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The role of hydrogen in the transition to a sustainable industry

CIEP-NOGEPA Gasdag
Marcel Galjee
September 6th 2018

The industry as enabler of the transition

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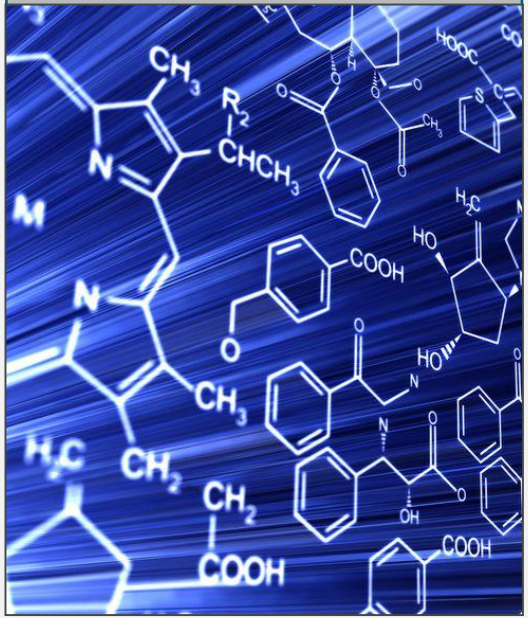
Energy		• Electrification of the industry • Lead off taker of renewable energy • Flexibility provider to the grid
Residential sector		• Residual and sustainable heat to residential sector • New and advanced insulation materials
Mobility		• Advanced and low weight materials • Next generation batteries • Hydrogen, synthetic and bio fuels
Food/Agro		• Bio-based feedstock for the industry • Low emission food life-stock • Low/no emission fertilizers

It's all about the industry



Accelerating the energy transition, broadening the scope beyond electricity

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Energy Transition
from fossil energy to renewables

- 100% Renewable and carbon neutral electricity
- Reliable and stable power grid
- Decarbonized heating

Energy Efficiency

Accelerating the industrial transition, building the zero carbon economy

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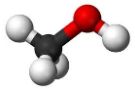

Industrial Transition
from fossil feedstock to circular/biobased

- Electrification
- Flexible and automated plants (Industry 4.0)
- Hydrogen economy
- Biobased and circular chemistry

Energy Efficiency

Accelerating the industrial transition, from electrons to molecules and back

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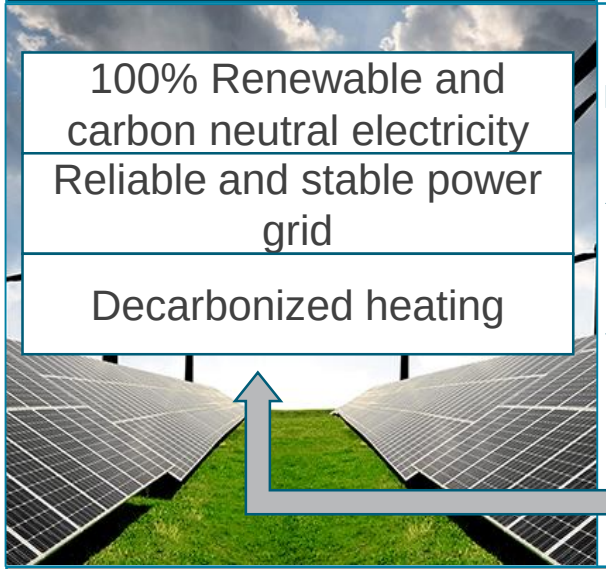
Energy Transition
from fossil energy to renewables



- 100% Renewable and carbon neutral electricity
- Reliable and stable power grid
- Decarbonized heating

Cost competitive energy pricing

H2 for flex heat and power

Re-use of industrial heat

Industrial Transition
from fossil feedstock to circular/biobased

- Electrification
- Flexible and automated plants (Industry 4.0)
- Hydrogen economy
- Biobased and circular chemistry

