



This project has received funding  
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SMART-Plant



# Techno-economic analyses of sludge management and phosphorus recovery from municipal wastewater in Milan metropolitan area

Andrea Lanuzza – Gruppo CAP

3rd EUROPEAN NUTRIENT EVENT @ ECOMONDO 2018

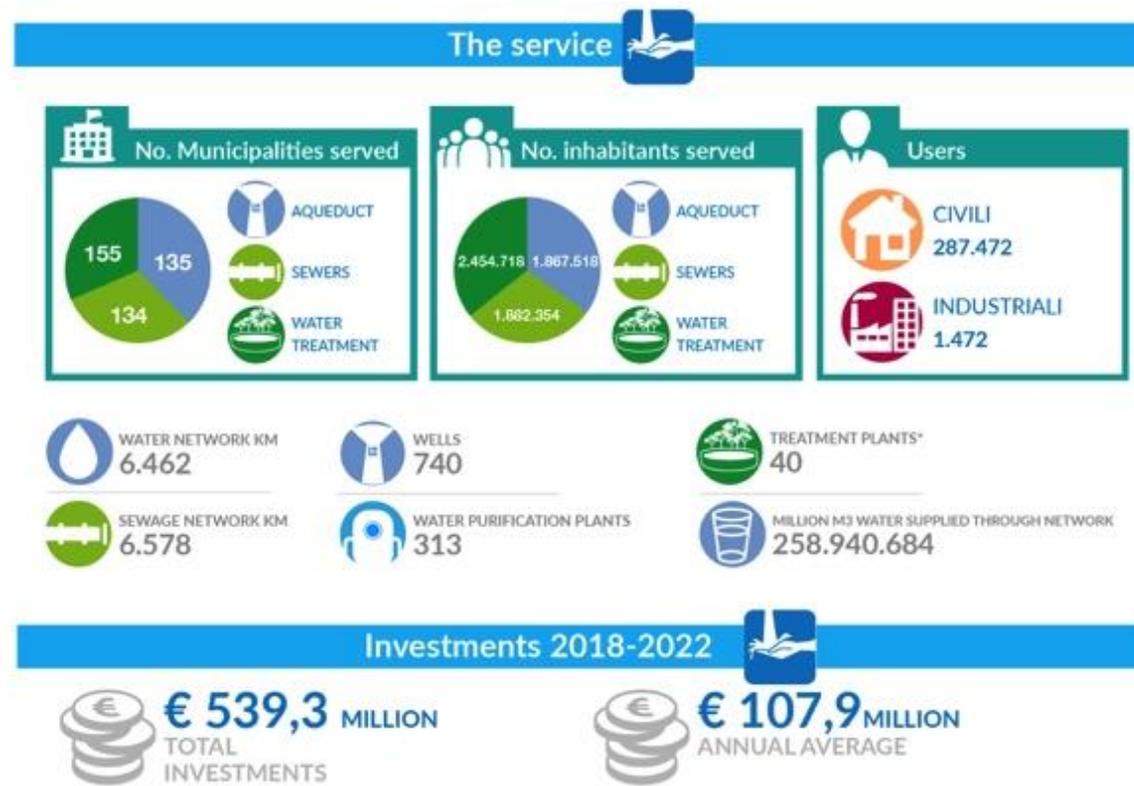
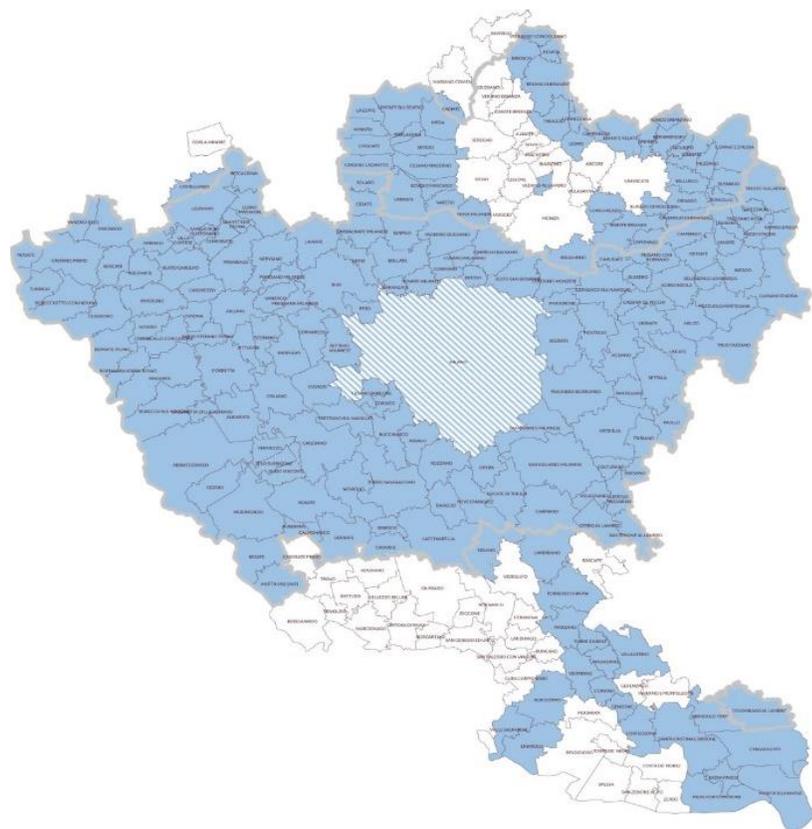
8 - 9 November 2018, Rimini, Italy

