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SUPPORTING THE DEVELOPMENT OF GASIFICATION BASED VALUE CHAINS

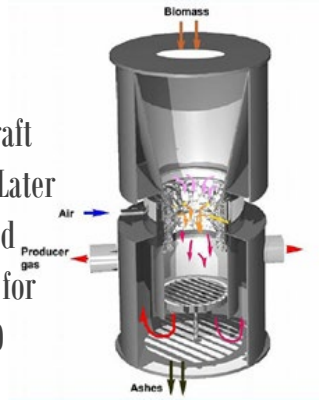
IR. B.J. VREUGDENHIL

GASIFICATION IS VERSATILE

LONG HISTORY IN GASIFICATION / CLEANING /UPGRADING

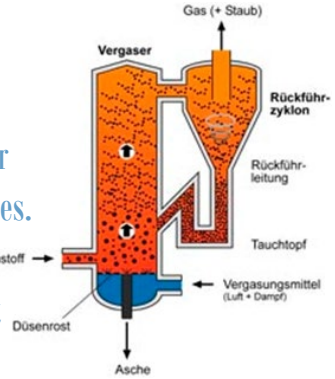
1980

300 kW_{th} Downdraft gasifier on coal. Later modified for wood operations. Used for gas cleaning R&D



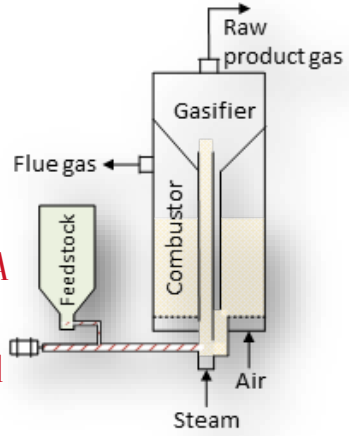
1995

500 kWth CFB gasifier, used for various biomasses. Technology licensed to HoSt



2004

Start of indirect gasification MILENA 25 kWth. Scaled to 800 kWth and used for SNG development



2020

New biofuel lab Gasification, cleaning, co-production (BTX), synthesis (MeOH, FT, DME and SNG)

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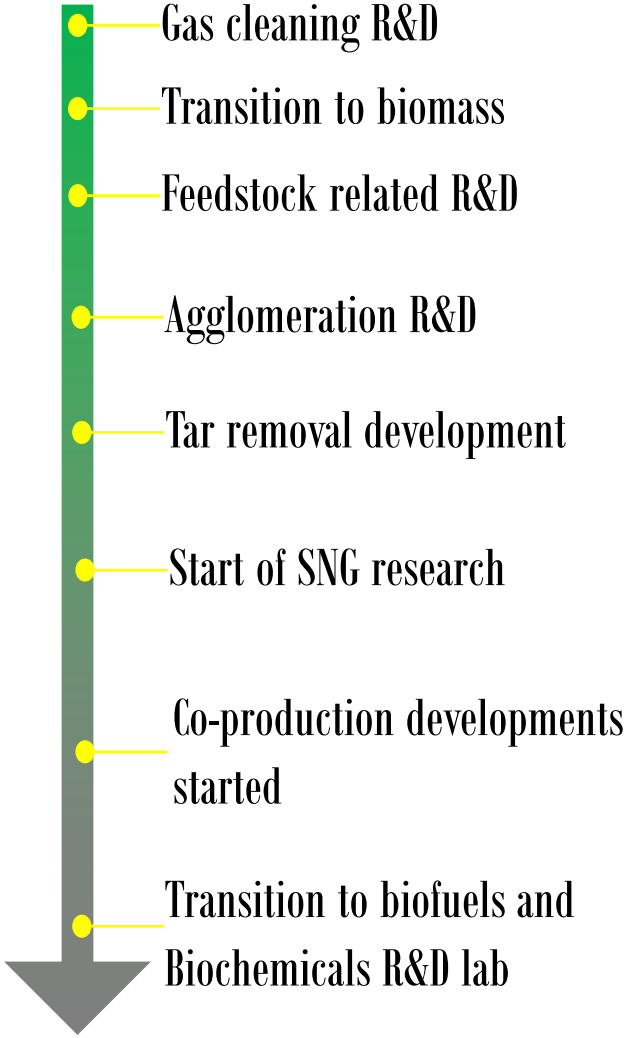
GASIFICATION RELATED MILESTONES

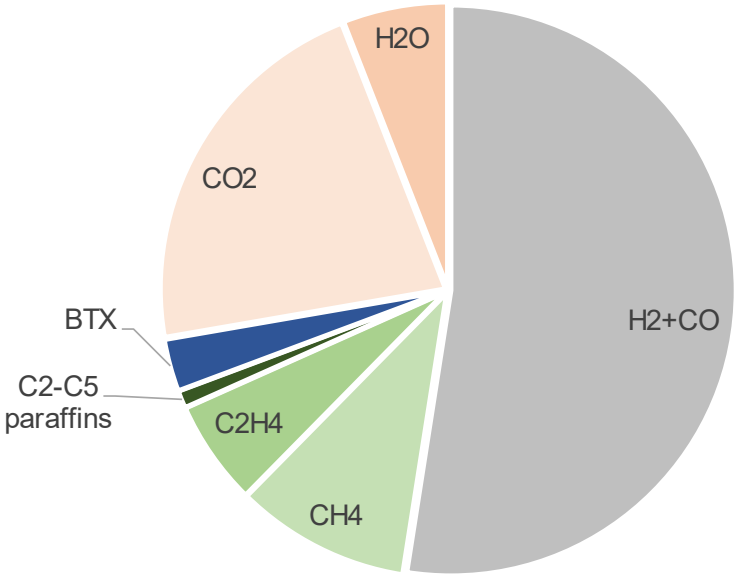
1980	Downdraft coal gasifier 300 kW_{th}
1990	Downdraft gasifier modified for wood
1996	CFB gasifier 500 kW_{th} → Licensed to HoSt in 2002
1998	BFB gasifier 5 kW_{th}
2000	OLGA tar removal system build → License to Dahlman in 2006
2004	Indirect gasifier 25 kW_{th} MILENA → License to Thermax (2012) and Dahlman (2013)
2008	Indirect gasifier scaled up to 800 kW_{th}
2012	Co-production schemes developed (BTX recovery)
2013	SNG system developed and proven at ECN
2020	Sustainable Biofuels Technology laboratory opened → biofuels and biochemicals research facility



