

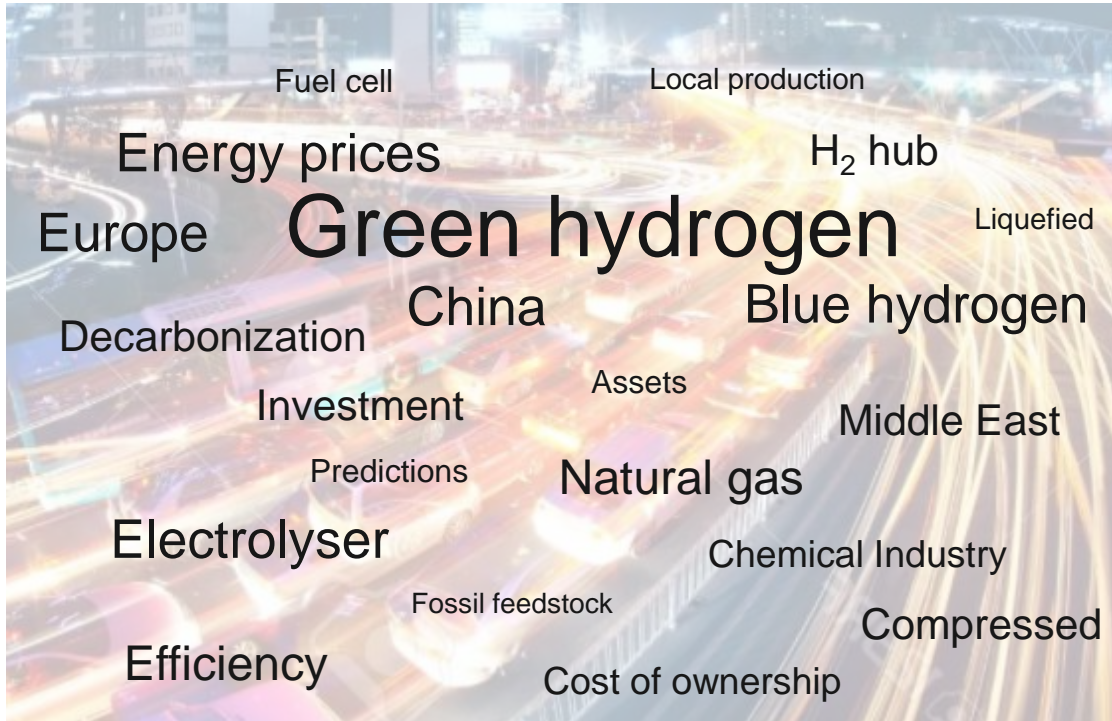


# Opportunities and Challenges for Green H<sub>2</sub>

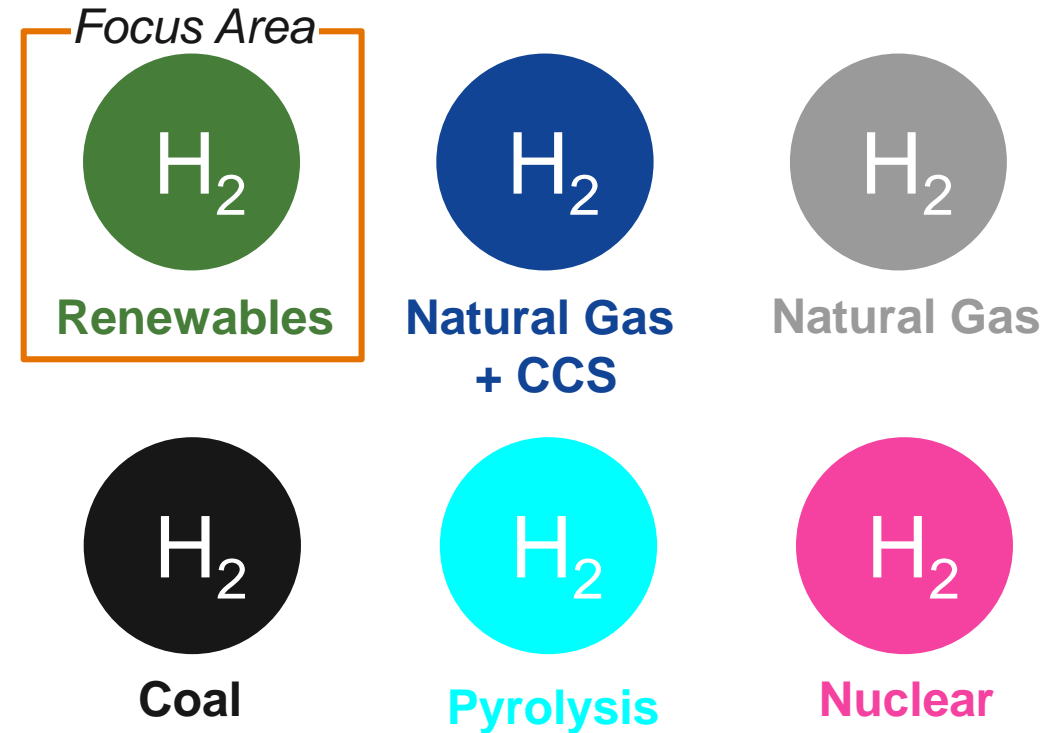
**Author: Michael Redhead**

# In