

Forward-thinking the application of olive mill by-products for biomethane production in Spain

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Head of Engineering

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Introduction

VORN Bioenergy

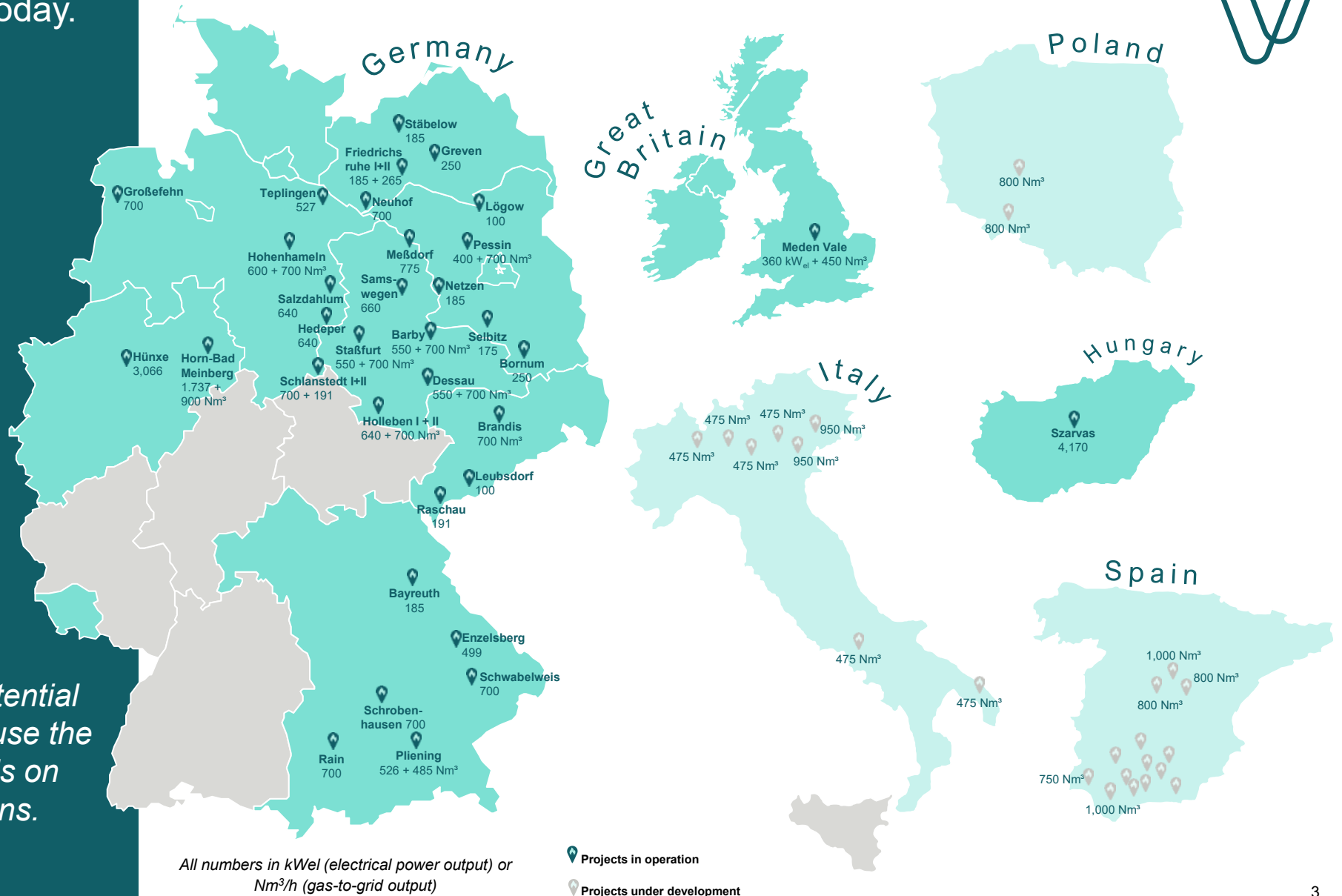
Tomorrow's Green Energy. Today.

20+ years of biogas experience and innovation

40+ biogas projects in six European markets

130+ MW total asset capacity realised

Our mission is to unlock the potential of biogas across Europe, because the green energy transition depends on low-carbon gas and fuel solutions.



1

Background

1. Introduction and background



What could be considered “conventional feedstocks” for biogas production?

Conventional Feedstocks



Cattle Manure



Cattle Slurry



Chicken Manure



Maize



Sugar beet



Straw



Grass

Conventional Biogas Process



1. Introduction and background



What could be considered “complex feedstocks” for biogas production?

Complex Feedstocks



Olive by-products

1. Introduction and background



What could be considered “complex feedstocks” for biogas production?

