



Optionen zur De-Carbonisierung der Mobilität

Potenziale von Alternativen Kraftstoffen

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Agenda

- Context & Motivation
- Overview: Pathways to Decarbonization
- Examples:
 - Alternative Fuels for Heavy Duty Trucks
 - H₂ History and Current Focus
- Wrap-up



Context & Motivation



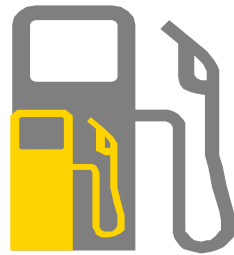
The energy challenge

There is more demand for energy globally as the world's population and living standards increase



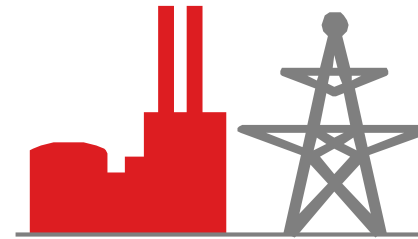
Growing population

Global population is expected to increase from around 7.4 billion today to nearly 10 billion by 2050, with 67% living in cities.



Rising demand

Global energy demand will likely be almost 60% higher in 2060 than today, with 2 billion vehicles on the road (800 million today).



Ongoing supply

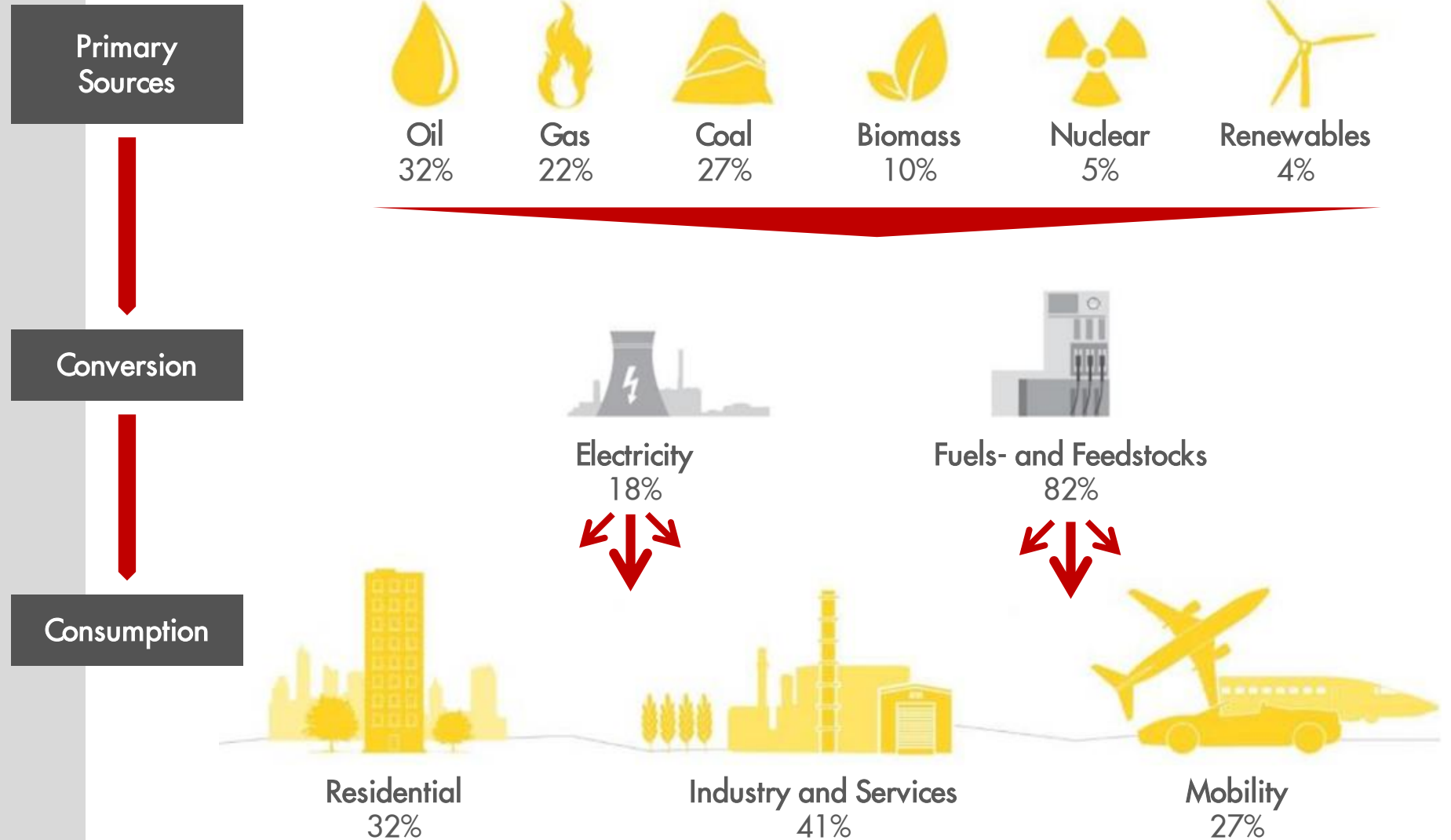
Renewable energy could triple by 2050, but we will still need large amounts of oil and gas to provide the full range of energy products that the world needs.



