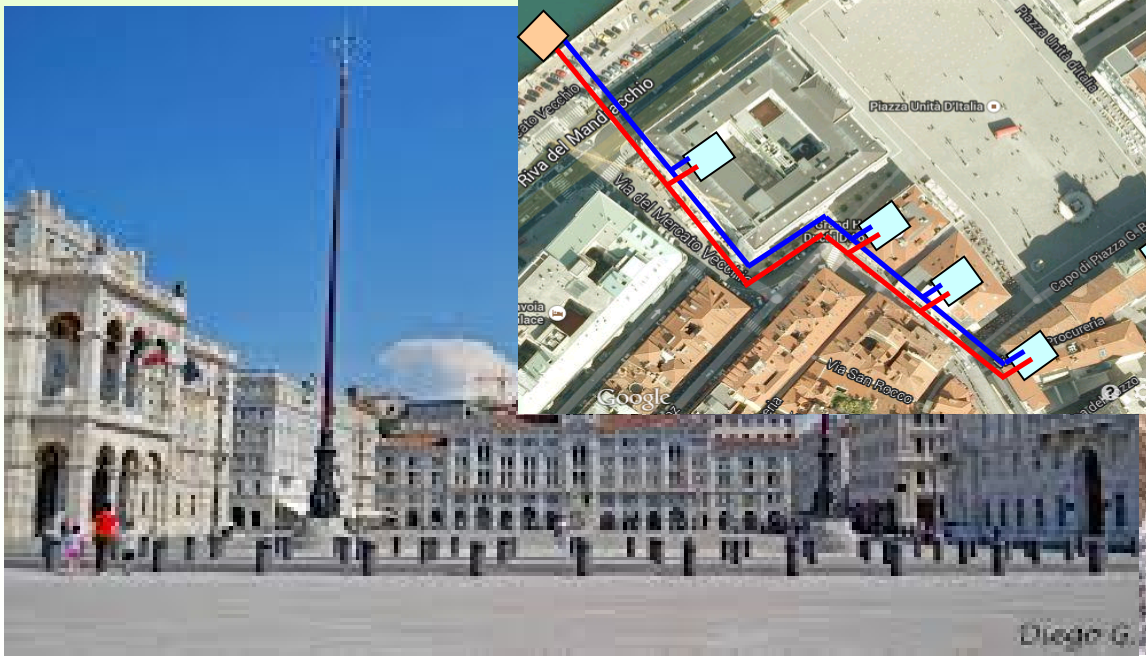
Low temperature water is provided by the sea close to Piazza Unità d'Italia



CDH – Cold District Heating

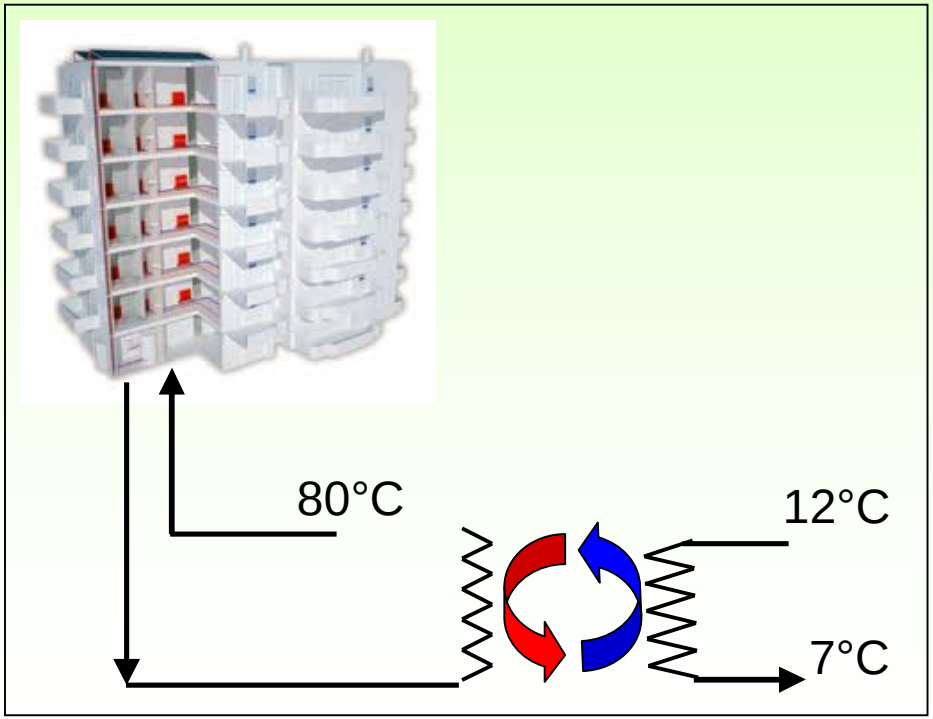
The piping for the distribution of freshwater from the heat exchanger seawater / freshwater to the central plant final users is a double-pipe PEAD pipework.