Complex Feedstocks

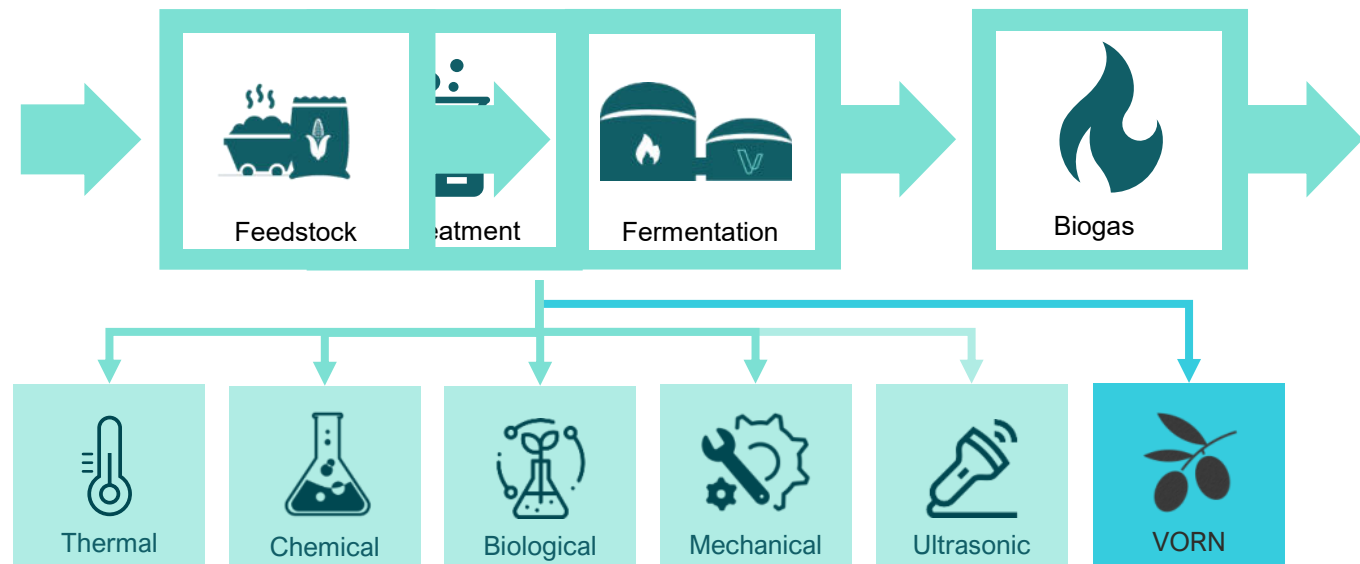


Olive by-products

Definition

“Pretreatment applied to **enhance the digestibility** of biomass, breaking down complex structures, removing inhibitory compounds and making them more **accessible to microorganisms**”

Innovative Biogas Process



How is VORN contributing to the development of new technological biogas processes with complex feedstocks?

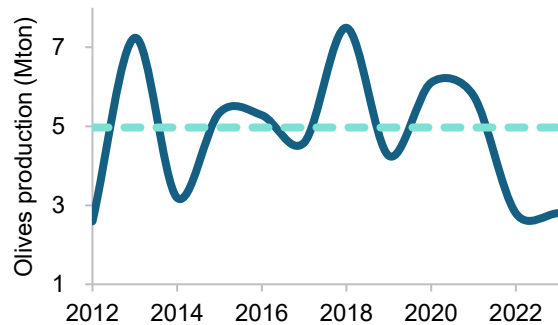
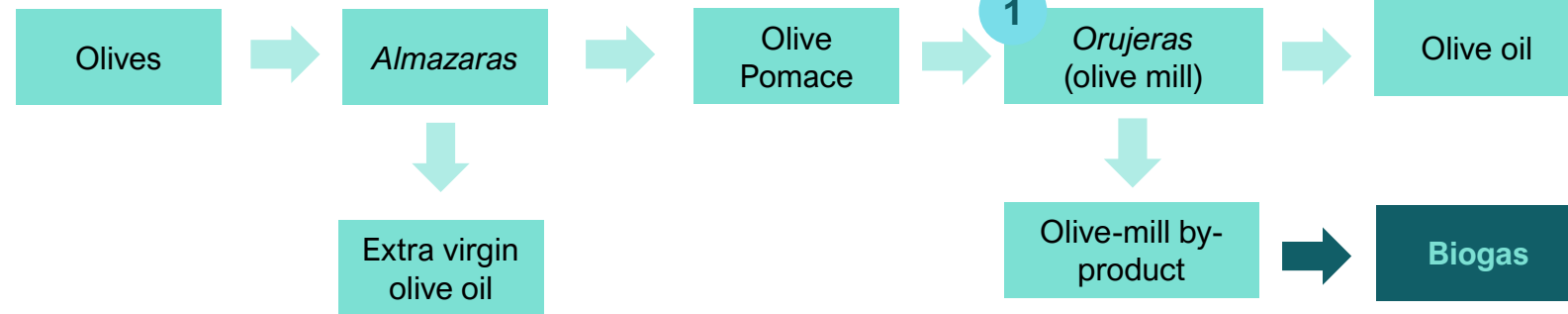
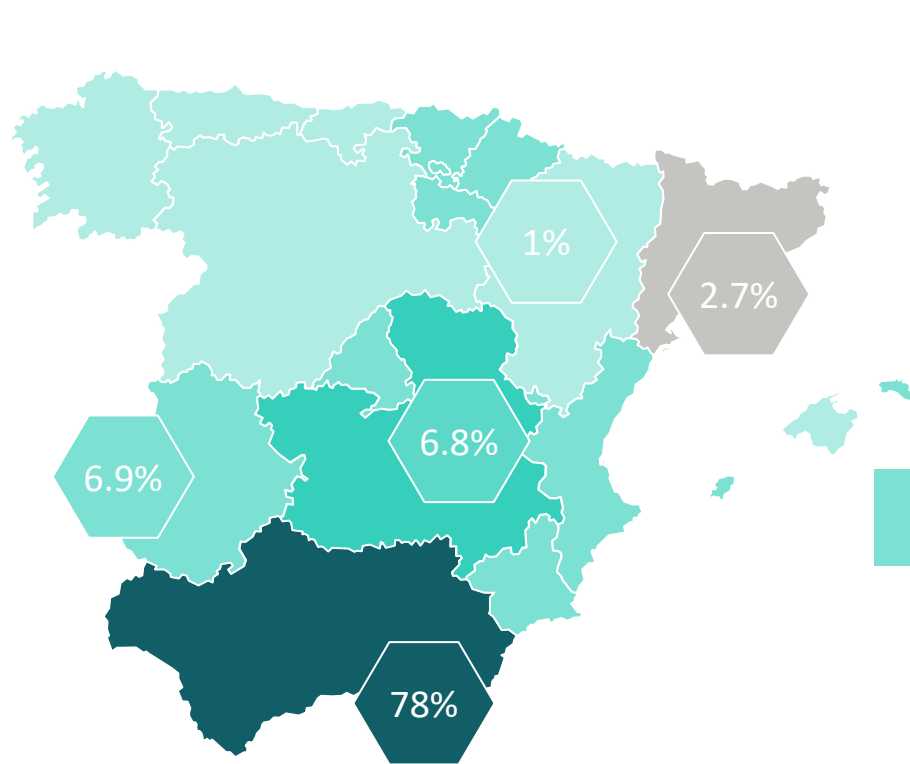
R.: New VORN pretreatment!

