Decarbonisation through hydrogen

Industrial decarbonisation and the big potential of hydrogen

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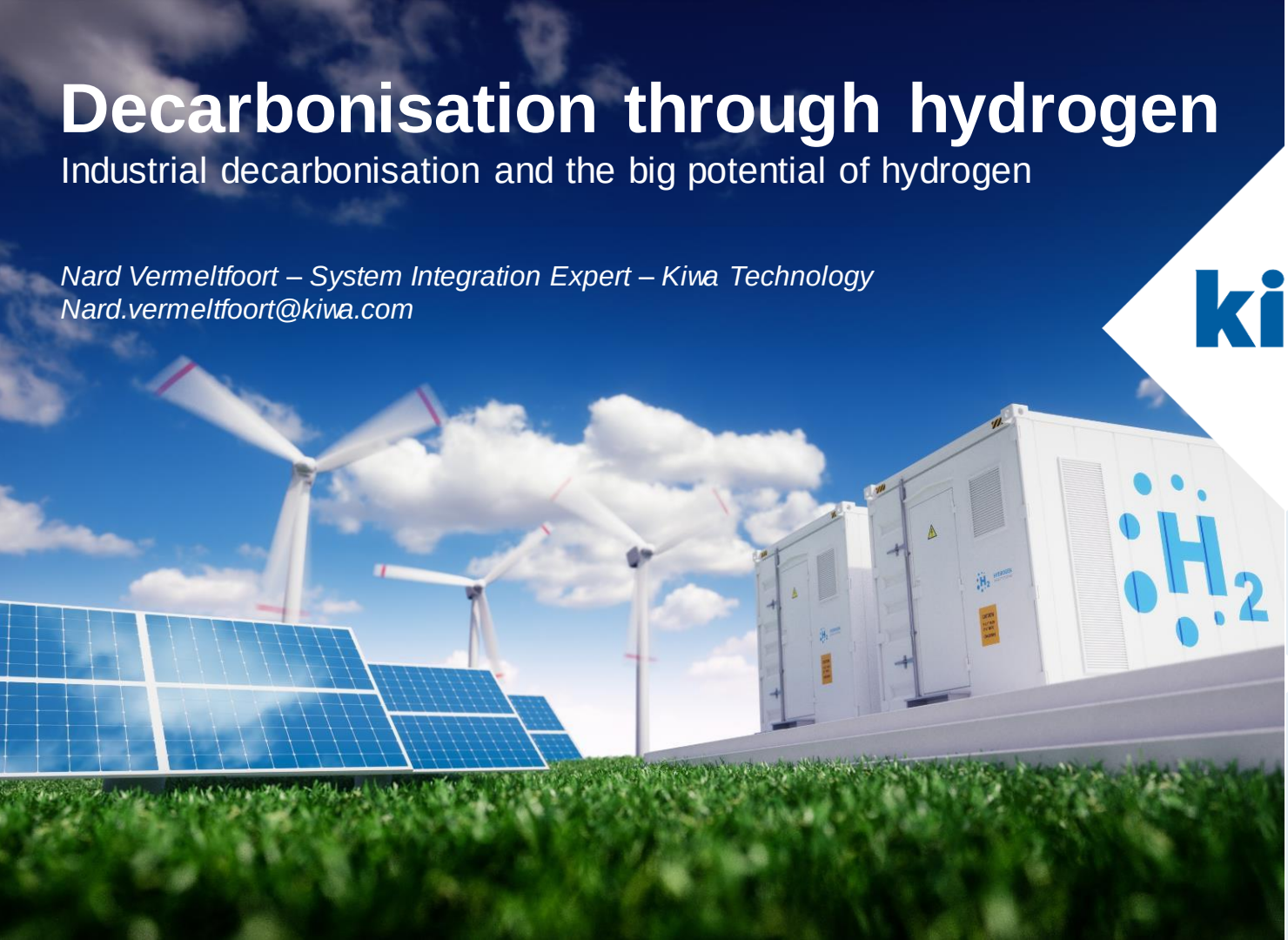


Partner
for
Progress

What we do for you

Testing

Inspection

Certification

There is a strict separation between our certification services and activities like training courses and consultancy

Training

Consultancy

Data services

Who we are as Kiwa Technology

The Kiwa team consists of members with different expertise and experiences on the field of safety, gas distribution and hydrogen