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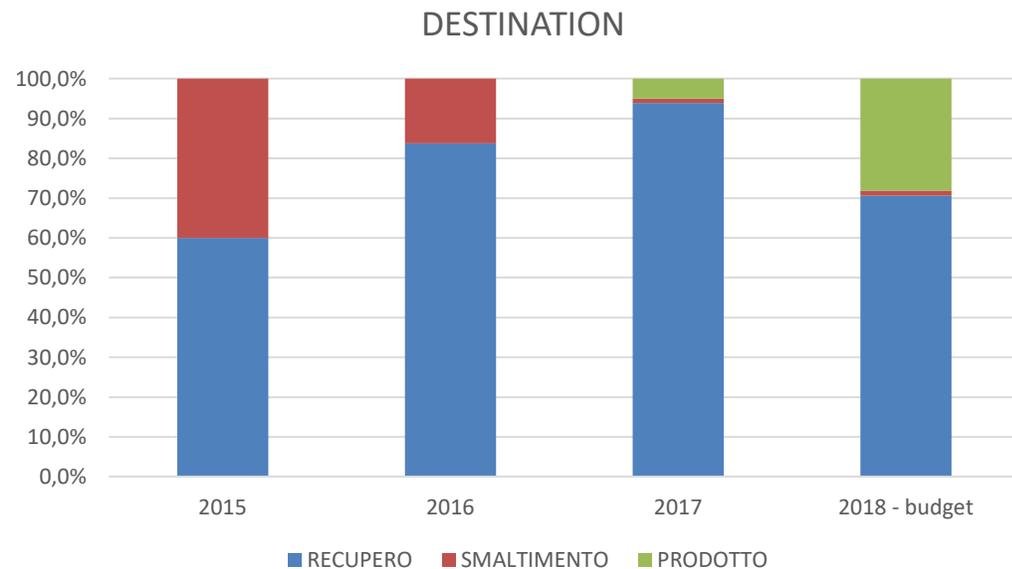
# Gruppo CAP





# Sludge disposal strategies

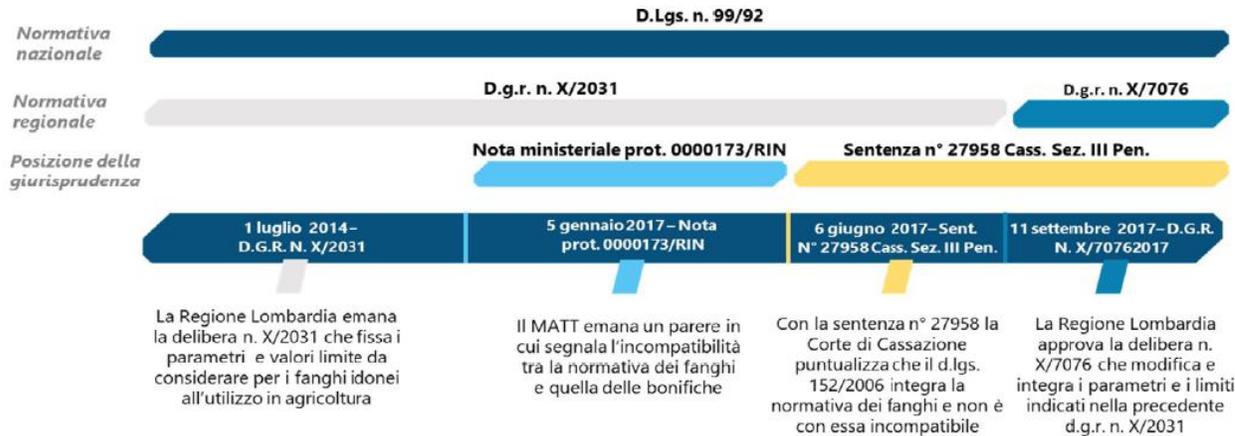
DESTINATION	2015	2016	2017	2018
AGRICULTURE	56,0%	77,4%	69,7%	51,1%
LANDFILL	40,0%	16,2%	1,1%	1,3%
CEMENT INDUSTRY	4,0%	2,3%	4,7%	3,6%
FERTILIZERS	0,0%	0,0%	5,0%	28,1%
CO-INCINERATION	0,0%	4,1%	19,4%	15,9%



- From 2016 we have redesigned our strategies with a «zero-landfill» approach.
- From July 2016, due to some market negative externalities, we have pushed on sludge to fertilizers solutions increasing, at the same time, sludge co-incineration.
- From 2017, sludge disposal in landfills is < 1,5%
- How long would it be sustainable without new strategies?