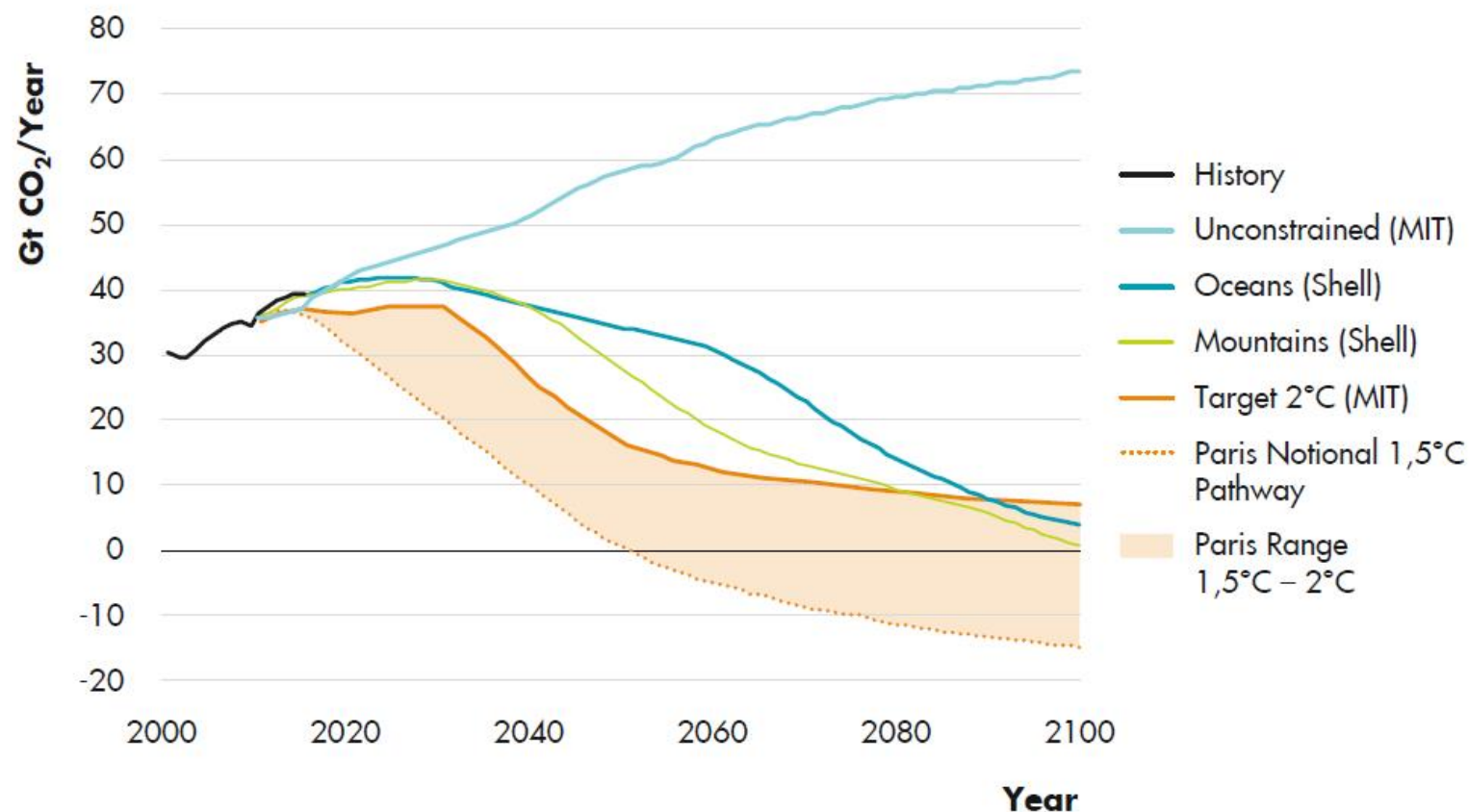
Mitigating climate change

Net-zero emissions is a potentially achievable societal ambition.

The Energy System today sets the context for the future



The Pathway to Net-Zero emission will need further technology break through and support of CO₂ capture to achieve the ambition of the Paris Agreement.



Source: Shell analysis - World Energy Model and MIT 2015 & 2016



Shell's role in the Energy Transition

- Grow our natural gas business,
- Build a profitable new energies business,
- Research and develop innovative low-carbon energy solutions,
- Improve the CO₂-efficiency of our own operations.



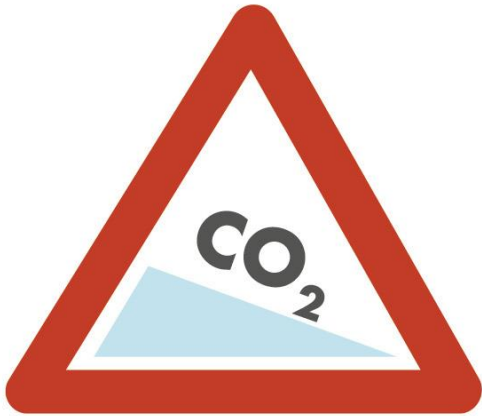
Overview: Pathways to Decarbonization

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A major issue in transportation

