


TAKING  
**COOPERATION**  
FORWARD

 Udine, 28/03/2022

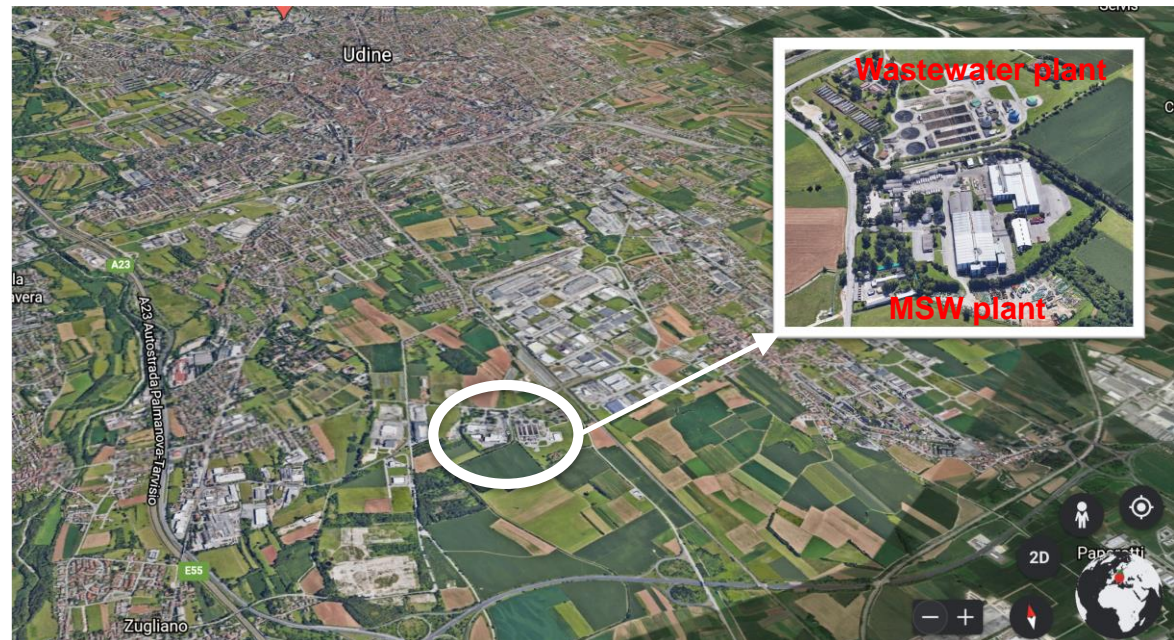
 **D.T3.3.4 - Experience Exchange Workshop**  
*Pilot implementation in Udine (Italy)*