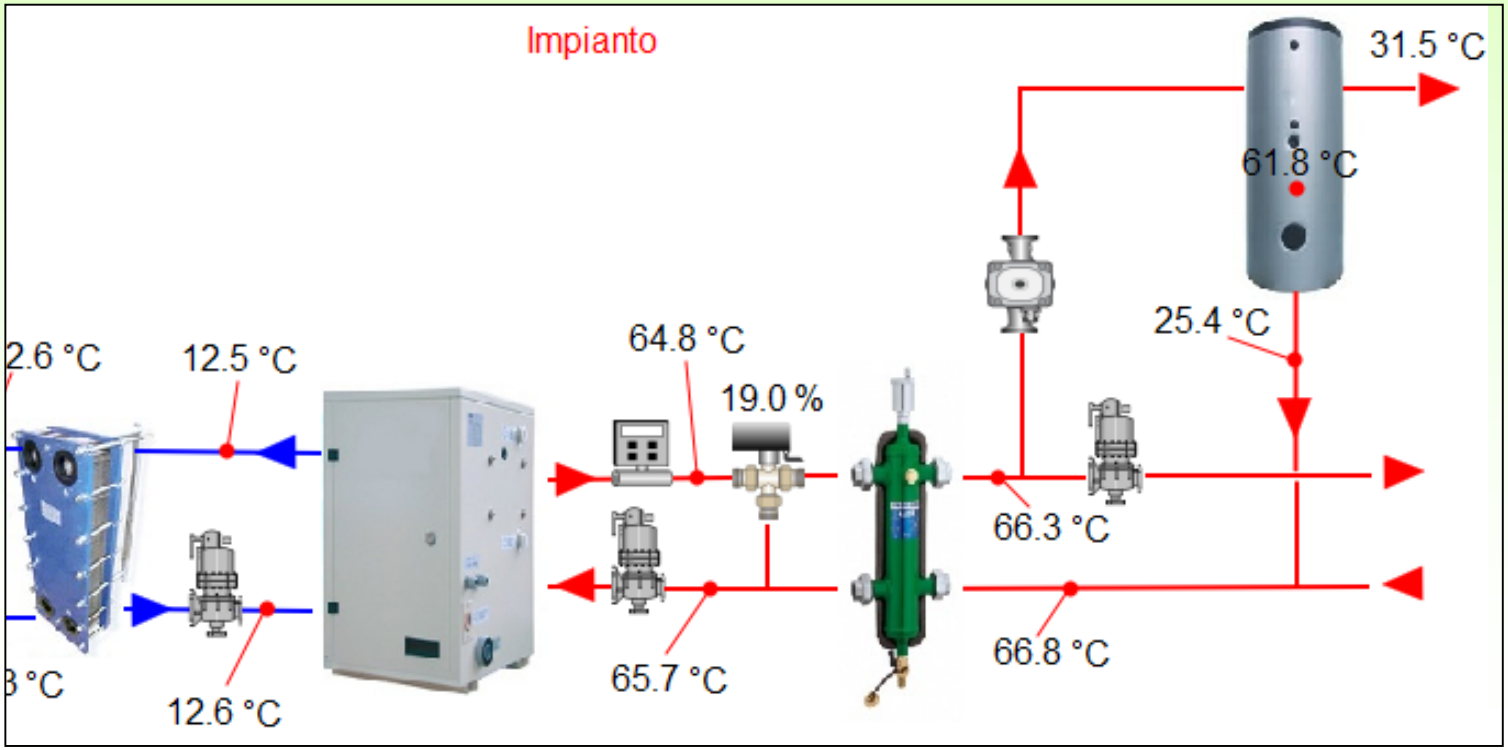
Central Plant (1/3)
for space heating and SHW production