The Emission challenge

Reduce GHG (CO₂)
Emissions



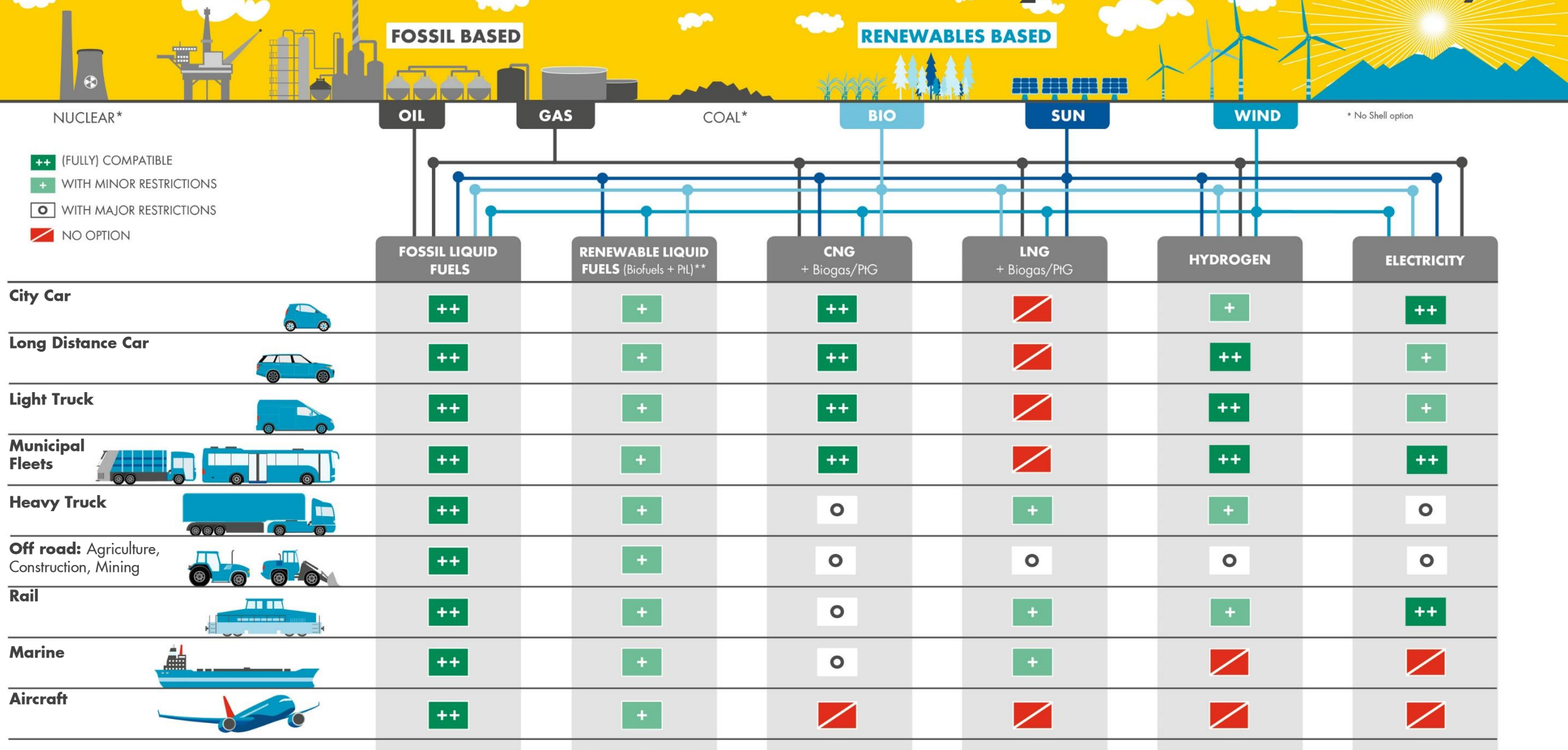
Reduce Local Air quality
related Emissions