 CITYCIRCLE | UNIVERSITA' DI UDINE | PATRIZIA SIMEONI, GIOVANNI CORTELLA,  
MATTIA COTTES, MATIA MAINARDIS

# WHERE WE STARTED FROM...

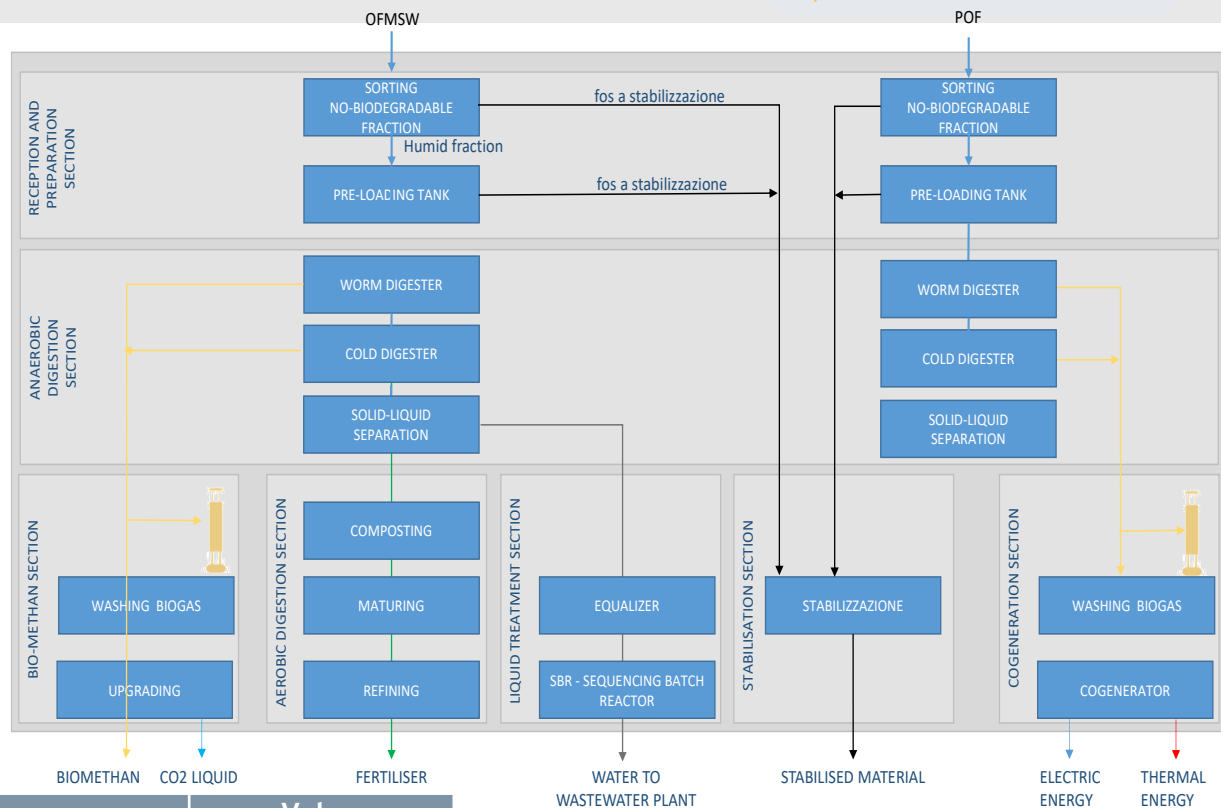
## ■ Industrial-Urban Symbiosis

- The presence in the area of two "service plants"
- The presence of an adjacent industrial area.
- The presence of thermal waste (heat otherwise dissipated) and fuels deriving from the construction of a waste treatment plant



# STAKEHOLDERS

## NET S.p.A.



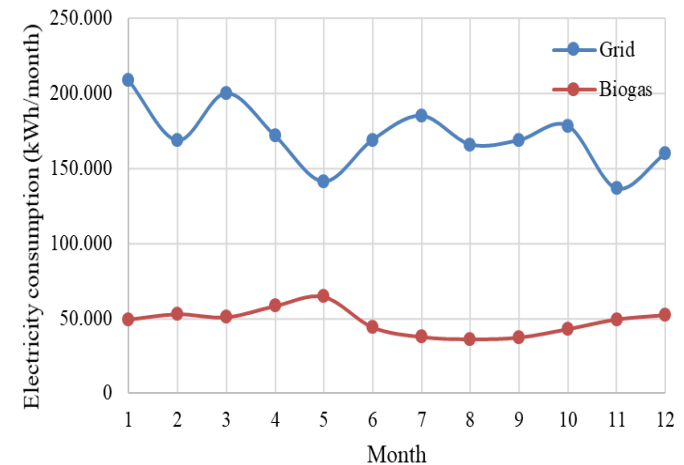
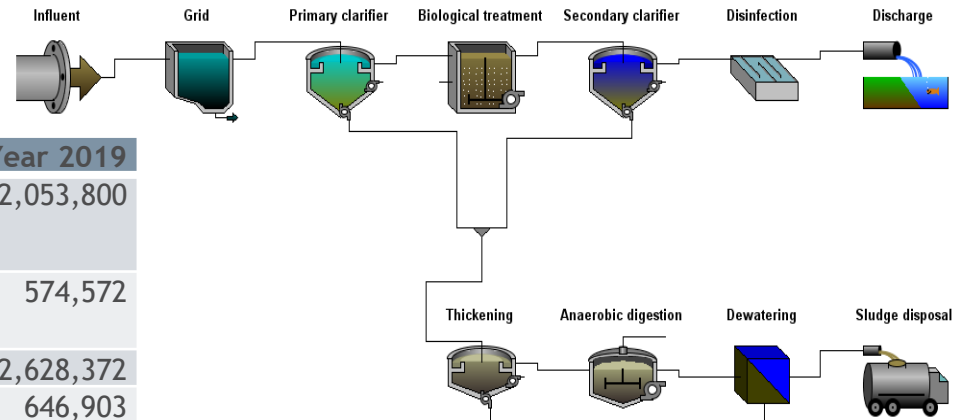
Parameters	Value
OFMSW amount treated in the plant (t/yr)	35,000
POF amount treated in the plant (t/yr)	19,000
Wood-cellulosic waste amount treated (t/yr)	12,500
Electric energy production (MWh/yr)	1,046
Bio-methan production from OFMSW (Nmc)	3,788,481
for veicles (Nmc)	400,000
biomethane fed into the grid (Nmc)	3,388,481
Total amount of fertilizer (t/yr)	17,484
Stabilised waste to recovery/landfill (t/yr)	13,020
Liquid amount to the wastewater plant (t/yr)	31,025

