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WP3. Demand boost activities:
Stakeholder engagement,
change of perceptions and
empowerment

Task 3.2.

Deployment of capacity building to key
actors

WEBINAR 5 – *DISTRICT HEATING, ALL YOU
EVER WANTED TO KNOW!*

13th March 23, DISTRICT HEATING, ALL YOU EVER
WANTED TO KNOW!

Paola Caputo – PoliMi

Vanessa Gallo and Margherita Brambilla - Fiper

Biomass, a multi-tasking renewable source



- Different sources
- Different conversion technologies
- Different uses
- Different global efficiencies
- Different challenges



Which types of biomass for Biomass District Heating (BDH)?

Biomass for energy conversion

- By products
 - From forests
 - From agriculture and food chains
 - From urban waste and industry
- SRF etc.
 - On ground
 - In water
- Biomass and biofuels
 - Solid e.g. wood
 - Liquid e.g. biodiesel
 - Gaseous e.g. biogas

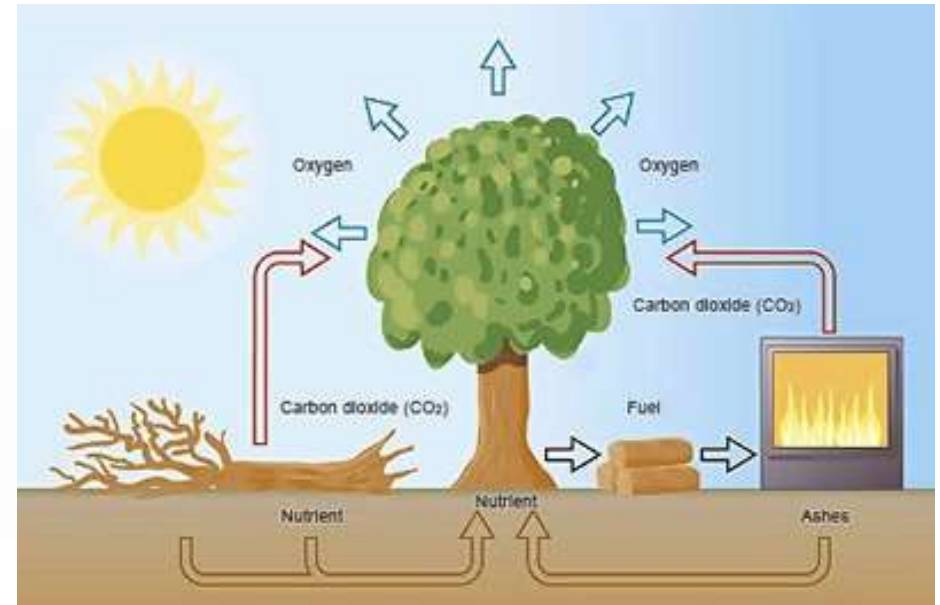
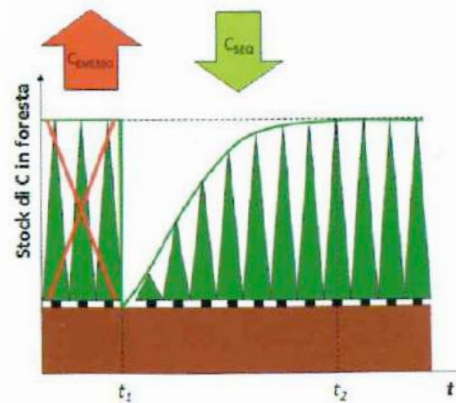


BDH allows the exploitation of an untapped renewable programmable source, contributing to lower CO₂

Is biomass a renewable and carbon neutral source?

This tree is around 25m tall and has an approximate crown diameter of 15m². With somewhere in the region of 800,000 leaves it multiplies its active surface area by a factor of ten from 160m² to 1,600m² of leaf surface area. The countless stomata (leaf pores) take 9.4 cubic metres of carbon dioxide out of the air into the leaf cells on a summer's day. The tree processes this, powered by the sun's energy and taking water and nutrients from the soil, into 12kg of carbohydrates (sugars and starches). This process also releases a quantity of 9.4m² of vital oxygen. Just 150m² of leaf area during the growth phase supplies the complete oxygen needs of one person. This tree therefore provides oxygen for 11 people. At the same time it consumes the daily carbon dioxide emissions of two and a half households.

If the tree should be felled for any reason and it is desired fully to replace this tree, it would be necessary to plant 2500 saplings each having a crown volume of 1m³. The costs for this planting would run to almost three-quarters of a million pounds.



In Italy, according to elaborations by FIPER and POLIMI, wood biomass (by products) can be considered at least 80% RE and almost CN (~ 53 gCO₂/kWh of biomass)

Why adopt wood biomass for DH?

The case of Italy

Factors affecting the use of biomass along the overall chain
from forests to final users

Growth

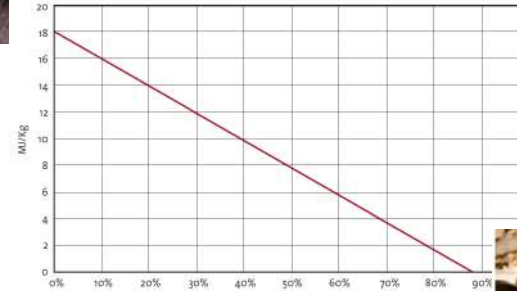
- Climates
- Types
- Etc...

Supply

- Collection
- Transportation
- Storage
- Etc...

Energy
conversion

- Characteristics
- LHV, Humidity
- Final uses
- Etc...