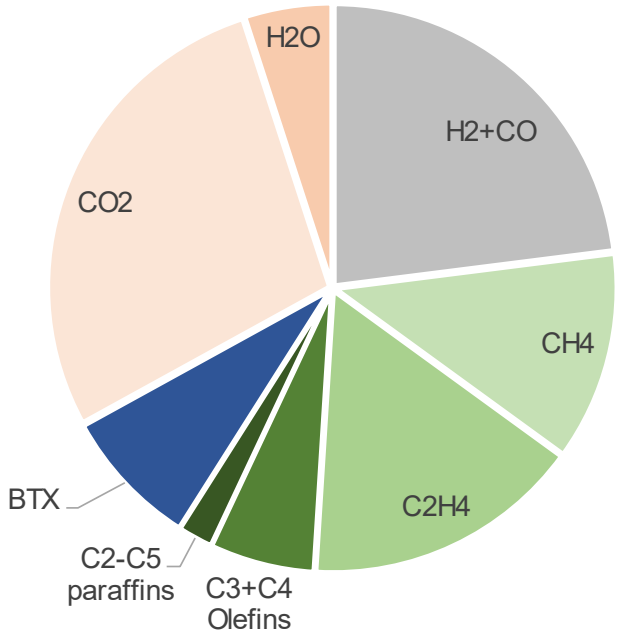
GASIFICATION

A PLATFORM TECHNOLOGY FOR ENERGY AND CHEMICALS

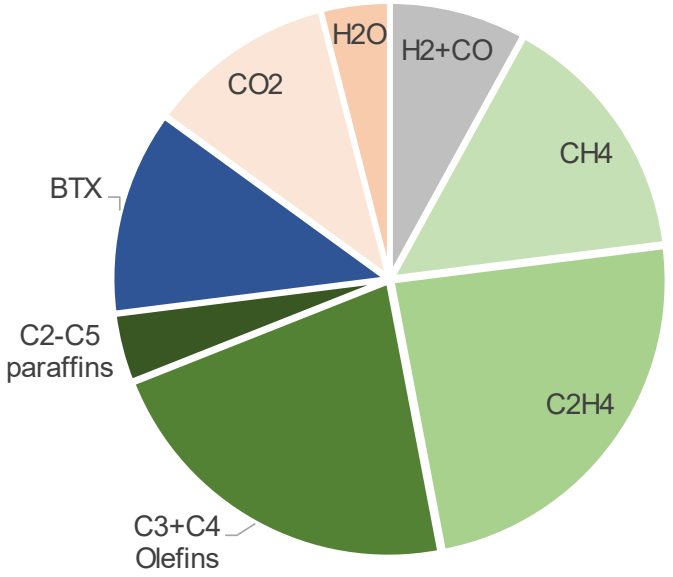
WOOD

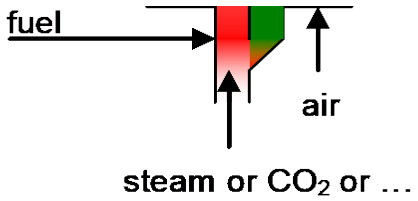


RDF (WOOD/PLASTIC)



MIXED PLASTICS





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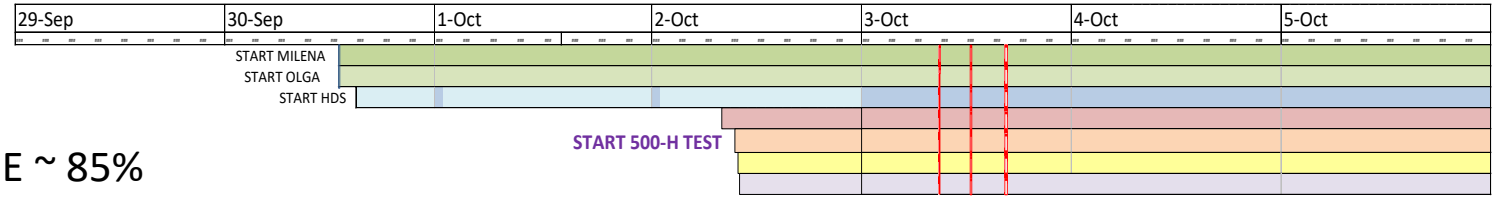
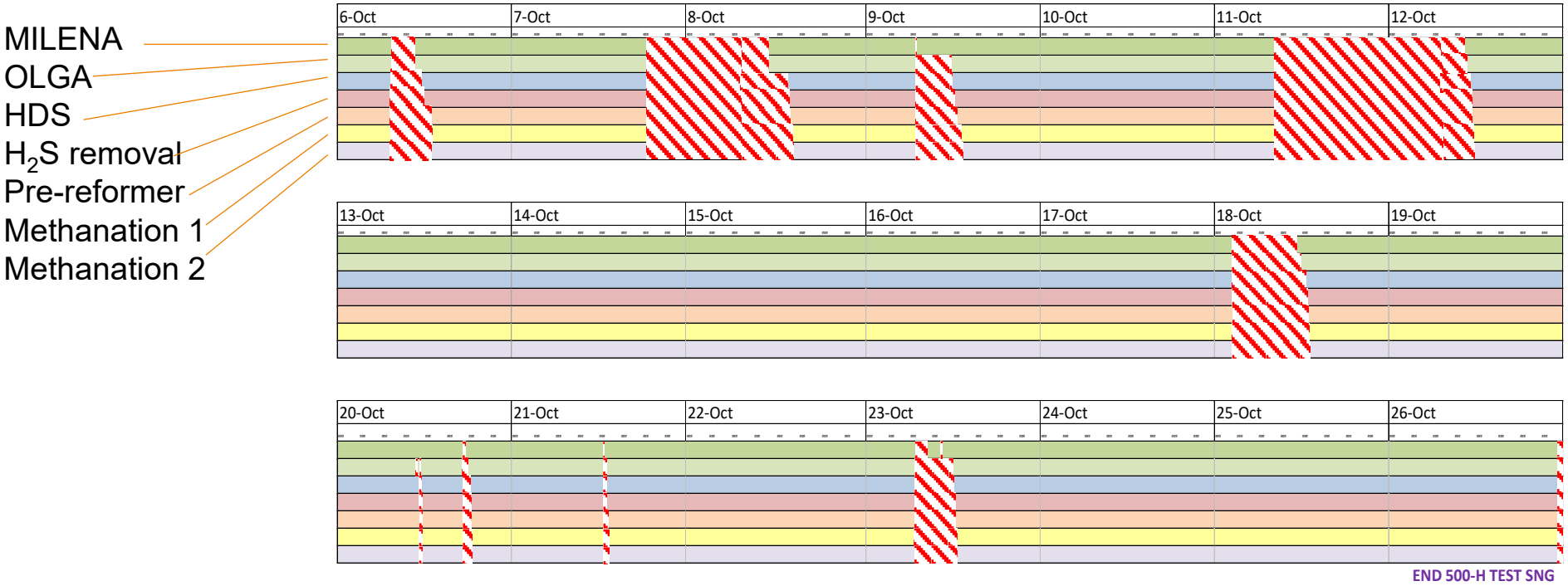
OVERVIEW 500-HOUR BIO-SNG TEST