Experienced in energy transition questions regarding biomethane and hydrogen

Since 1978 specialist on the field of energy, gases and infrastructure

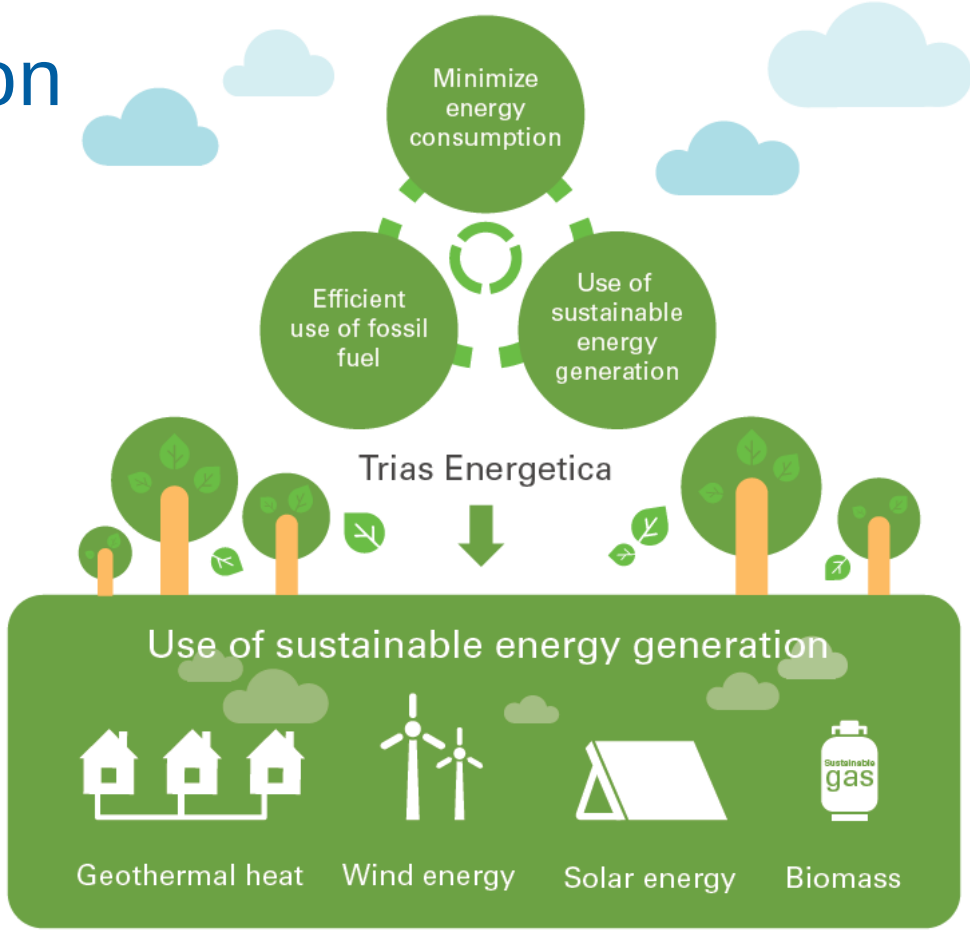
Participating in (hydrogen) platforms like Hydrogen Europe, GERG, HyDelta and pilots

Direct access to manufacturers, district system operators and other players in the hydrogen supply chain

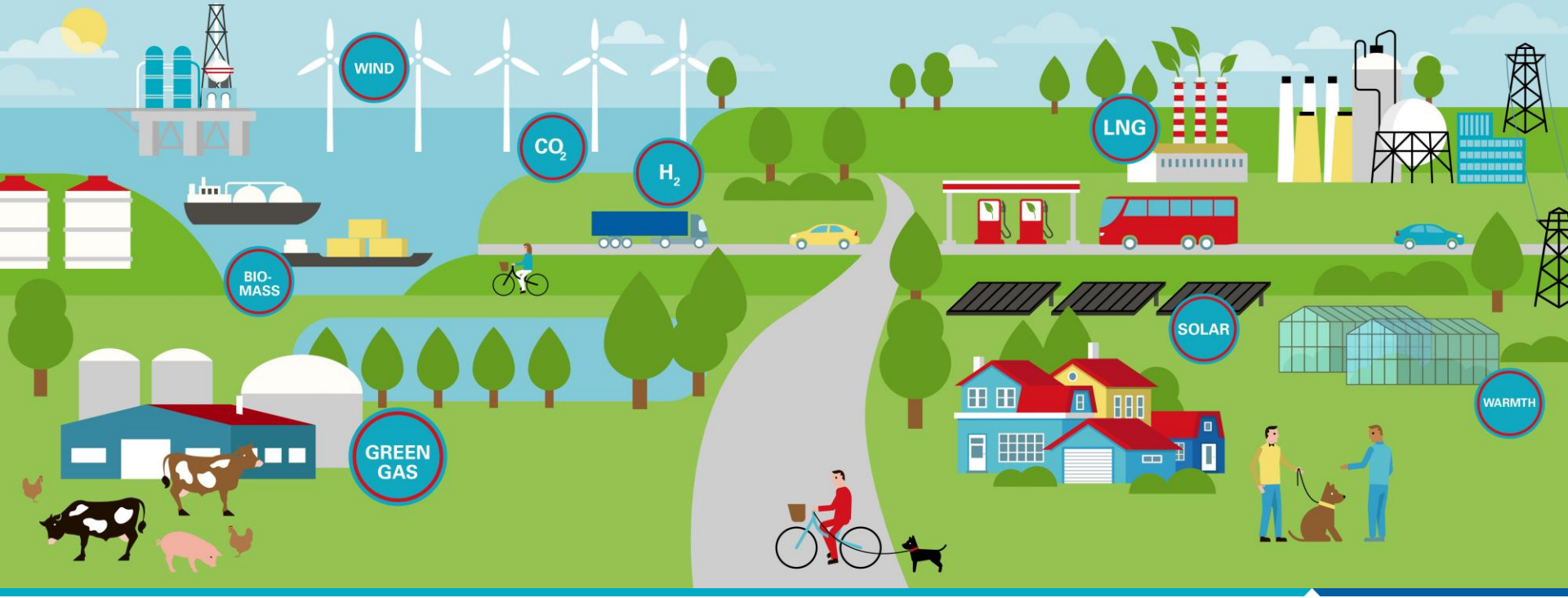
Actively involved in the development of technical standards for use of hydrogen (ISO, CEN, NEN)