COOPERATION FORWARD

# STAKEHOLDERS

## CAFC S.p.A

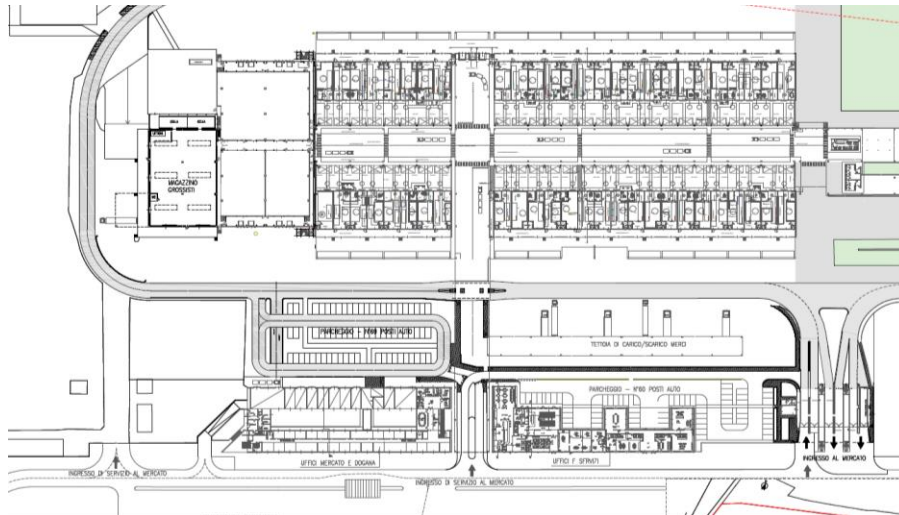
Parameter	Year 2018	Year 2019
Electricity consumption (from the grid) (kWh/yr)	1,859,488	2,053,800
Electricity consumption (from biogas) (kWh/yr)	541,337	574,572
Total electricity consumption (kWh/yr)	2,400,825	2,628,372
Heat consumption (from natural gas) (kWh/yr)	694,919	646,903
Heat consumption (from biogas) (kWh/yr)	400,000	336,000
Total thermal consumption (kWh/yr)	1,094,919	982,903
Treated wastewater (m <sup>3</sup> /month)	945,542	1,116,694
Sludge amount treated in the digester (m <sup>3</sup> /yr)	50,027	52,295
Specific biogas production (Nm <sup>3</sup> /m <sup>3</sup> sludge)	5.41	5.51
Specific biogas production (Nm <sup>3</sup> /ton of volatile solids-VS)	160.30	171.74



# STAKEHOLDERS

## UDINE MERCATI s.r.l

- Interested in renewing its facilities to improve internal logistic and reduce energy consumption
- Electric load:
  - Current: 400kWel
  - After revamping: + 200 kWel



