NEXTCHEM ROUTE TO DECARBONIZE ROAD TRANSPORT

COP29 Baku Azerbaijan

HYDROGEN VALLEYS AND CIRCULAR METHANOL

NEXTCHEM
MAIRE Sustainable Technology Solutions

AGENDA

01	MAIRE GROUP
02	THE DRIVERS
03	NX CIRCULAR™ FROM WASTE TO PRODUCTS
04	NX CIRCULAR™ HYDROGEN AND METHANOL FOR A SUSTAINABLE ROAD TRANSPORT
05	CONCLUSIONS

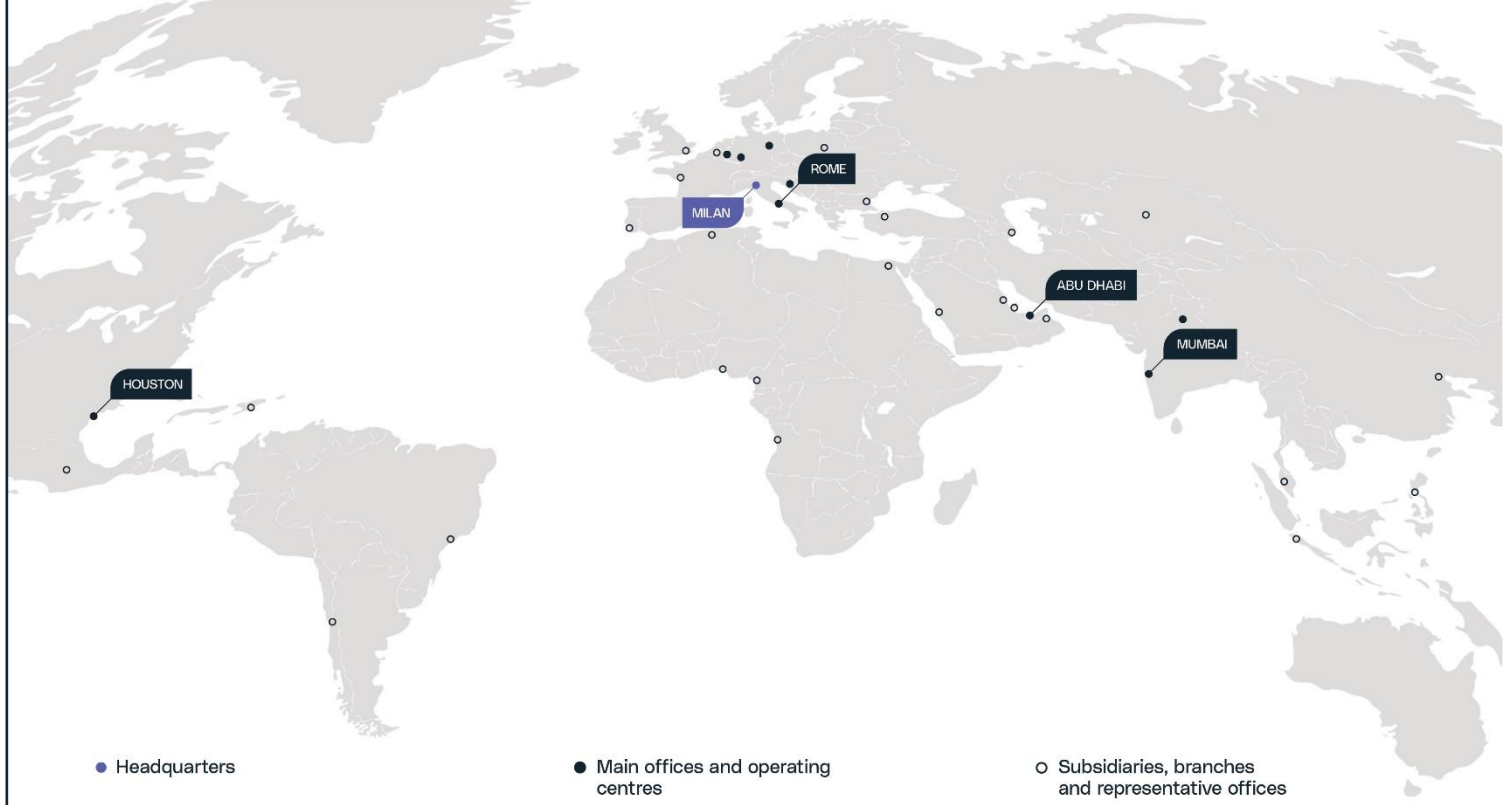
01

MAIRE GROUP

MAIRE GROUP

We are an engineering group that develops technologies to implement innovative solutions for facilitating the energy transition.

We offer **Sustainable Technology Solutions** and **Integrated E&C Solutions** for the production of nitrogen fertilizers, hydrogen, circular carbon, synthetic fuels, chemicals, and polymers.