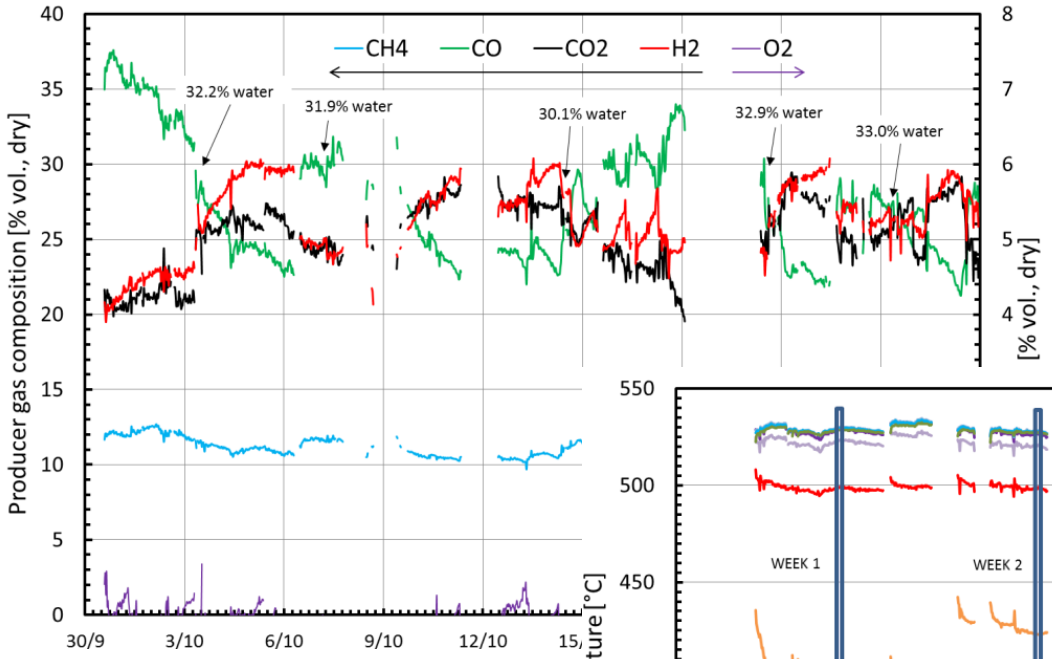
Availability

- MILENA: ~90%
- MILENA + OLGA + ESME ~ 85%

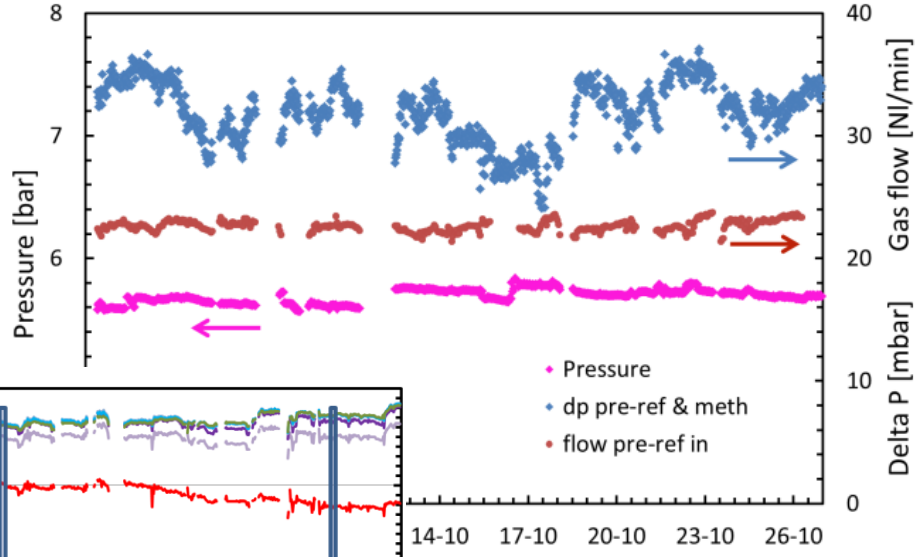




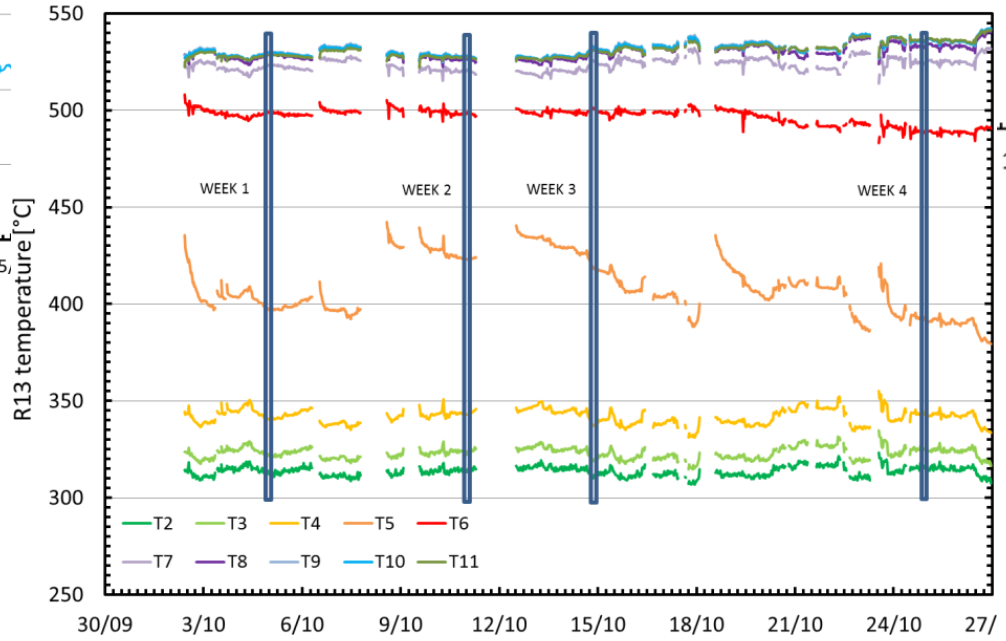
SOME RESULTS OF THE 500 HOUR TEST