Need to protect from
environmental risks

«Ever-growing»
forests



BDH should be promoted towards the local, national and European energy goals

Targets:

- Climate neutrality
- Conservation of biodiversity and ecosystems
- Transition to circular economy
- -> Drastic growth to 2030-50 at EU level



Renewable and available does not mean wastable
RES penetration must be coupled to energy efficiency strategies



Biomass has to be adopted by
efficient and up to date technologies



BDH – drivers and challenges

The example of Italy



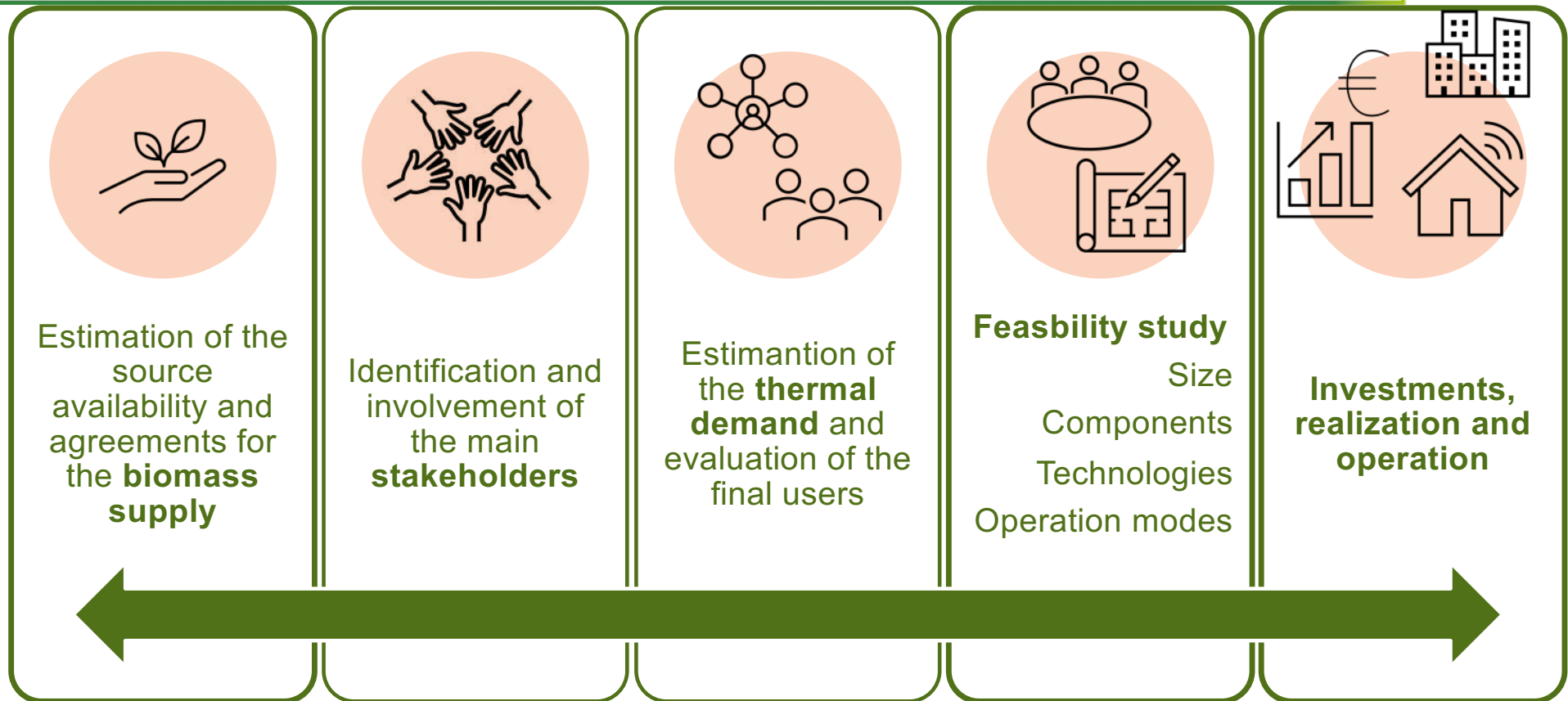
- There is a forest heritage with 10-11 millions hectares of forests;
- The withdrawal is ~ 20-30% of the growth (average in EU ~ 60-70%);
- Biomass is a programmable source for thermal uses;
- Recent trend of the energy market makes biomass more competitive
- There are strict energy and environmental goals for energy efficiency and REs integration

Biomass DH

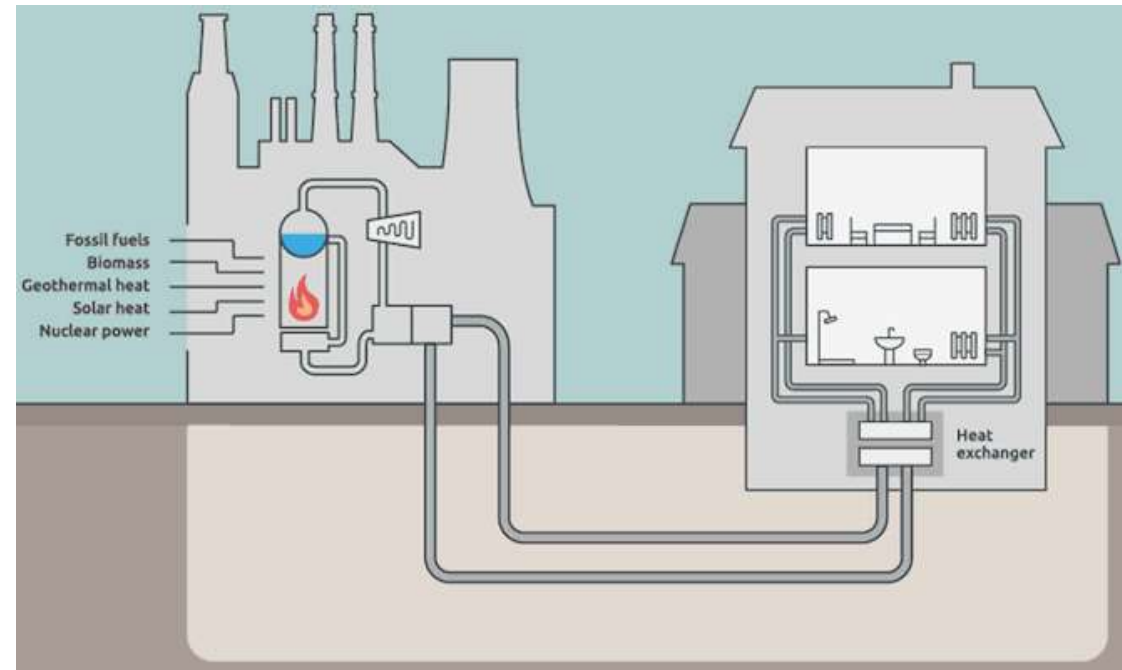
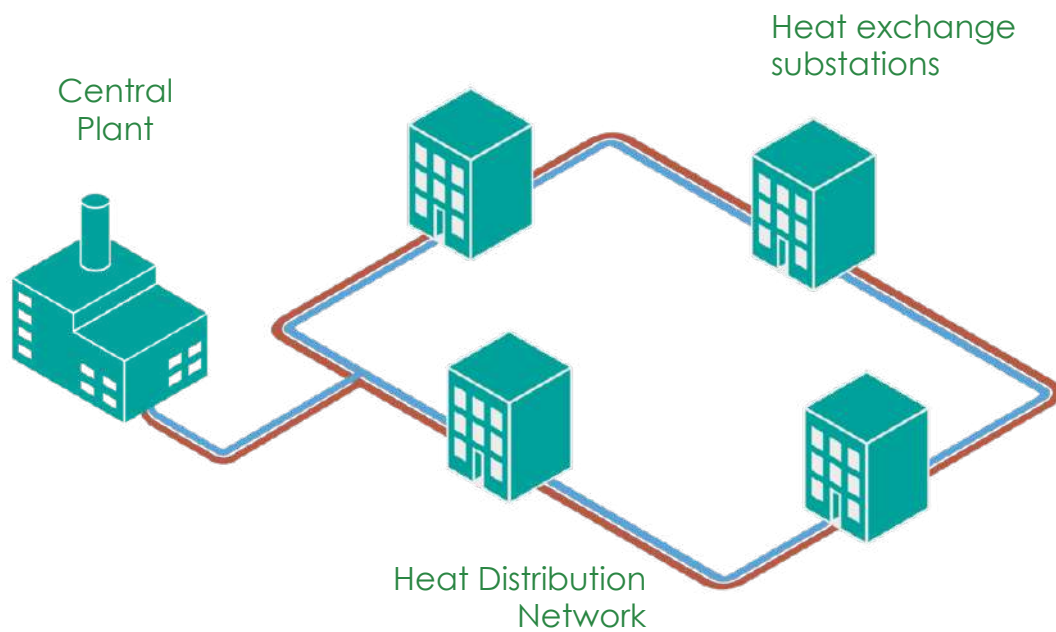
- < 1% heating needs
- Competitive technologies for thermal generation
 - Gas boilers
 - HPs
- Competitive technologies for biomass exploitation
 - Electricity generation
 - Use in domestic appliances
 - Other thermal technologies.