Reduce Noise
Emissions



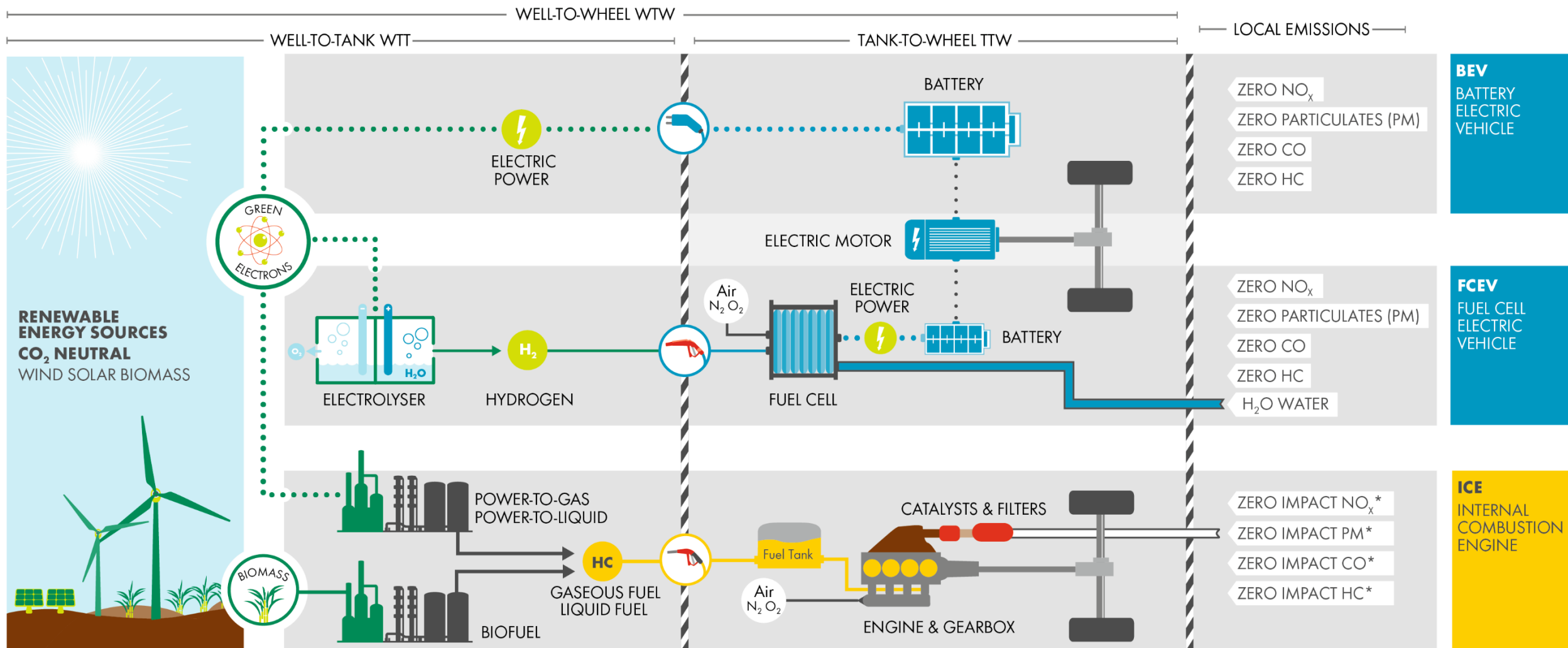
More Diversification foreseeable to achieve CO₂ Reduction in Mobility



** Engines to be designed for Bio and PtL fuels

Pathways to clean vehicle drivetrains

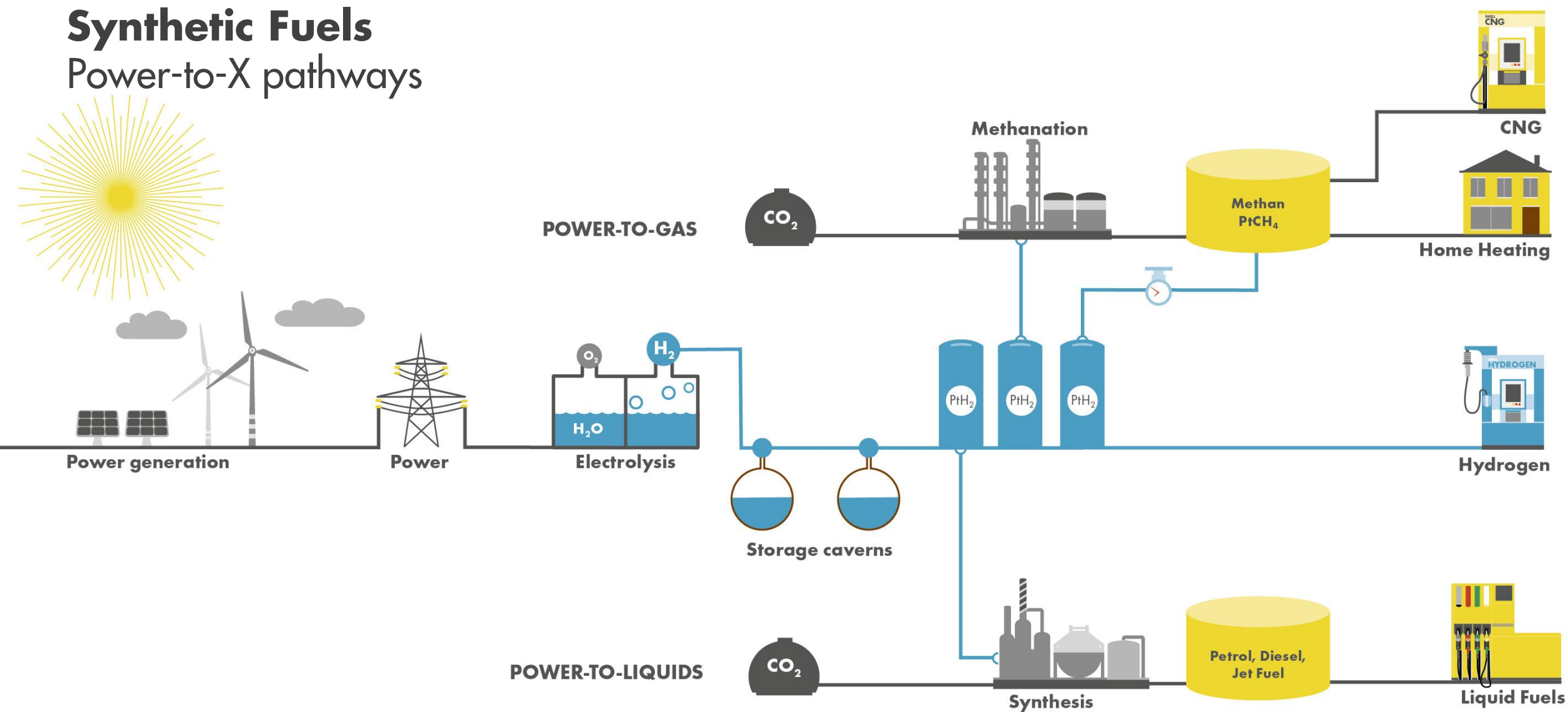
Zero GHG Emissions, Zero Air Pollution



*Under development as part of SULEV (Super Ultra Low Emission Vehicle)