Energy Efficiency

Hydrogen can play seven roles in the energy transition

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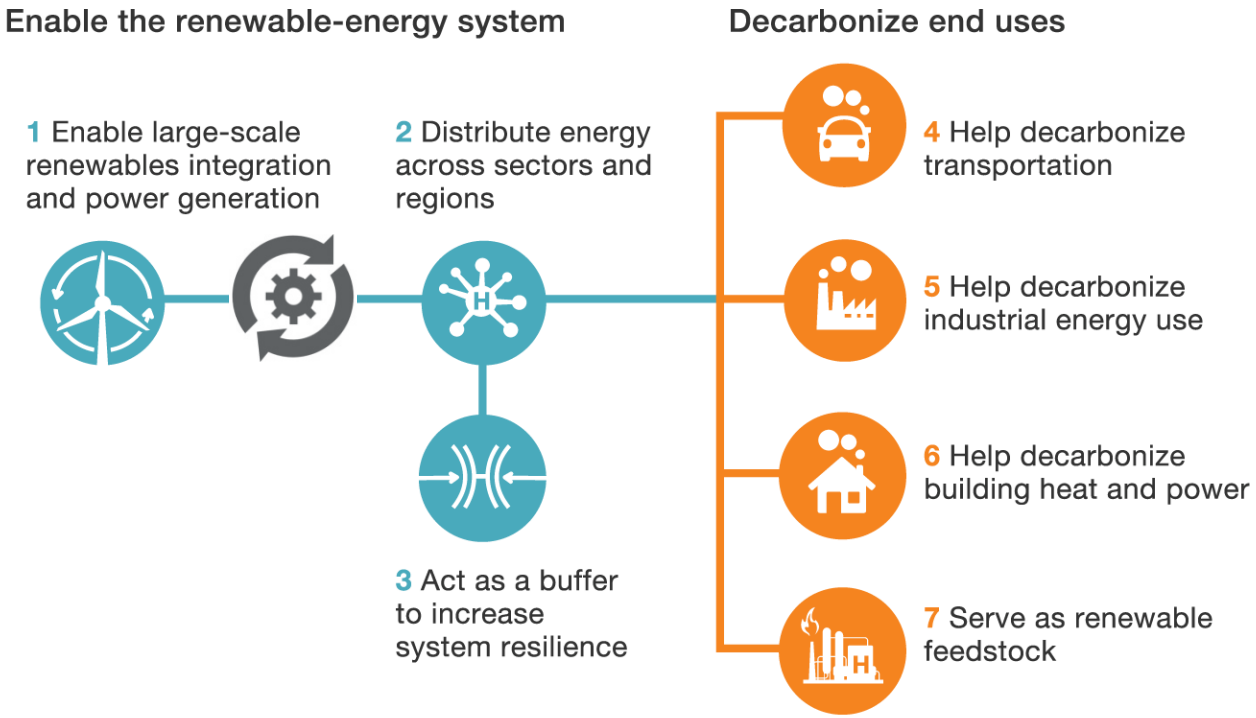

Electrochemistry in practice, we operate over 1000 MW of electrolysers

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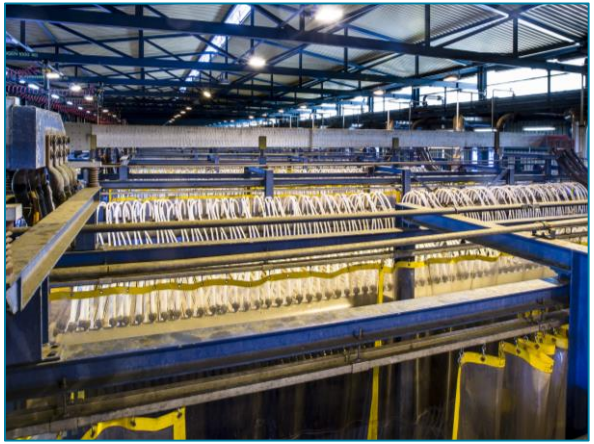
Chlor-alkali



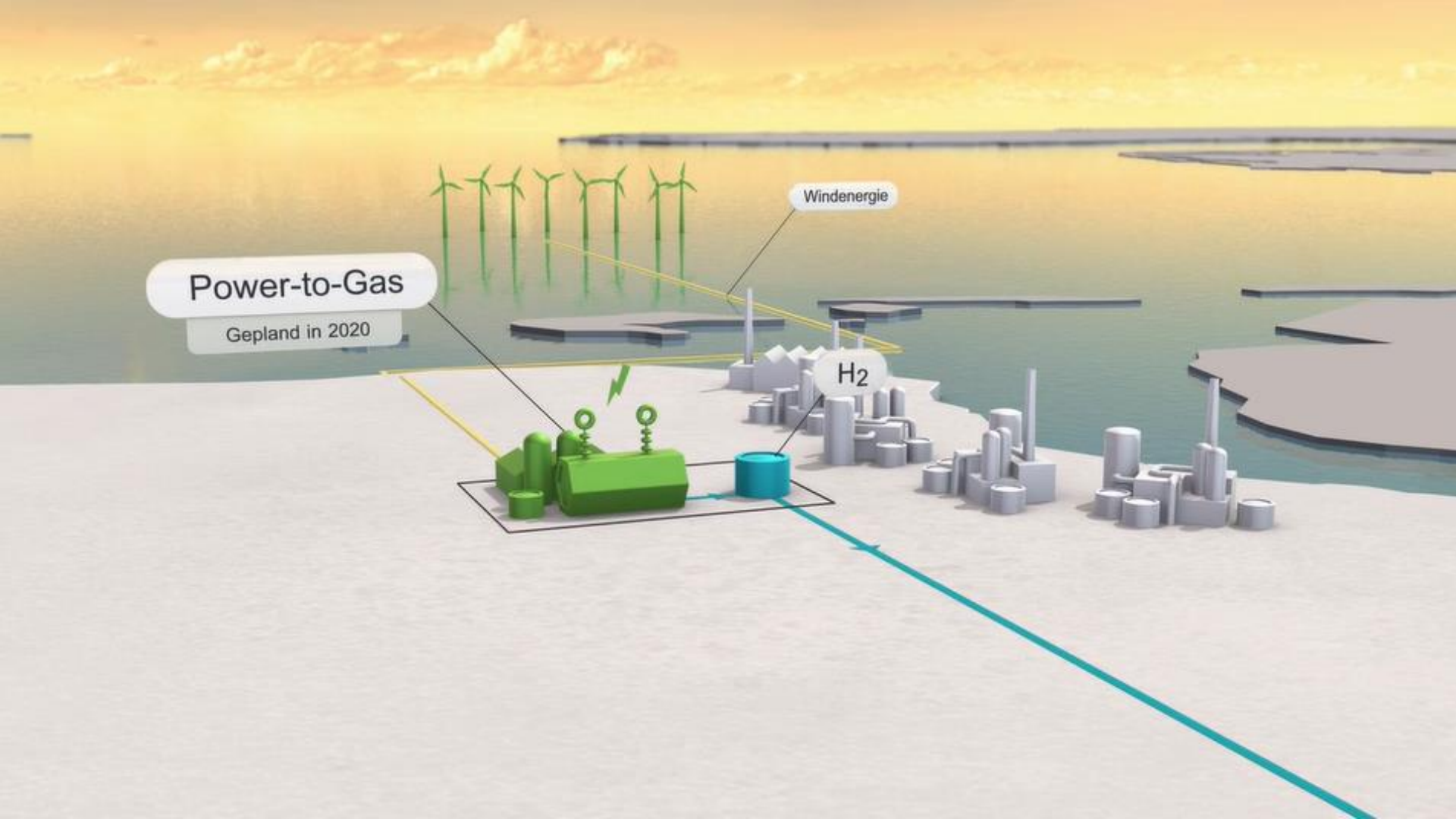
Installed capacity: 380 MW
H_2 production: 38 kta