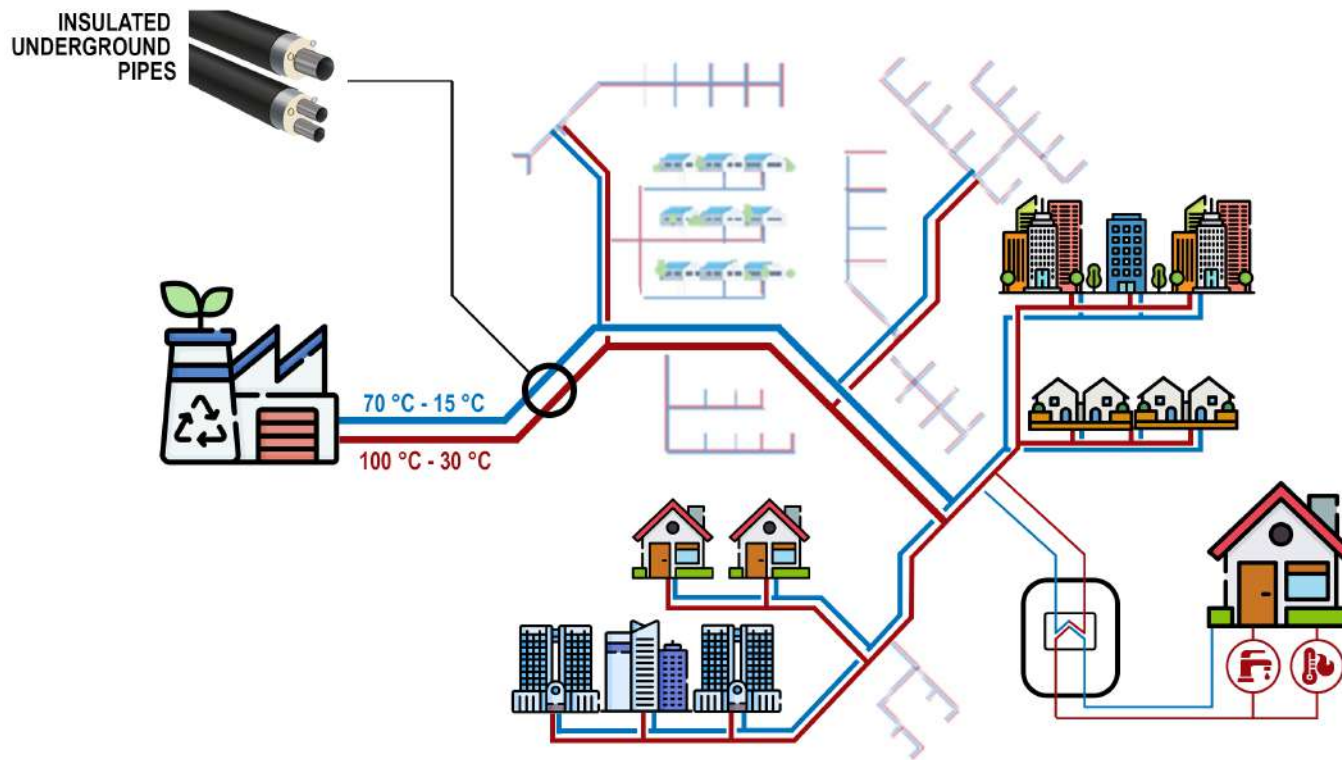
Process for the realization of a BDH system