4.3
Revenues (€ billion)

15.0
Backlog (€ billion)

129.5
Net Income (€ billion)

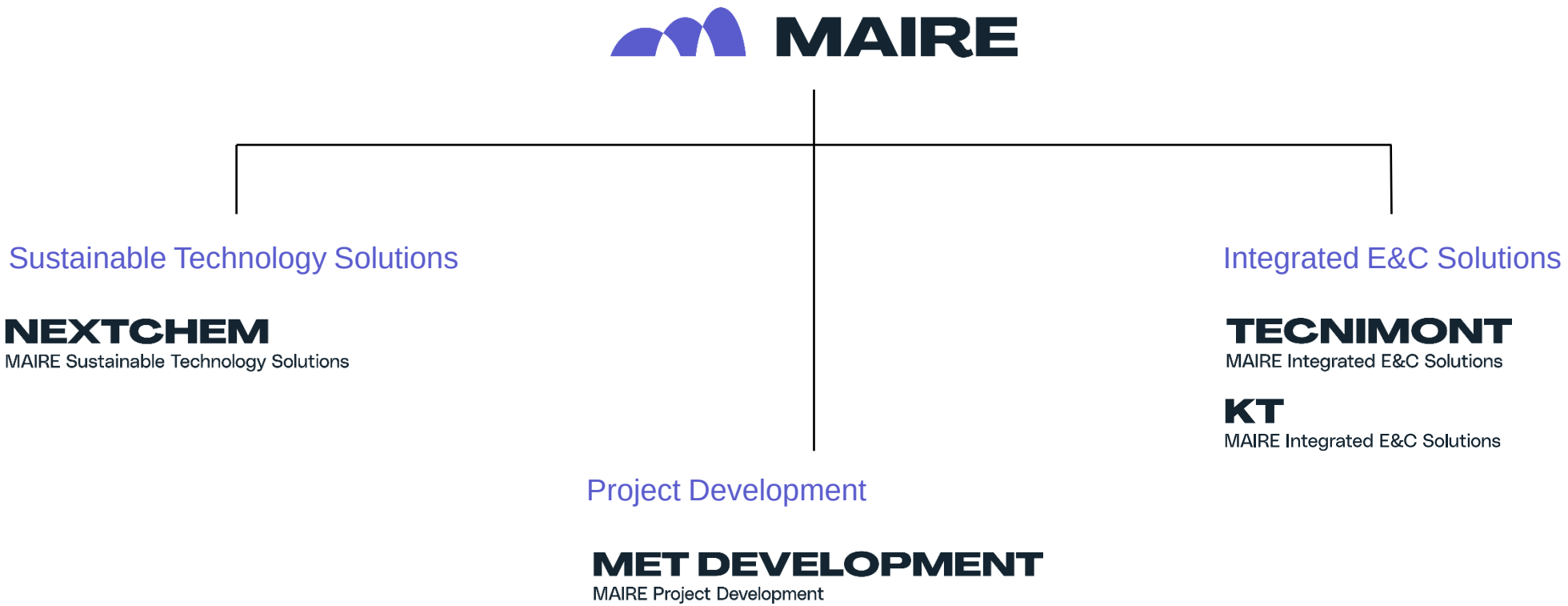
~45
Countries

~8,300
Employees worldwide

29,000+
Personnel worldwide*

September 2024 data
*including employees, advisors, third parties

MAIRE INTEGRATED ORGANIZATION



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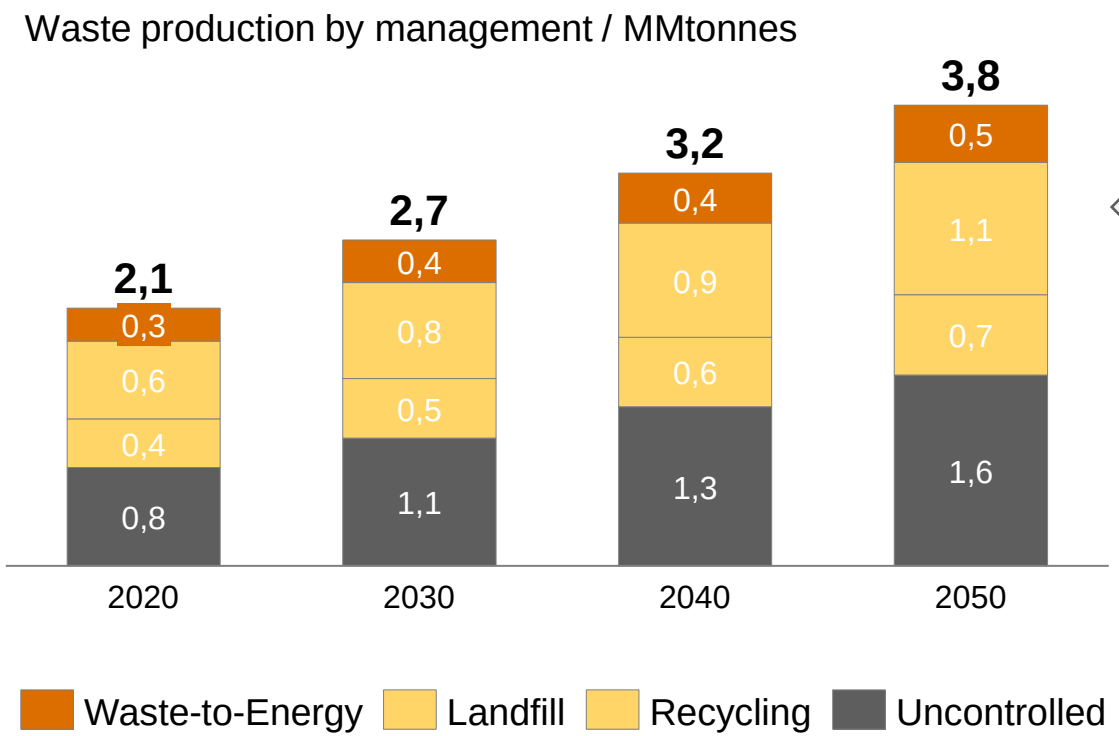
02