2

Biomethane from olive-mill by-product

VORN + OET + GREENAR

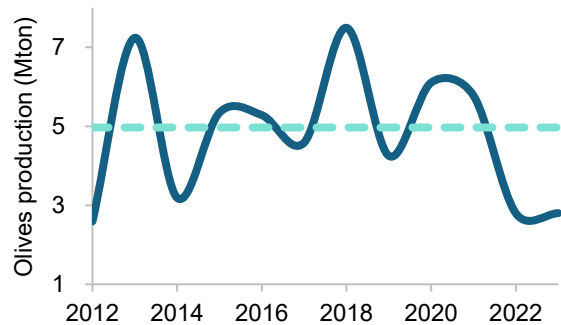
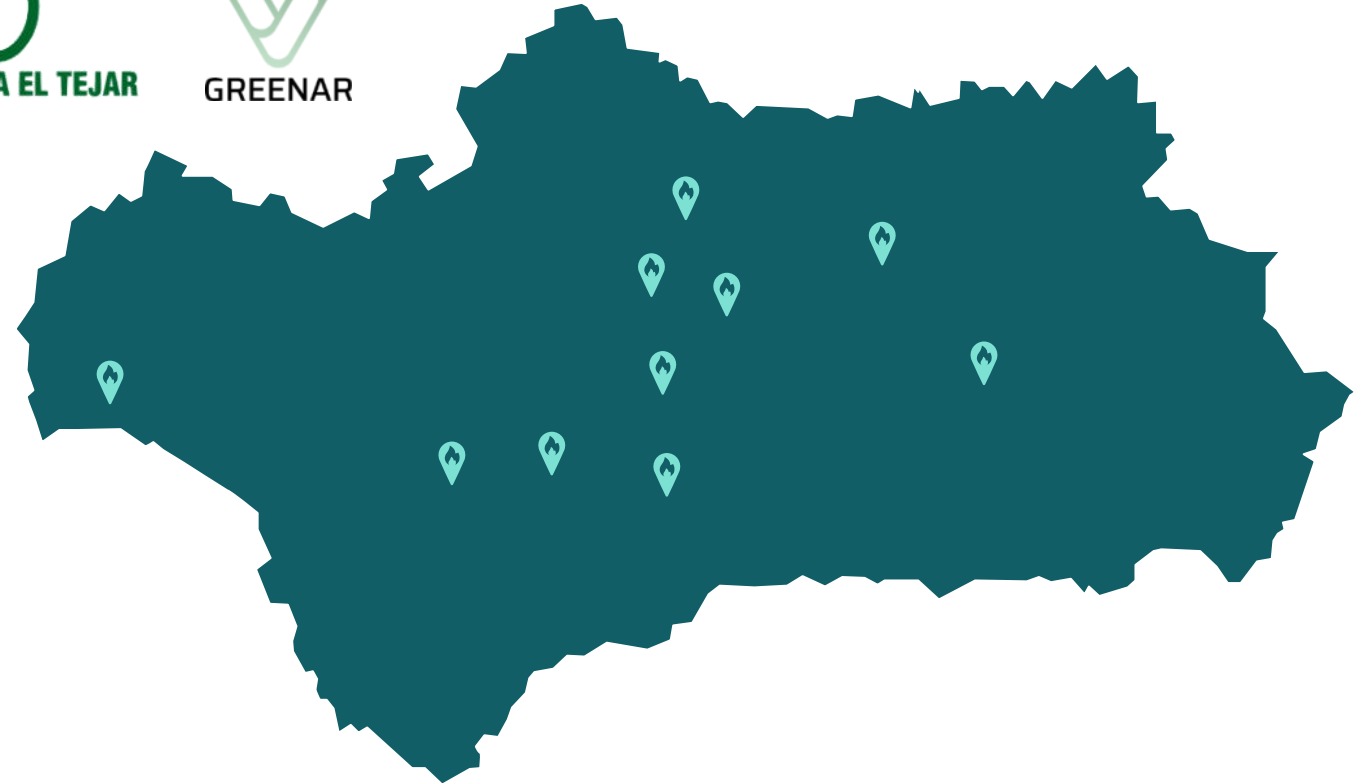
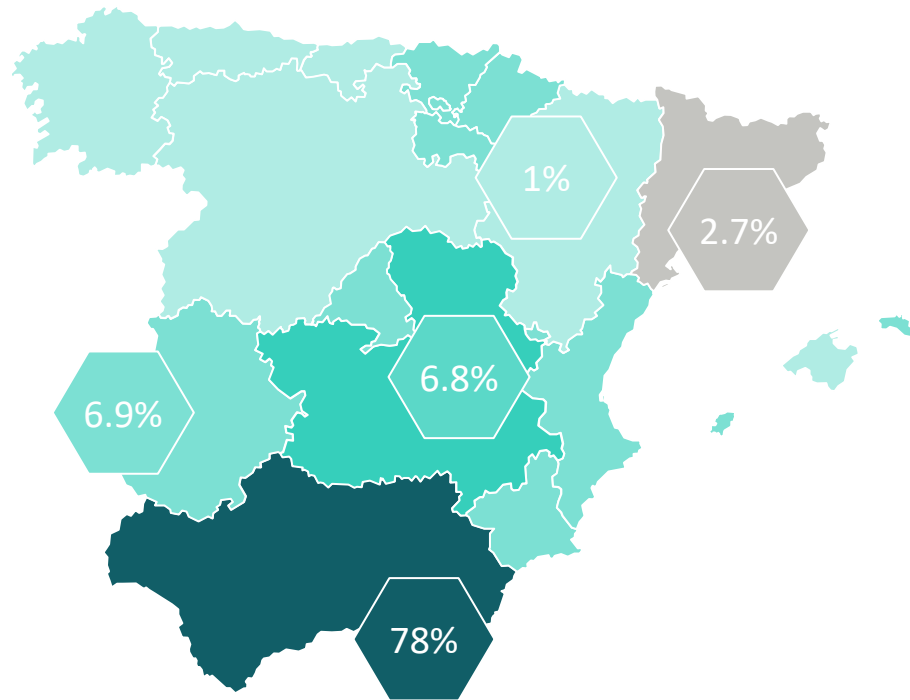
2. Biomethane from olive-mill by-products