Knowledge partner and trainer when it comes to hydrogen and renewable energy

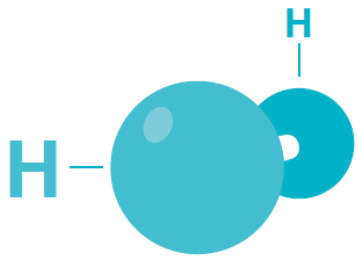
Energy transition basics



Max CO_2-reduction with ‘minimal’ investment



HYDROGEN MOLECULE



In nature, hydrogen exists as a molecule

CONSISTING OF 2 ATOMS

MOLECULAR MASS

DIFFUSIVITY AND CONDUCTIVITY[1]

Diffusivity in air:
0.61 cm^2/s

Thermal conductivity:
187 mW/(m.K)

1 1.0079

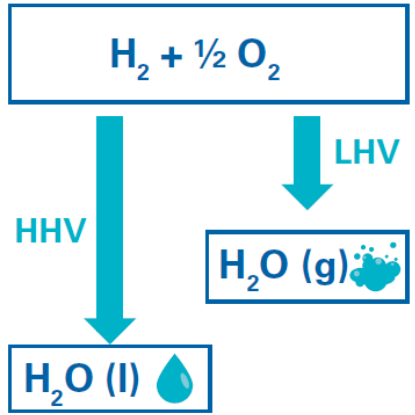
H

Hydrogen

HEATING VALUES

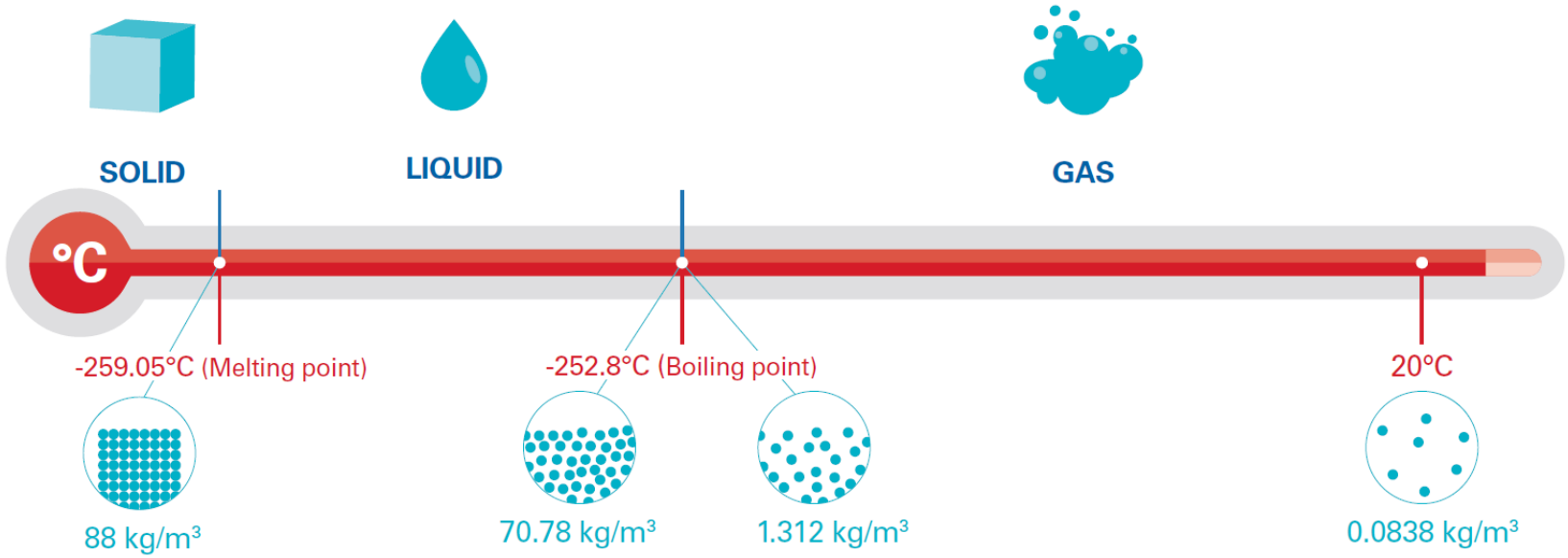
Lower Heating Value (LHV):
119.93 kJ/g
10.05 MJ/Nm^3