future, a trend towards green H<sub>2</sub> can be derived for multiple use cases

## Trends

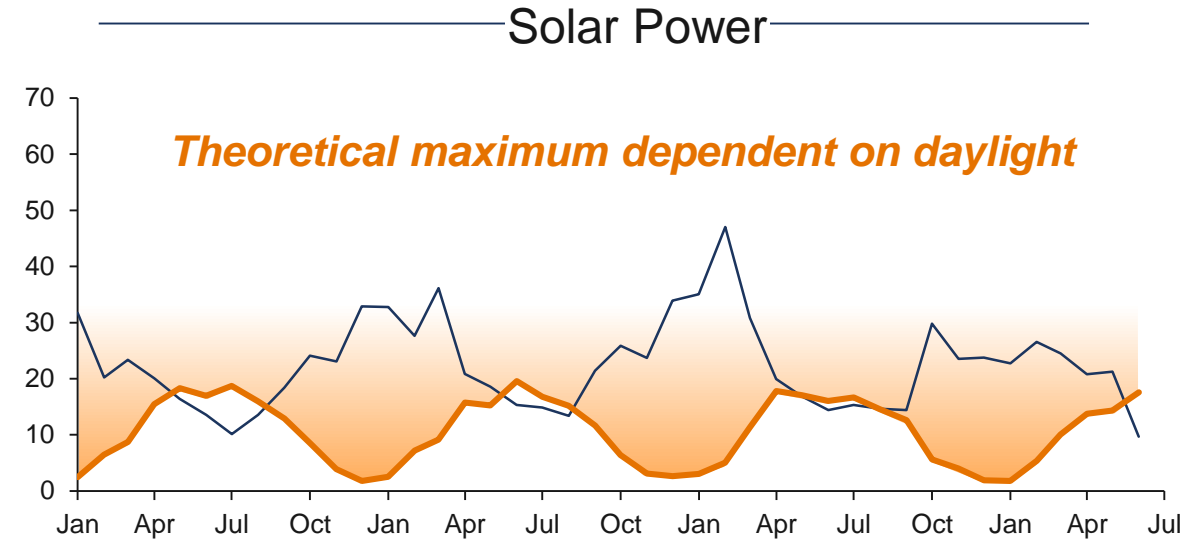
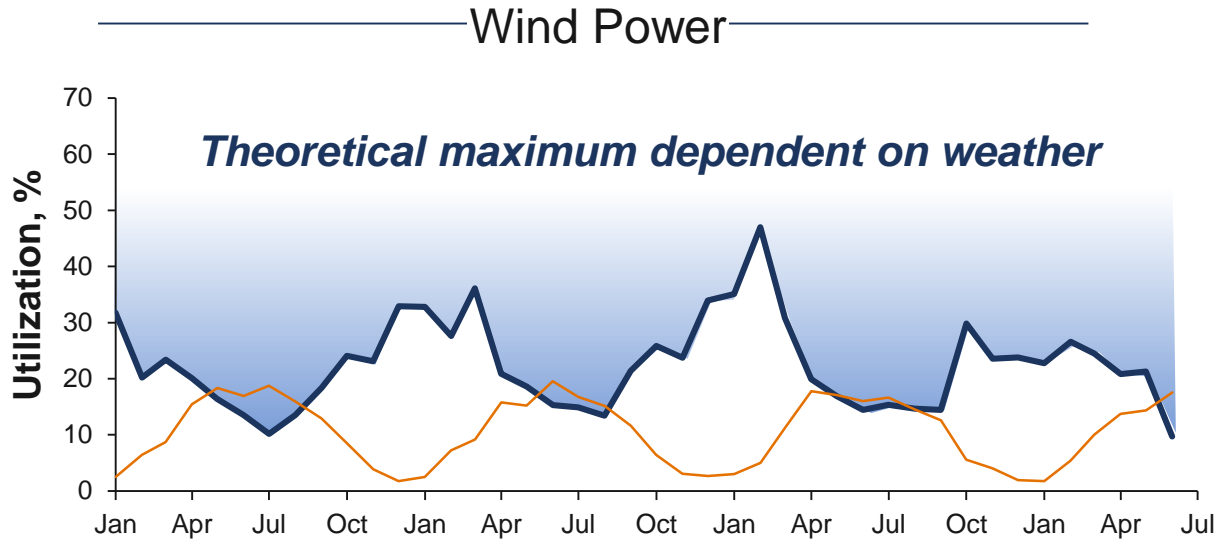