MILENA gas



ESME **pressure**, **flow** and **pressure drop**



Pre-reformer temperatures

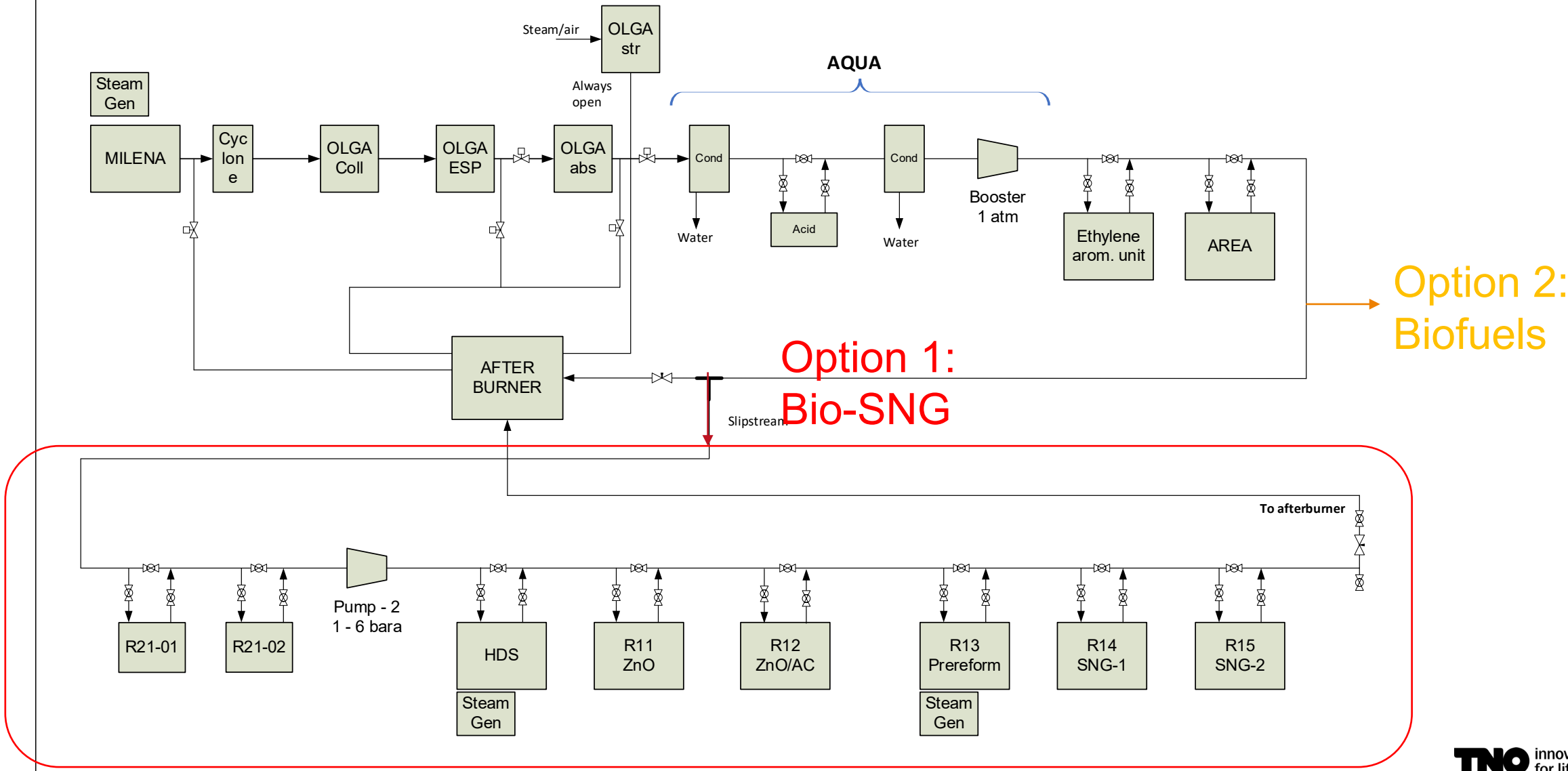
BIO-BTX PRODUCT

- Bio-BTX sample composition, main constituents, some examples:

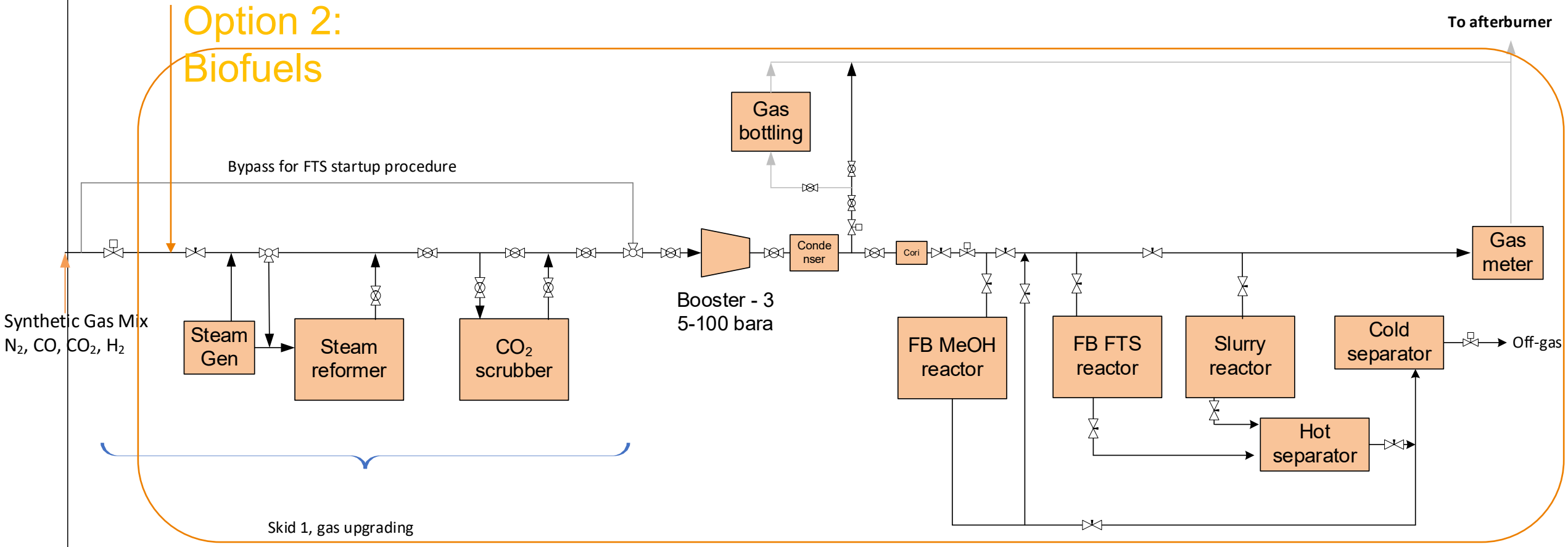
BTX samples		Beech wood	Paper rejects	RDF (Qlyte)
Benzene	[wt%]	85.5	74.1	59.2
Toluene	[wt%]	8.9	10.7	14.9
Ethylbenzene	[wt%]	0.2	1.0	1.4
m/p-Xylene	[wt%]	0.2	0.4	0.7
o-Xylene+Styrene	[wt%]	1.5	4.7	6.5
Total S-organics (thiophenes)	[mg/kg]	1602	1782	2712

- Much S impurities (mostly thiophenes present) due to similar physical properties to benzene
  - Post/pre-treatment of BTX required.