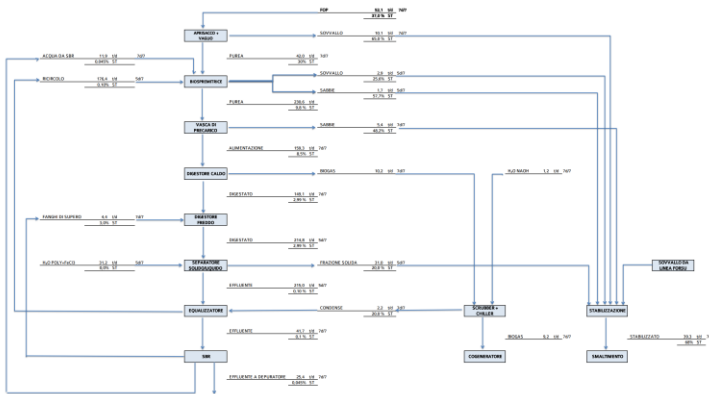
# TIMELINE OVERVIEW

## Data collection

- Visits to the plants and updates
- Analysis of technical documents

Remote mode due to pandemic situation

1. Virtual meetings with industrial project partners
2. Source analysis (waste treatment plant and wastewater plant).
  - ✓ Plant layout and technical choice
  - ✓ material flow analysis
  - ✓ plant energy requirements
  - ✓ surplus of energy production



- a. Identification of energy availability to be recovered in a circular economy perspective
- b. Identification of potential synergies between sources
- c. Identification of strengths and weaknesses of sources available and potential synergies

# TIMELINE OVERVIEW



## Technology identification

1. Technologies currently analysed:
  - ✓ Heat Exchanger (HE)
  - ✓ Cogeneration engines
  - ✓ Absorption / Electric Chiller
  - ✓ Biogas upgrading technologies

Waste recovery and energy efficiency oriented technologies

## Scenario identification

Identification of best feasible scenarios based on different synergies combination possibilities

1. ENDOGENOUS SCENARIOS: Circular economy improvement scenarios in Facilities HUB
2. EXOGENOUS SCENARIOS: Circular economy improvement scenarios with synergy in Industrial area
3. INDUSTRIAL-URBAN SCENARIOS circular economy improvement scenario with synergy between sources-users-territory

# TIMELINE OVERVIEW



## Preliminary solution

- Technical economic environmental assessment preliminary solutions identification
- Solutions' strength and weaknesses identification

## Business model draft

- Business model structuring
- Technical economic environmental assessment solutions identification

