



Accelerating industrial electrification

# E-FUELS

for truck transport, shipping and aviation

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# E-fuels

## Comparative assessment & roadmapping

- Cooperative project between stakeholders from the logistics sector, industry and knowledge institutes, with participation from a wide range of organisations
- Questions:
  - Which e-fuels are suitable for which modalities?
  - Future costs throughout the value chain of the various e-fuels?
  - Requirements for renewable energy production and land use?
  - Stakeholder actions to promote development and application?

Results will be published in May as a  
Voltachem vision paper



### KPIs

#### Applicability & safety

- vehicle modifications
- TRL level
- impact on infrastructure
- safety

#### Environmental impact

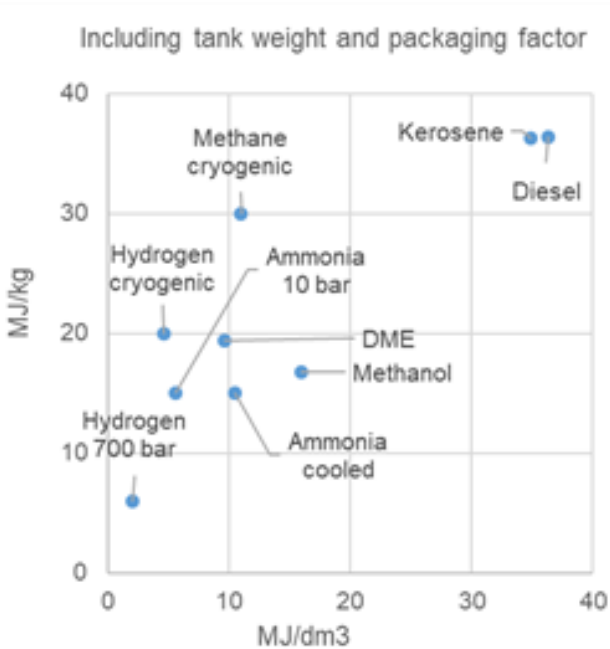
- pollutant emissions: NO<sub>x</sub>, PM
- GHG emissions

#### Economics

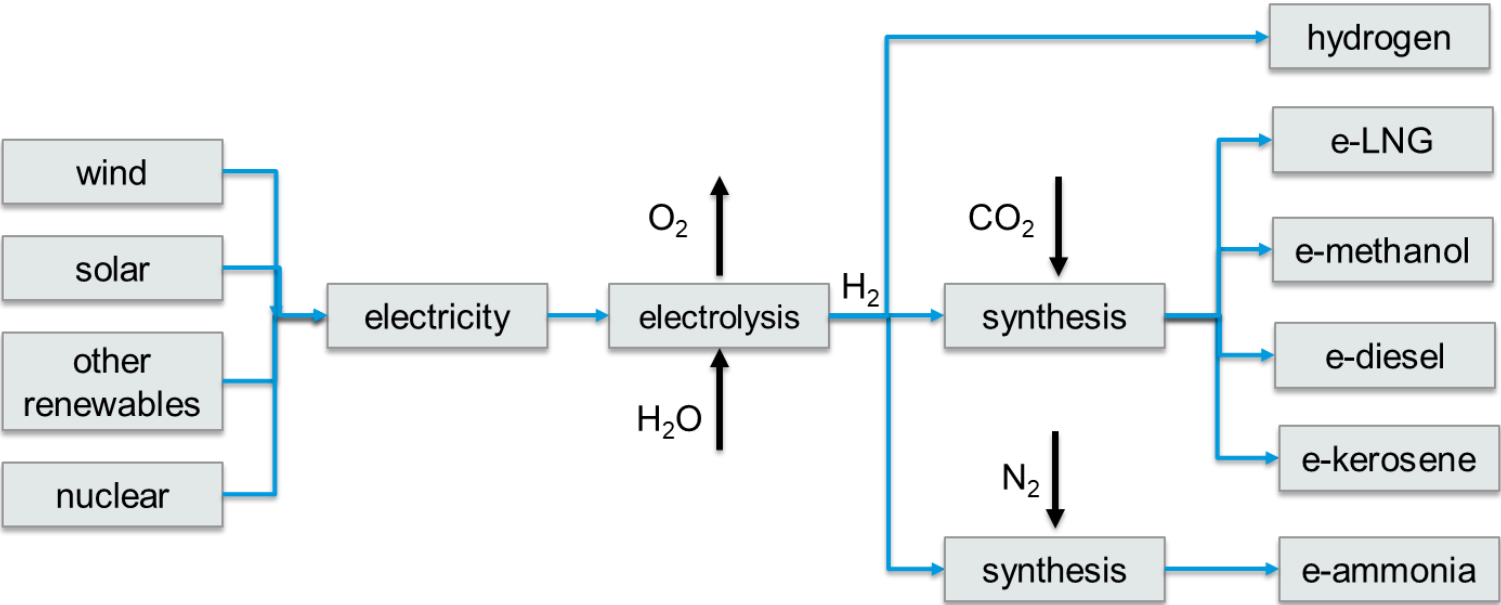
- production costs of fuel
- storage & distribution costs
- vehicle costs
- powertrain efficiency