Sodium chlorate

Installed capacity: 620 MW
H_2 production: 62 kta

Water electrolysis

Installed capacity: 10 MW
H_2 production: 1.5 kta


Power-to-Gas
Gepland in 2020
Windenergie
H_2

AkzoNobel and Gasunie
jointly scaling up the conversion of sustainable electricity into green hydrogen

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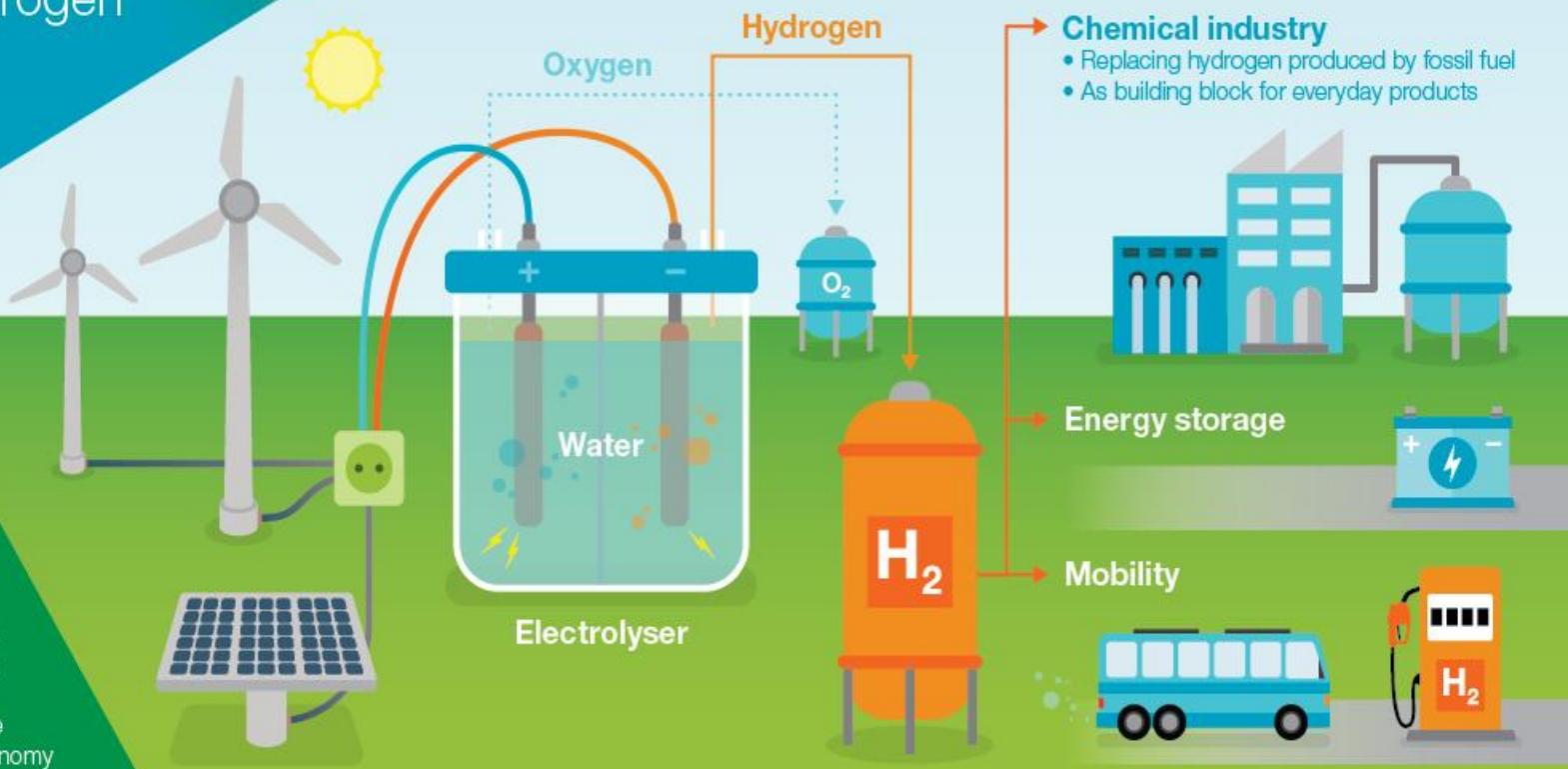