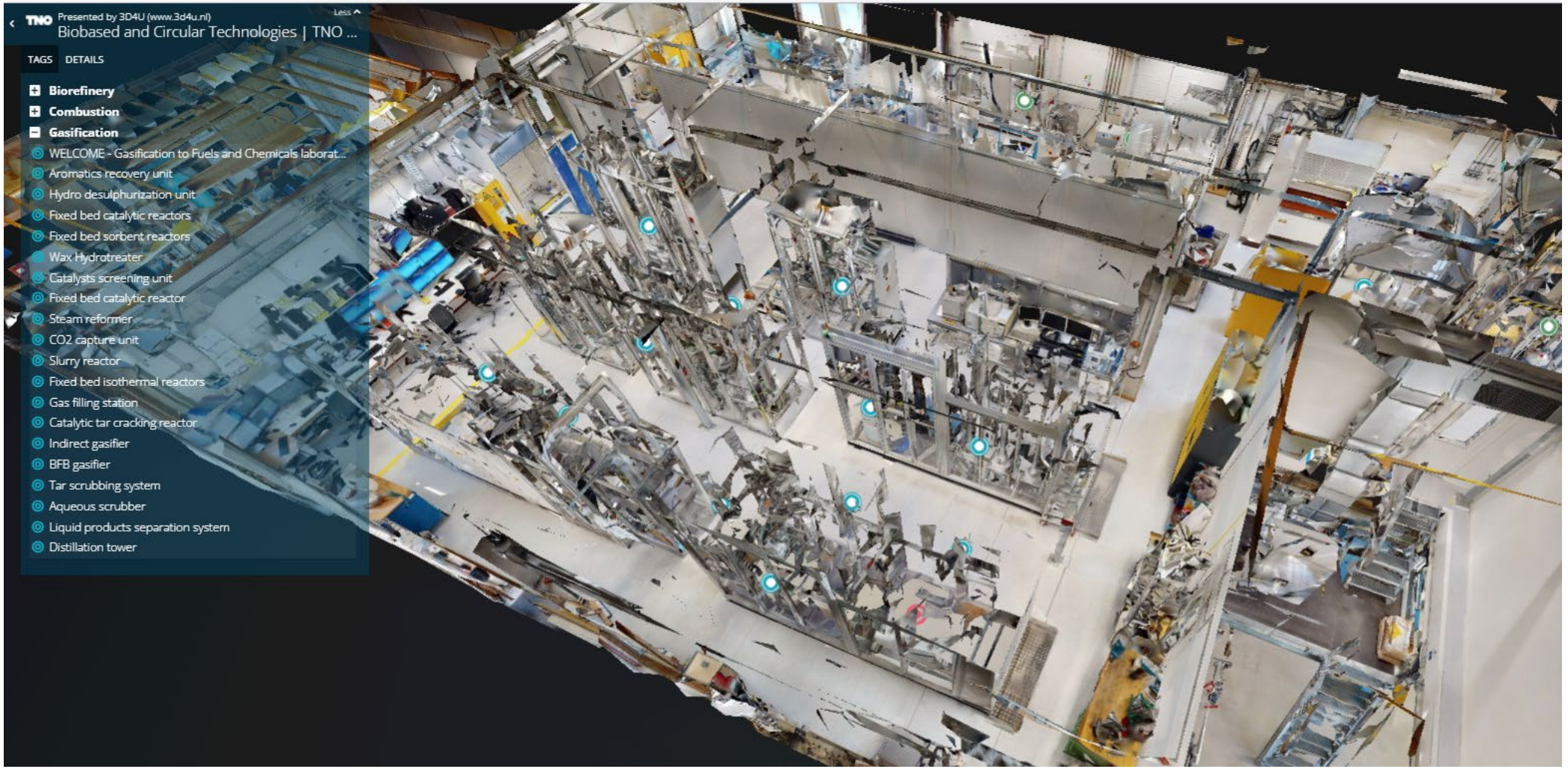
SBT LAB, BIO-SNG PRODUCTION



SBT LAB, BIOFUELS PRODUCTION



EXTENSIVE BIOFUELS AND CHEMICALS LAB



https://mpembed.com/show/?m=boa5wBYZMb9&mpu=77

For password contact berend.vreugdenhil@tno.nl

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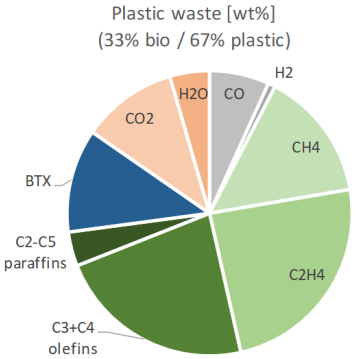
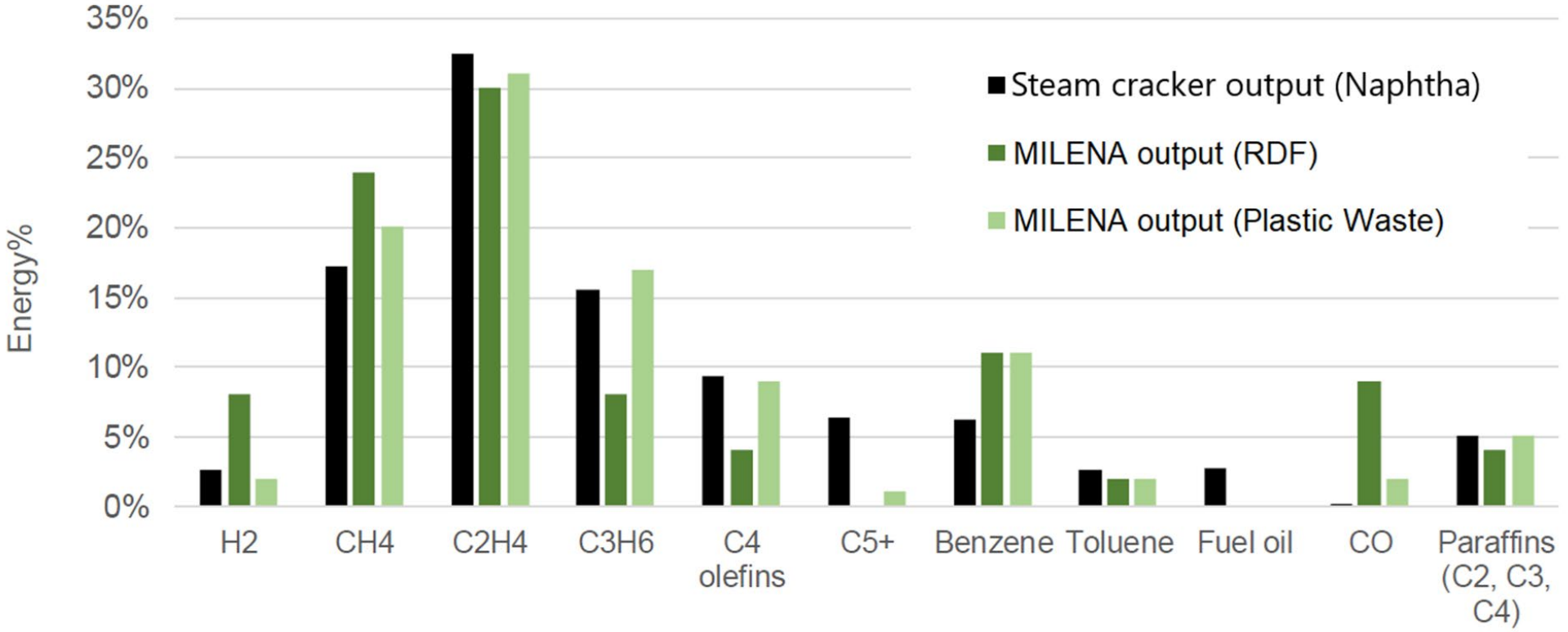
MOVING TOWARDS WASTE