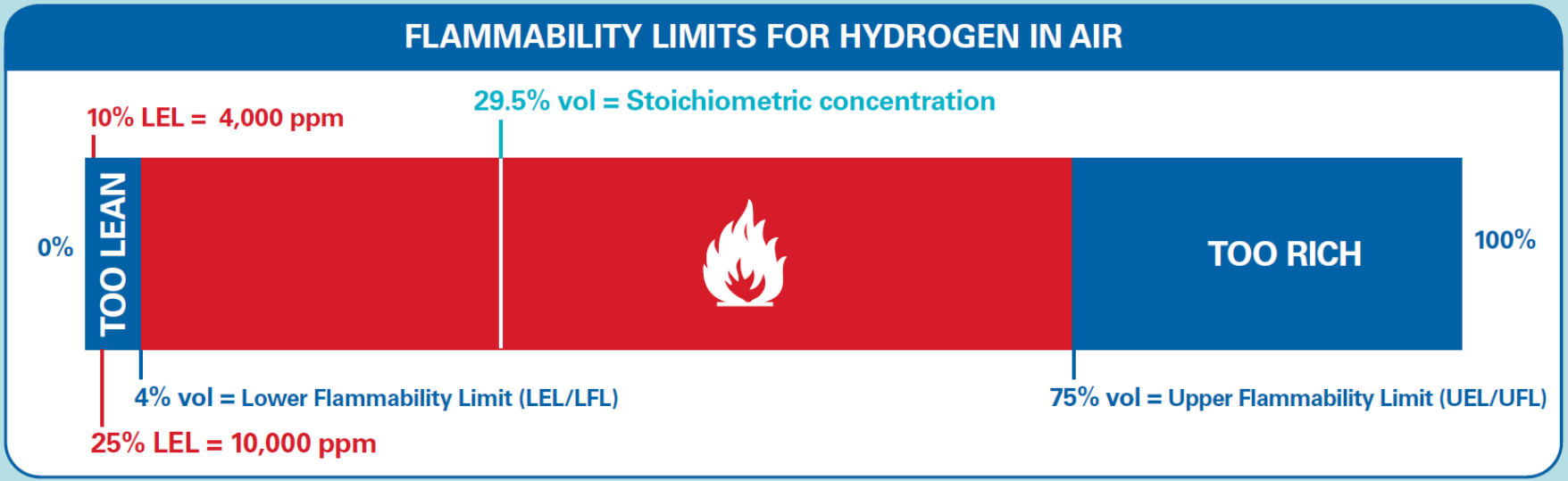
Higher Heating Value (HHV):
141.86 kJ/g
11.89 MJ/Nm^3



Energy released during combustion

DENSITY AND PHASE OF HYDROGEN AT DIFFERENT TEMPERATURES[2]

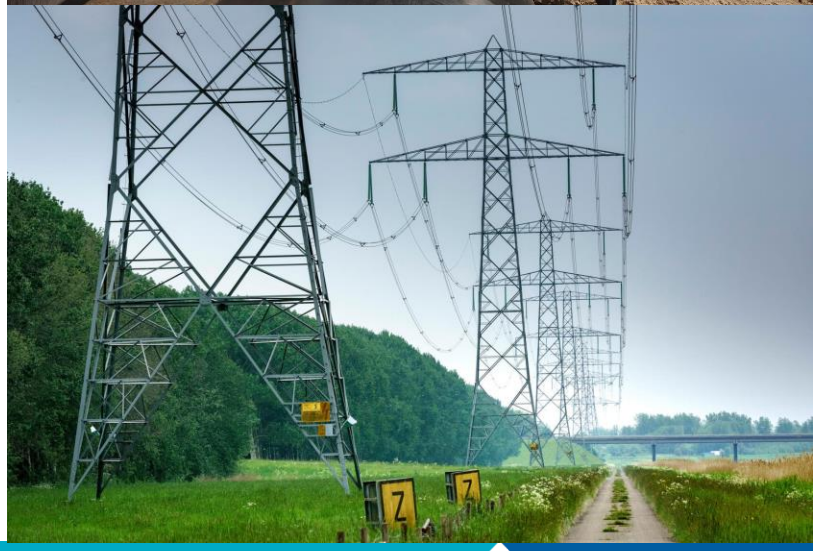




1. NTP (20 °C, 1 atm) 2. Pressure = 1 atm

Why there is a role for hydrogen in the industry

- **More cost efficient to transport large amounts of energy (typical factor 10)**
- Needed for processes (Refining, fertilizer, ammonia, food industry, metal processing)
- High temperature processes (adiabatic flame temperature is around 10% higher)
- PQ & Grid congestion; Possibility to generate on own premises, buffering capability, more flexibility