Andalusia

5.000.000 ton olives per year	2.600.000 ton olive-mill by-product per year
32% of the world's olive oil	1.5 TWh/a biomethane

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1.5 TWh/a biomethane



VORN + OET + GREENAR

1.600.000 ton olive-mill by-product per year

1 TWh/a biomethane

3

Pretreatment as the key step

3. Pretreatment as the key step



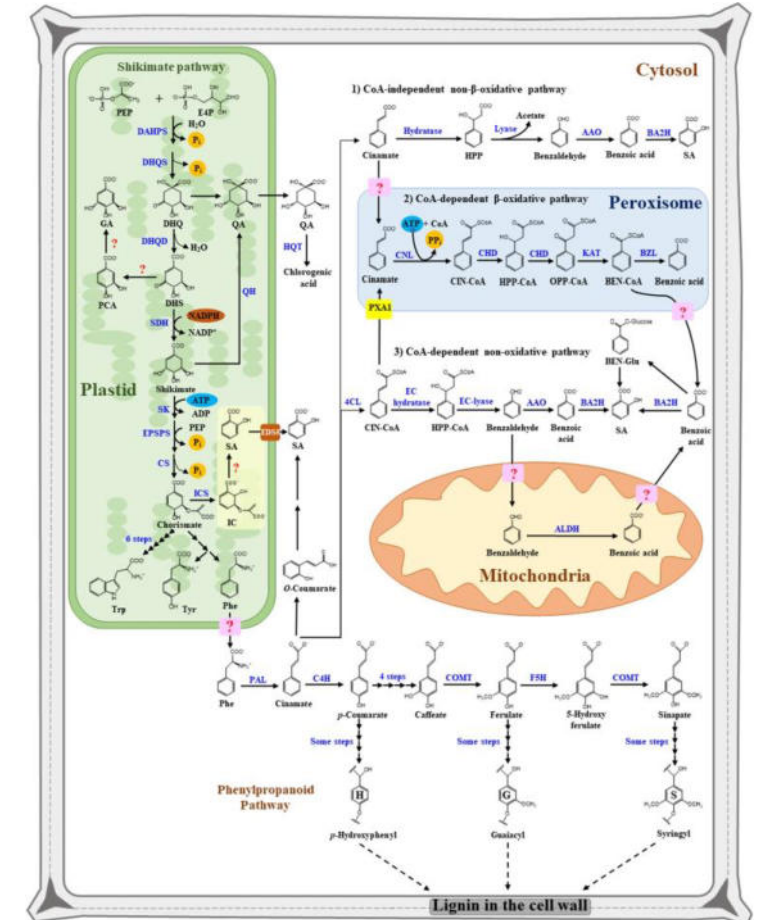
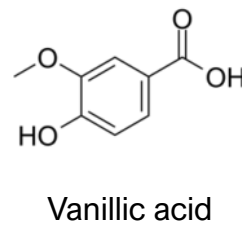
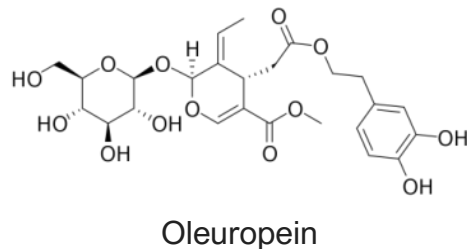
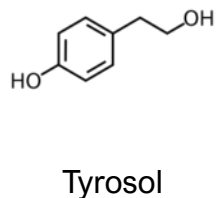
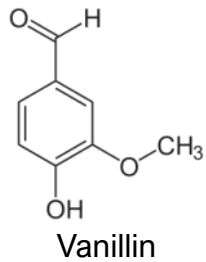
Biogas production from olive mill by-product

Contextualization



Olive mill by-product

Parameters	Composition	Unit
DM	10 - 14	[%FM]
oDM	85 - 90	[%DM]
pH	4 - 4.5	-
COD	90 - 107	[kg/ton FM]
N	0.7 - 0.9	[kg/ton FM]
P	1.2 - 1.5	[kg/ton FM]
K	8 - 10	[kg/ton FM]
Phenolic compounds (PC)	7 - 9	[kg/ton FM]