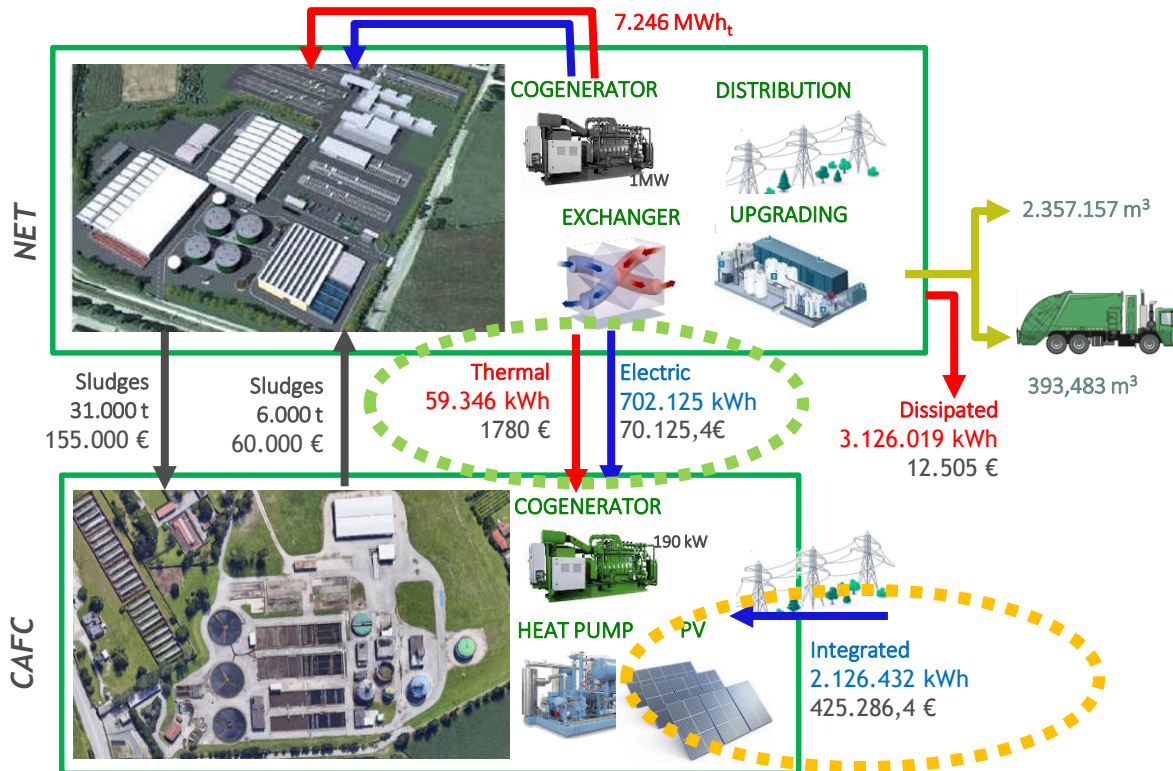
## Decision support system development

- Multi-objective modelling
- Scenario simulation
- Best compromise solution identification





# ENDOGENOUS SCENARIO



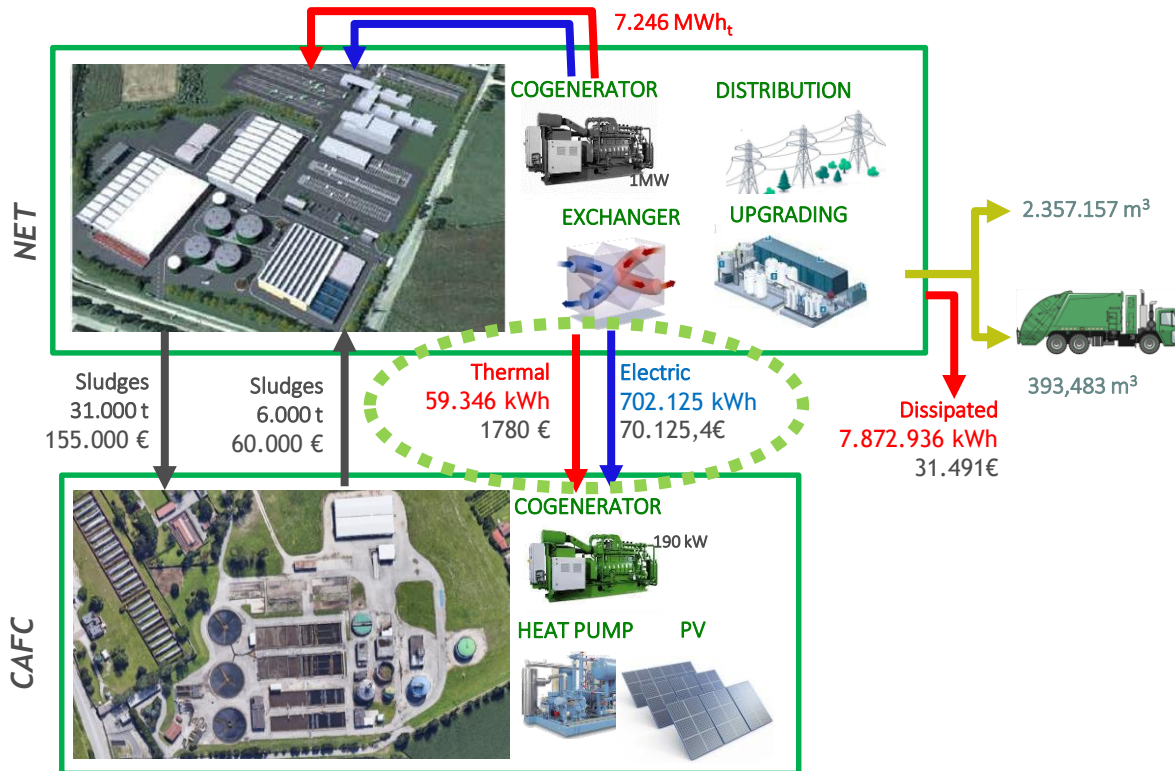
## ENDOGENOUS scenario: Facilities HUB

- CHP = 999 kW
- Electric energy sold cost: 10 c€/kWh
- Thermal energy sold cost: 30 €/MWh<sub>t</sub>
- Bio-methane production loss: 492.881 m<sup>3</sup> (- 123.320€)