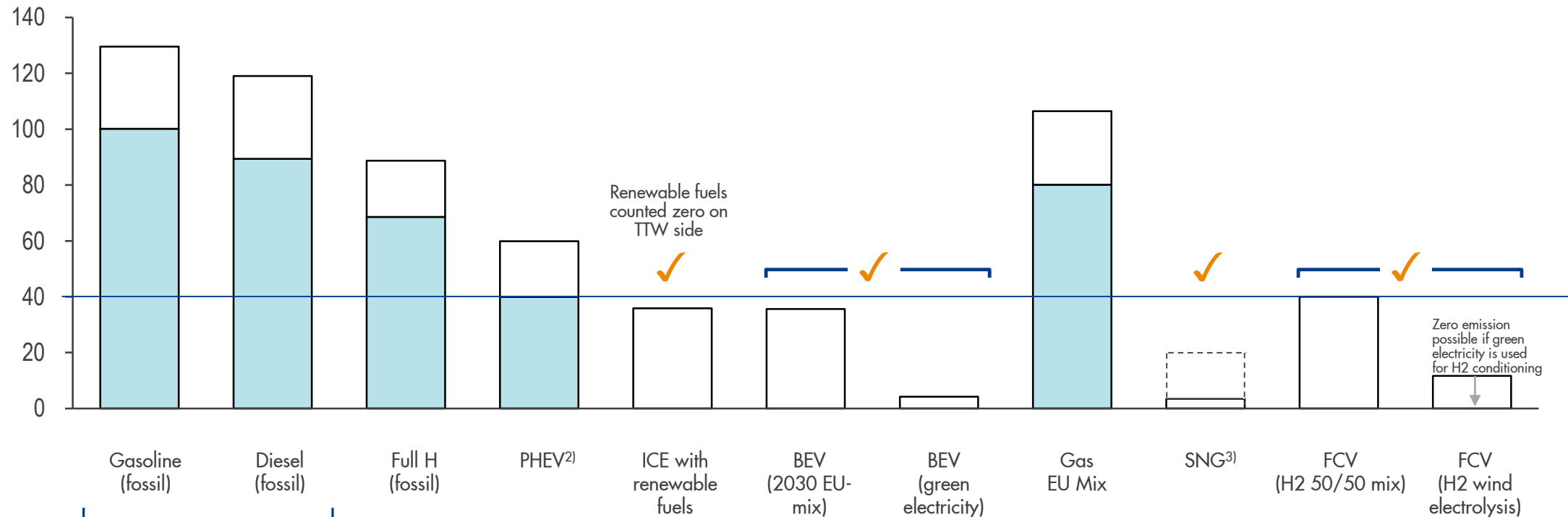
Synthetic Fuels

Power-to-X pathways



To achieve EU 2050 transport decarbonisation targets technologies with average TTW GHG emissions below ~40 g/km are required

WTW GHG efficiencies by technology¹⁾, average C-segment 2030 [g/km]



Conventional ICE

✓ = Potential vehicle/fuel combination for low-carbon economy

Well-to-tank Tank-to-wheel

1) Biofuel adjusted 2) With 30% electric driving 3) If NG is produced via power-to-gas from renewable electricity TTW = 0