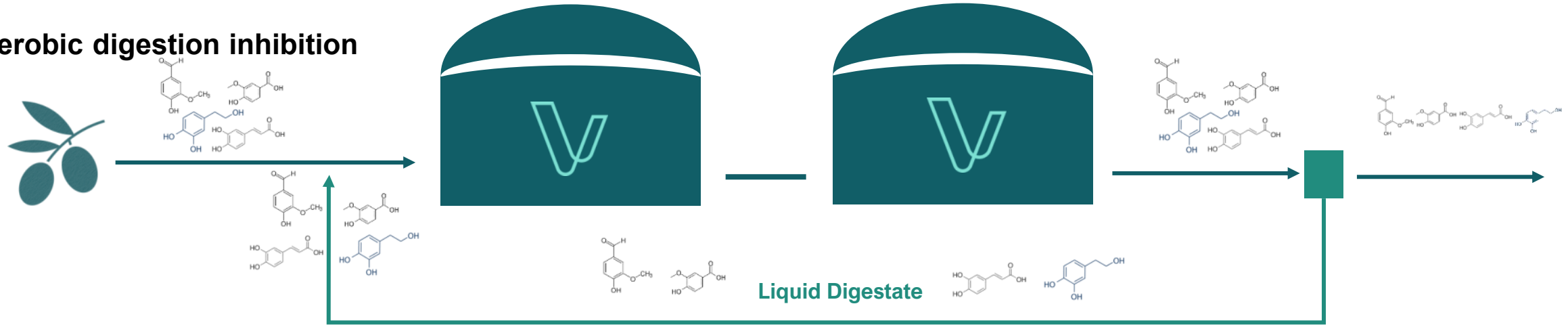


3. Pretreatment as the key step



Biogas production from olive mill by-product

Anaerobic digestion inhibition

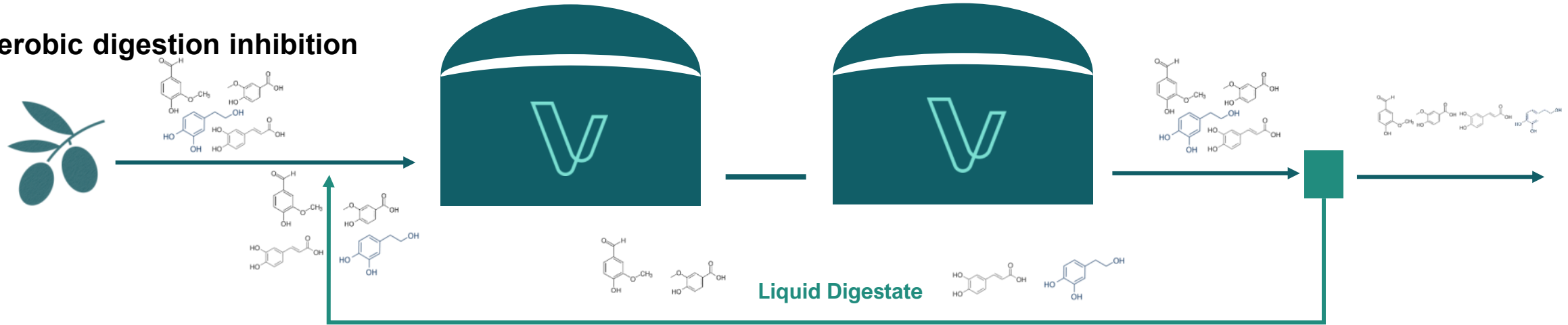


3. Pretreatment as the key step



Biogas production from olive mill by-product

Anaerobic digestion inhibition

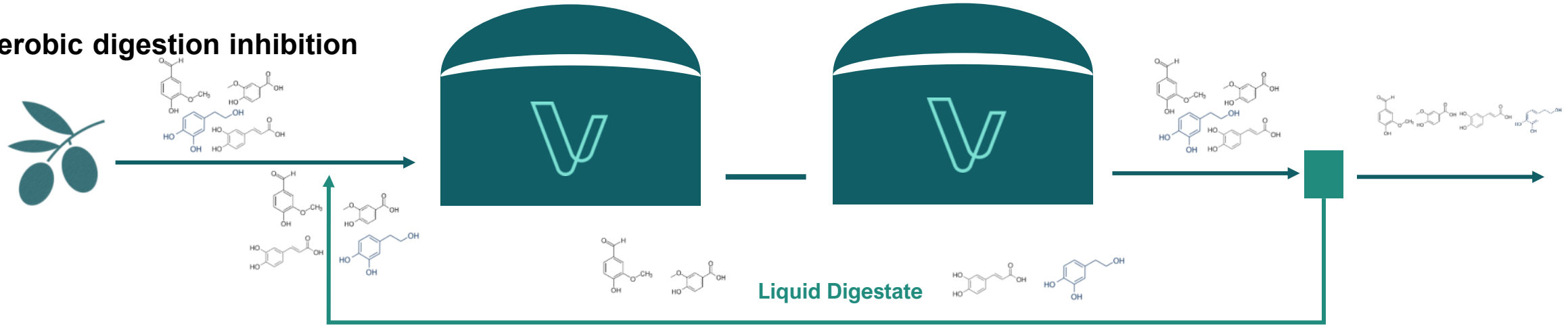


3. Pretreatment as the key step

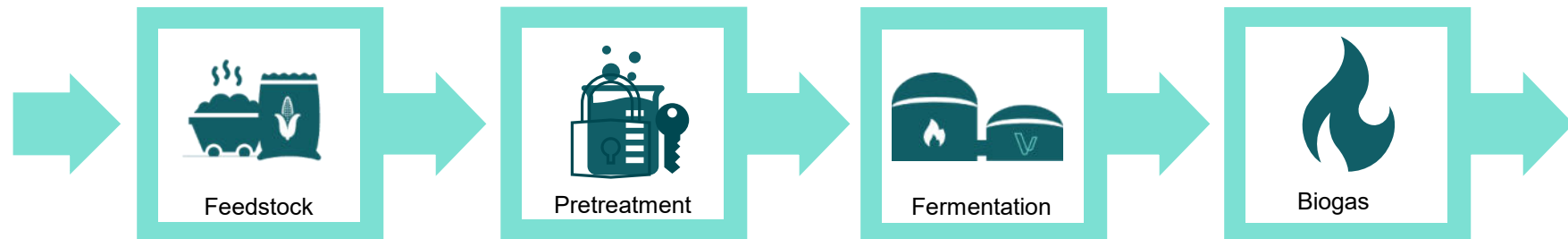


Biogas production from olive mill by-product

Anaerobic digestion inhibition



The key step for biogas production!