In the thermal power plant of each building there are heat exchangers connected to the evaporator of the High Temperature Heat pumps (HT HP).



Central Plant (2/3)
for space heating and SHW production

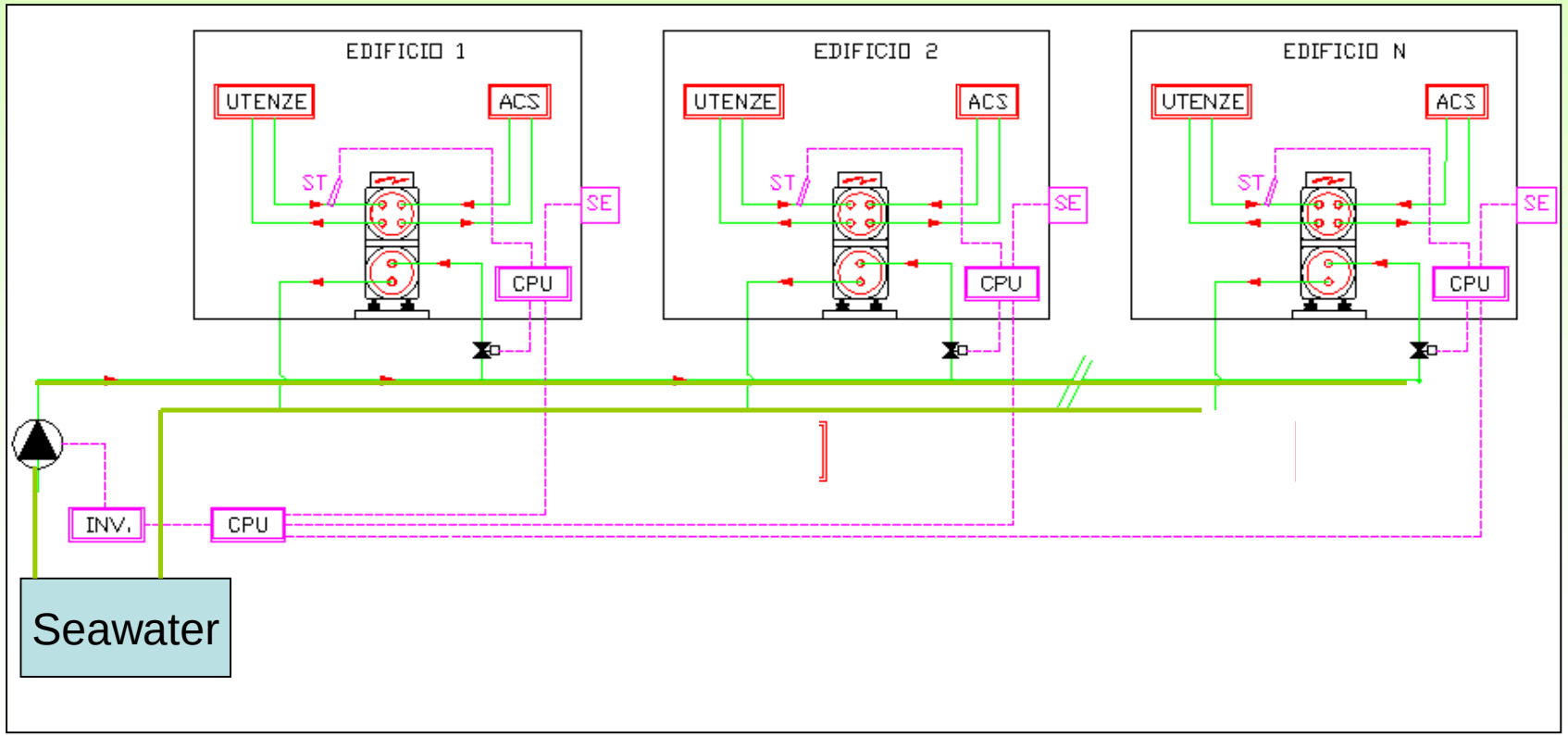
In the central plant of each building there are High Temperature Heat Pumps with the condenser to be connected with the existing central heating system.