THE DRIVERS

FROM WASTE TO PRODUCTS: ONE SOLUTION FOR TWO ITEMS

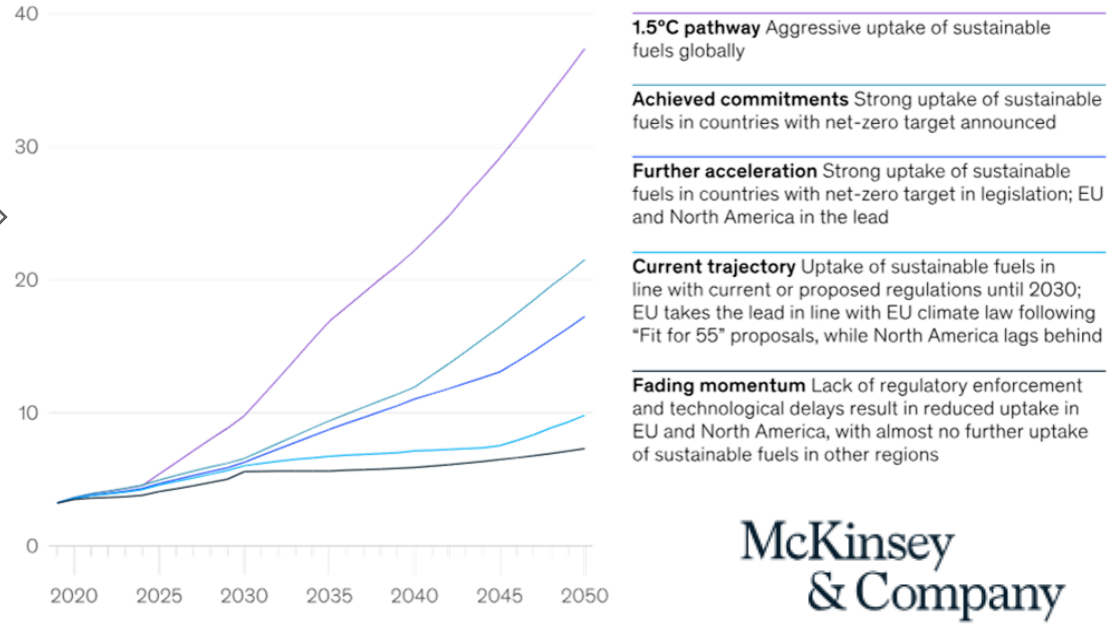
WASTE

Increasing global production of MSW



PRODUCT

Increasing demand of sustainable fuels / %



Source: https://www.mckinsey.com/industries/oil-and-gas/our-insights/charting-the-global-energy-landscape-to-2050-sustainable-fuels
Source: What are the recycling rates in the World? - recycl3r

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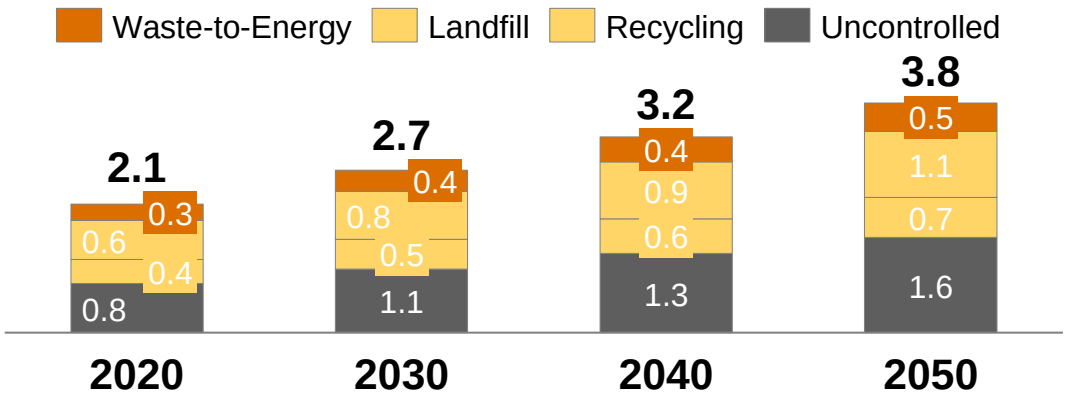
NEW WASTE MANAGEMENT SOLUTIONS NEEDED FOR MSW