- Energy cost: **-12%**
- Energy integration need: **-25%**
- Primary Energy Saving: **2.144 tep**
- GHG emission reduction: **4.862 tCO<sub>2</sub>**



# ENDOGENOUS SCENARIO



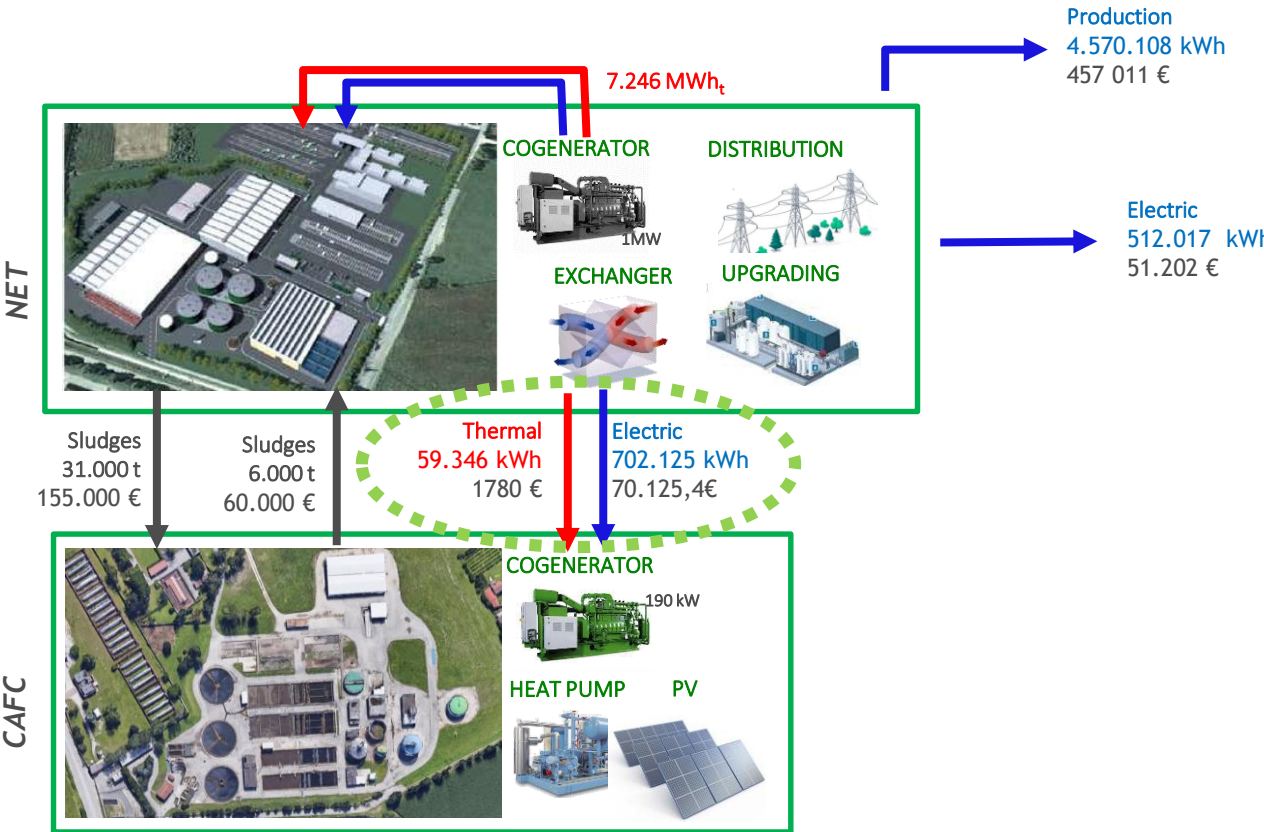
## ENDOGENOUS scenario: Facilities HUB

- CHP = 1499 kW
- Bio-methane production loss: 1.455.128 m<sup>3</sup> (- 363.788 €)