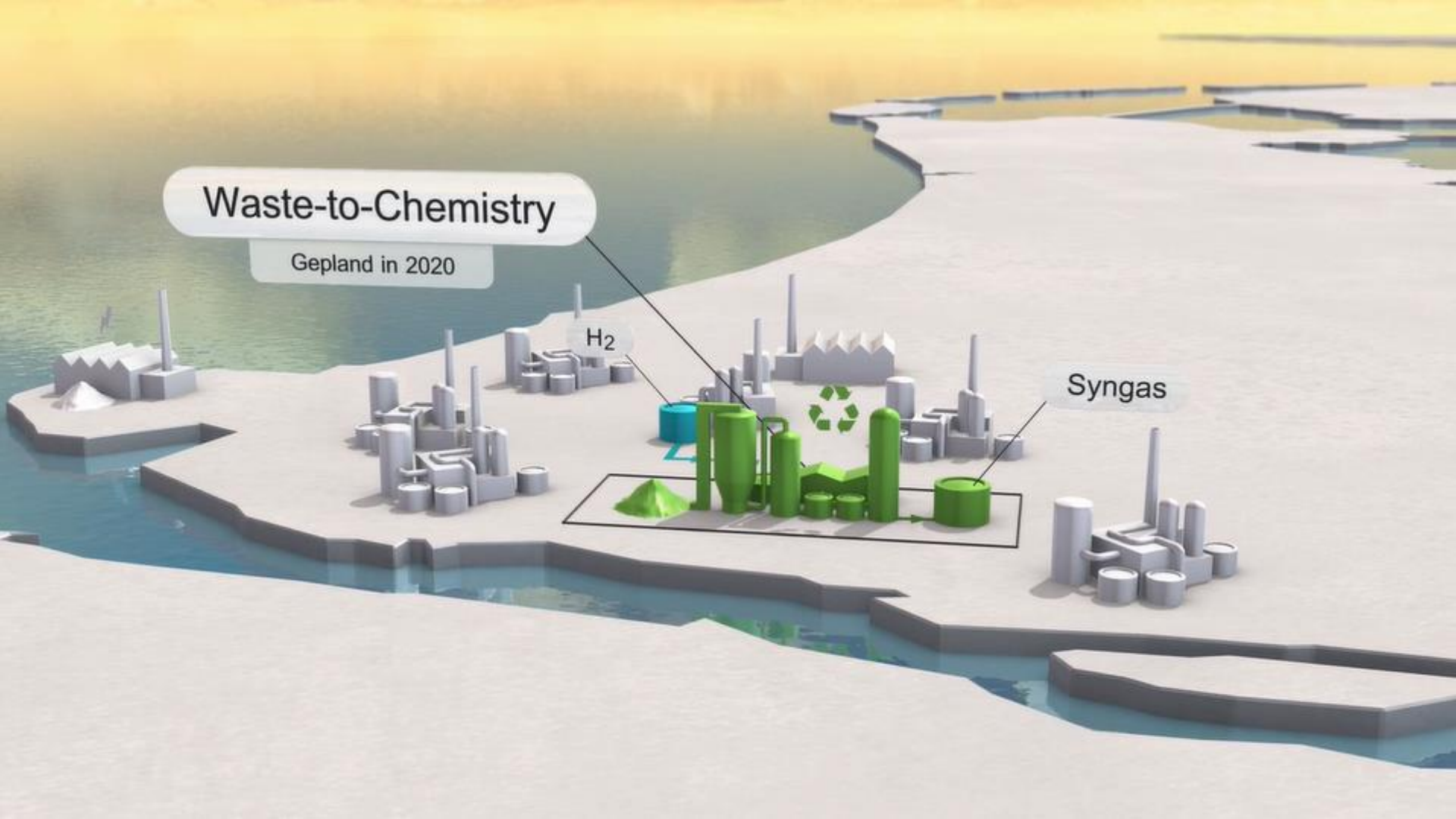


- 20 megawatt water electrolyser, the largest in Europe
- Producing 3 kiloton (30 million m^3) of green hydrogen
- Enough to fuel 300 buses, or enough for 1 bus to drive around the world more than 1100 times
- Upscaling is essential for the transition to a hydrogen economy