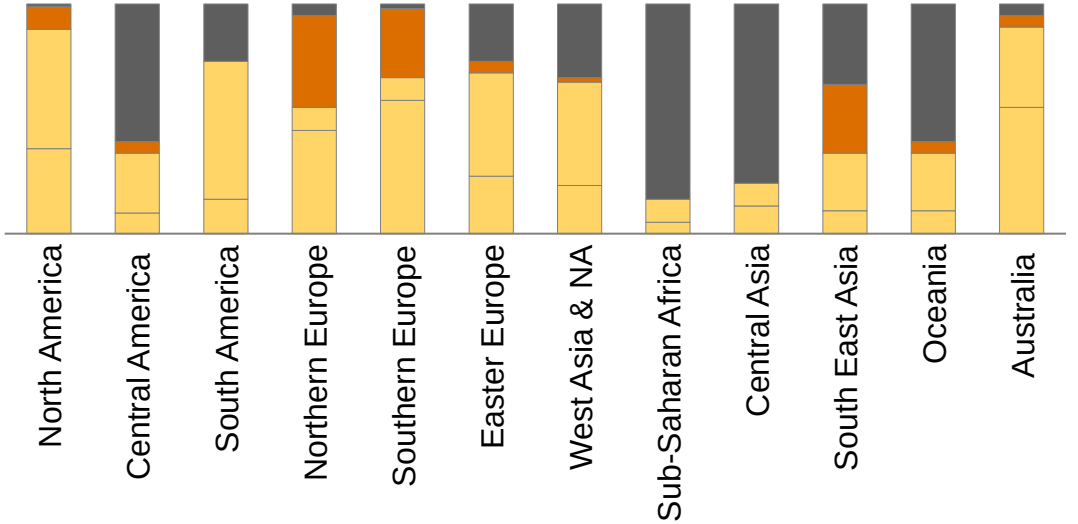
MSW will increase over 3.5 Btonnes in 2050

The global production of Municipal Solid Waste (MSW) is more than 2 billion tons per year. Industrial and agricultural residues are an additional source of waste.
Due to population growth and GDP, it is expected that MSW will exceed 3.5 billion tons per year by 2050 (equivalent to one and a half times the weight of all the cars in the world!).



Mechanical recycling by itself is not enough

Unfortunately, mechanical recycling can solve the waste problem only partially. Even the most virtuous countries do not exceed 50% mechanical recycling; the rest goes to incineration (emitting CO2 and various contaminants) or to landfills (damaging land and water resources)



Source: What are the recycling rates in the World? - recycl3r

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03

NX CIRCULAR ™

FROM WASTE TO PRODUCTS

FROM WASTE TO PRODUCTS: WASTE AS CHEMICAL BUILDING BLOCKS

RDF

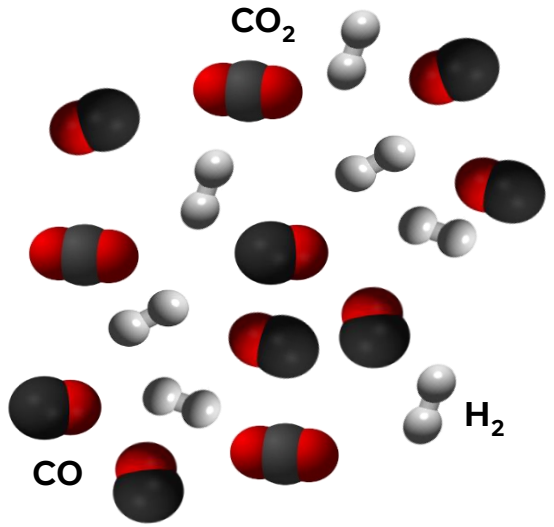
Carbon	32 ÷ 55 wt%
Hydrogen	5 ÷ 8 wt%
Oxygen	20 ÷ 28 wt%
Chlorine	0,5 ÷ 3,0 wt%
Nitrogen	0,5 ÷ 1,5 wt%
Sulphur	0,1 ÷ 1,0 wt%
Moist	10 ÷ 20 wt%
Dust	5 ÷ 20 wt%

PLASTIC MIXTURE

Carbon	47 ÷ 61 wt%
Hydrogen	5 ÷ 7 wt%
Oxygen	14 ÷ 20 wt%
Chlorine	0,8 ÷ 1,5 wt%
Nitrogen	0,2 ÷ 0,5 wt%
Sulphur	0,02÷ 0,3 wt%
Moist	5 ÷ 9 wt%
Dust	7 ÷ 20 wt%

WOOD SCRAPS

Carbon	36 ÷ 45 wt%
Hydrogen	4 ÷ 6 wt%
Oxygen	32 ÷ 36 wt%
Chlorine	0,01 ÷ 0,5 wt%
Nitrogen	0,2 ÷ 1,2 wt%
Sulphur	0,01÷ 0,2 wt%
Moist	15 ÷ 25 wt%
Dust	1,5 ÷ 3,0 wt%