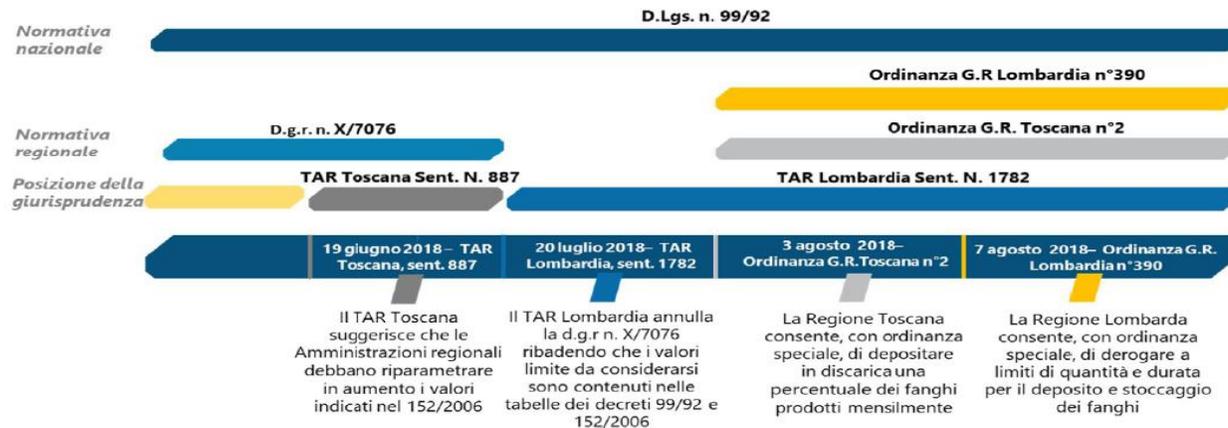


# Changing legislation for sludge disposal in agriculture



Fonte: elaborazione Laboratorio REF Ricerche

## LINEA DEL TEMPO DEI PROVVEDIMENTI RIGUARDANTI LO SPANDIMENTO DEI FANGHI IN AGRICOLTURA (2° parte)



### ITALY

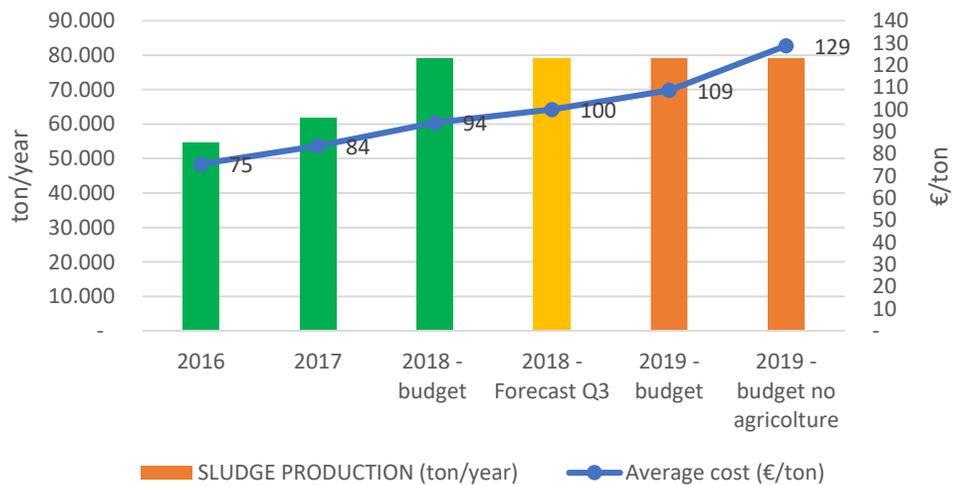
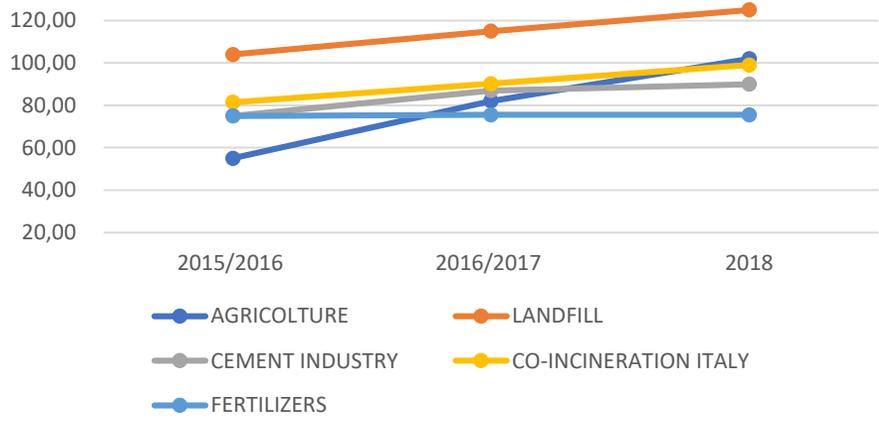
- 8 changes in legislation in less than 4 years
- Need for a complete revision of the old national one (1999)
- New pollutants included in the national legislation: IPA, C10-C40, Se....