- NO energy integration for CAFC
- Energy cost: **-50%**
- Primary Energy Saving: **2.144 tep**
- GHG emission reduction: **4.862 tCO<sub>2</sub>**



# EXOGENOUS SCENARIO



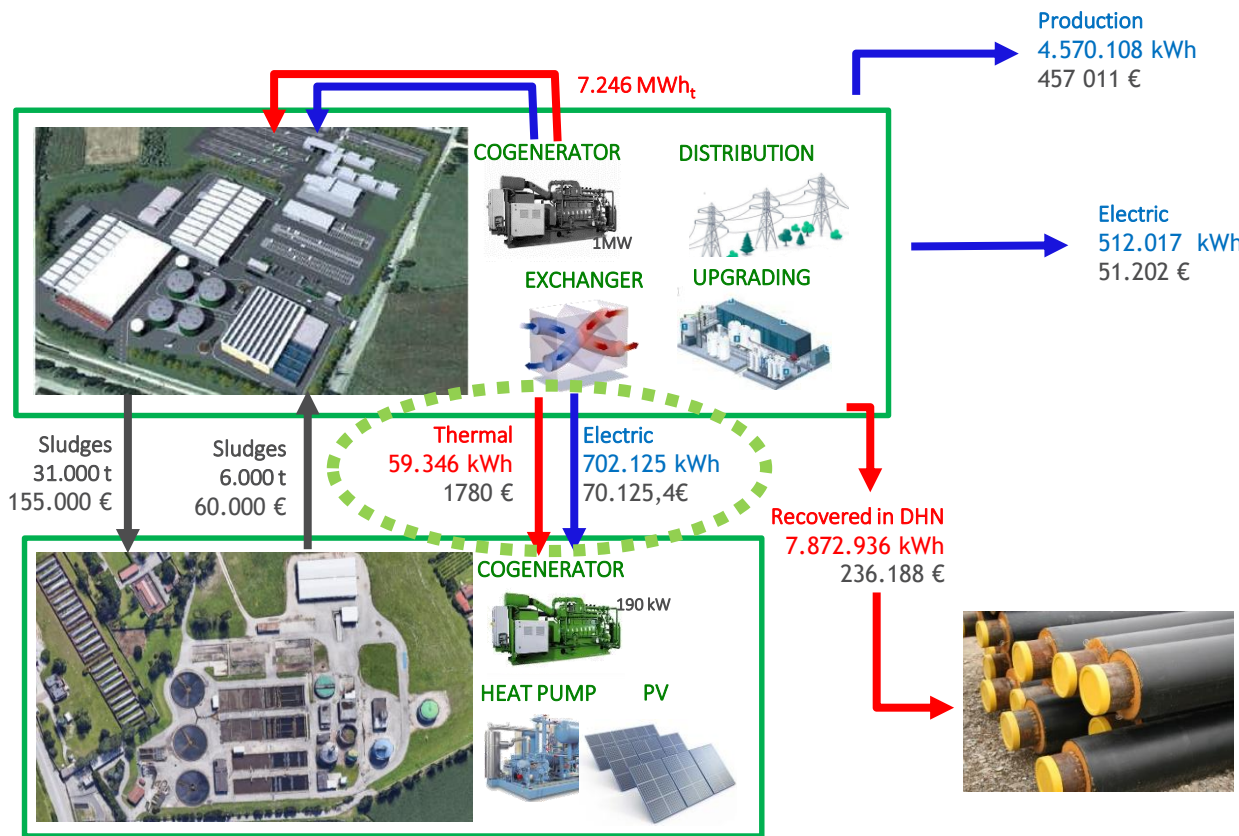
## EXOGENOUS scenario

- CHP = 1499 kW
- Bio-methane production loss:  
1.455.128 m<sup>3</sup> (- 363.788 €)
- TOTAL UDINE MERCATI load coverage