Waste-to-Chemistry
Gepland in 2020
H_2
Syngas

Waste2Chemistry – Rotterdam

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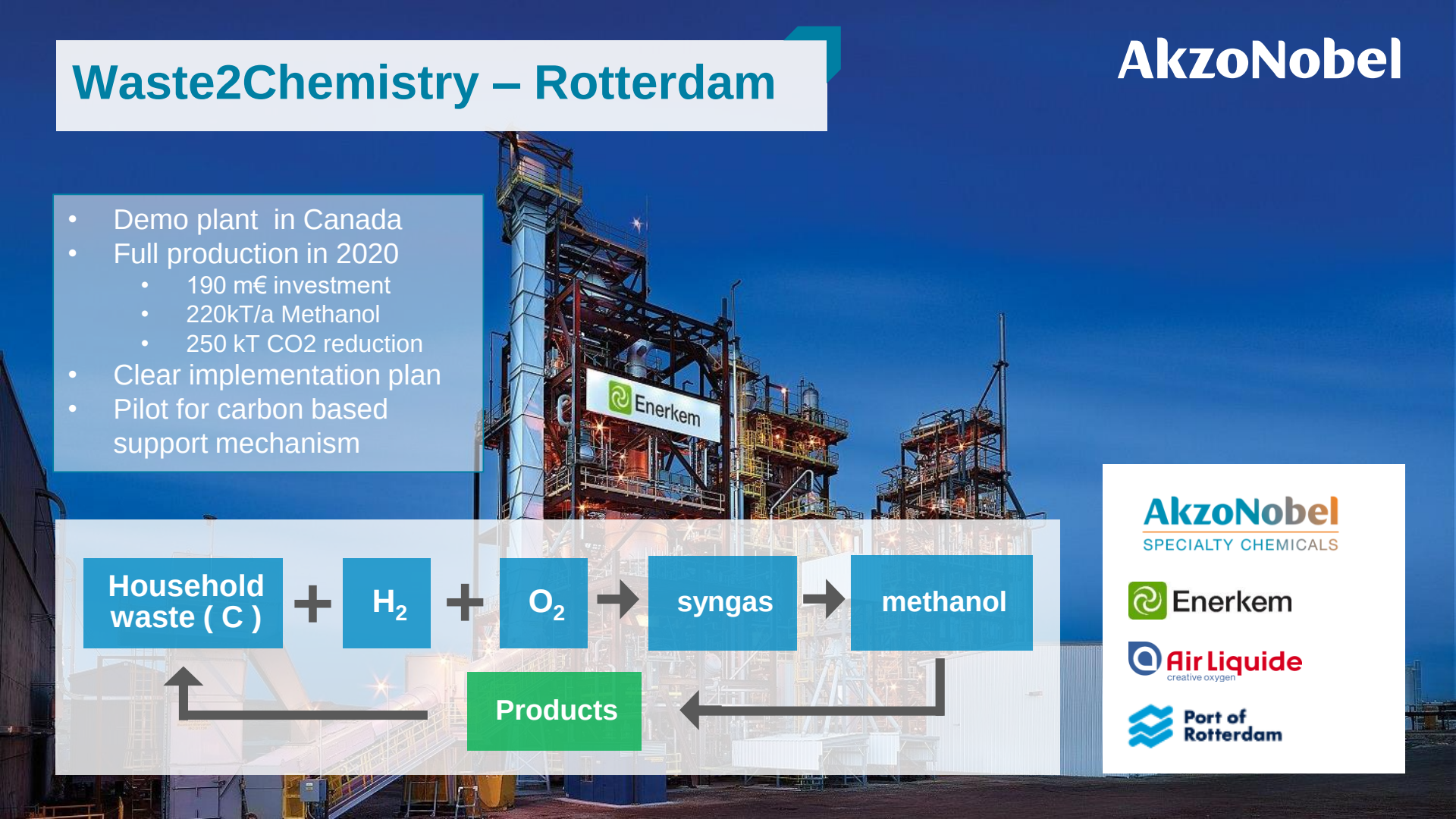
- Demo plant in Canada
- Full production in 2020
  - 190 m€ investment
  - 220kT/a Methanol
  - 250 kT CO2 reduction
- Clear implementation plan
- Pilot for carbon based support mechanism



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Enerkem

Air Liquide creative oxygen

Port of Rotterdam

Carbon2Chem – Germany

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ThyssenKrupp	Hydrogen electrolysis / network stability
AkzoNobel	Methanol
Linde	Gas cleaning/catalysis
Evonik	Higher order alcohols / polyalcohols
Covestro	Polymers
BASF	OME