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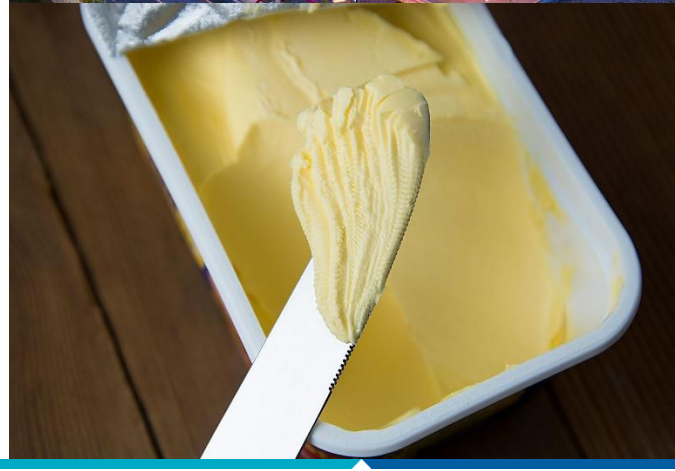

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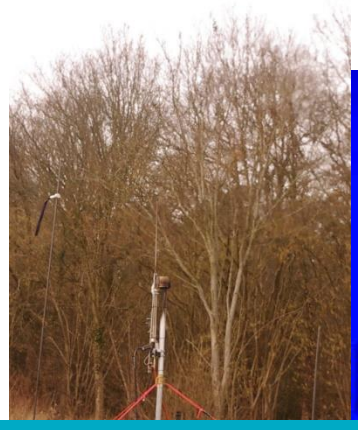

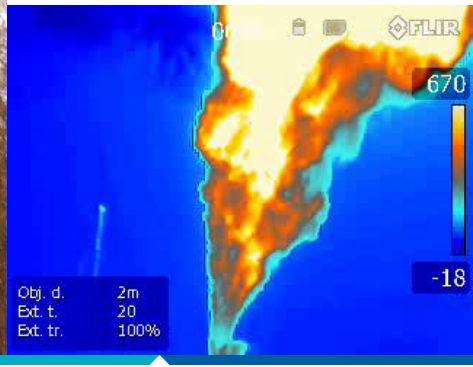

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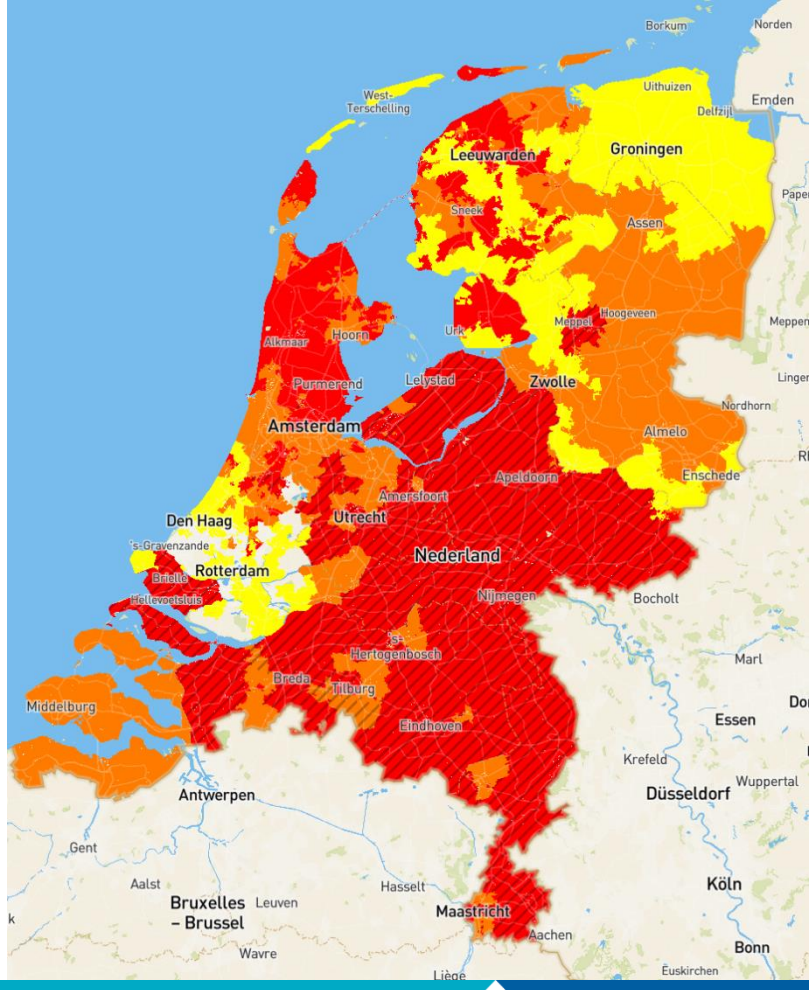
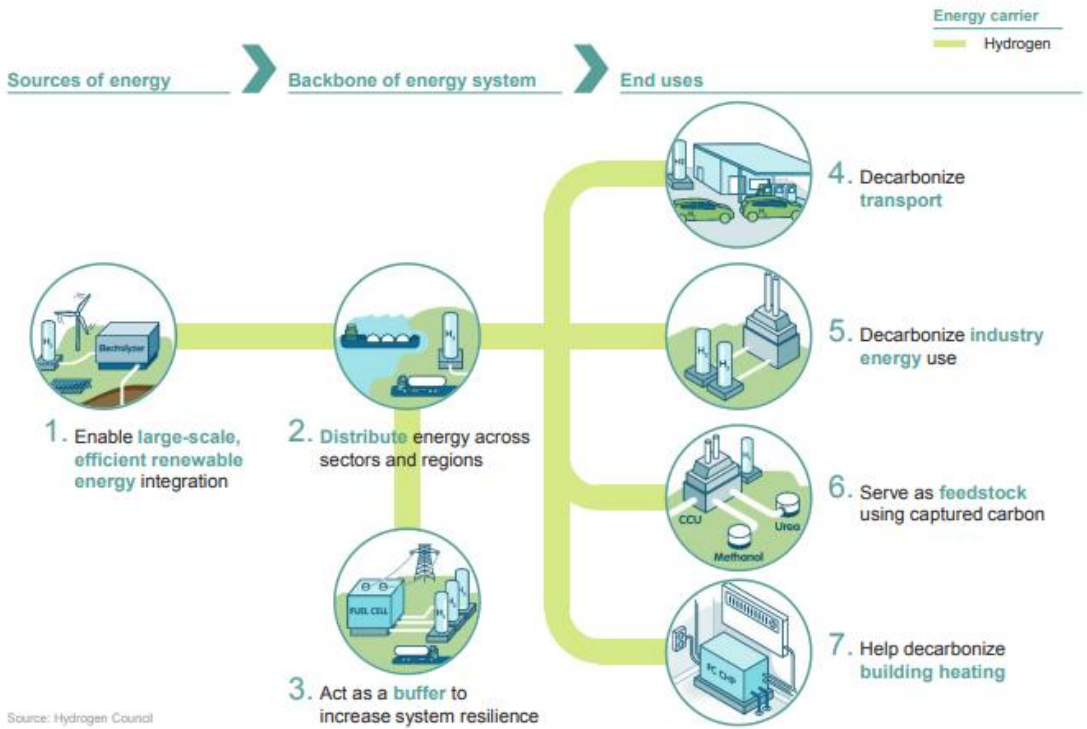