- NO energy integration for CAFC
- Energy cost: **-50%**
- Primary Energy Saving: **2793 tep**
- GHG emission reduction: **6338 tCO<sub>2</sub>**



# URBAN-INDUSTRIAL SYMBIOSIS SCENARIO



## Urban - Industrial symbiosis scenario

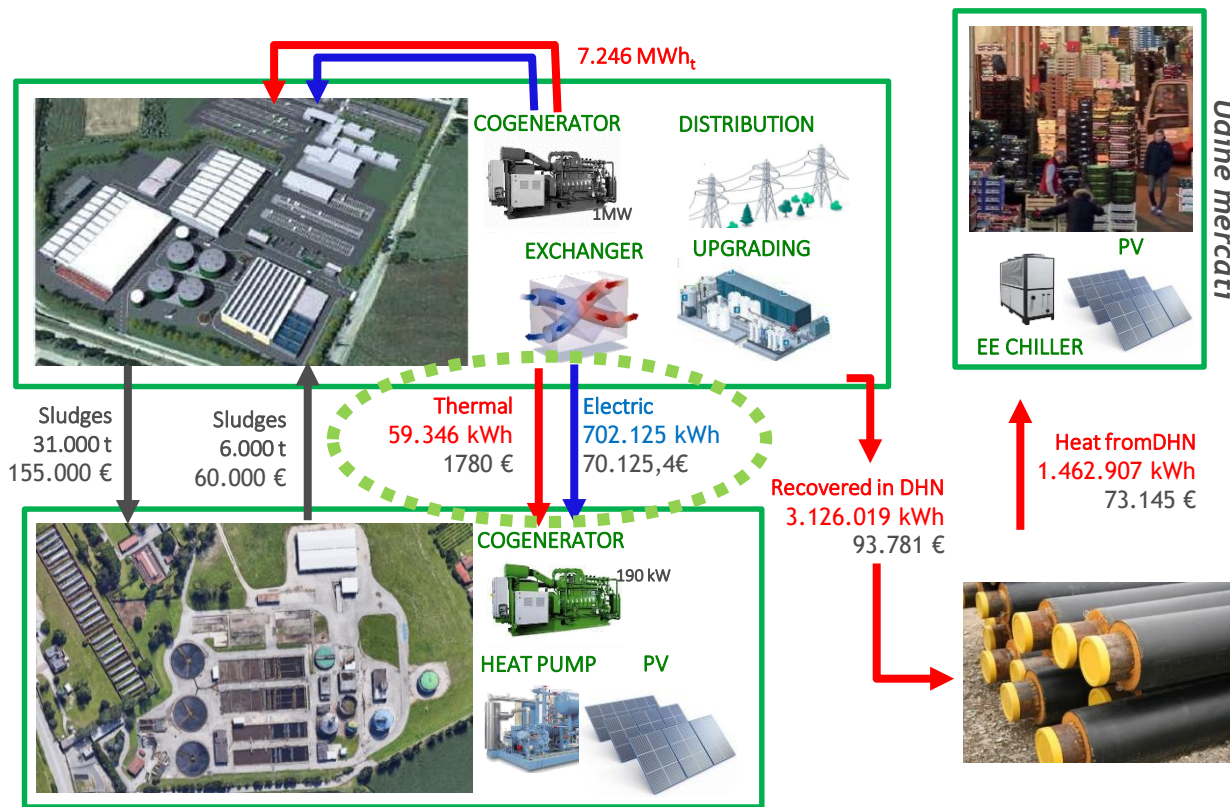
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# URBAN-INDUSTRIAL SYMBIOSIS SCENARIO



## Urban - Industrial symbiosis scenario

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- Primary Energy Saving: **2189 tep**
- GHG emission reduction: **4969 tCO<sub>2</sub>**



## Highlights

- Different stakeholders are needed to maximize energy recovery
- Waste energy allows excellent energy and economic performances



# CONTACT INFO



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# PROJECT PARTNERSHIP