Central Plant (3/3)
for space heating and SHW production

All the heat exchangers are connected

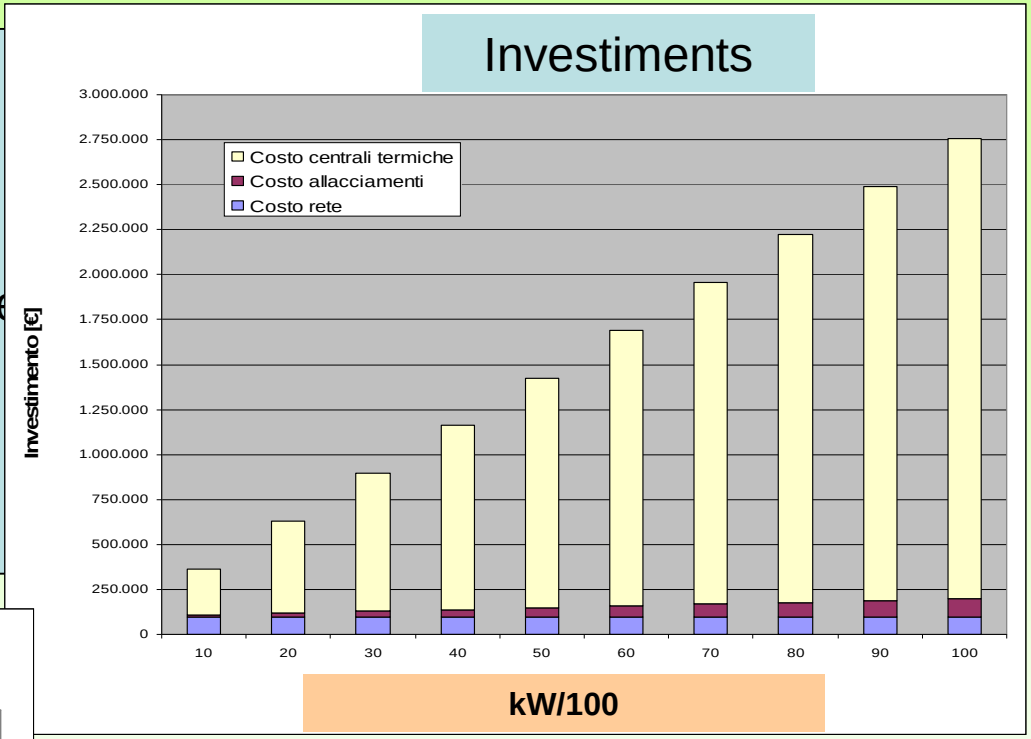
to the CDH pipework.