3. Pretreatment as the key step

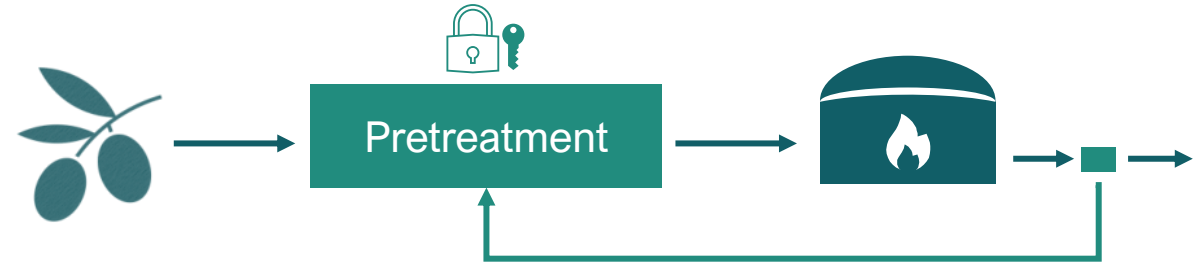


Biogas production from olive mill by-product

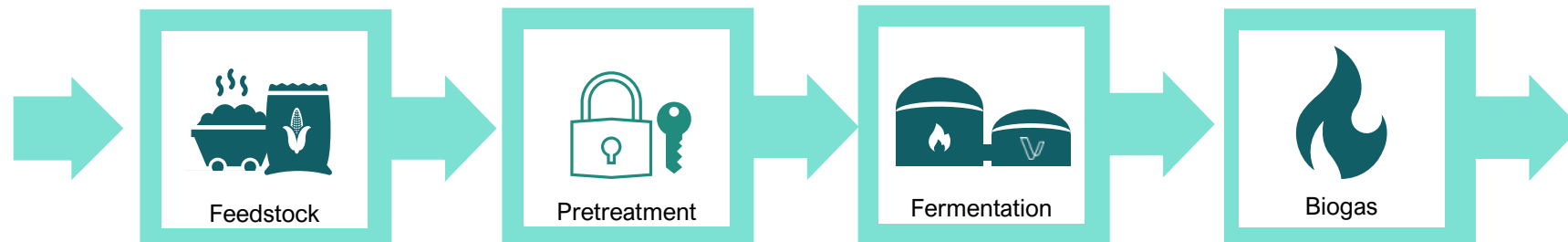
Possible operational problems

- 1 Inhibition of fermentation with high amounts of olive mill by-product (mono-digestion)
- 2 Presence of stones in the by-product
- 3 Presence of VOC in biogas. Negative effect on the biomethane upgrading process.
- 4 Presence of phenolic compounds in the digestate. Negative effect on regulations for classification as organic fertilizer. Max limit of 8 kg PC/ton¹. Possible cost of digestate treatment.

VORN's solution



¹Real Decreto 506/2013.