Summarized why hydrogen?



Project example bakery oven on 100% hydrogen

Energyscan: 3 steps towards decarbonisation

1

- Map current energy usage (scope 1&2)
- Energy efficiency
- Process optimalisation
- Process flexibility
- Temperature study

2

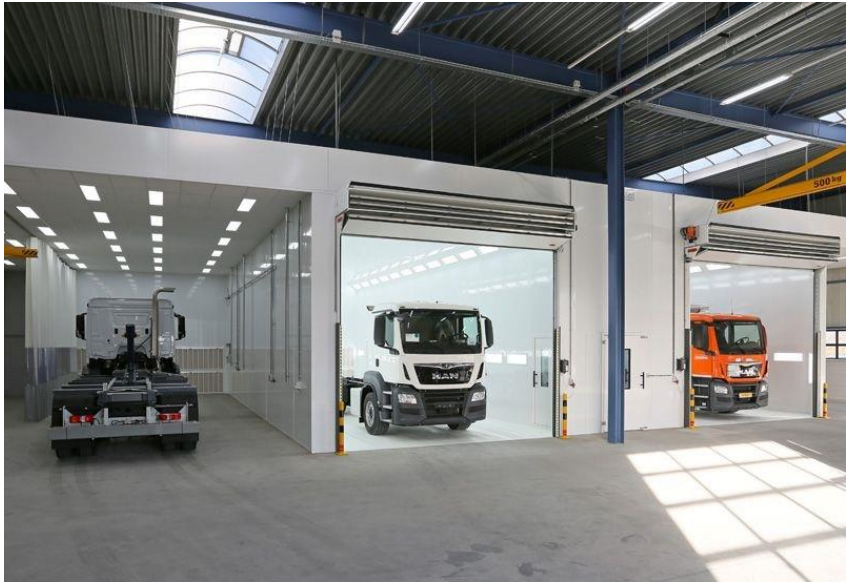
- Electrification, usage of renewable generated energy
- What possibilities are there for electrification?
- What are the possibilities for energy buffering?
- Possibilities for PV or wind energy generation nearby?

3

- If electrification is not an option, then what?
- Which alternatives are possible? (geothermic, CSP, batteries, H2 or H2 carrier)
- What are the possibilities for energy buffering?
- Possibilities for cooperation with local industry, or for an energy hub?

Project example* (I)

Small/medium sized company in the Netherlands:
~1000 GJ/year gas and ~1000 GJ/year electricity
50% generation of E with photovoltaics.