SYNGAS

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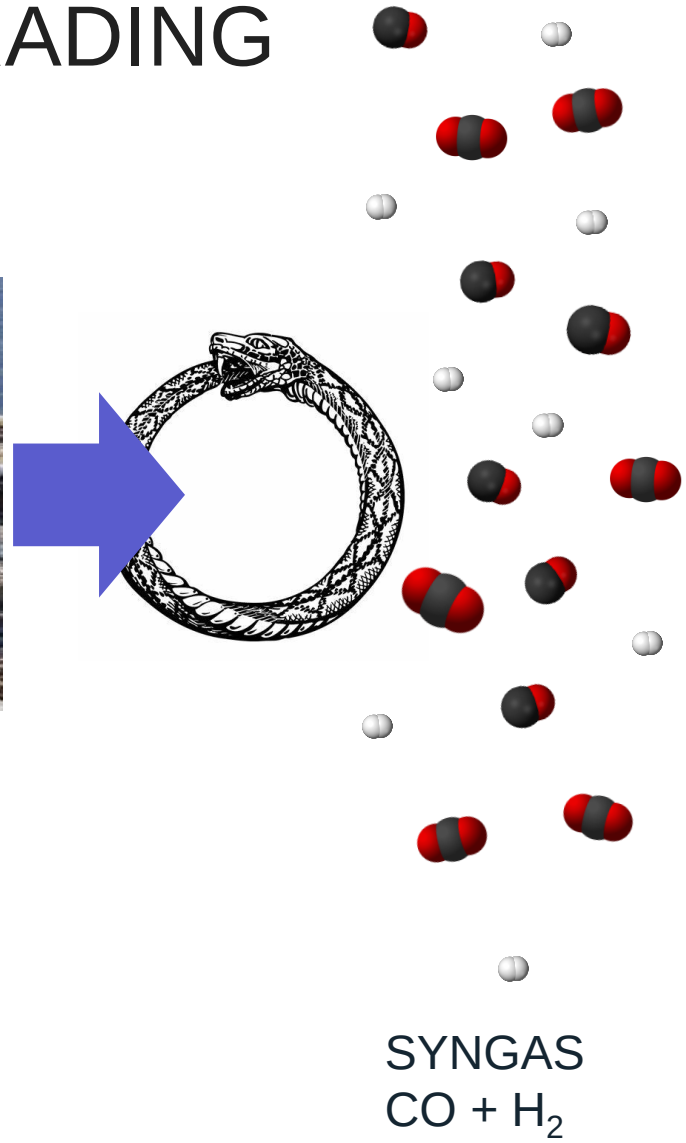
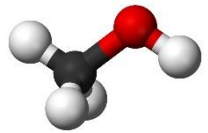
CHEMICAL CONVERSION OF WASTE: SYNGAS UPGRADING

WASTE SCRAPS
LHV 14÷20 MJ/kg



SYNGAS
CO + H_2

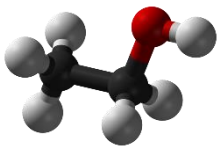


Circular Me(OH)

Methanol is an intermediate used in wood recycling, a sustainable fuel for ships, an intermediate for chemistry, disinfection, industry (all imported today).

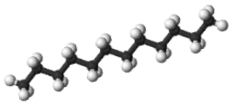
Circular H_2

Hydrogen is the ultimate molecule for energy transition, useful in transport, chemistry, steel production, glass and cement.



Circular Et(OH)

Ethanol has always been an alternative to gasoline or its component, but also a molecule from which to produce intermediates to create polymers and rubbers.



Other molecules

From the syngas can be generated fertilizers, building materials, chemicals, sustainable fuels for aviation (SAF) and much more.