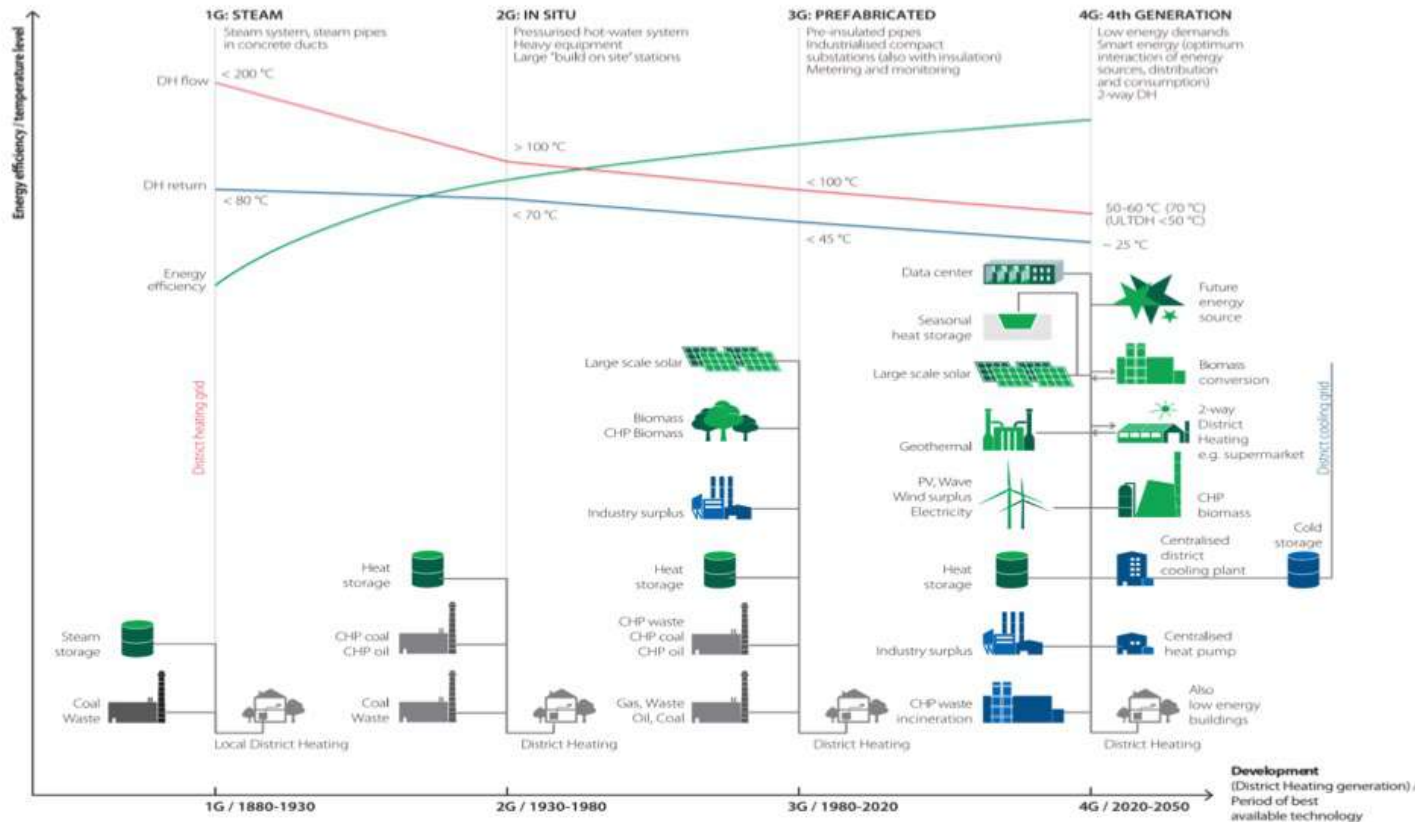
District Heating – concept and components/1



District Heating – concept and components/2



District Heating – a technology in evolution



Current challenge:

- Decarbonization

i.e. integration of RES in existing DH systems and future systems

-> New sources, new technologies, new management approaches

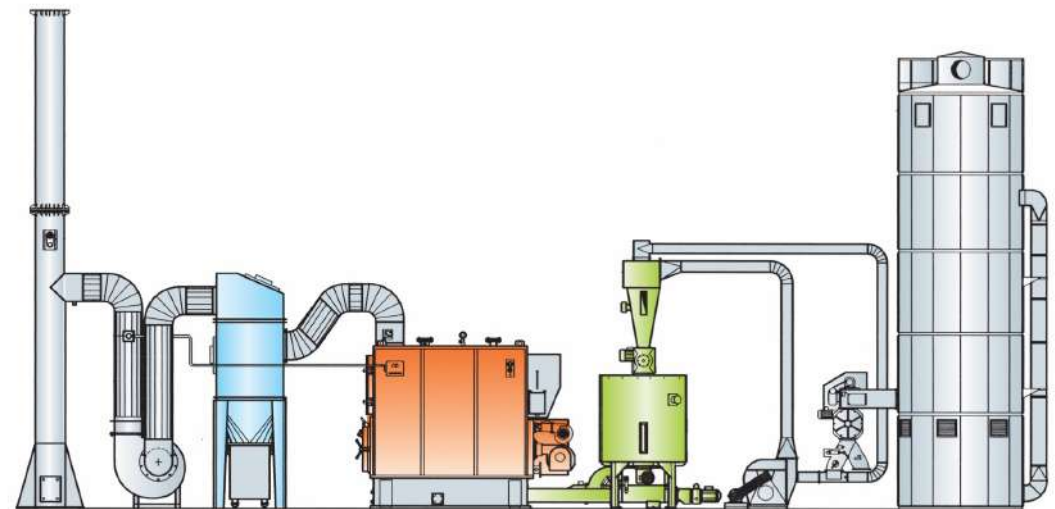
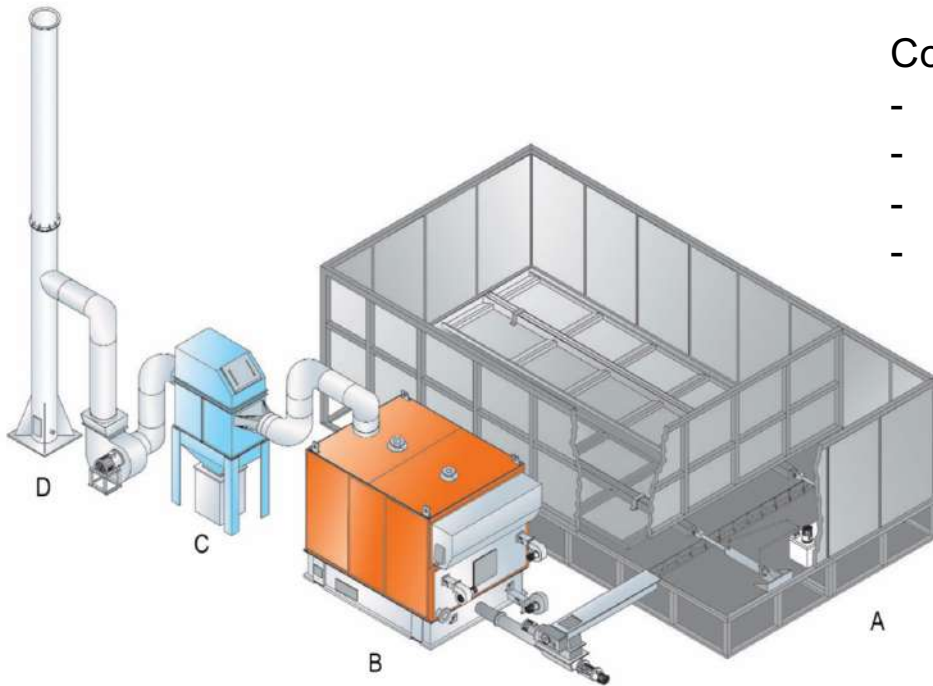
-> Opportunities and challenges for biomass