Towards a sustainable industry and system integration

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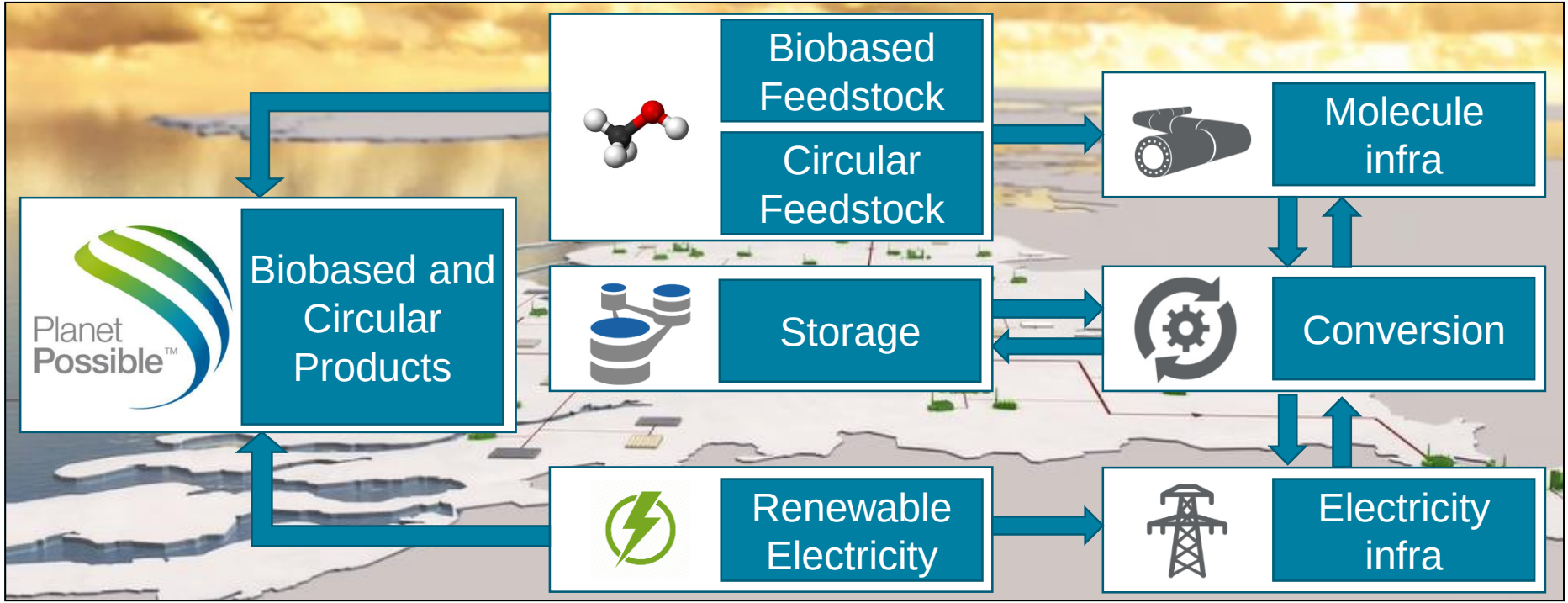

The value chain is traditionally based on a fossil power market

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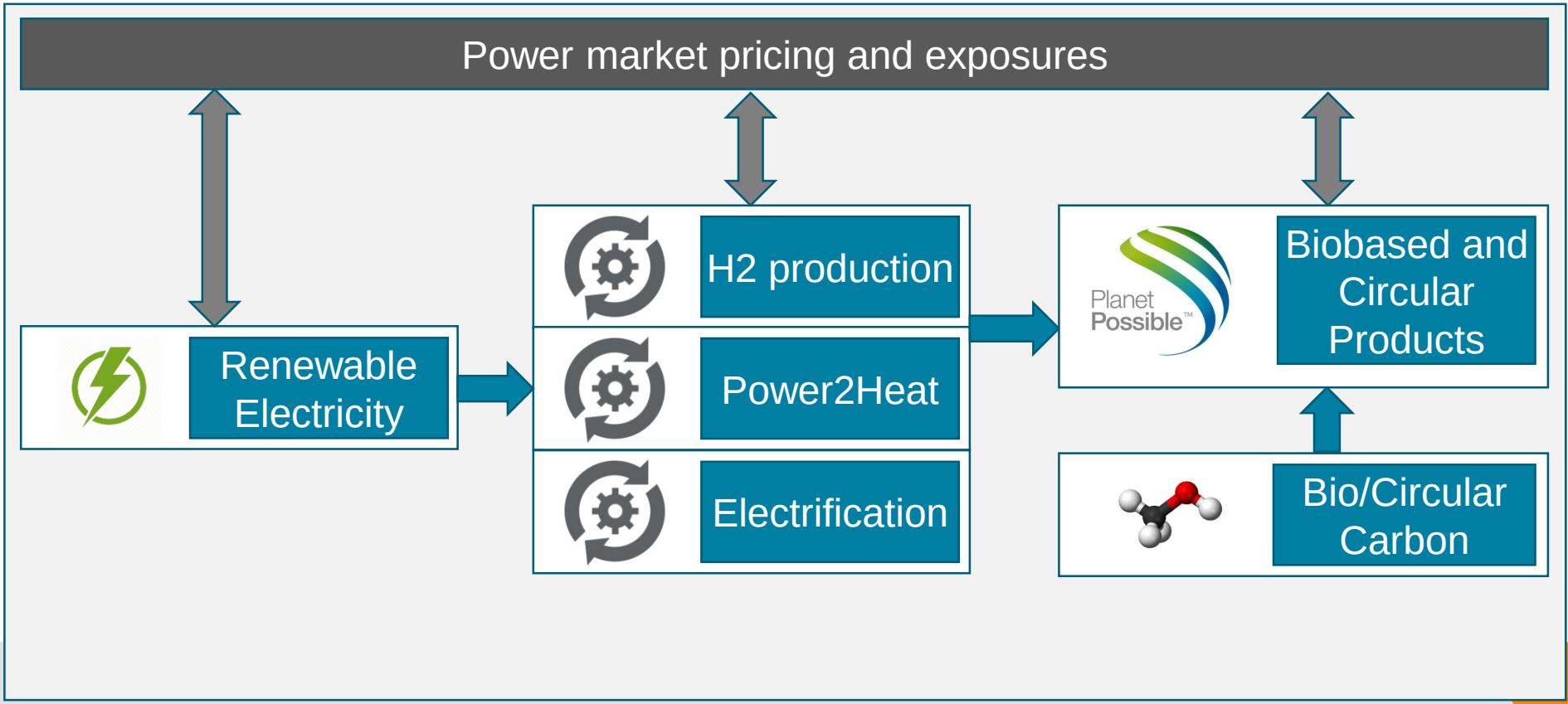