1. Lower capacity gas grid connection, lower the sealing, balance ventilation
2. Heat pumps for heating and oven, big buffer and boosters (-75% gas)
3. Grid capacity is limited, keep the gas installation for transition into hydrogen

** = The examples have been anonymized.*

Project example* (II)

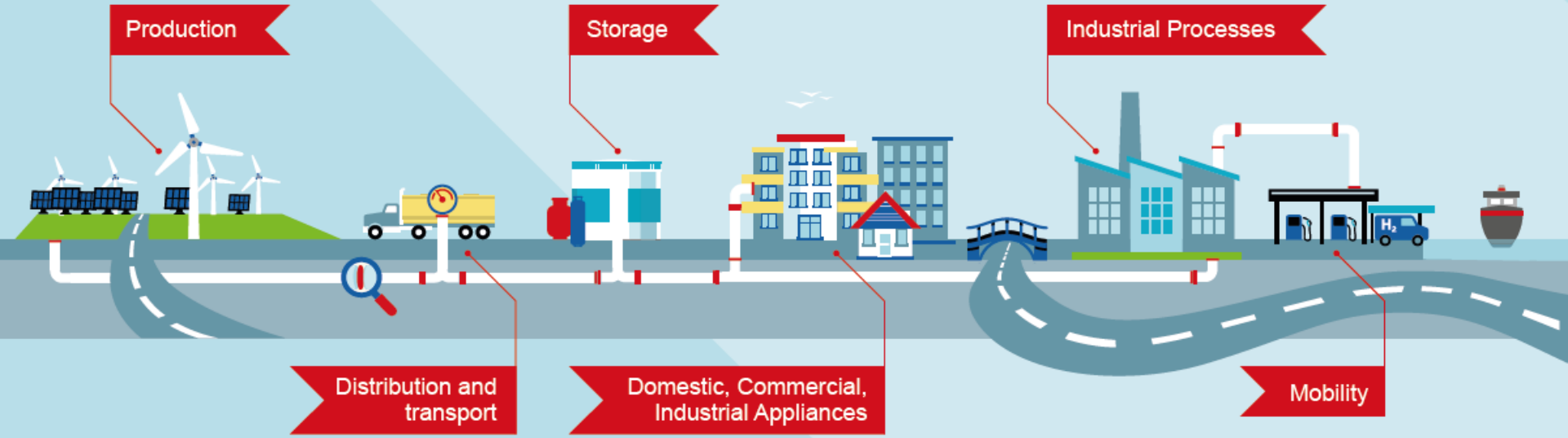
Paper factory in Portugal ~1000 TJ/year
33% E (-20%) and 66% G
Steam production and direct heat

1. Reuse energy in the exhaust gasses, process adaptations
2. Electrify steam production (with additional flexibility)
3. Use hydrogen for the main burners (high energyflux)

** = The examples have been anonymized.*

Kiwa Hydrogen experience table

Services focus on end-to-end H2 Infrastructure



Contact

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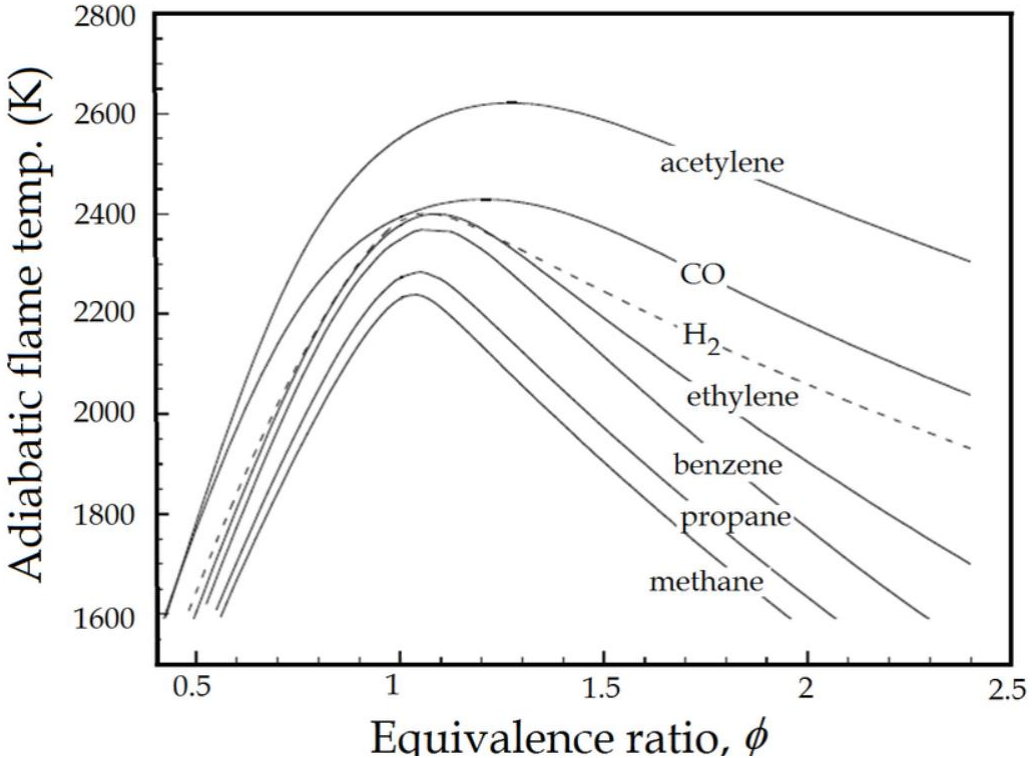
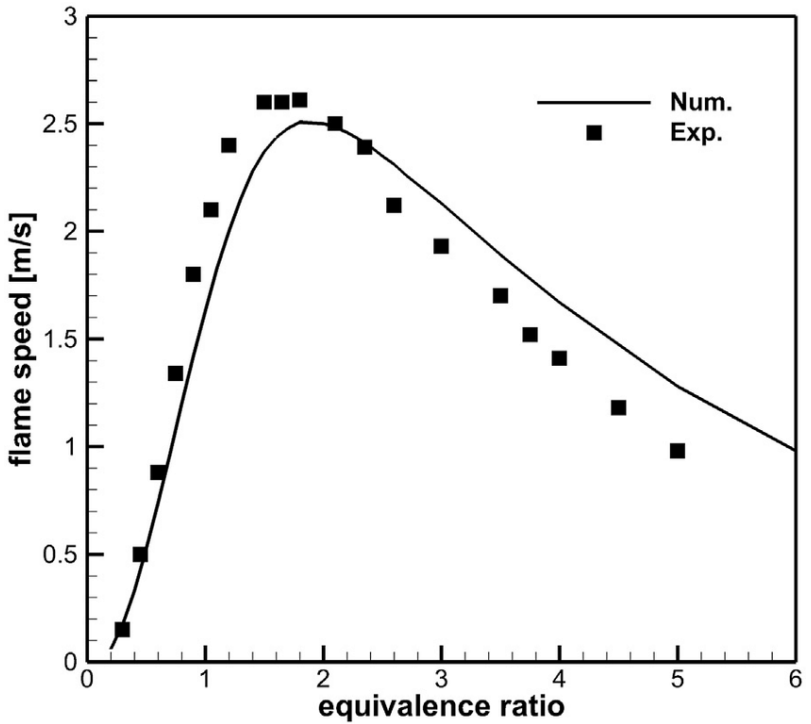
https://www.kiwa.com/nl/nl/markten/energie-en-energiemanagement/