BDH: details of the central thermal station

Common layout for BDH system:

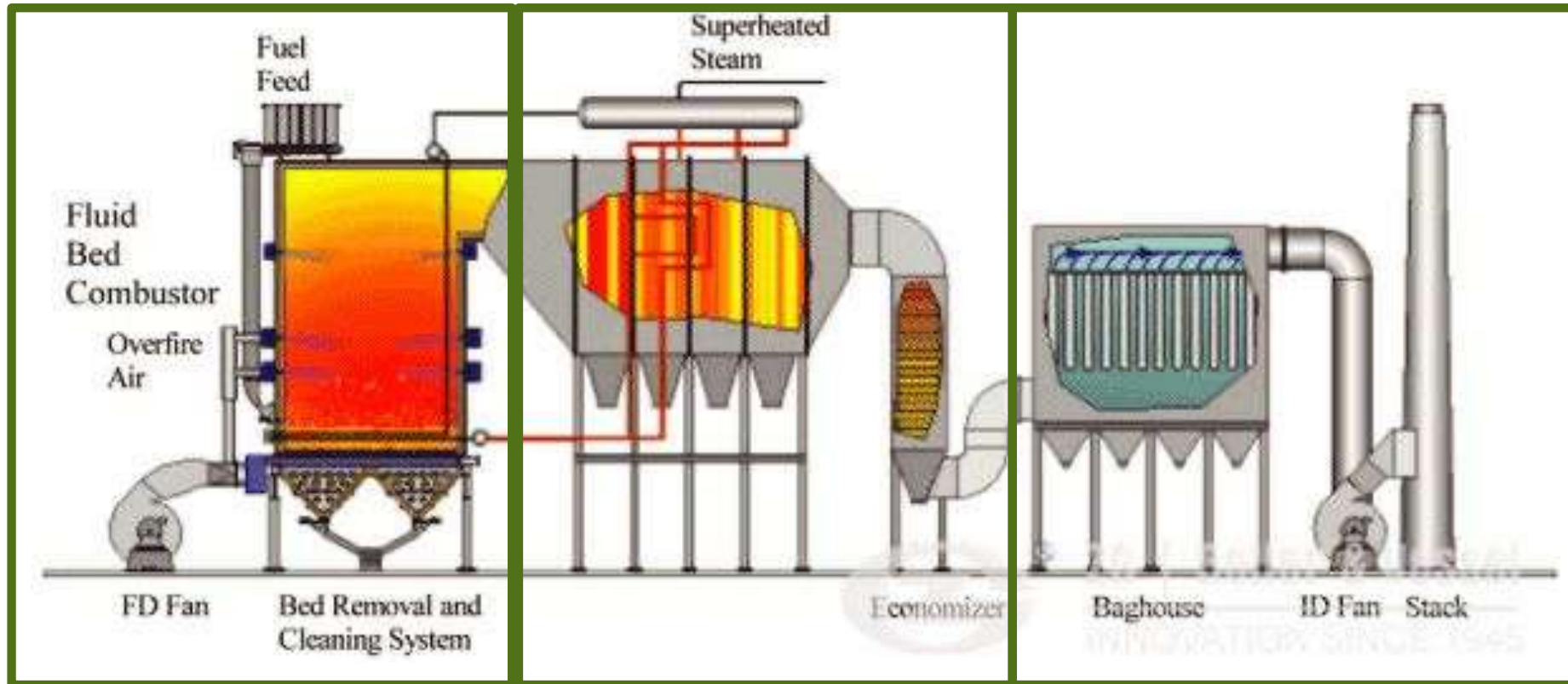
- Biomass storage and supply (A);
- Combustion chamber and boiler (B);
- Ash separation section (C);
- Flue gas treatment section and extraction (D).