## Production Pathways



- Hydrogen can be obtained from a number of different sources, with varying emissions
- Development expected for **green H<sub>2</sub>** especially from **renewable sources**

# Installed renewable capacity could be fully utilized to increase green H<sub>2</sub> production



- **Already installed** infrastructure required for peak demand could be used to generate H<sub>2</sub> when idle
- Higher utilization rates result in production of an **additional energy carrier**

Potential use cases

**Industry**

- Steel Production

**Transport**

- FCEV vs BEV

**Energy Generation**

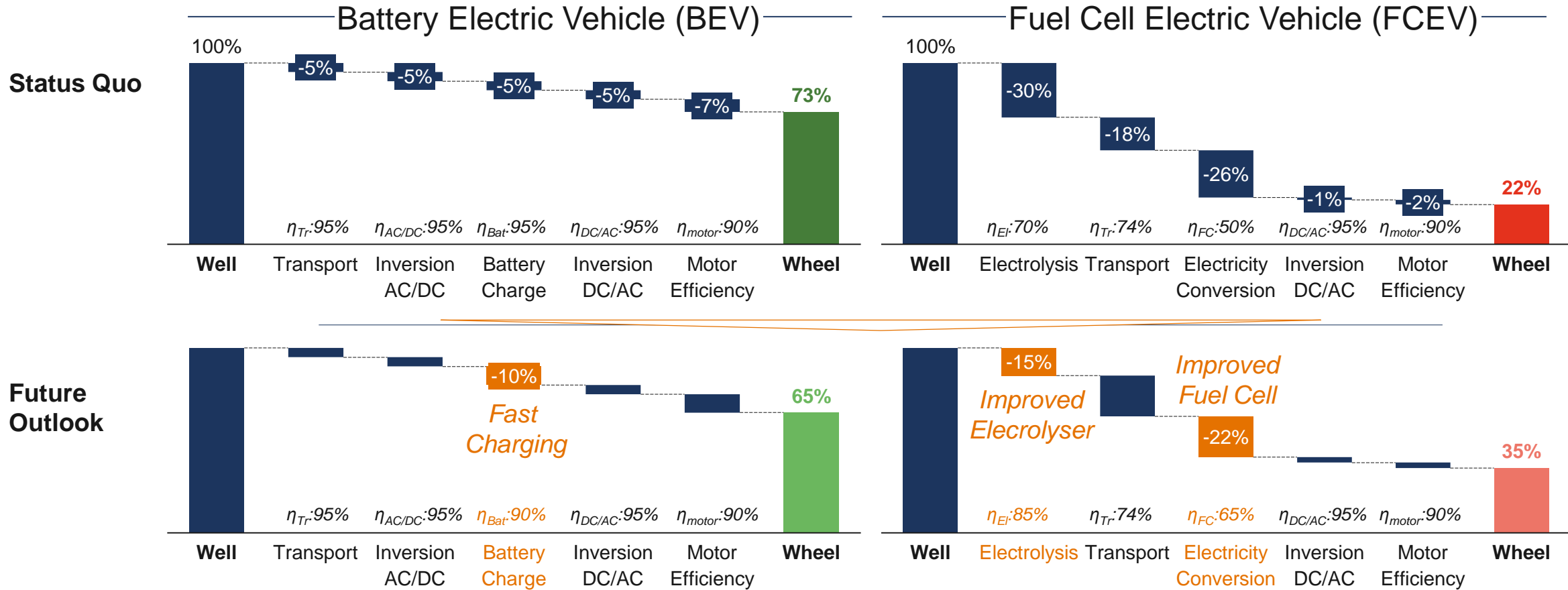
- Large fuel Cells

**Buildings**

- Comb. Heat/Power

Source: Destatis

# Currently, BEV is more efficient in the transport sector

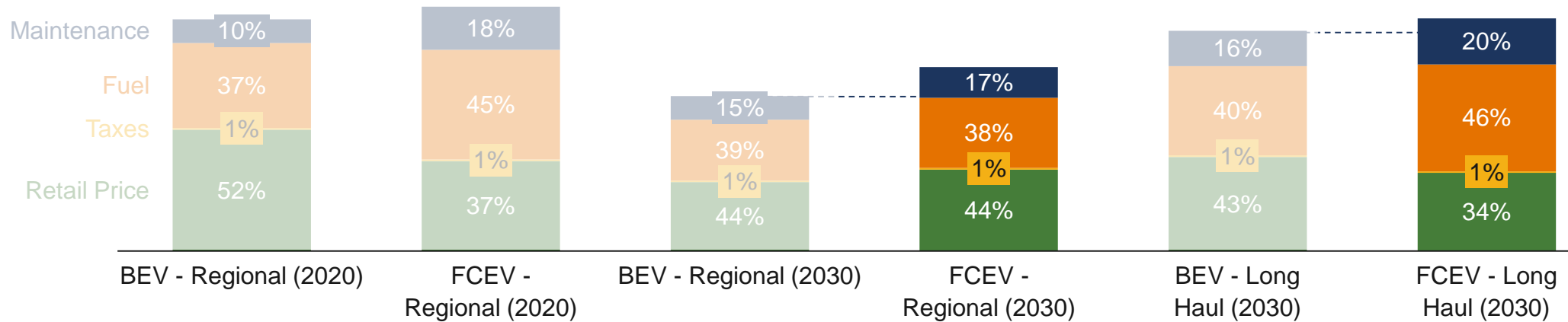


- In future, the best case scenario for FCEV is still less efficient than the worst case scenario for BEV
- Well to wheel efficiency for BEV is generally higher, however further criteria also have to be considered

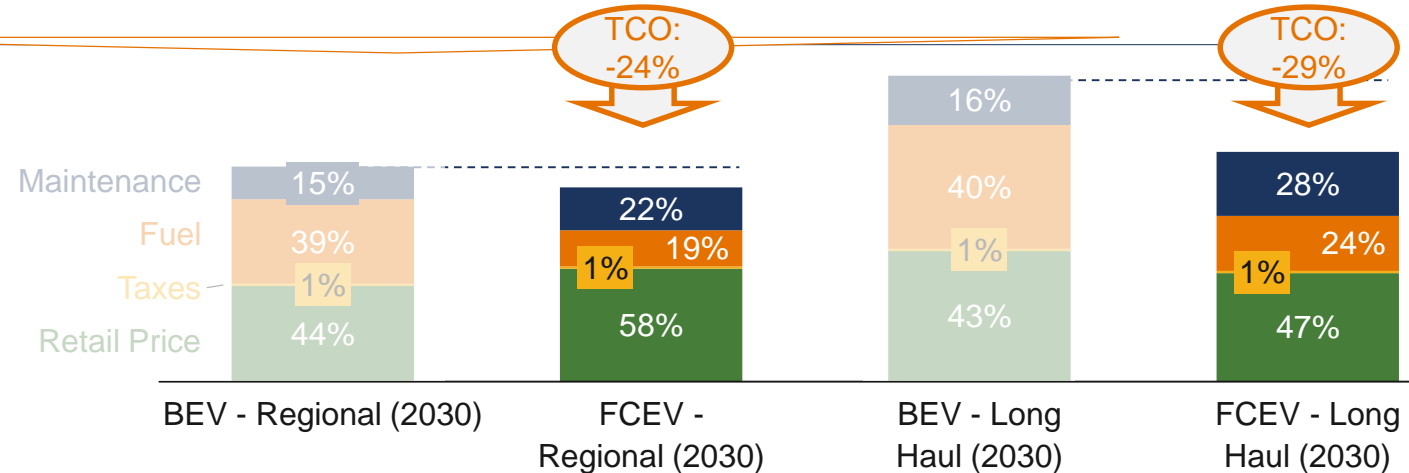
Source: Transport and Environment (Belgium)