4

**VORN's solution for olive mill
by-products valorization**

3. VORN's solution for olive by-products valorization



Biogas production from olive mill by-product

VORN's Pretreatment

Patented Process

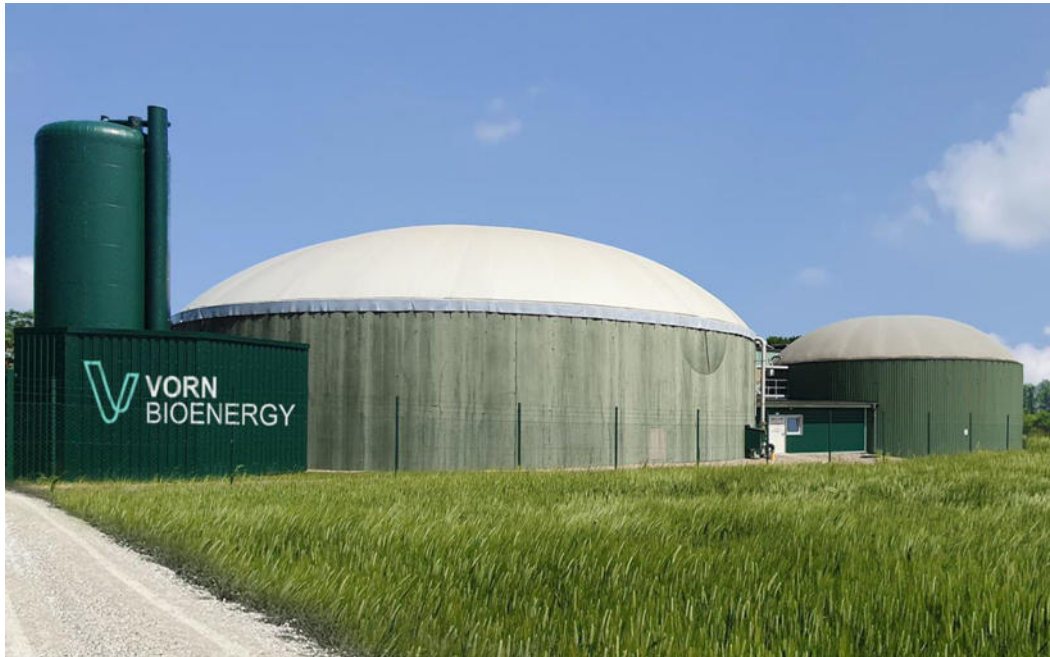


3. VORN's solution for olive by-products valorization

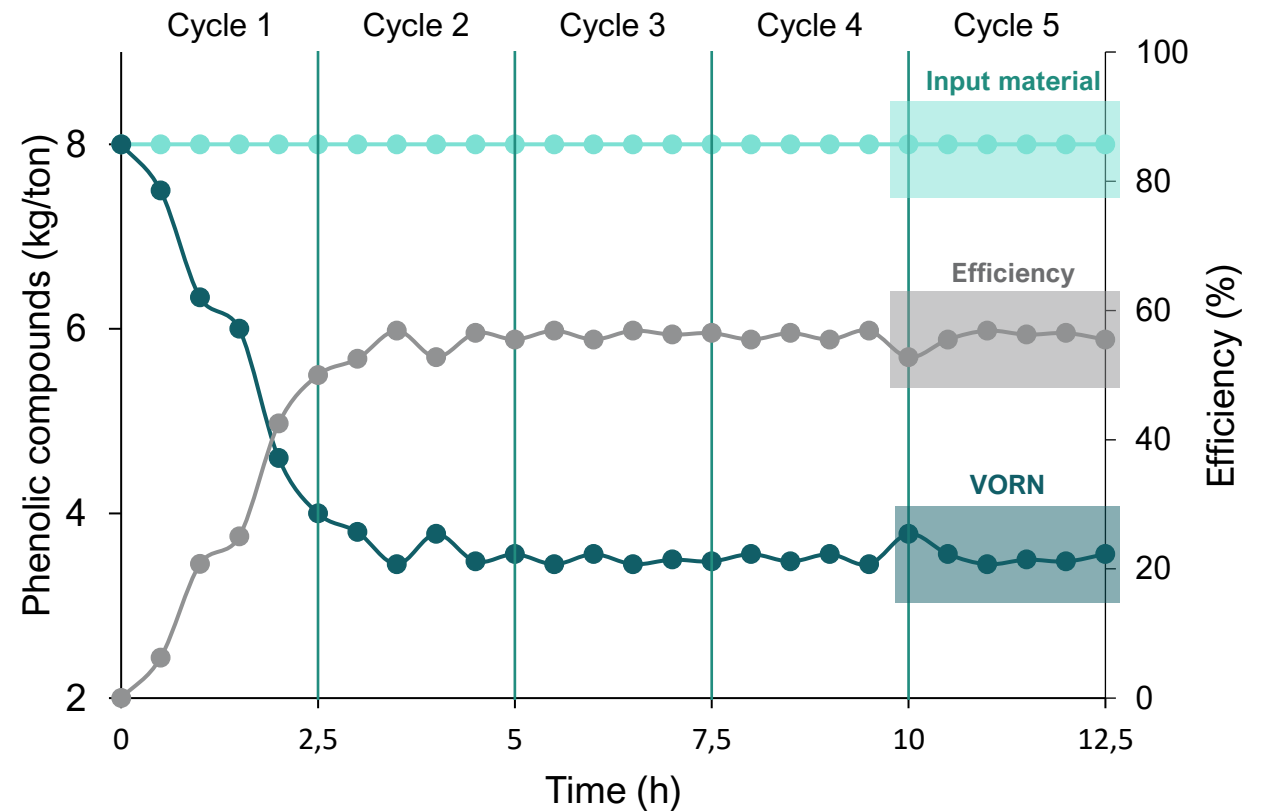


Biogas production from olive mill by-product

VORN's Pretreatment
Patented Process



Removal efficiency of phenolic compounds

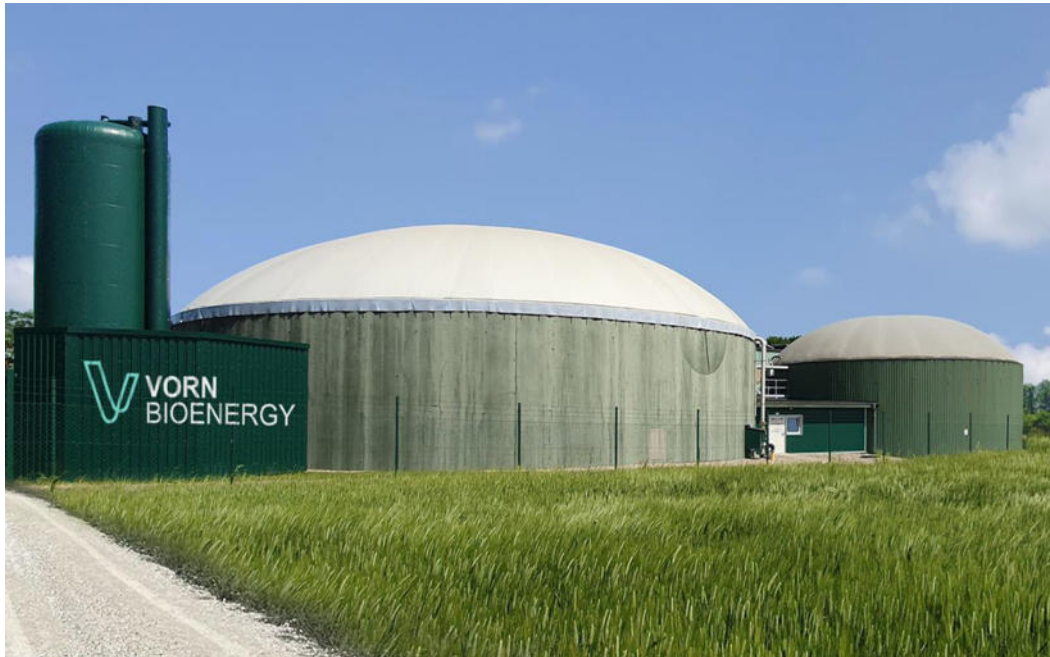


3. VORN's solution for olive by-products valorization

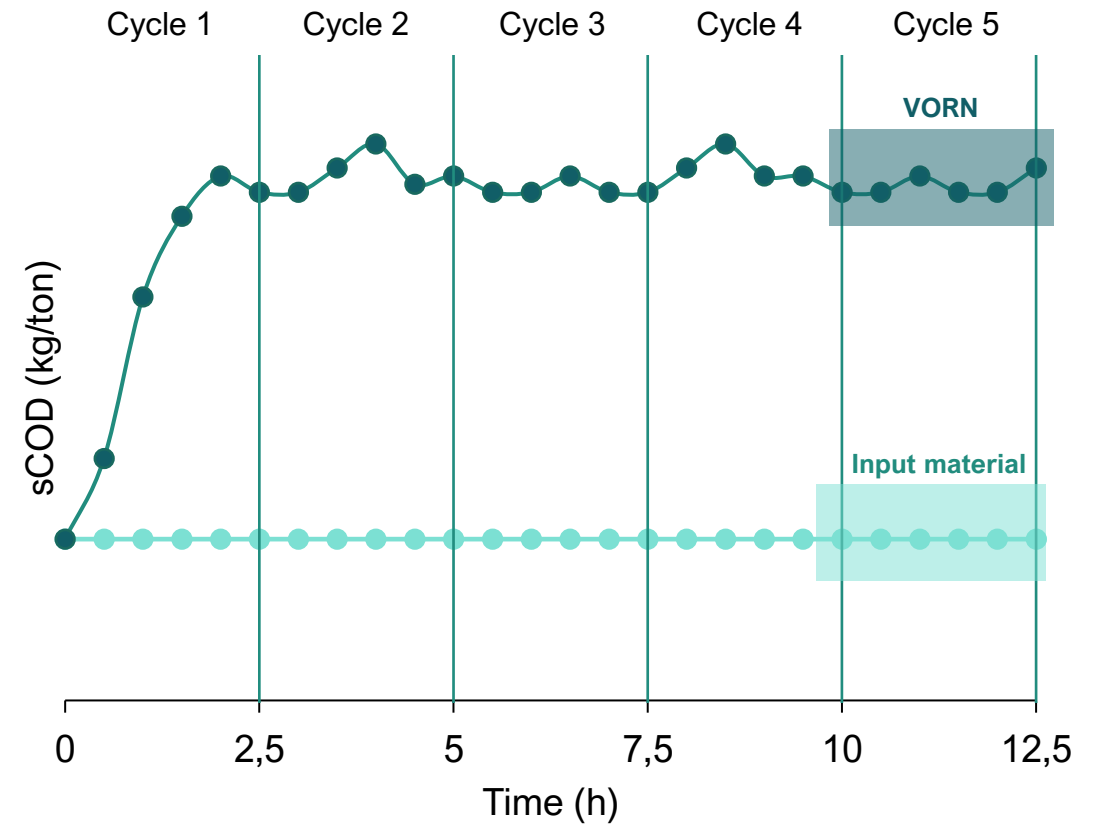


Biogas production from olive mill by-product

VORN's Pretreatment
Patented Process



Stability of sCOD



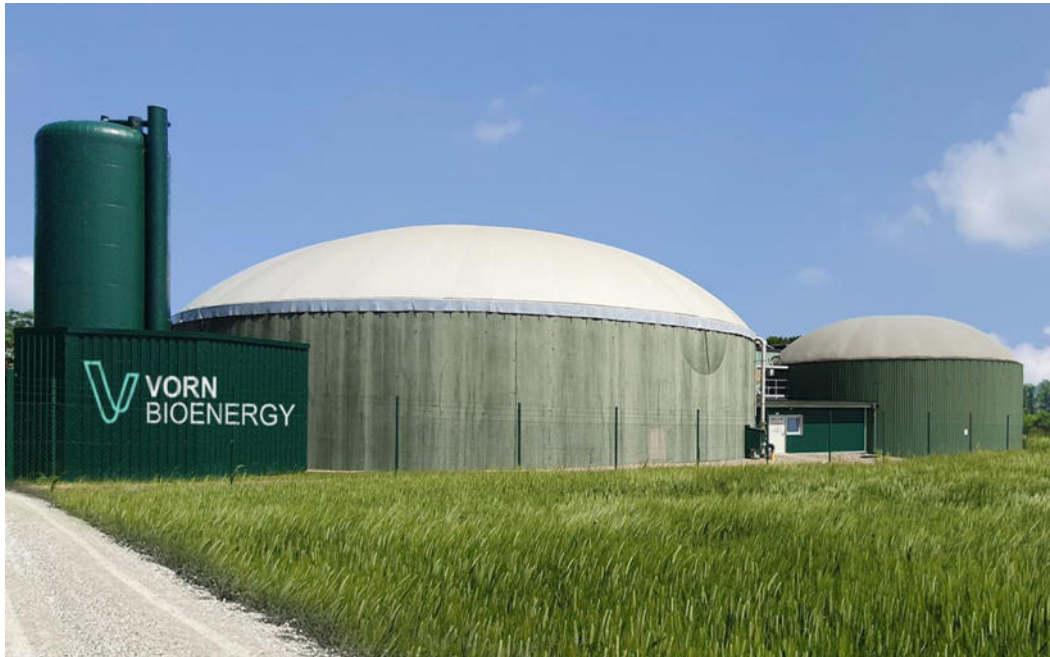
3. VORN's solution for olive by-products valorization



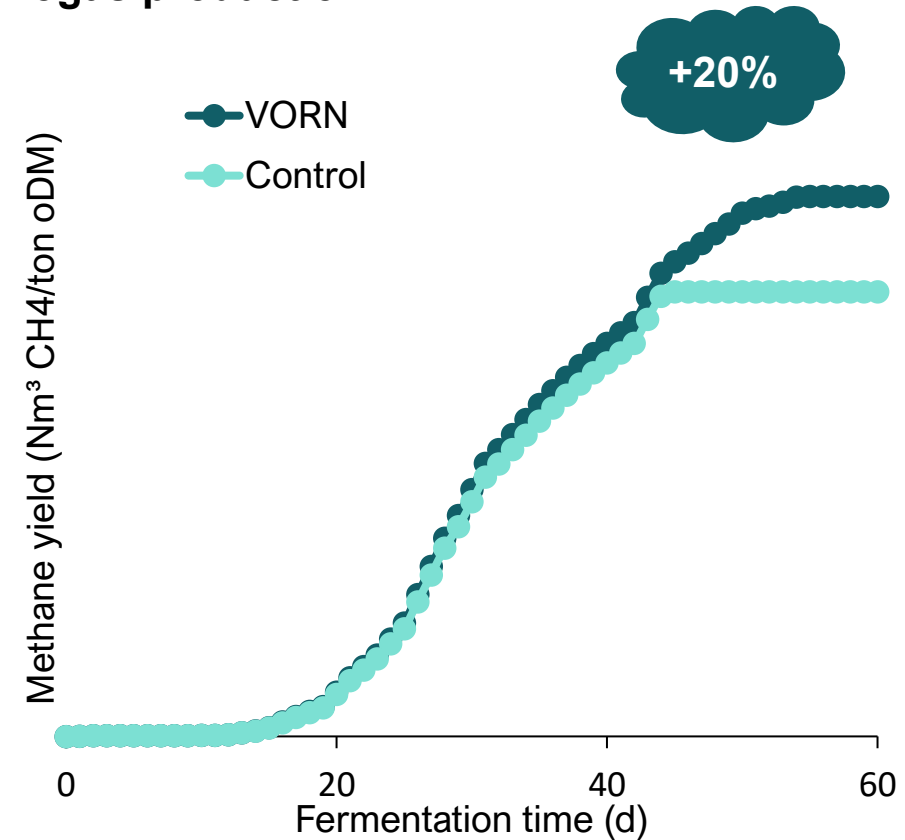
Biogas production from olive mill by-product

VORN's Pretreatment

Patented Process



Biogas production



5

Conclusion

5. Conclusion



VORN is at the forefront of technology development for biomethane production

Conclusion and Outcome

- 1) Complex feedstock can be used for biogas production
 - Technical validation
 - Development of new concepts
 - New technological processes
- 2) Final validation of VORN pretreatment
 - Pilot plant with treatment capacity of 1 ton/d
 - Operation over one year
 - From TRL 5 to TRL 7 (*development to demonstration*)
- 3) Implementation at industrial scale
 - Treatment of 1.600.000 ton/a olive mill by-products
 - Integration with biomethane plant
 - Improvement of profitability
 - From TRL 7 to TRL 9 (*demonstration to operation*)



1.600.000 ton olive-mill by-product per year

1 TWh/a biomethane

Tomorrow's Green Energy. Today.

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