From biomass to hot water to the network to the final users



BDH: details of the central thermal station, example



combustion

heat transfer

pollutant abatement



Details of the flue gas abatement line



For filtering PM



For DeNO_x

SNCR
Selective NON
Catalytic
Reductin



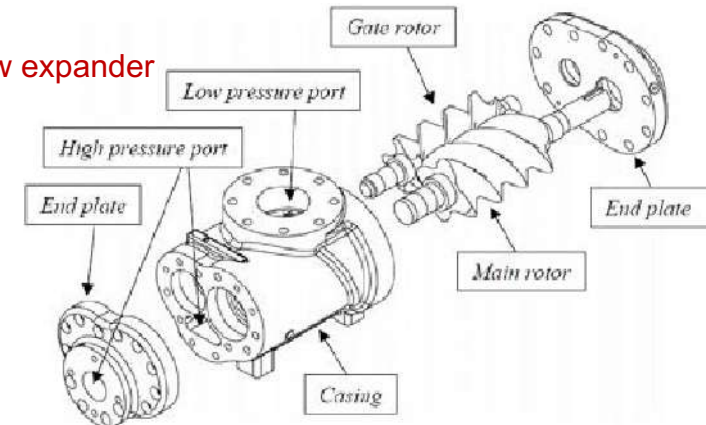
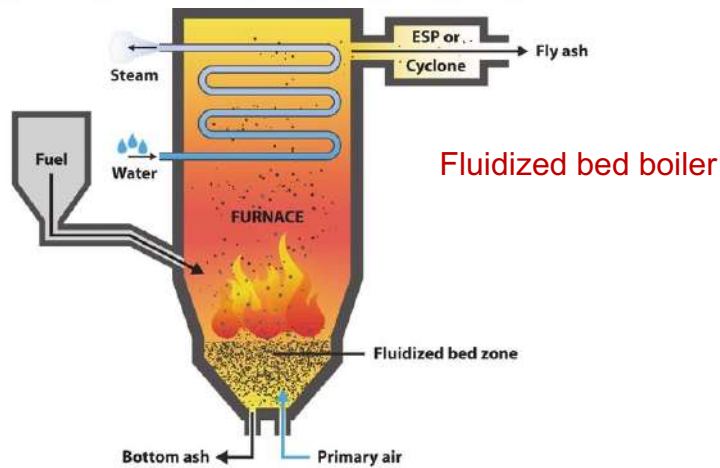
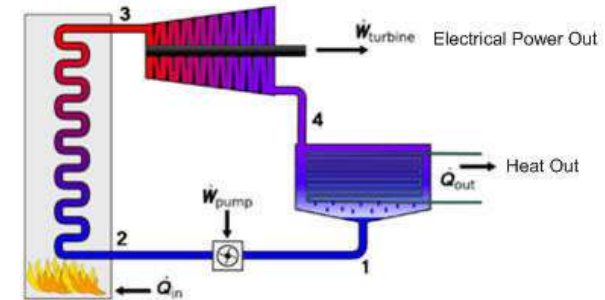
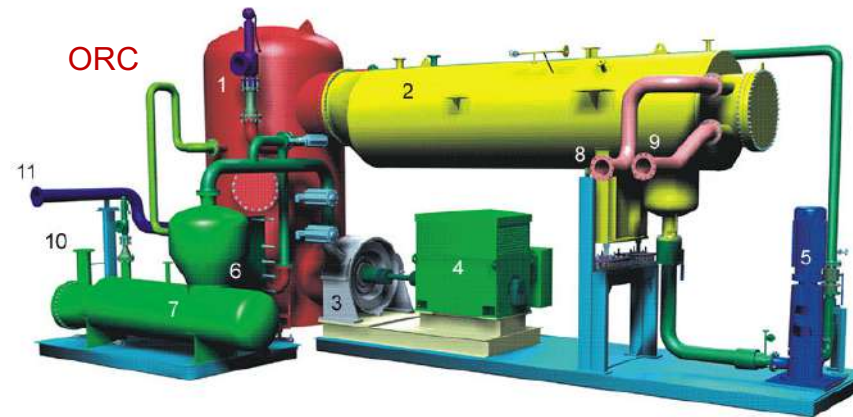
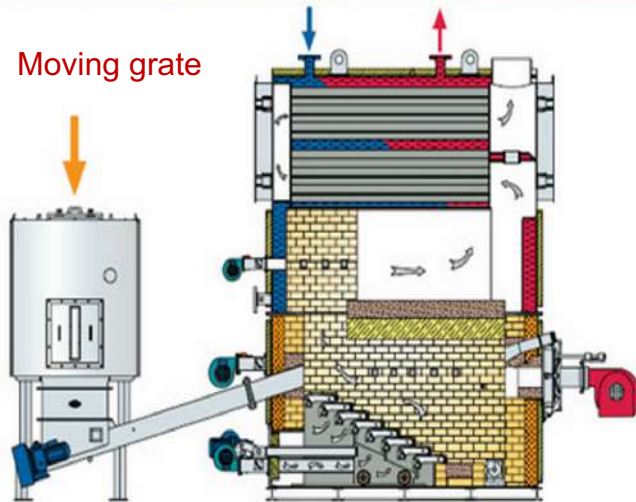
SCR
Selective
Catalytic
Reduction



