Hydrogen
scaling up

A sustainable pathway for the global energy transition

HYDROGEN COUNCIL | COP 23 | 13 NOVEMBER 2017

This study is the first comprehensive, ambitious Hydrogen roadmap

Objectives of the study

- First **comprehensive quantified vision** and **roadmap** for deployment
- Not a forecast, but an **ambitious yet realistic** scenario
- Answers the question “How could hydrogen contribute to **achieving the two degree scenario**?”

SOURCE: Hydrogen Council

We estimated the potential of hydrogen in a two degree scenario

Step 1

Bottom-up model of energy system

Segmented the energy system into sectors

Defined sub-segments by sector, such as fleet turnover and efficiency development

Step 2

Definition of the 2050 vision of hydrogen potential

Estimated **adoption potential and sales share** per subsegment by each company

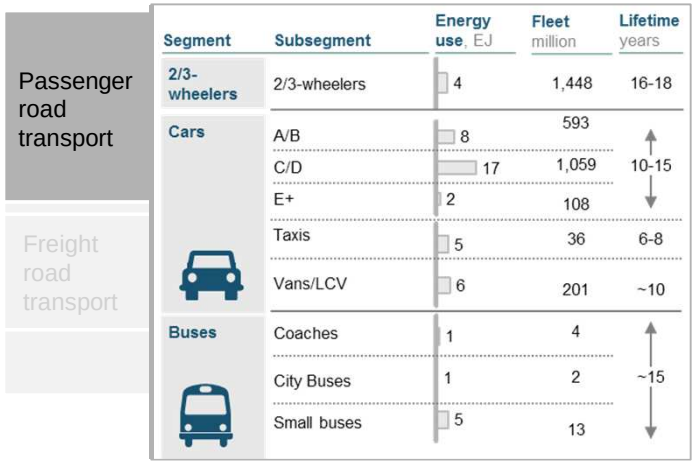
Consolidated a **joint view,** modeled fleet, consumption and hydrogen demand, and pressure-tested results

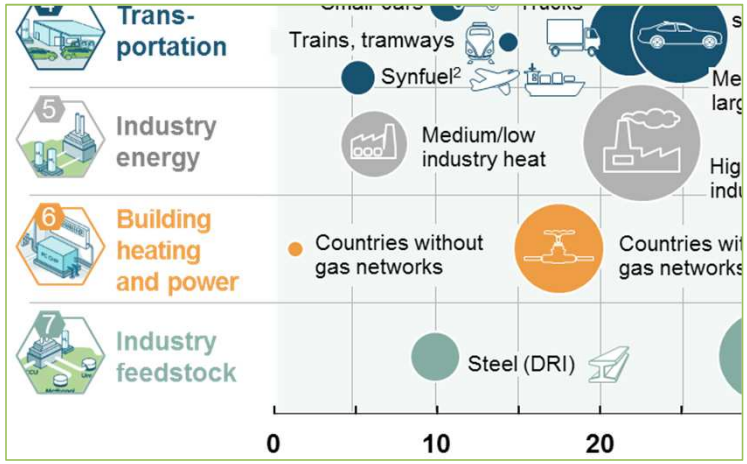
Step 3

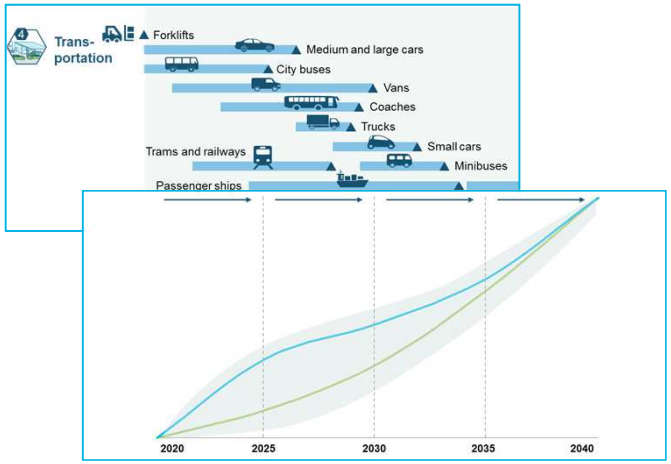
Development of the roadmap and 2030 view