# E-fuels

## Options considered



- easy
- quite feasible
- quite feasible
- feasible
- feasible
- not impossible
- not possible



Example: feasibility of on-board storage

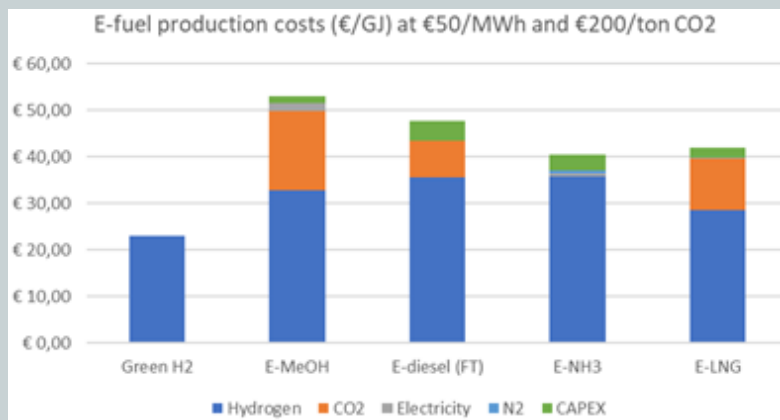
Storage in vehicle	green hydrogen	e-methanol	e-diesel (FT)	e-ammonia	e-kerosine	e-LNG
Distribution & longhaul trucks	compressed or cryogene	standard liquid	standard liquid	compressed (± 10 bar)	n.a.	cryogene (or compressed)
Inland shipping	compressed or cryogene	standard liquid	standard liquid	compressed (±10 bar) or cooled (ca -33°)	n.a.	cryogene
Short sea shipping	cryogene	standard liquid	standard liquid	cooled (ca -33°)	n.a.	cryogene
Deep sea shipping	-	standard liquid	standard liquid	cooled (ca -33°)	n.a.	cryogene
Aviation	-	-	-	-	standard	cryogene