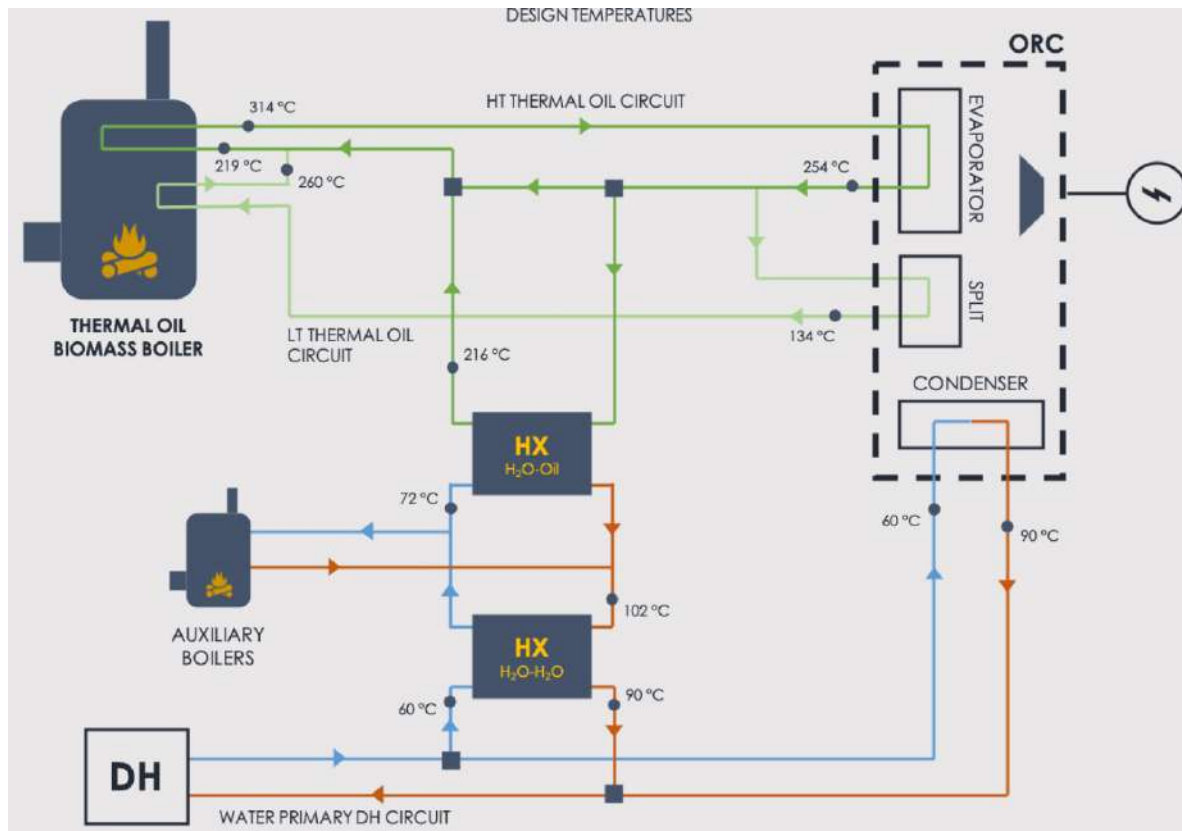
Source:
<https://www.areaimpanti.it>



Technical details for Combustion and Cogeneration sections



The opportunity of the cogeneration - CHP unit



Common layout for CHP BDH system

- CHP by ORC

Video



ORC – Turboden

<https://www.youtube.com/watch?v=FOhVQPevQvk>

TSE - Heliex

<https://www.heliexpower.com/technology>

TSE - Example of paper

<https://www.mdpi.com/1996-1073/13/24/6586>



Existing case: BDH in Tirano (IT)



20 MW_{th} biomass thermal power installed

1 Mw_{el} biomass electric power installed

33 km network

768 final users

60 MW at the final users



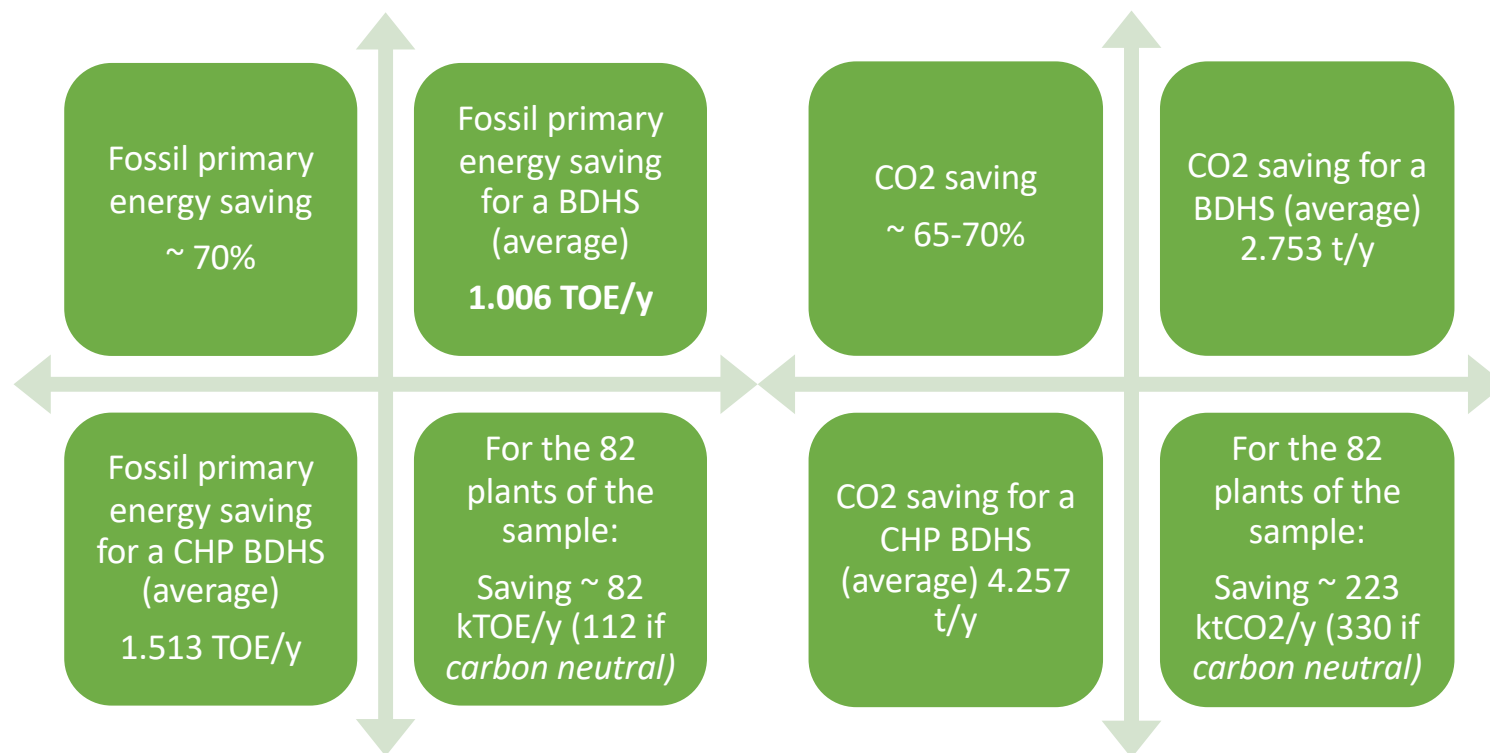
Main results of the last Italian survey on BDH/1

Last Fiper report about BDH in Italy

- 82 plants
- 423 MW biomass and 786 MW in total (biomass + fossil back up)
- Main data on the sample considered:
 - «Alto Adige» is the area with the most part of the systems (51% in number and 43% as biomass power)
 - Thermal power 1-20 MW; 15% systems with biomass power ≤ 1 MW; 40% with biomass power 1-6 MW; 34% with biomass power 6-20 MW; 11% with biomass power >20 MW
 - CHP systems: 46%; Small CHP system (1 MW el for 6 MW th)
 - Systems in areas without the NG grid: 70%
 - Thermal efficiencies on yearly basis: 75-80%
 - Electric efficiencies (CHP) on yearly basis: 15-18%
- Technologies available on the market and mature
- High costs for the network
- Operation modes and CHP configurations to be optimised