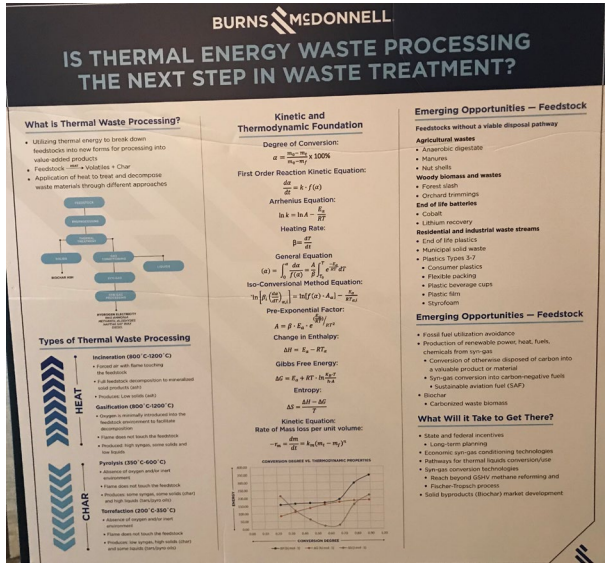
THERMAL CRACKING OF WASTE
FROM 100% BIOLOGICAL → ~70% FOSSIL BASED

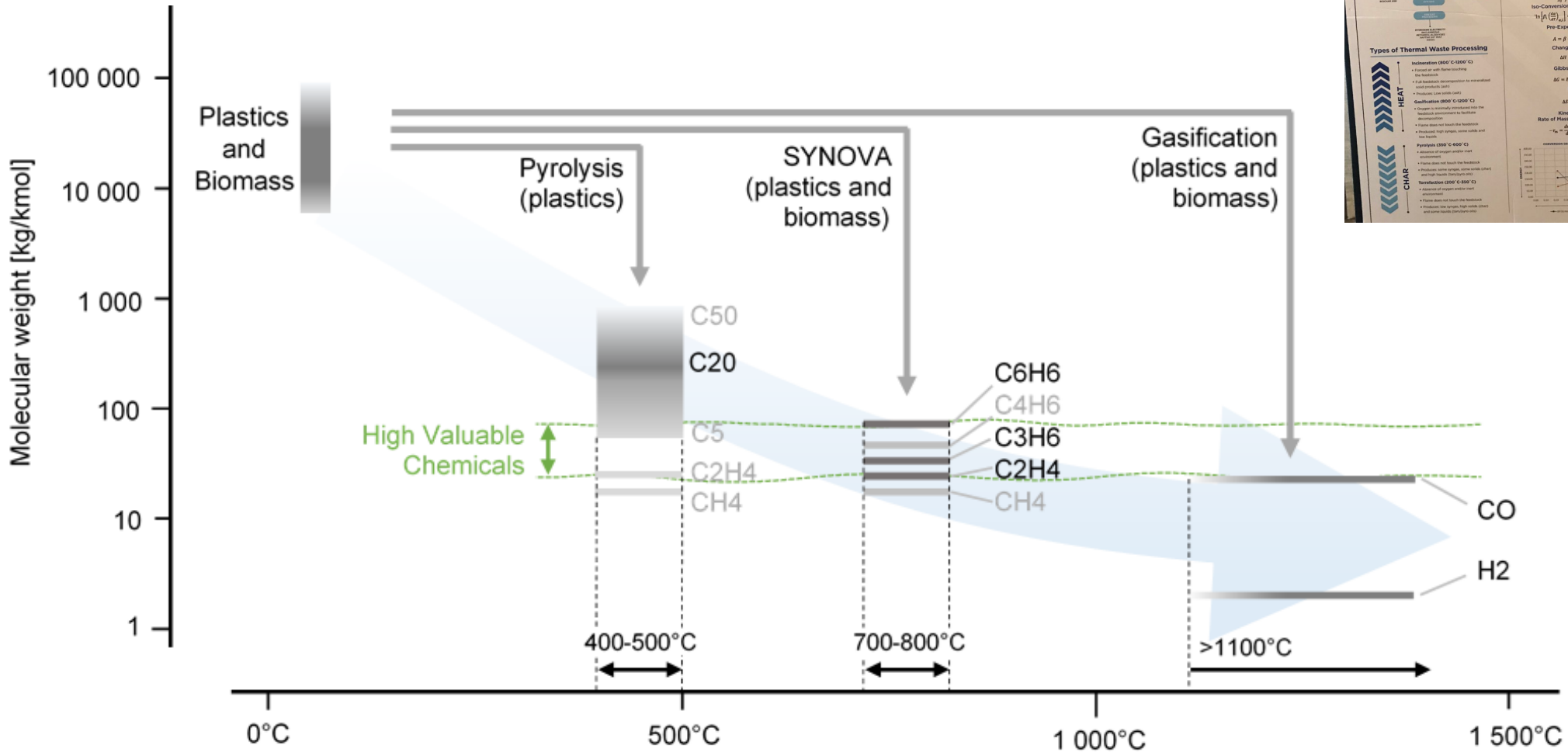


Valorisation options for instance at a naphtha cracker

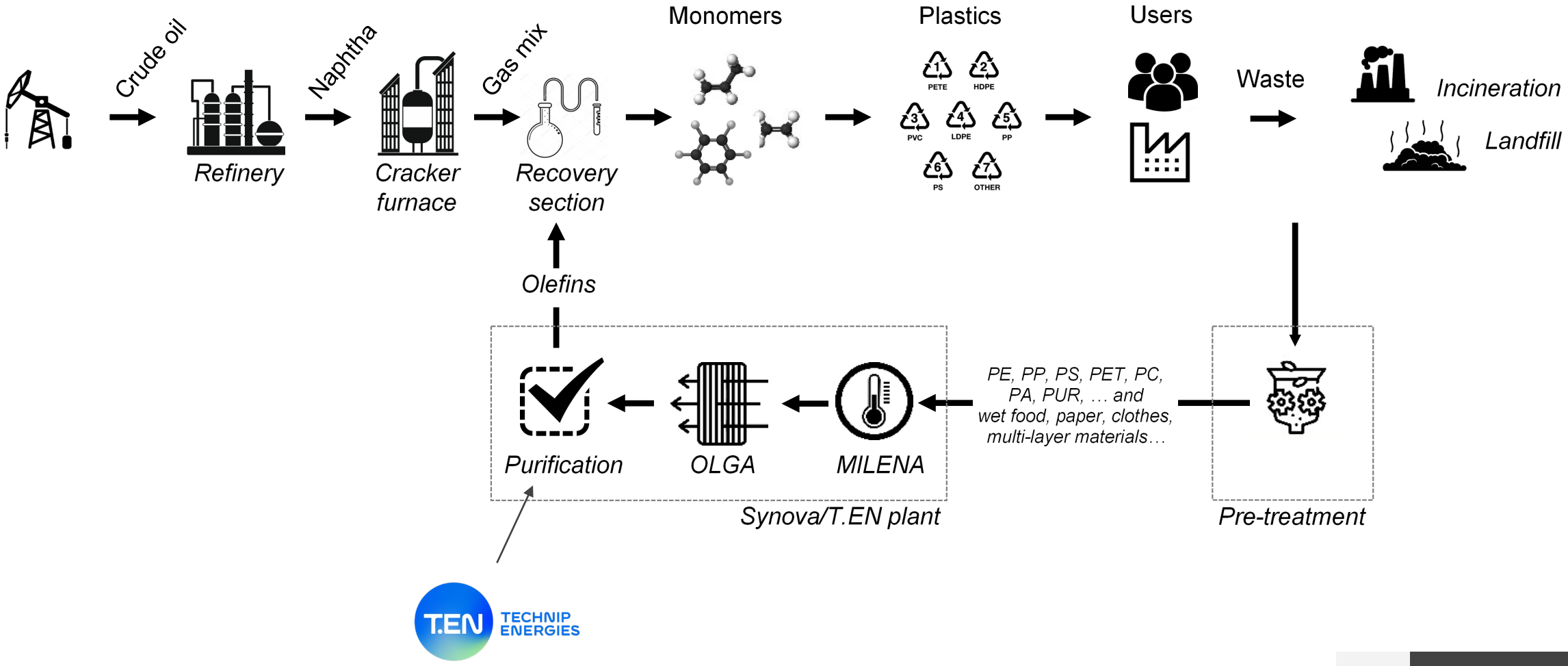


SYNOVA'S SOLUTION





SYNOVA/T.EN's SOLUTION REPLACING THE CRACKER FURNACE



WHAT DOES IT BRING US….

MILENA APPLICATIONS IN THE MARKET

NEED TO KNOW

PRESS RELEASE

Trinseo Chemical Recycling Plant on Track

Trinseo's plant will be dedicated to recycled polystyrene (rPS), meeting increased demand for the material. PS is one of the most widely-used plastics.

Feb 08, 2022

SUPPLY CHAIN