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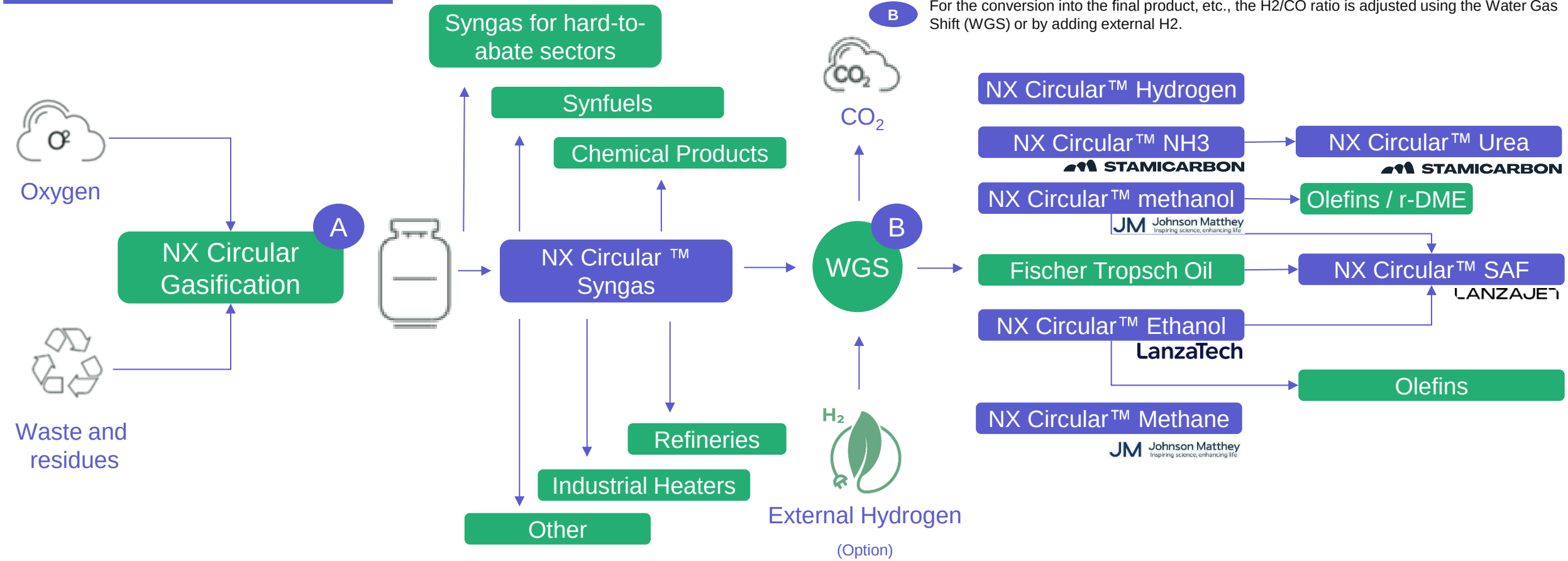
NX-CIRCULAR GASIFICATION BRIDGES WASTE MGMT TO FLEXIBLE FUELS & CHEMICALS PRODUCTION

A The raw material undergoes partial oxidation, thermally controlled and self-sustained by the complete oxidation of part of the C and H contained in the raw material (Boudouard equilibrium).

B For the conversion into the final product, etc., the H2/CO ratio is adjusted using the Water Gas Shift (WGS) or by adding external H2.

INTEGRATED SOLUTION



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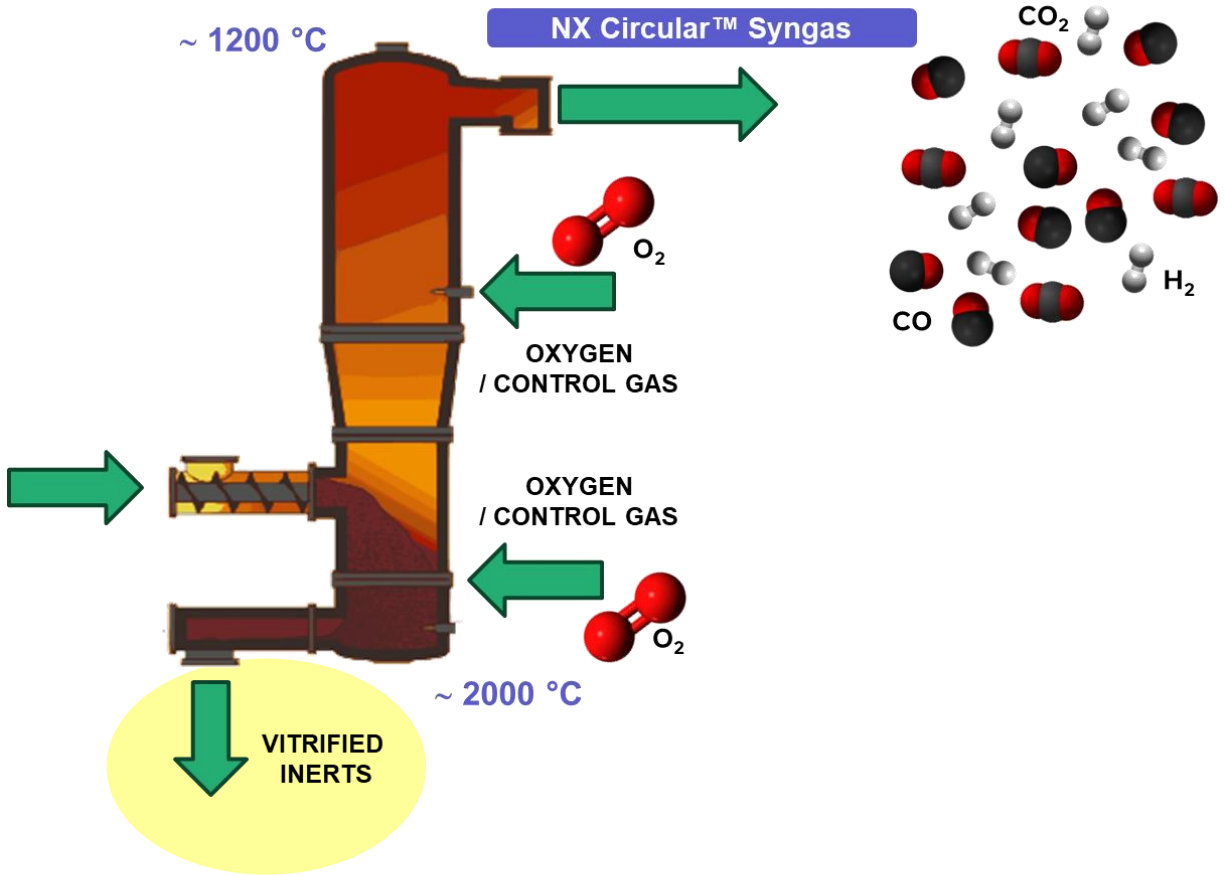
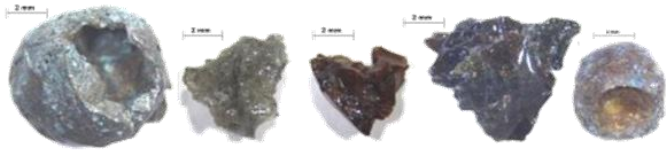
WASTE TO CHEMICAL CONVERSION: HOW IT WORKS