In all technologies significant vehicle efficiency improvements are included

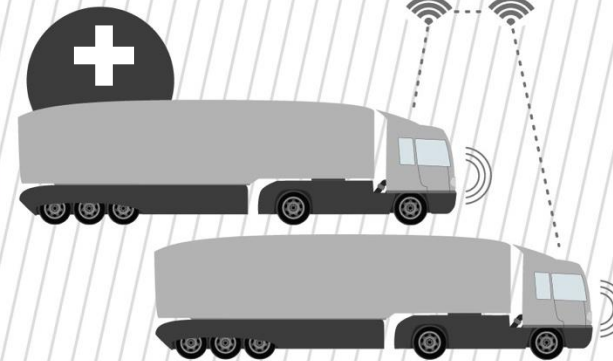
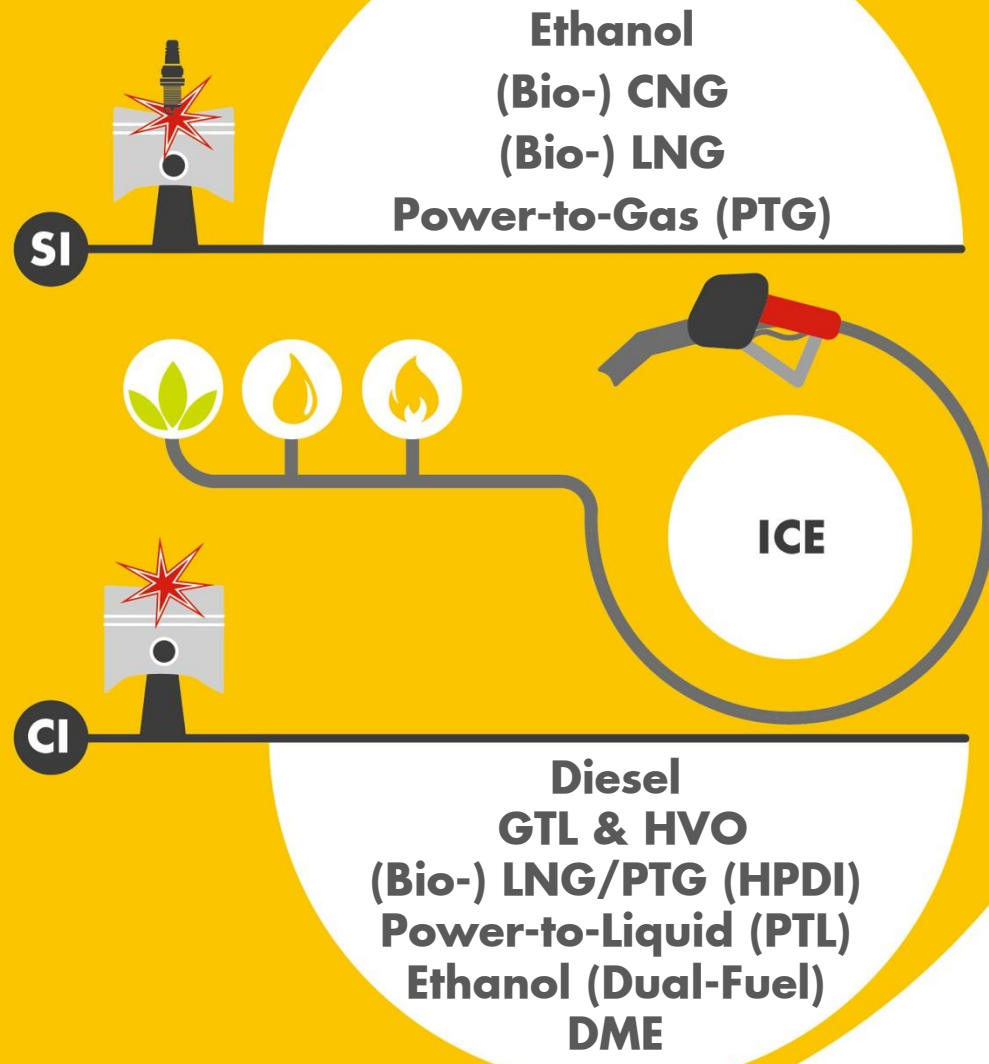
Source: Integrated Fuels and Vehicles Roadmap to 2030+, Roland Berger 2016

Examples:

- **Alternative Fuels for Heavy Duty Trucks**
- **H2 History and Current Focus**

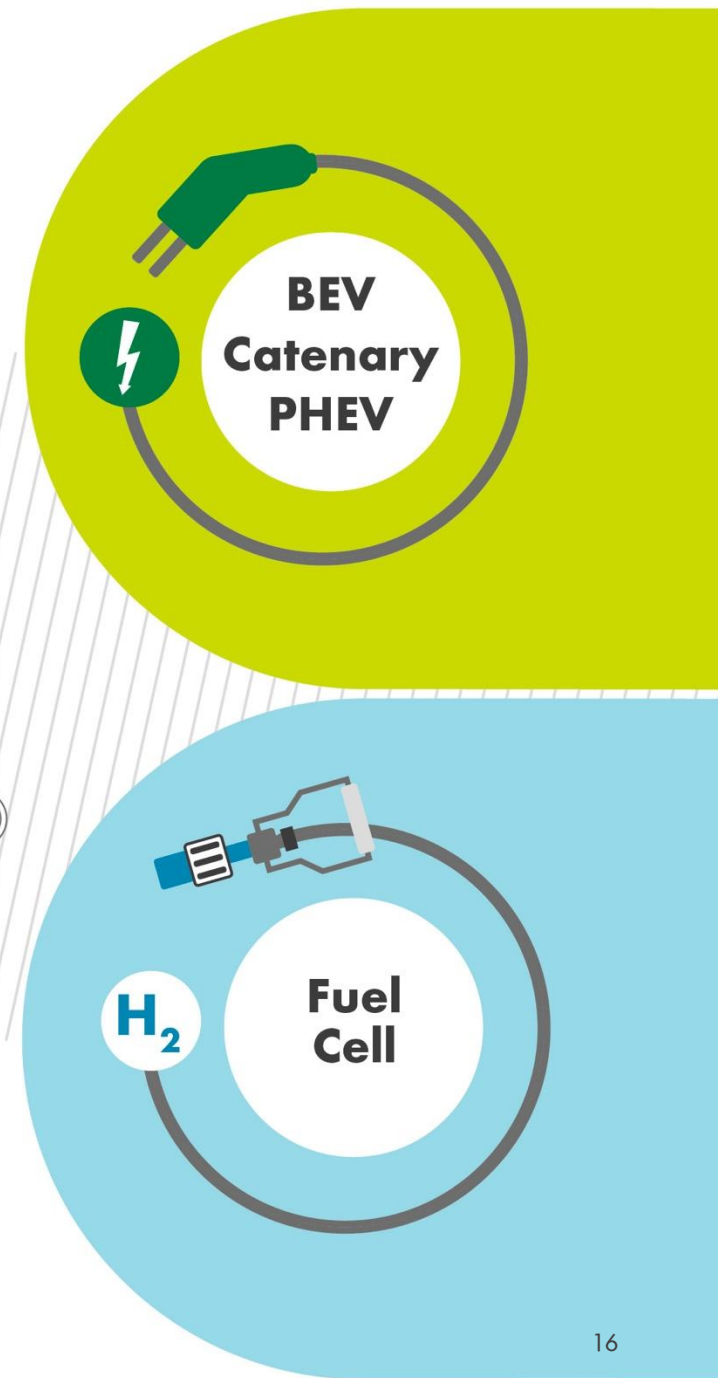
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HD Roadmap – Technology Options