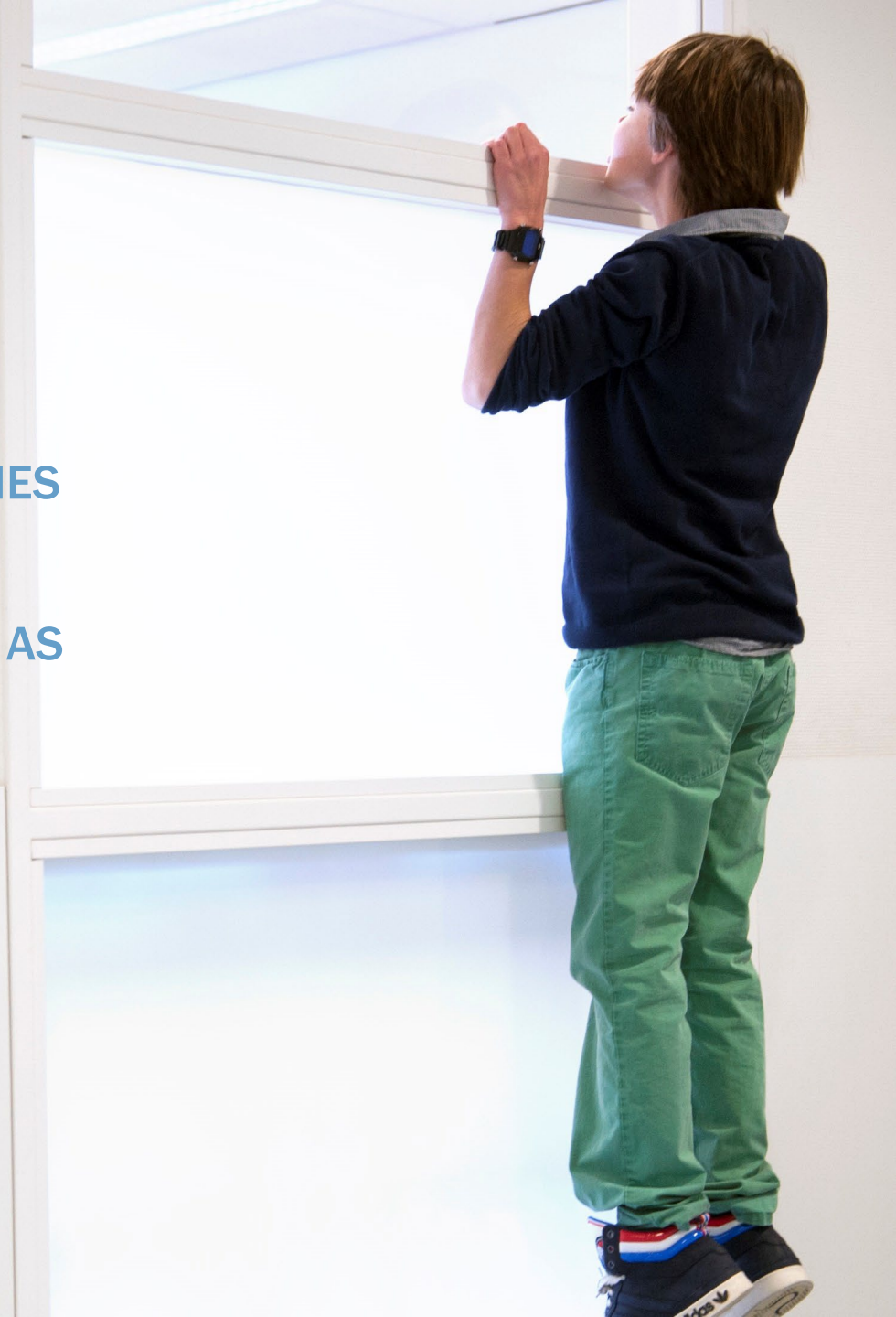
Synova and Technip Energies Enter into Strategic Partnership

The agreement aims to commercialize Synova's advanced plastic waste-to-olefins technology in conjunction with Technip Energies' steam-cracking expertise.

Clare Goldsberry | Mar 17, 2021

CONCLUSION

- TNO HAS DEVELOPED AN SNG VALUE CHAIN
- TNO SUCCESSFULLY DEVELOPED CO-PRODUCTION SCHEMES
- TNO HAS EXTENSIVE BIOFUELS CAPABILITIES
- TNO SUCCESSFULLY DEVELOPED INDIRECT GASIFICATION AS RECYCLING TECHNOLOGY



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THANK YOU FOR
YOUR TIME
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