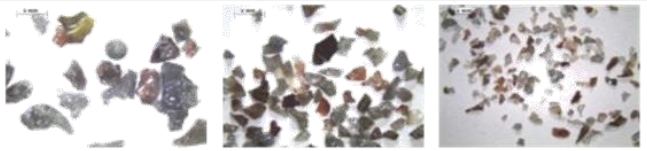
VITRIFIED GRANULES

HIGHLY HETEROGENEOUS

FRAZIONE 4-8 mm



FRACTION 1-2 mm	FRACTION 0.5-1 mm	FRACTION 0.25-0.5 mm



CHEMICAL ANALYSIS

Metodo	Parametro	Valore	
UNI14346	Residuo 105°C (%)	100	
IRSAQ64	Residuo 550°C (%)	100	
UNI13657+UNI11885	Alluminio (mg/kg)	75000	*
UNI13657+UNI11885	Antimonio (mg/kg)	<5	
UNI13656+APAT3130A	Calcio (mg/kg)	94000	*
UNI13657+UNI11885	Arsenico (mg/kg)	8	
UNI13657+UNI11885	Bario (mg/kg)	1800	
UNI13657+UNI11885	Berillio (mg/kg)	<1	
UNI13657+UNI11885	Ferro (mg/kg)	130000	*
UNI13657+UNI11885	Cadmio (mg/kg)	<5	
UNI13657+UNI11885	Cobalto (mg/kg)	76	
UNI13657+UNI11885	Cromo totale (mg/kg)	3100	
IRSAQ64	Cromo VI (mg/kg)	<5	
UNI13657+UNI11885	Fosforo (mg/kg)	3900	
UNI13657+UNI11885	Magnesio (mg/kg)	8100	

Metodo	Parametro	Valore	
UNI13657+UNI11885	Manganese (mg/kg)	2500	
UNI13657+EPA6010	Mercurio (mg/kg)	<1	
UNI13657+UNI11885	Nichel (mg/kg)	1300	
UNI13657+UNI11885	Piombo (mg/kg)	290	
UNI13657+UNI11885	Rame (mg/kg)	6000	
UNI13657+UNI11885	Silicio (mg/kg)	260000	*
UNI13657+UNI11885	Selenio (mg/kg)	<5	
UNI13657+UNI11885	Stagno (mg/kg)	160	
UNI13657+UNI11885	Titanio (mg/kg)	3300	
UNI13657+UNI11885	Vanadio (mg/kg)	54	
UNI13657+UNI11885	Zinco (mg/kg)	2200	
EPA3010+APAT3240A	Potassio (mg/kg)	2100	
EPA3010+APAT3270A	Sodio (mg/kg)	8100	
EPA5050+EPA9056A	Cloro totale (%)	0.23	
EPA5050+EPA9056A	Zolfo totale (%)	0.10	