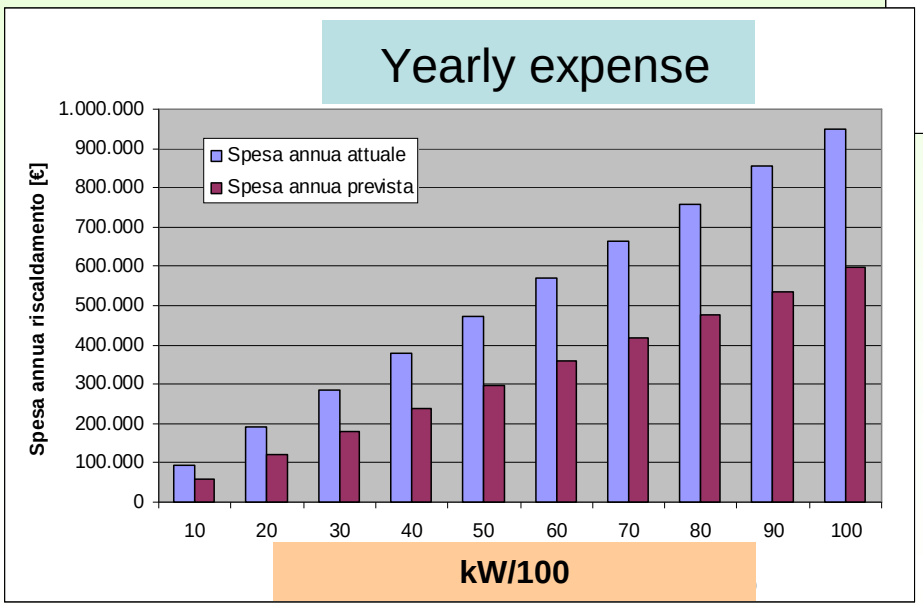


Analysis - Economics

Investments depending on space heating thermal power need

- Blue → Cost of the pipework
- Magenta → Cost of the heat exchange connections
- White → Cost of the central plants components (heat exchanger + HT HP)