### EU

- Policies requiring phosphorus recycling from sewage, pressures on agricultural use of sewage biosolids and current proposals regarding sewage biosolids in the EU Fertilisers (expected to be excluded from composts, digestates, biochars, but authorised for precipitated phosphate salts and ash-based recycling).
- European Parliament and Council discussions about increasing transparency on sewage sludge
- .....

# Increasing disposal costs

Costs (€/ton)



- Disposal costs are increasing
- Unit costs by destination are now flat with **no correlation with potential nutrients/energy recovery opportunities**
- From 2018 several water utilities have started sending sludges to **other EU countries (200 €/ton)**



# Phosphorus recovery in the CAP Area

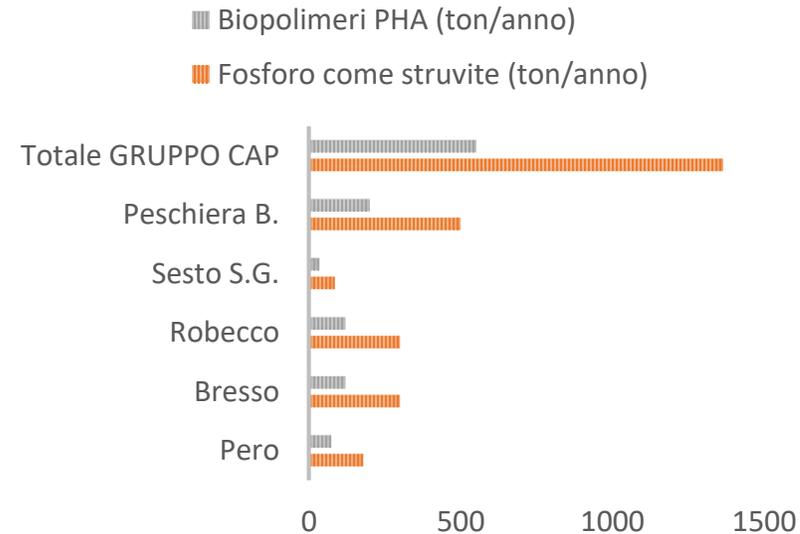
- The average concentration of phosphorus in the sewage sludge produced in Lombardy is 2.10% (as P<sub>tot</sub>), in line with the value of the 75th percentile of the sample on a national scale.
- The average ash fraction in the sludge of the same sample is about 30%, leading to an estimate of **7% P<sub>tot</sub> in sludge ashes** or **16% as P<sub>2O5</sub>**.
- In Lombardy, almost all wastewater treatment plants (WWTPs) do not operate biological phosphorus removal.
- There are two main reasons that make phosphorus recovery from the water line less attractive in Italy if compared to other typical situations in Northern Europe:
  - Firstly, in the WWTPs considered, influent P concentration is about 4-5 mg/l, lower than the reference system considered for the assessments in Northern Europe WWTPs, usually about 8-9 mg/l.
  - Secondly, the use of iron and aluminium salts for the chemical precipitation of phosphorus is widely used.

*Source: R. Canziani and R. Di Cosmo 2018 - STATO DELL'ARTE E POTENZIALITÀ DELLE TECNOLOGIE  
DI RECUPERO DEL FOSFORO DAI FANGHI DI DEPURAZIONE – Ingegneria dell'Ambiente vol 5 3/2018*



# The IDEA and the MASTER PLAN

- Gruppo CAP provides municipal water and wastewater services to over 2 million inhabitants, producing in 61 wastewater treatment plants where almost 70.000 ton/year dewatered sludge is produced.
- **In such a scenario Gruppo CAP can and wants to deliver a circular economy approach.** To this aim Gruppo CAP has defined a territorial **Master Plan** to implement eco-innovative and energy-efficient solutions to
  - **renovate and innovate existing wastewater treatment plants**
  - **close the circular value chain by applying low-carbon techniques to recover materials that are otherwise lost.**



- The existing municipal wastewater treatment plants can be renovated and integrated to become multi-purpose urban biorefineries that serve the citizens to treat and valorize municipal waste streams, such as wastewaters and organic waste, towards a coherent urban strategy
- In order to include leading edge sustainable solutions, the **Master Plan (50 M€ budget)** considers synergic interaction with large ongoing European Horizon2020 innovation actions, **such as the “SMART-Plant” project.**
- Existing anaerobic digesters will be valorized towards the best exploitation of the existing reaction volumes, industrial symbiosis opportunities will be explored in order to provide better and cheaper services to our customers