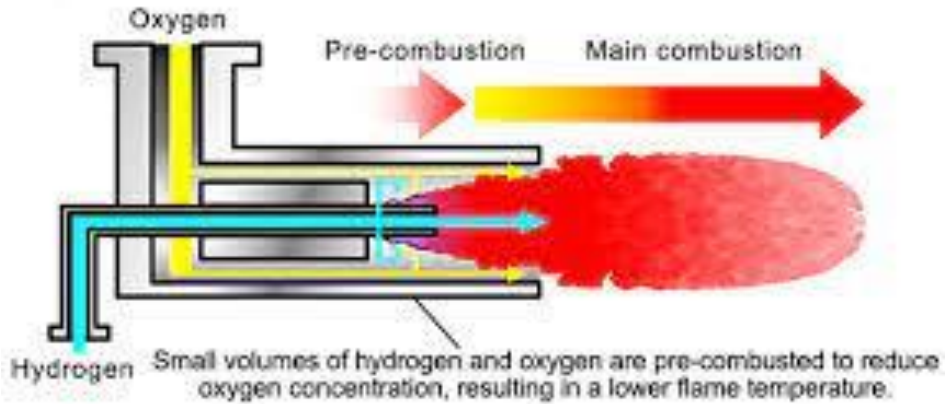
Happy to discuss your challenges!

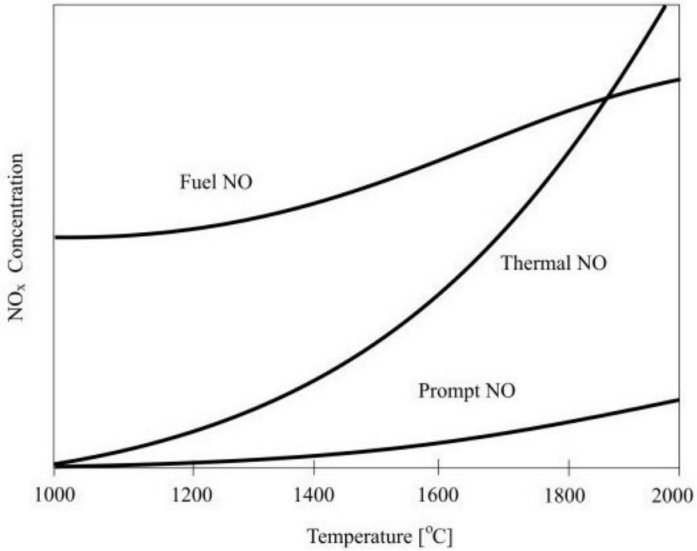
Adiabatic flametemperature & Laminair flame speed





Hydrogen in processes





Main differences

- ❑ Hotspots (High NOx)
- ❑ Flame detection (Ionisation)