Is this still needed, looking at the full value chain?

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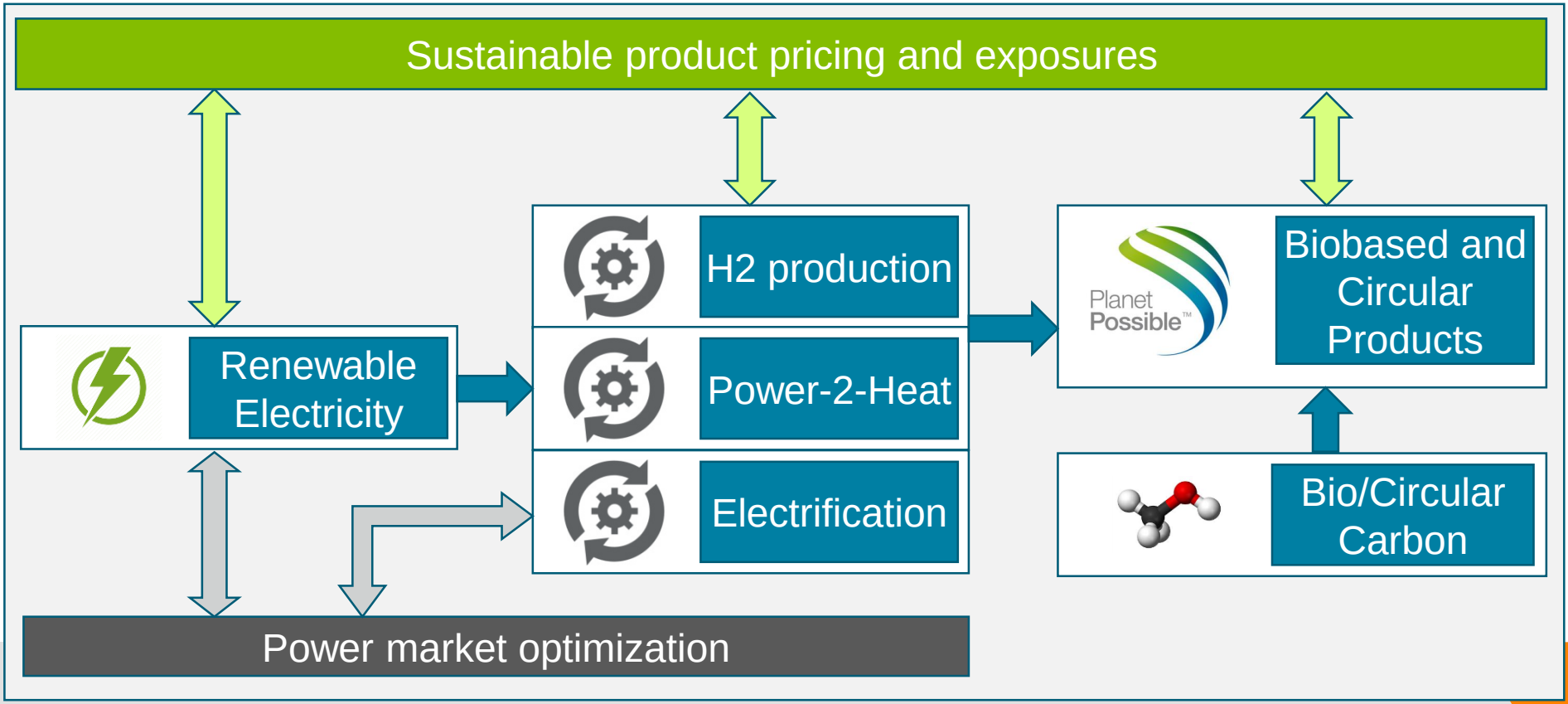
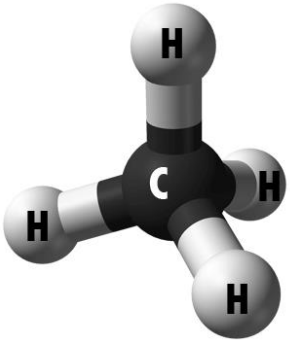


