# POWER-2-FUELS

## SUSTAINABLE SYNTHETIC FUELS

## NATIONAAL BINNENVAART CONGRESS

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### CONTENT

- Introduction
- Practical use of P2X fuels
- > Energy efficiency
- > Energy demand for transportation 2030-2050
- > Large scale P2X implementation in Netherlands energy system



#### **ENERGY SYSTEM TRANSITION**



Graph: Detz, R.J. et.al.: The future of solar fuels, 2018



### **POSSIBLE ROADMAP**

Dependent on major EU and world-wide policies



#### **ENERGY DENSITY OF FUELS - PRACTICAL APPLICATION**





#### **TKI PROJECT POWER-2-FUELS INNOVATION OUTLOOK**

Power-2-X brandstoffen voor zwaar wegtransport, scheepvaart en luchtvaart en hoe kunnen zij in het licht van de klimaatdoelstellingen versneld worden ontwikkeld?





#### **STORAGE IN VEHICLE AND DISTRIBUTION**

Storage in vehicle	Hydrogen	Methanol	Ammonia	Synthetic kerosine	Methane
Distribution & longhaul trucks	compressed or cryogene	standard liquid	compressed (± 10 bar)	n.a.	compressed or cryogene
Inland shipping	compressed or cryogene	standard liquid	compressed (±10 bar) or cooled (ca -33°)	n.a.	cryogene
Short sea shipping	cryogene	standard liquid	cooled (ca-33°)	n.a.	cryogene
Deep sea shipping	-	standard liquid	cooled (ca-33°)	n.a.	cryogene
Aviation	-	-	-	standard	cryogene

#### Criteria:

- Space & weight
- Safety
- Costs (of tank)

easy		
Quite feasible		
quite feasible		
feasible		
feasible		
not impossible		
not possible		

Preliminary results TKI project 'Power-2-Fuels innovation outlook

### WELL TO TANK EFFICIENCY

 Highest efficiency for batteryelectric

 $\rightarrow$  about 3x more efficient if powertrain in ship is included, but range is limited.

- > Others are quite similar
- No C/CO<sub>2</sub> source needed for H<sub>2</sub> and NH<sub>3</sub>
- Only battery, H<sub>2</sub> and NH<sub>3</sub> with fuel cell are real zero emission.



JRC WELL-TO-TANK Report, Version 4a, April 2014

#### **ENERGY DEMAND FOR TRANSPORT**

International bunkers is responsible for more than 60% of energy need for transportation

National and international energy demand in the Netherlands



Aviation

- Deep sea shipping
- Short sea shipping
- Inland shipping
- Long haul trucks
- Distribution trucks
- ∎Vans
- Passenger transport

Other

About 1200 PJ fuel demand requires about 2500 PJ electric energy (~700,000 GWh)

Assumptions:

- Based on fuel demand bunkered in NL in 2017
- Also renewable fuels that replace fossil will be bunkered in NL
- Based on data from NEV, CBS and EU
- Energy demand from passenger transport and vans will decline due BEVs

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#### > Production opportunities of P2X fuels in main-ports, but also (large) imports will be necessary:

- > Electricity grid needs to be expanded after 2030, but production of P2X fuels in main-ports will minimize impact.
- Expansion of fuel storage facilities, due to lower energy density of P2X alternatives and additional buffer requirements
- The green electricity needed for all sectors cannot be produced in the Netherlands if large part of the fuels becomes P2X:

 $\rightarrow$  Large energy imports will be necessary: sustainable electricity, biofuels, P2X

 $\rightarrow$  Further comparison of feasibility and business cases between different import and production options

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## **THANK YOU FOR YOUR ATTENTION**

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