# THE OPPORTUNITY

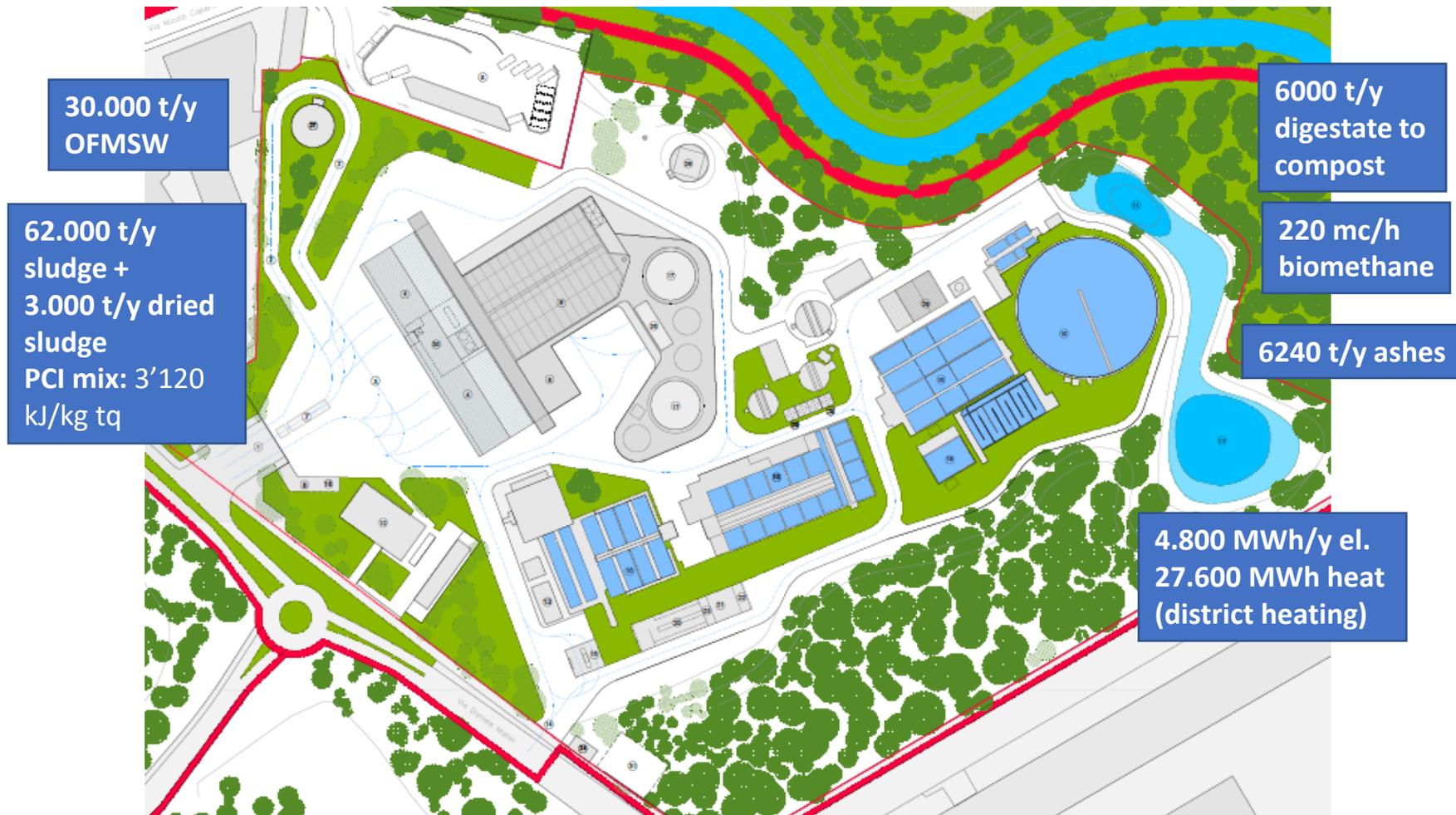


## OBJECTIVE

Transforming the existing municipal waste incineration plant into a bioplatfrom for sludge (65.000 ton/y) and OFMSW (30.000 ton/y) treatment and for nutrients/energy recovery