# ECONOMICS

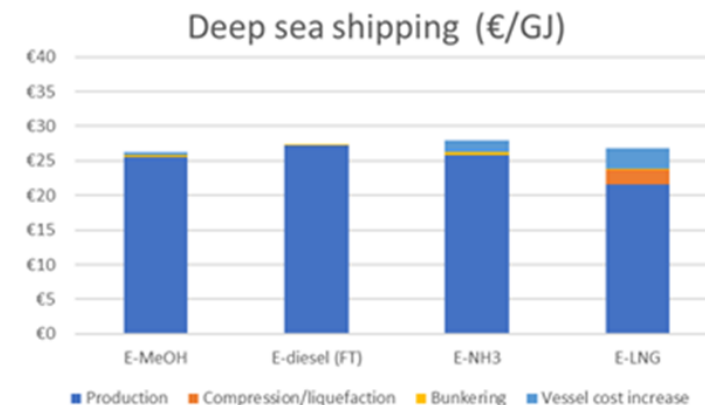
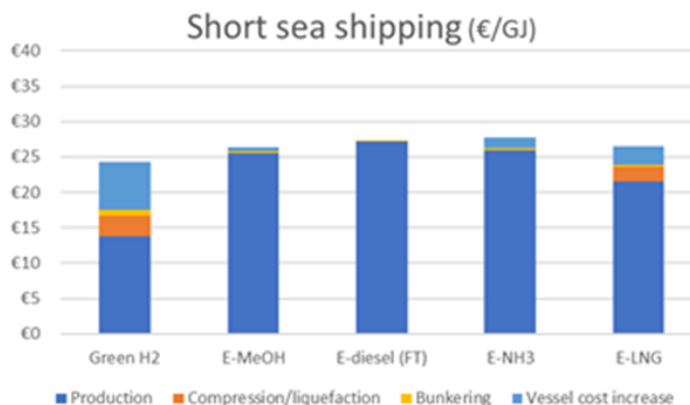
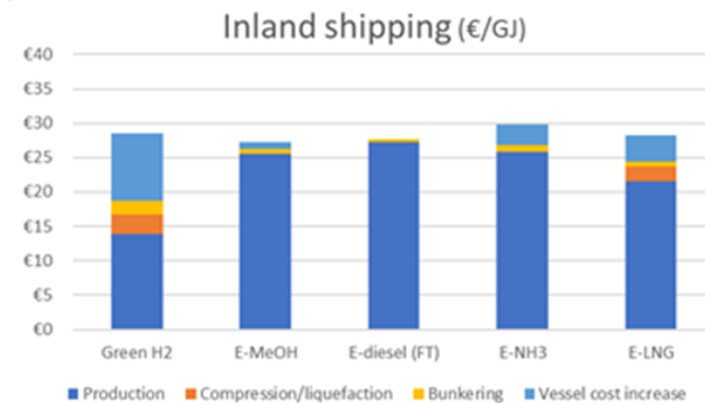
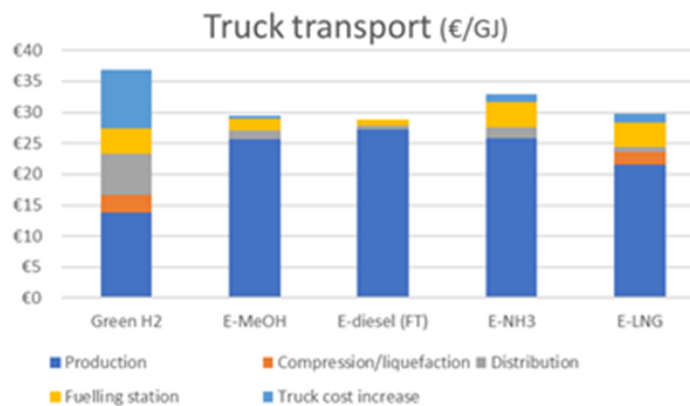
## Small differences between options

- Lower production costs for H<sub>2</sub> are compensated by higher costs for distribution and vehicles / vessels

- Comparison sensitive to costs of electricity and CO<sub>2</sub>






2030: electricity costs of €30/MWh and CO<sub>2</sub> costs of €40/ton

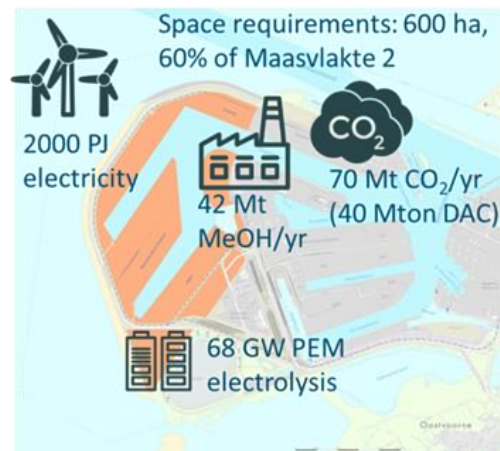


# SOME CONCLUSIONS

- Overall summary of results

			
Hydrogen	For short distances, in case of high electricity and CO <sub>2</sub> costs		
E-methanol	Feasible		
E-diesel			
E-LNG			
E-ammonia	Unsafe	In case of high CO <sub>2</sub> cost	Only feasible option
E-kerosene			

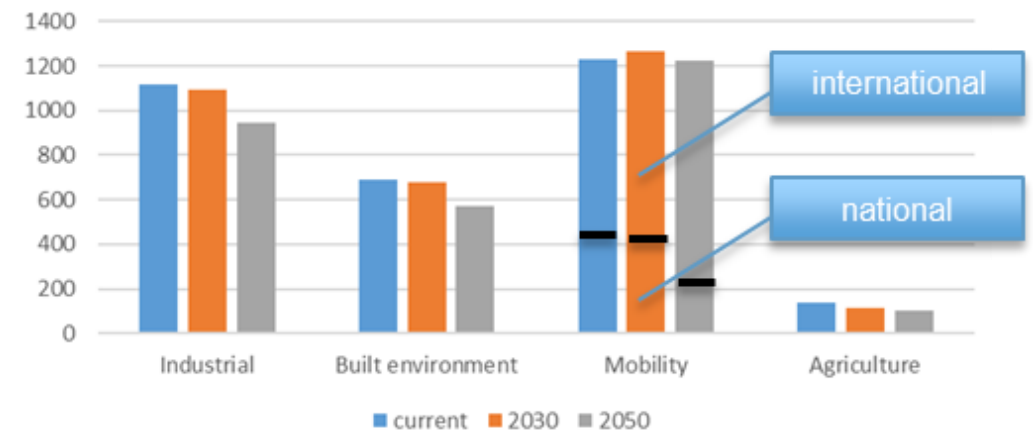
- Space requirements for 960 PJ of e-methanol production on Maasvlakte 2