The role of gas in the transition to a sustainable industry…but maybe not the gas you were expecting



Cost competitive option to transport energy

Leveraging existing gas infrastructure

Hydrogen
1
H
1.0078

Enabler of the biobased, circulair economy and zero emission mobility

Large scale storage potential in salt caverns

Key enabler for electrification of the industry

The Dutch Transition should benefit all

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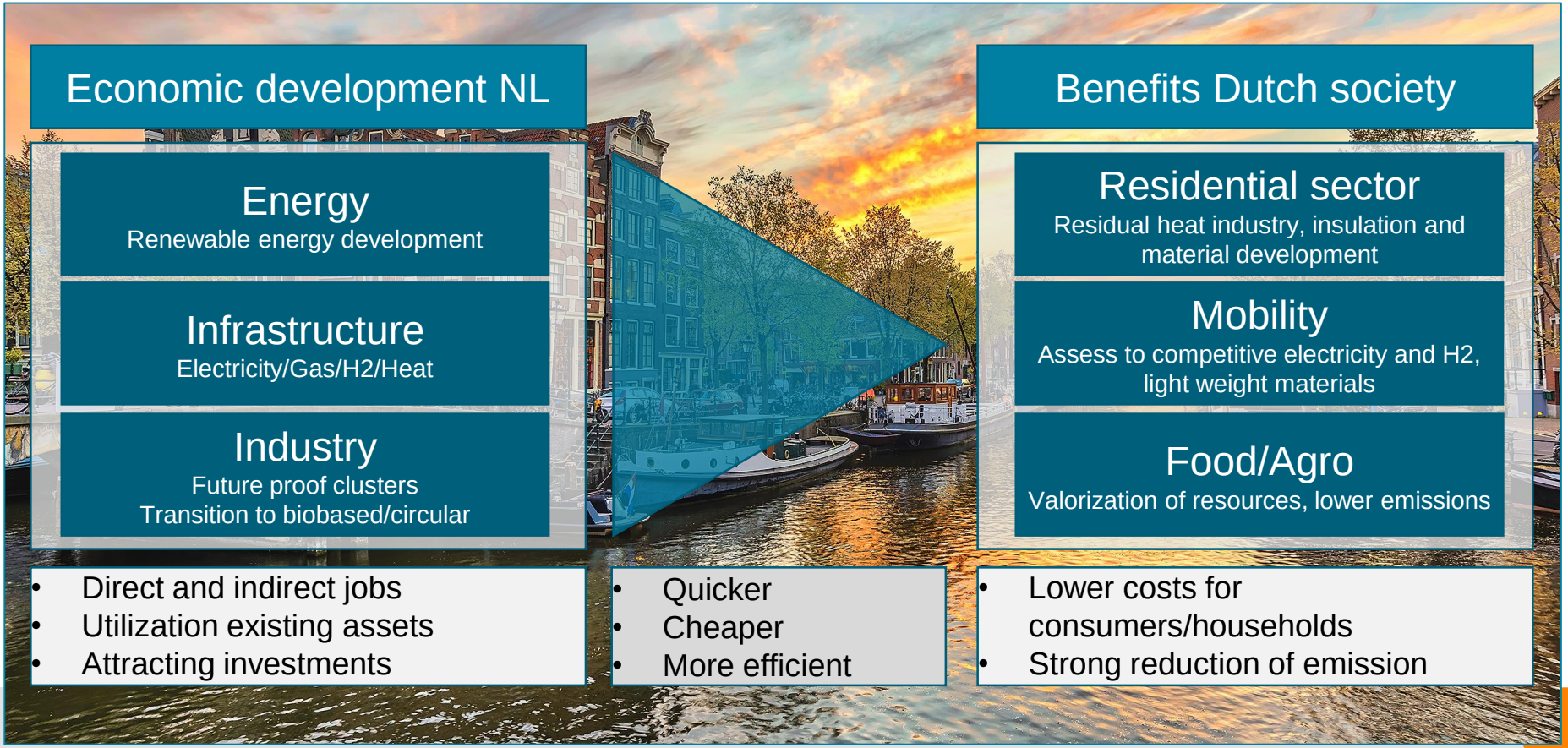

Economic development NL

Energy
Renewable energy development

Infrastructure
Electricity/Gas/H2/Heat

Industry
Future proof clusters
Transition to biobased/circular

- Direct and indirect jobs
- Utilization existing assets
- Attracting investments

- Quicker
- Cheaper
- More efficient

Benefits Dutch society

Residential sector
Residual heat industry, insulation and material development

Mobility
Assess to competitive electricity and H2, light weight materials

Food/Agro
Valorization of resources, lower emissions

- Lower costs for consumers/households
- Strong reduction of emission

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Thank you