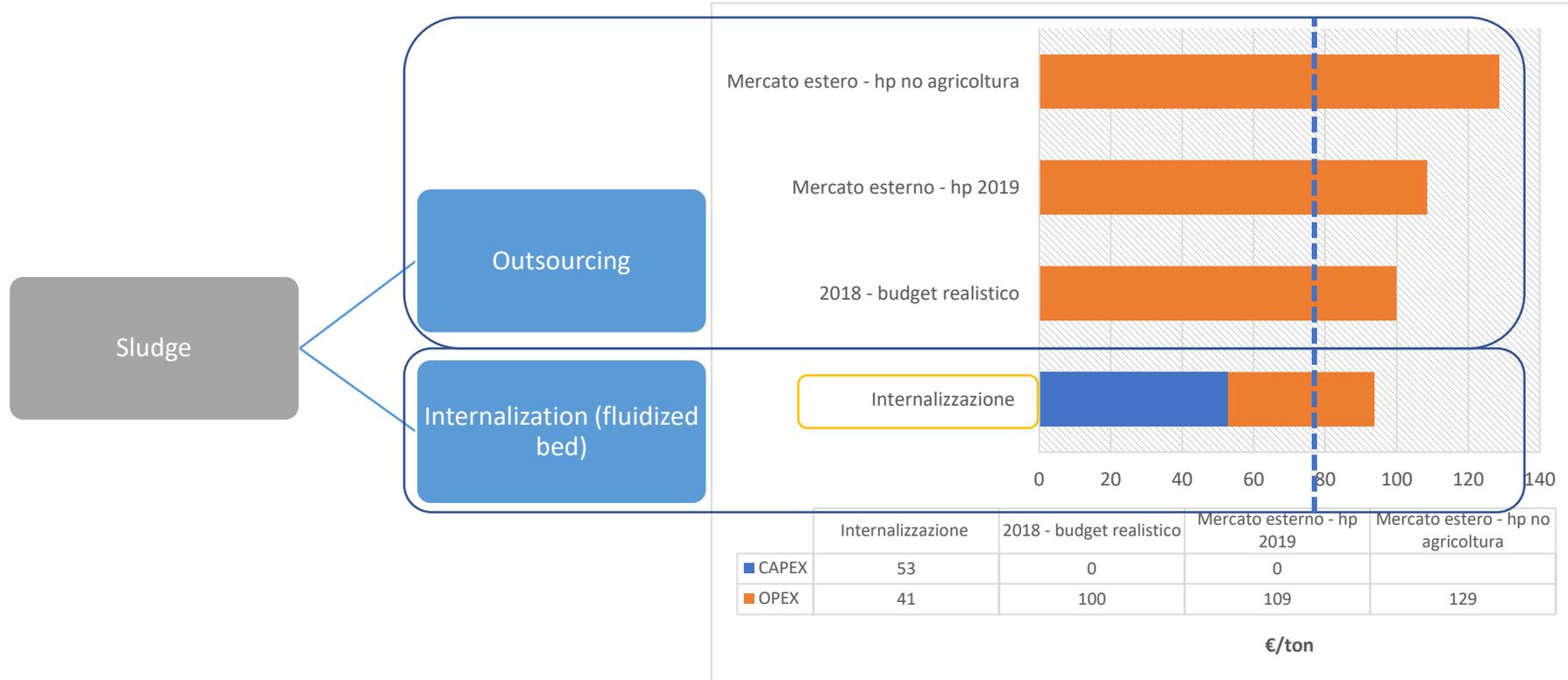


# THE OPPORTUNITY





# Positive effect on sludge disposal costs





## Positive effect on the environment - LCA

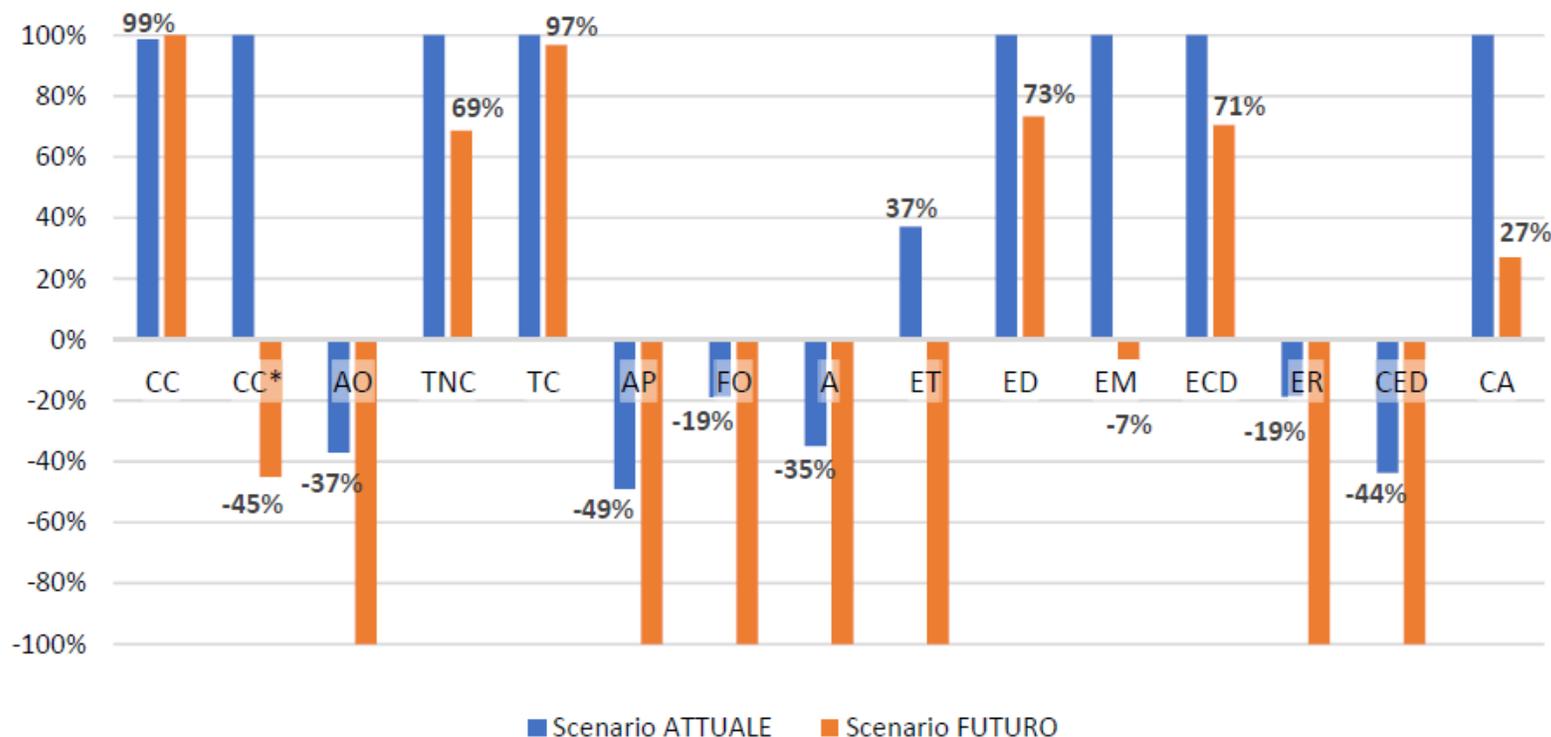
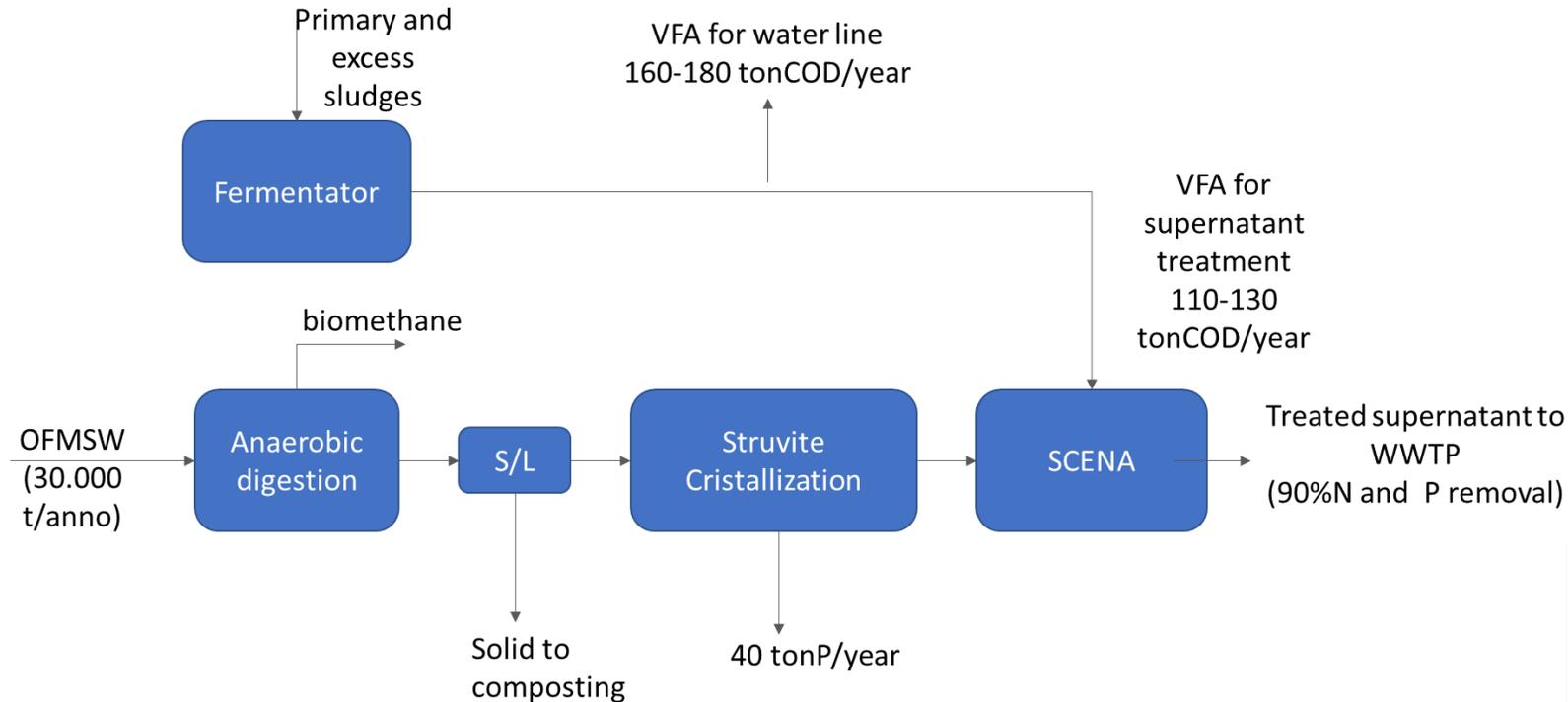


Figura 3.22: confronto delle prestazioni ambientali della piattaforma integrata CAP nella gestione attuale e futura. Per ogni indicatore, allo scenario caratterizzato dall'impatto/consumo maggiore in valore assoluto è stato associato il valore di 100% (impatto/consumo con segno positivo) o di - 100% (impatto/consumo con segno negativo).