# With increasing renewable capacities and utilization, the price of green H<sub>2</sub> continues to fall over time

**Status Quo**  
 » 5.40 €/kgH<sub>2</sub>  
 » 0.22 €/kWh electricity



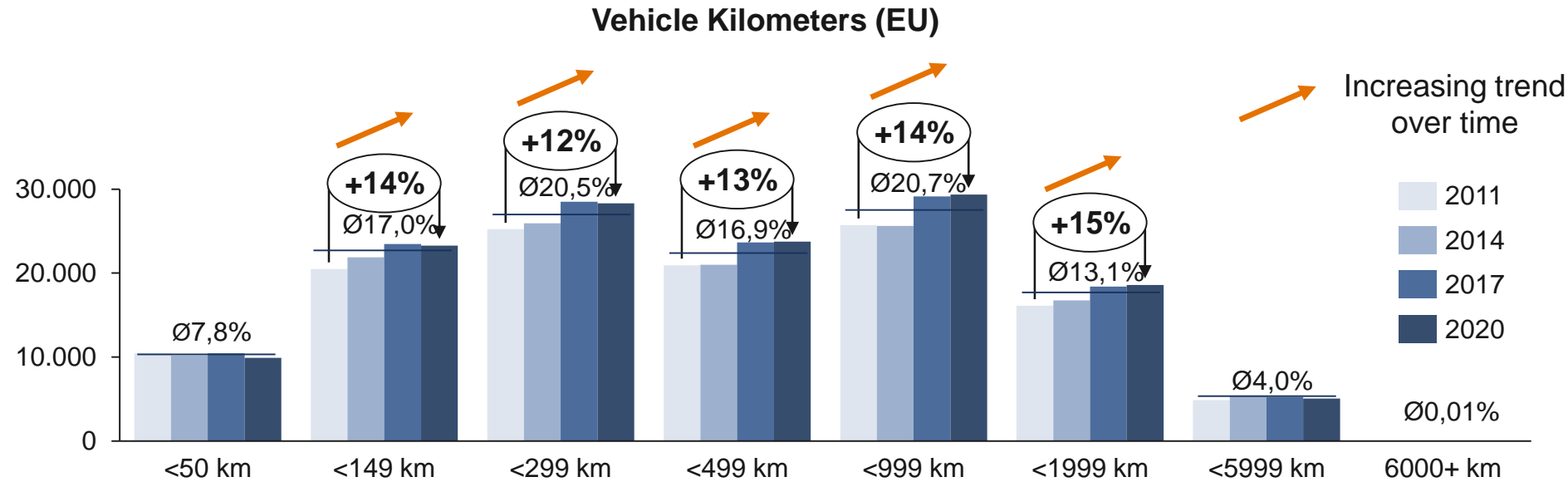
**Future Outlook (H<sub>2</sub>)**  
 » 2.00 €/kgH<sub>2</sub> (2030 EU Target)  
 » 0.22 €/kWh electricity



- Green H<sub>2</sub> from renewable sources: 2€/kgH<sub>2</sub> (2030 target) due to increased production and economies of scale
- Based on these assumption, an early competitive advantage for long haul vehicles can be deduced

Source: Transport and Environment (Belgium), with updated electricity/H<sub>2</sub> prices

# From a fleet perspective, the mix of alternative drivetrain technologies must follow a strategic approach



## Single Tank Trips: BEV

## Multi Tank Trips: FCEV

- Range: 150 – 300 km
- Frequent charging

- Range: 200 – 500 km
- Moderate charging

- Range: 300 – 800 km
- Infrequent charging

## Further Considerations

### Pattern of use:

- Vehicle “downtime”
- Charging Speed

### Temperature Sensitivity:

- Cold start for FCEV
- Restricted electron flow of BEV

- Balance of Plant
- Recycling
- Life Cycle Analysis

- Due to a **rising demand** in transportation worldwide, **growth** is expected in both **long** and **short haul trips**
- **BEV** and **FCEV** can cover **distinct use cases** and have to be **considered** in the **fleet composition**

## Summary

- Existing grid infrastructure could be used to create additional green hydrogen
- Hydrogen is not energetically efficient, but has other strong characteristics (e.g. high range, better recycling)
- Total cost of ownership of FCEV and BEV is falling over time
- 2€/kgH<sub>2</sub> can make Hydrogen competitive (2030 EU target)

## Potential Questions for Businesses

- Which technology mix is best for my fleet or application?
  - **Strategic Portfolio Assessment**
  - **CO<sub>2</sub> Compliance Strategies and Footprint**
- How do the components within my system need to be dimensioned?
  - **Technology Assessment and Evaluation**
- Which products or business areas are likely to be most affected by these technologies?
  - **Market Assessment and Strategy**
- Which end of life considerations need to be taken into account?
  - **Life Cycle Analysis (LCA)**

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