***MAJOR ELEMENTS**

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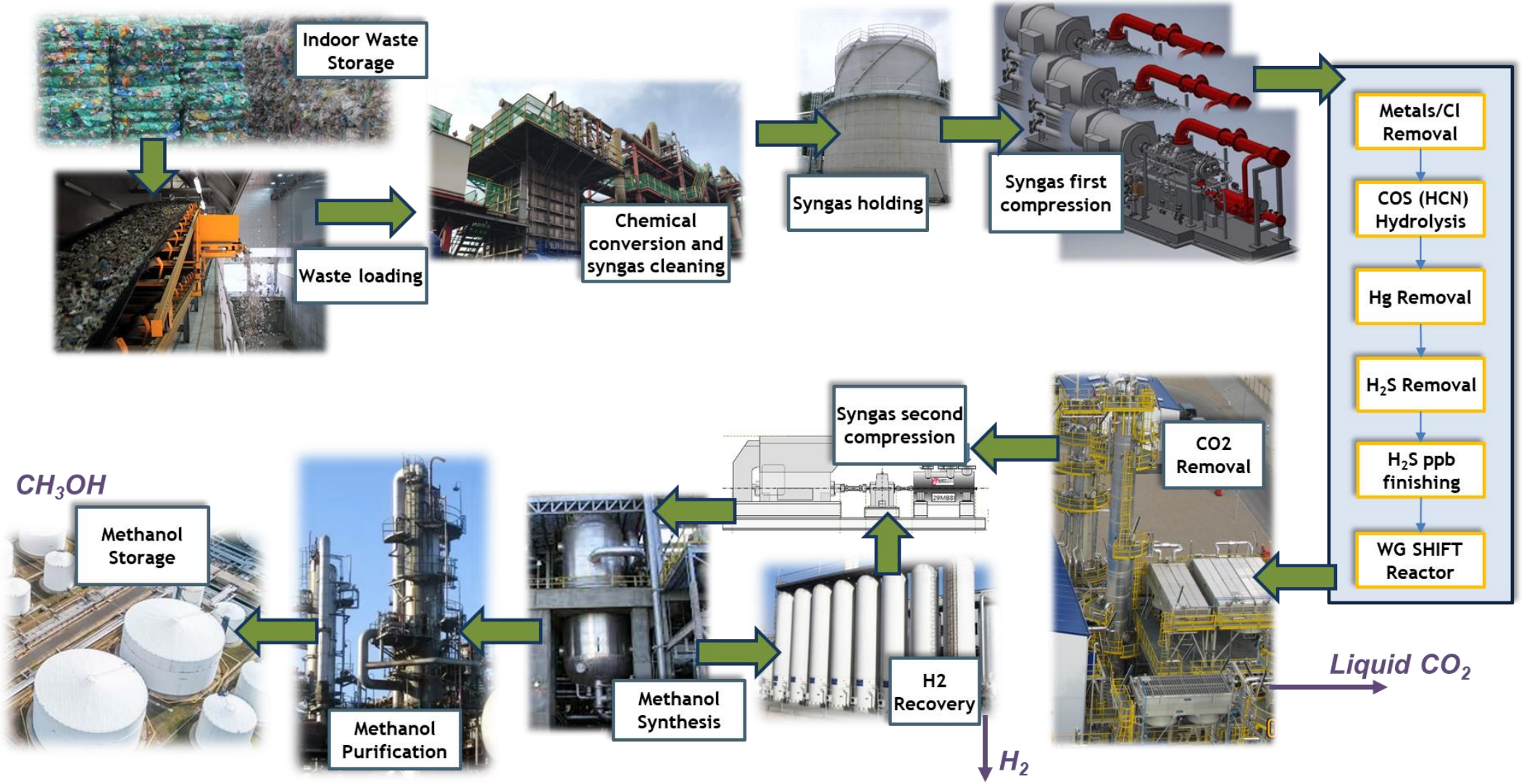
WASTE TO METHANOL & HYDROGEN



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NX CIRCULAR ™ HYDROGEN & METHANOL

FOR A SUSTAINABLE ROAD TRANSPORT

CIRCULAR H2: ENABLING HYDROGEN VALLEYS

- H2 can always be produced at competitive prices by Waste to Chemical plant as a product or co-product in parallel with a liquid fuel or chemical (e.g., methanol).
- This flexibility (0÷100% H2) allows to follow step by step the growing demand of H2.
- The low price of H2 from Waste to Chemical (~ 50% of the price of H2 produced via electrolysis) enables the deployment of Hydrogen Valleys for road transport sector.

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CIRCULAR MEOH: KEY INGREDIENT FOR SUSTAINABLE MOBILITY

- Oils or fats can be combined with M**ethanol**, in the presence of a catalyst. This produces methyl esters, the FAME/Fatty Acid Methyl Ester or biodiesel, and glycerine as by-product.
- Biodiesel offer a significant reduction in greenhouse gas emissions, contributing to more green and sustainable mobility.
- The use of circular methanol in Biodiesel production increases the potential to decarbonize the road transport sector.

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05

CONCLUSIONS

CONCLUSIONS

- Hydrogen Valleys, with circular Hydrogen from scraps, are the solution to the waste management in the Countries.
- Waste to Chemical solutions can produce circular Hydrogen at 6÷7 Euro/kg (half the price of electrolysis Hydrogen).
- 10 MMton/year of municipal/non-municipal global waste can be converted to 1 MMton/year of circular Hydrogen at low cost: in EU, 100 MMton/year of waste can be diverted from incineration to chemical conversion, producing 10 MMton/year of circular Hydrogen.
- Waste to Chemical schemes can be placed at brown fields, creating Hydrogen Valleys in industrial areas.
- In the next future, heavy truck will go Hydrogen, and low-cost Hydrogen shall be available to consumers as soon as possible.
- The residual CO_2 in the Hydrogen production (via chemical conversion of waste) is captured at high purity and can be valorized and/or sent to geological storage.

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THANK YOU

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