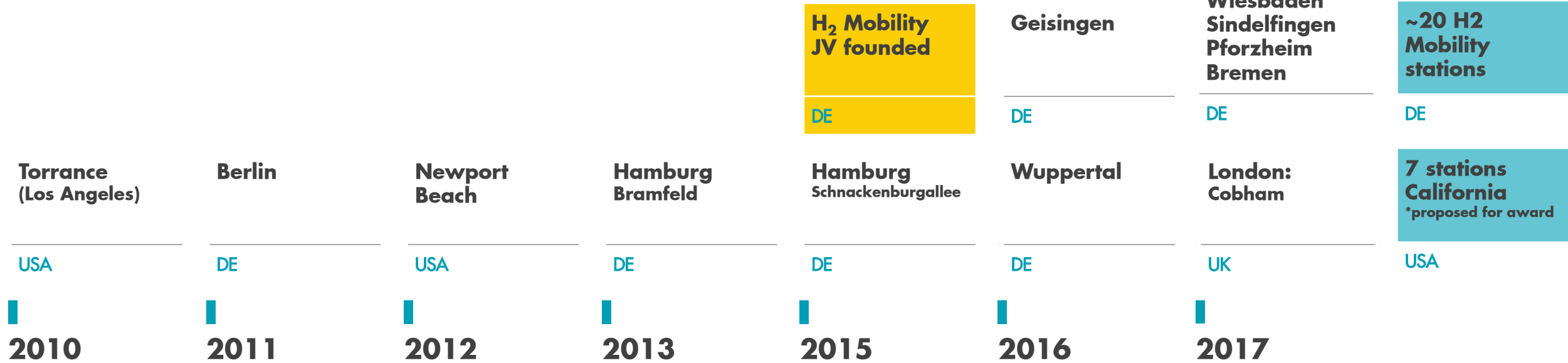


IT-assisted driving & Trailer design

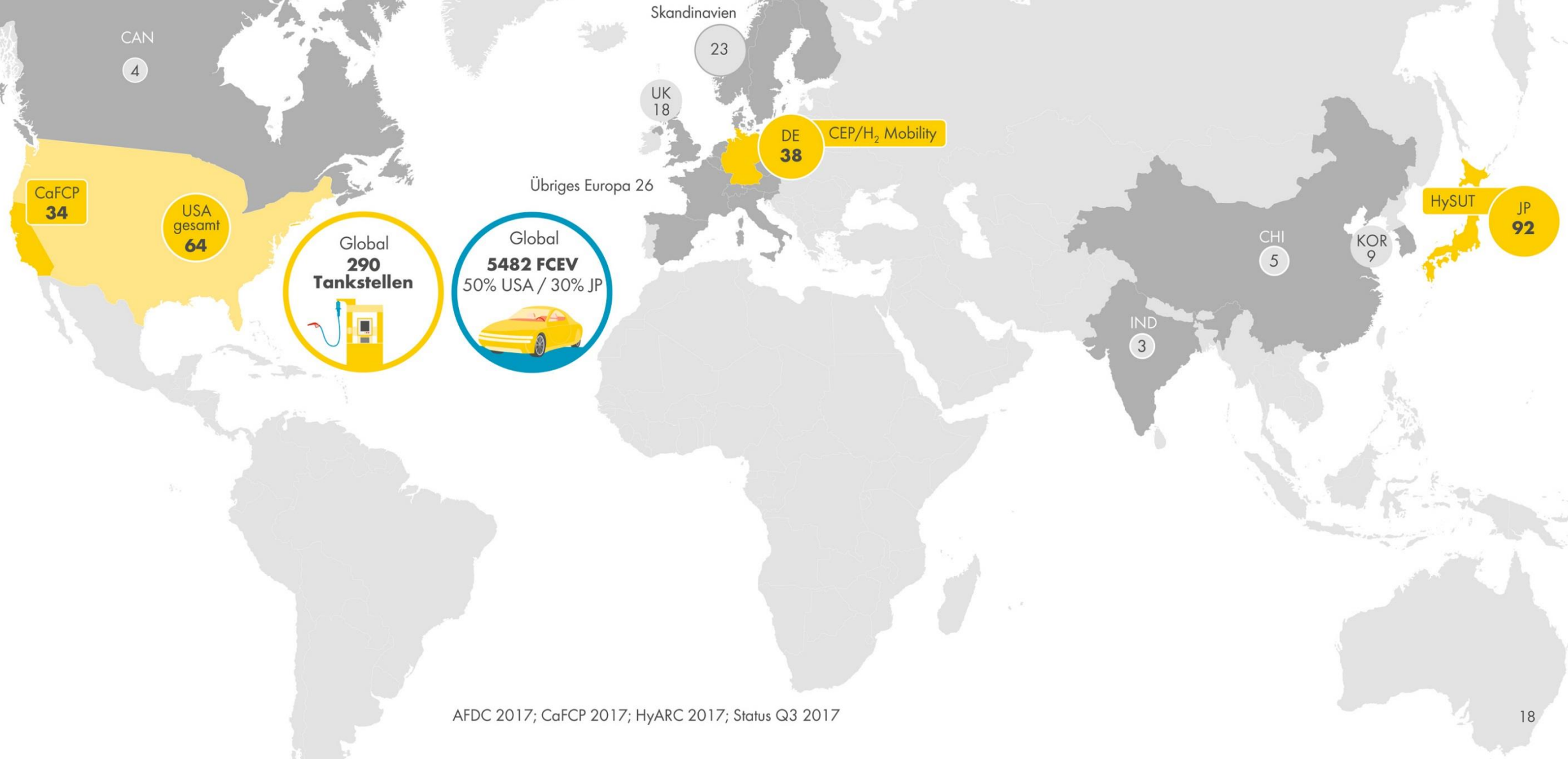
A large number of different powertrain / fuel options are currently being researched