Main results of the last Italian survey on BDH/2

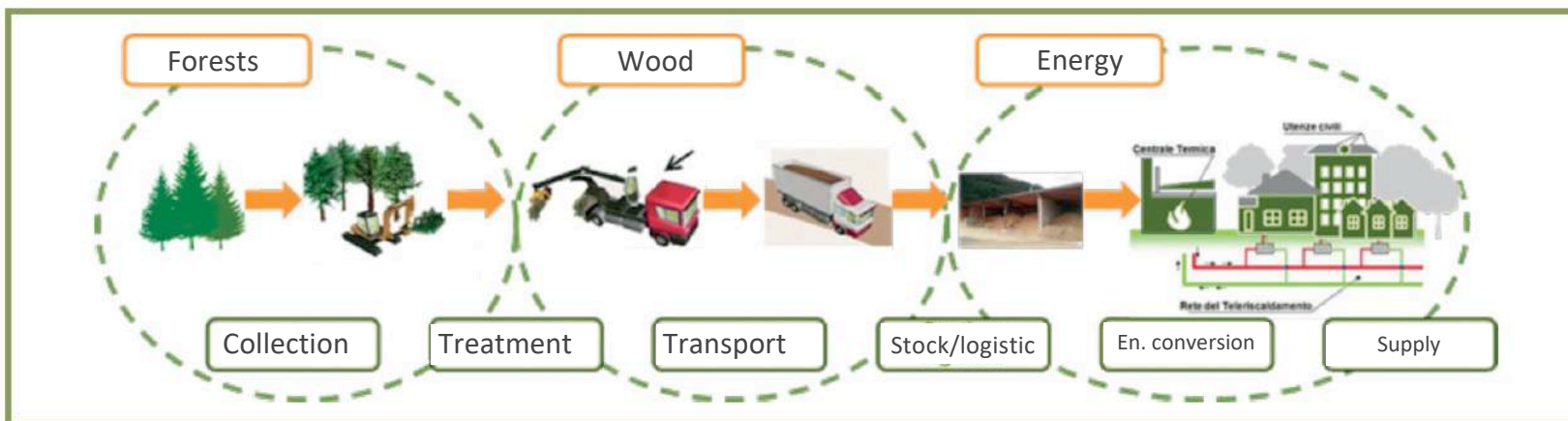


Adding also NEW possible biomass plants

+ ~ 156 kTOE/y
+ ~ 430 ktCO2/y



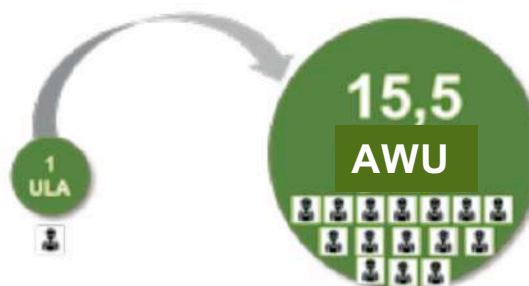
Main results of the last Italian survey on BDH/3 Economic benefits



Monetary impact on the territory



Employment impact on the territory



In addition: externalities



Main results of the last Italian survey on BDH/3 DISCUSSION on the macro-pollutants (PM) and general pros



BDHS analised

Sample of # 16

Average concentration
mg/Nm³ 9

Average Emission Factor (EF)
(mgPM/kWh) 14

EF comparison

NG boiler 0,72

Oil boiler 18

Domestic biomass boiler (old
device) 515

mgPM/kWh



In comparison to domestic
appliances, DH allows saving ~10 t/y
for each BDH system on average

PROS:

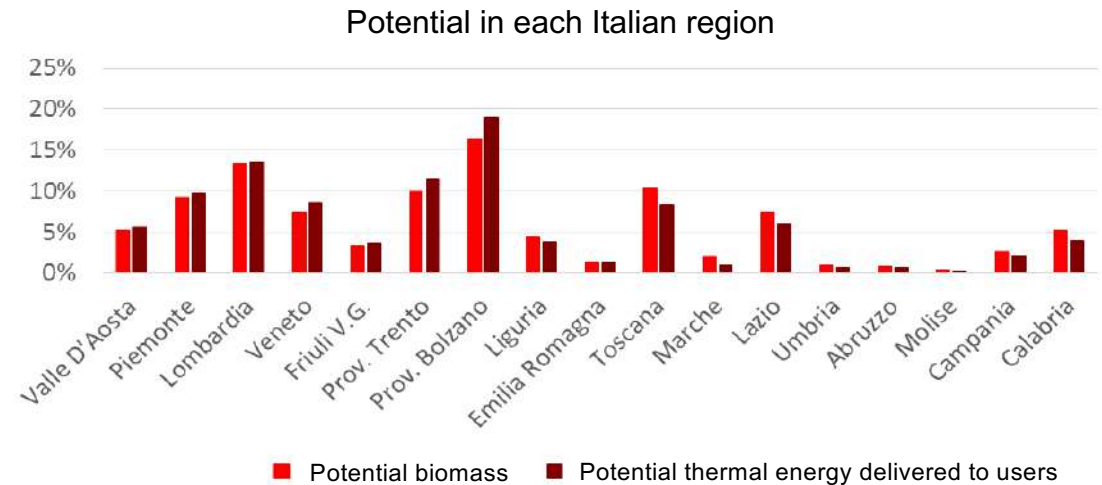
- Successful experiences
- Use of local energy sources and reduction of fossil fuels dependency
- Care of the territory and synergies
- Opportunity for economic development
- Benefits for replication



DISCUSSION - potential penetration in Italy in cold zones without NG grid

At least we can double existing systems

About **1 GW** and **1700 GWh/y** as heat from wood biomass

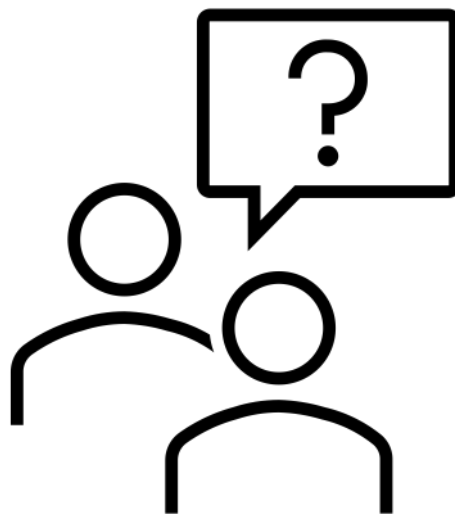


| Developent scenarios | Biomass power, MW | Heat, GWh/year | Num. of municipalities | Num. of citizens | Volume heated, Mm ³ |
|----------------------|-------------------|----------------|------------------------|------------------|--------------------------------|
| A | 1.228 | 2.092 | 660 | 485.331 | 58 |
| B | 1.478 | 2.517 | 660 | 485.331 | 70 |
| C | 815 | 1.450 | 458 | 339.166 | 40 |
| D | 981 | 1.746 | 458 | 339.166 | 48 |

DISCUSSION - Barriers



Thanks
Questions and answers





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