- Questions:

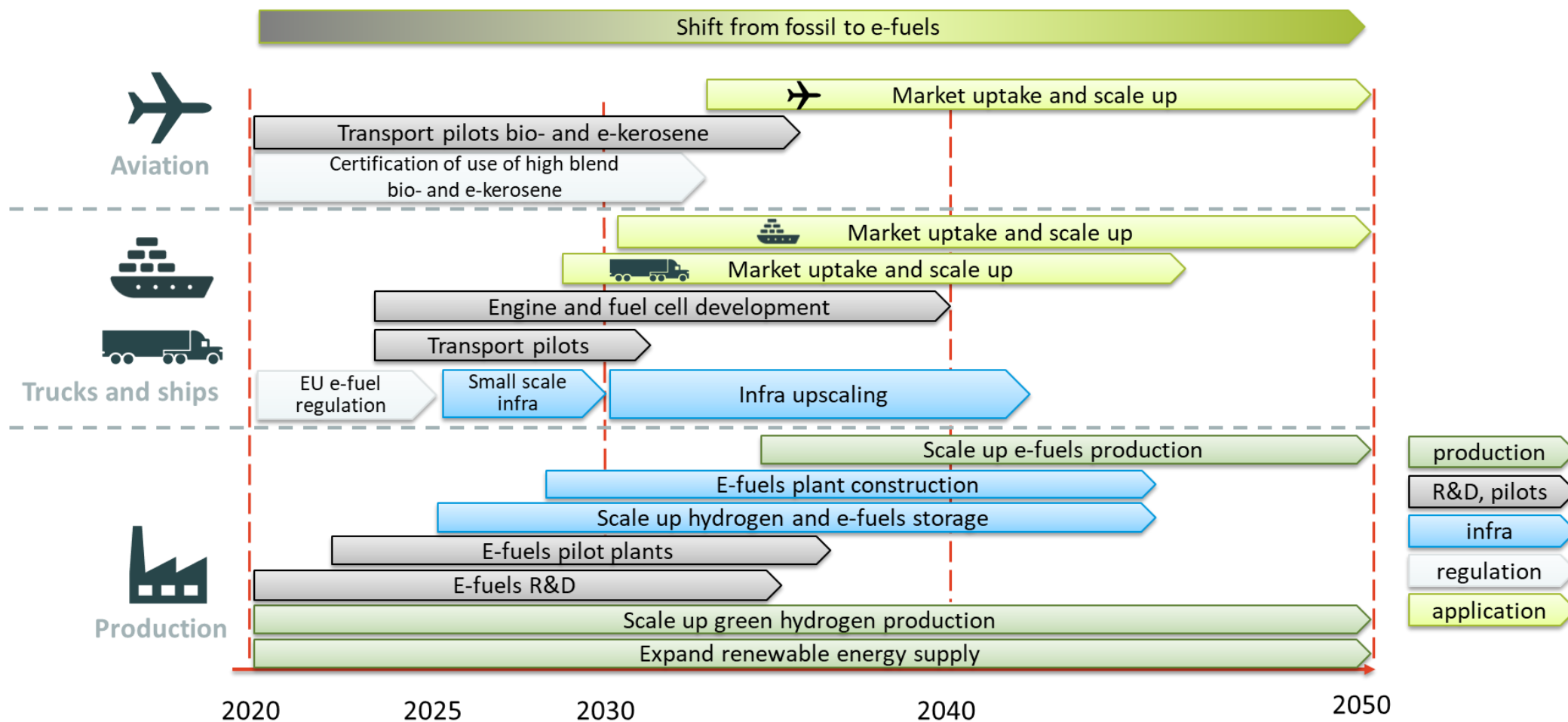
- Do we continue to supply the same amount of bunker fuels?
- If so, will that be based on domestic renewable energy production or import of e-fuels?

NL Energy use per sector (PJ/year)  
(incl. international mobility)



# INDICATIVE ROADMAP

## Production & application in transport





**voltachem.com**

The paper can be obtained by sending an e-mail to:  
**info@voltachem.com**



**smart-port.nl**

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TNO Sustainable Chemical Industry