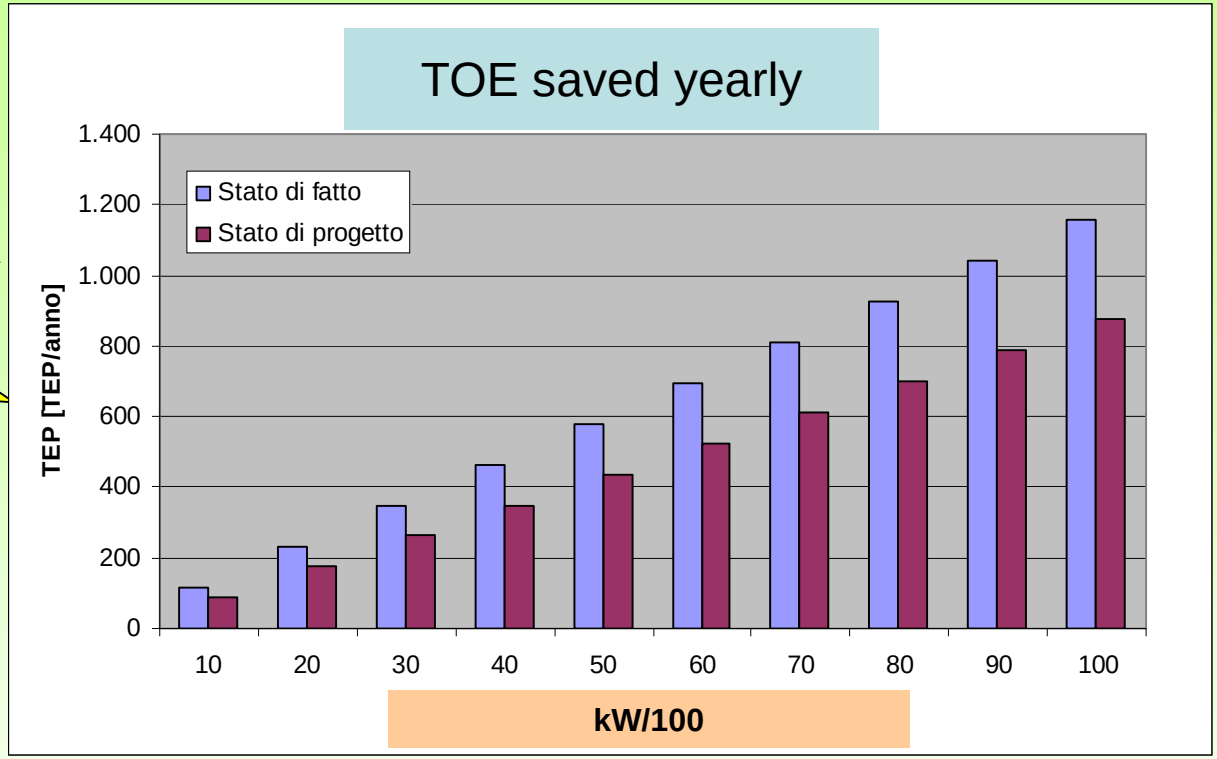


Yearly costs depending on space heating thermal power need

- Blue → Current costs
- Magenta → New costs with CDH

Analysis - Energy

Minimum
70% of renewable
energy

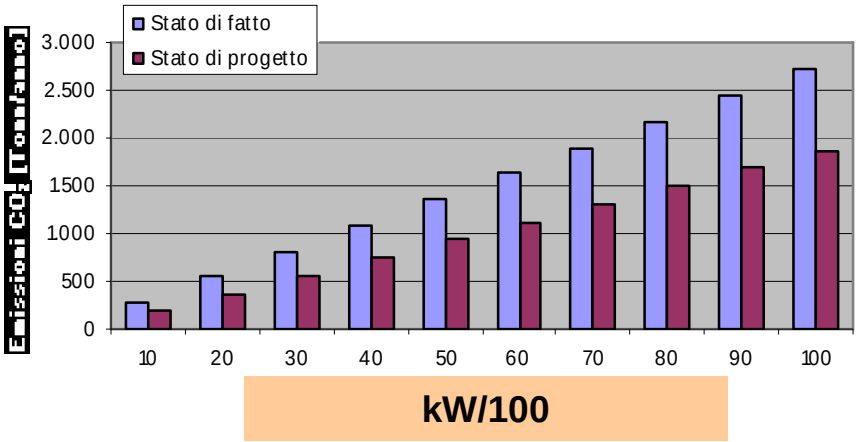


Yearly saved energy depending on space heating thermal power need

- Blue → Current TOE
- Magenta → New TOE with CDH

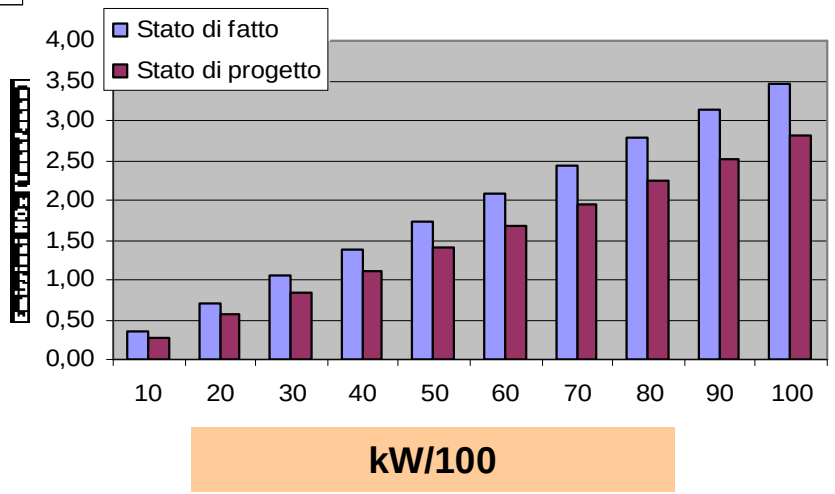
Analysis - Emissions

Emission reduction of CO_2



Zero local emission

Emission reduction of NO_x



Yearly emission reduction depending on space heating thermal power need

- Blue → Current Emissions
- Magenta → New Emissions with CDH

Conclusions

- Reduction of urban pollution associated to combustion heating plants.
- Simple retrofit: boilers are replaced by heat pumps without modifying the heating system inside the buildings.
- Initial costs are balanced by reduction in energy bills and maintenance cost (35÷60%).
- *Payback* time for Italy, based on climate and energy rates: 3÷5 years, depending on fuel and type of installation.
- Solution applicable both to the existing stock (residential, historical buildings, hospitals, commercial, industrial, etc.).
- At least 70% of energy input is renewable.

Thank you for your attention!

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