The Shell hydrogen journey



Hydrogenmobility – Focus Regions



Wrap-up

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Summary: Shell & New/Alternative Fuels



Biofuels

Conventional & advanced biofuels



Hydrogen

Active in hydrogen electric



Electricity

Exploring a role in the charging of EVs



GTL

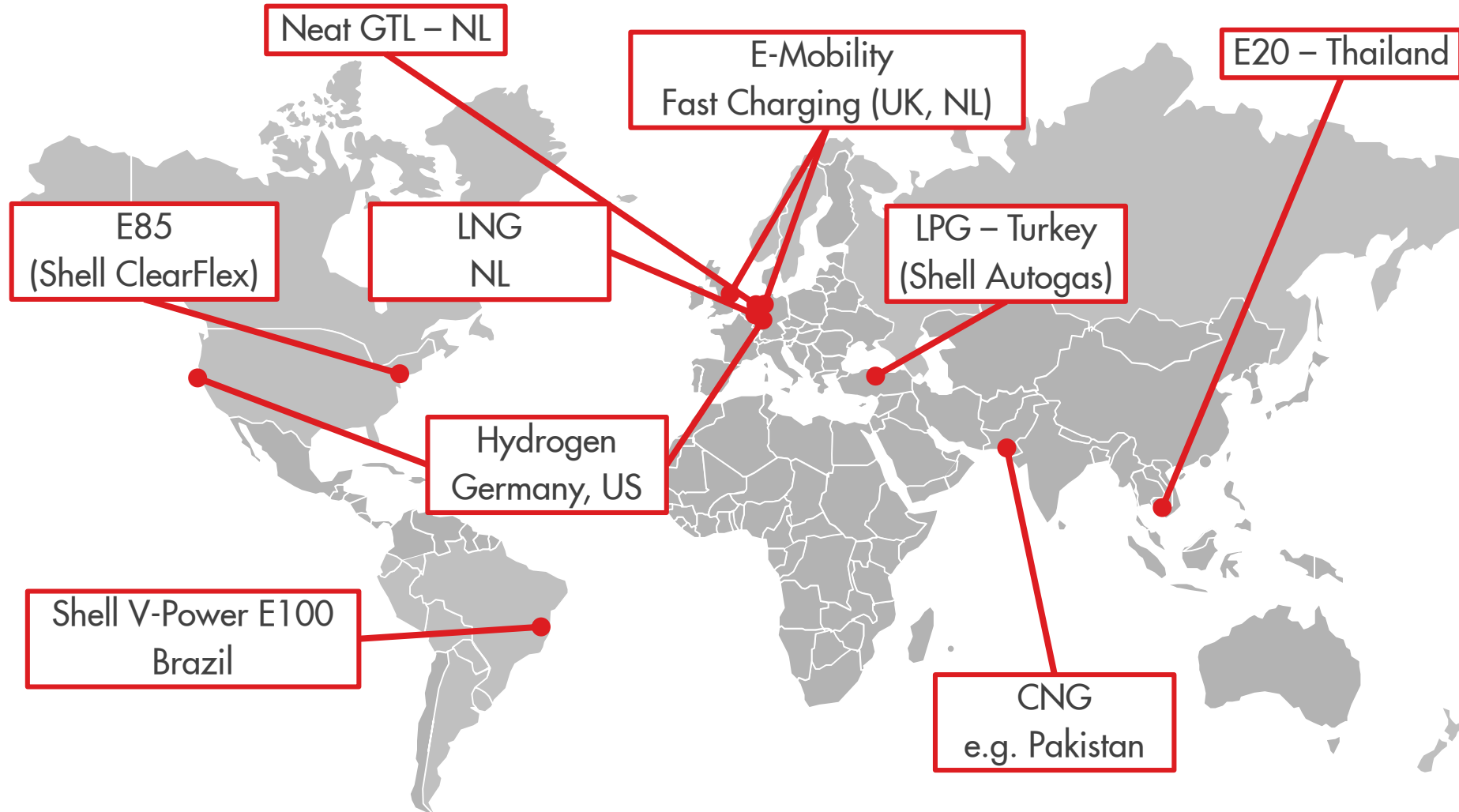
Pioneering Gas to Liquid (GTL) technology



LNG

Leading LNG in transport

Being Ready – Future Energy for Mobility



Shell is actively selling lower emission fuels today

Danke!

Q&A