# A real opportunity for phosphorus recovery – water stream

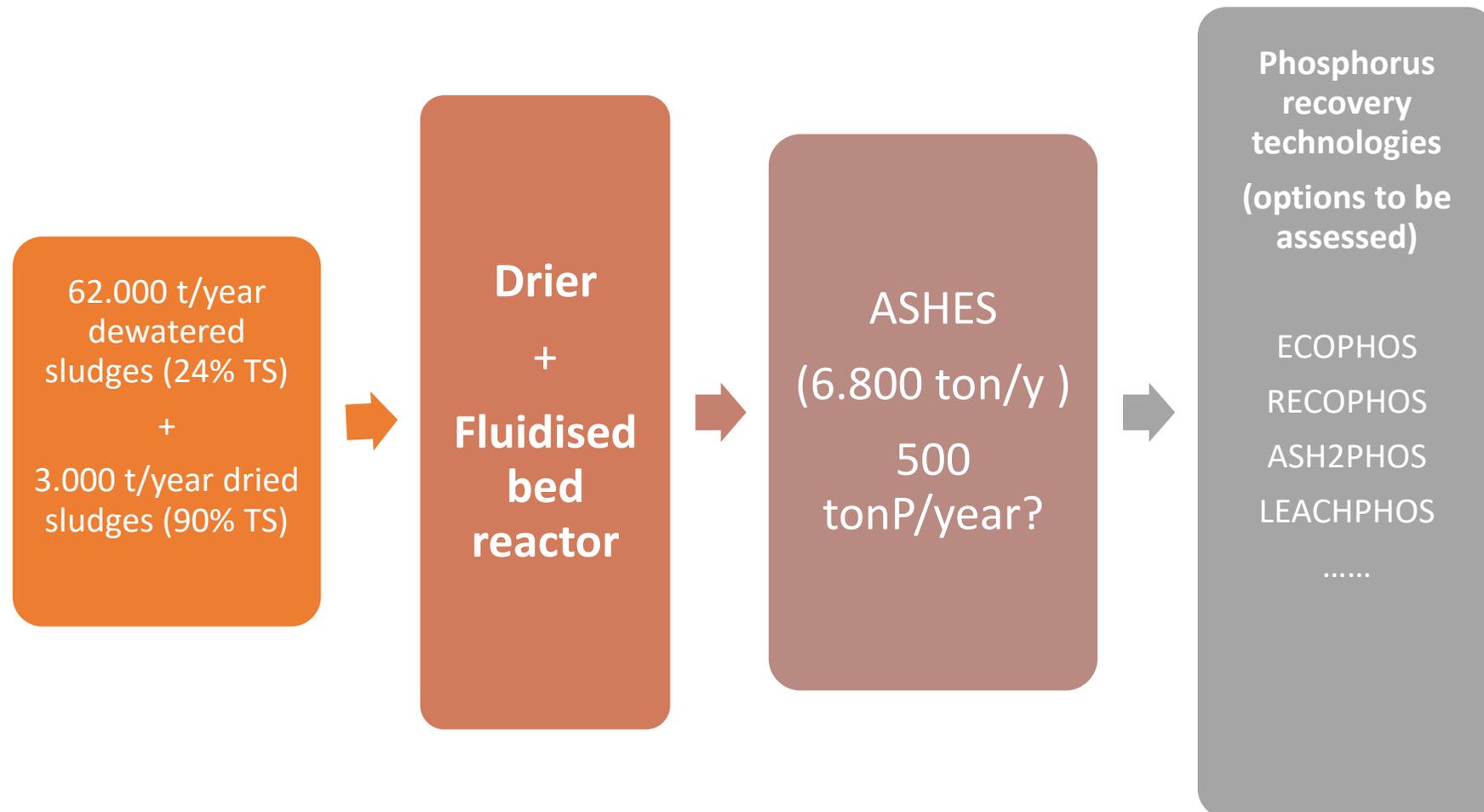


## Integrated treatment of sewage and OFMSW:

- 40 tonP/y of phosphorus as struvite (compared to 6 tonP/year with only sludges)
- 160-180 tCOD/y of organic chemical (VFA) for denitrification



# A real opportunity for phosphorus recovery – sludge stream



# VALUE CHAIN still to be defined

## Raw materials

- Need for centralized treatment plants (sludge mono-incineration and WWTP+OFMSW still to be developed in Italy)
- Real productivity to be assess trough pilots

## Legislation and other initiatives

- STRUBIAS
- Organic fertilizers regulation
- Italian Phosphorus platform

## Treatment and extraction

- Is the CAP project «big» enough to ensure profitability?
- Which is the most suitable technical solution for the CAP case
- Which is the best business model?
  - Decentralized P-extraction plants?
  - One unique regional platform?
  - Export of ashes?

## End use

- End-users still to be involved in Italy



# TIME SCHEDULE





European Sustainable  
Phosphorus Platform



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**ECOMONDO**  
THE GREEN TECHNOLOGIES EXPO

22<sup>a</sup> Fiera internazionale  
del recupero di materia ed energia  
e dello sviluppo sostenibile

Green & Circular Economy  
**6-9 Novembre 2018**  
Rimini Italy

IN CONTEMPORANEA CON  
**KEY ENERGY**

# Thank you for your attention

Andrea Lanuzza – Gruppo CAP

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