Calculated **potential scale-up paths** based on technology readiness

Derived **implied investments** in scale-up and quantified **benefits** – in growth, jobs and emissions







SOURCE: Hydrogen Council

Hydrogen: a central pillar of the required energy transition

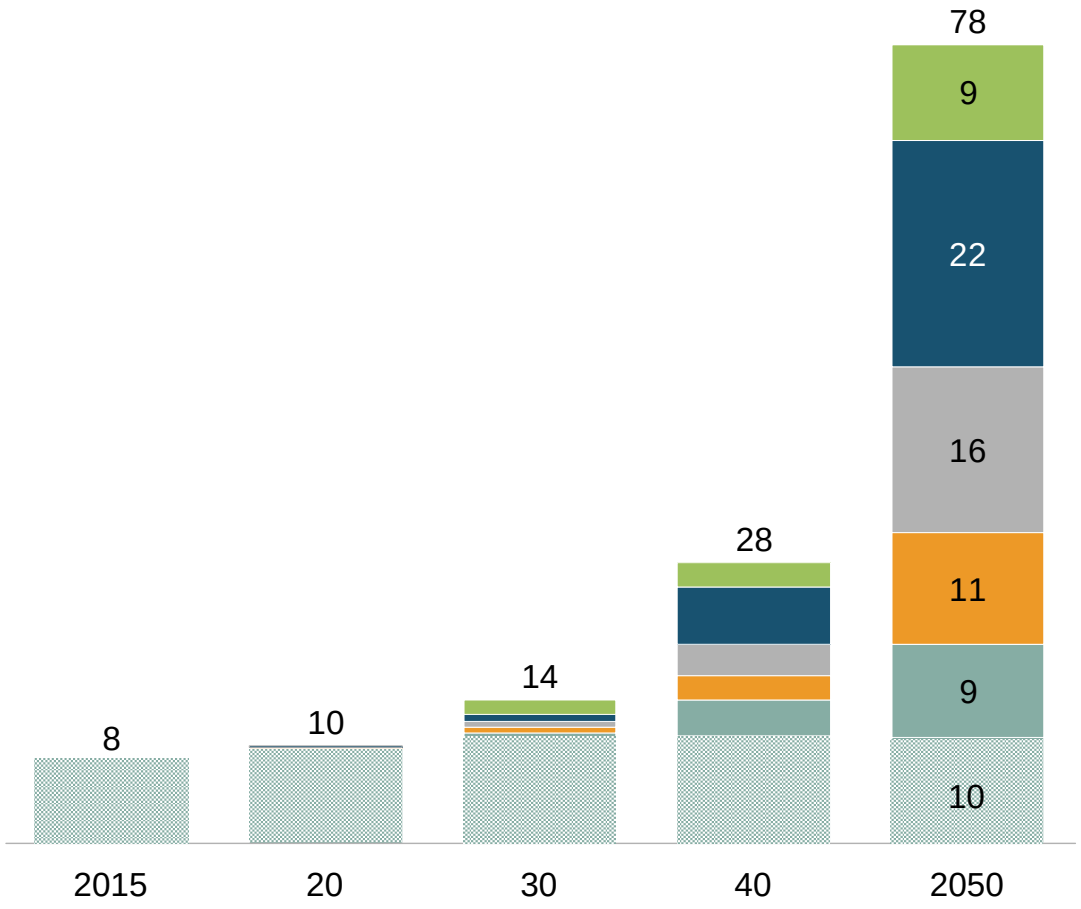
Estimated impact in 2050

1 Value add of fuel cells

SOURCE: Hydrogen Council, IEA ETP Hydrogen and Fuel Cells CBS, National Energy Outlook 2016

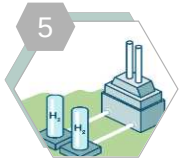
In a 2-degree-world, hydrogen could contribute ~18% of demand

Potential global energy demand supplied with hydrogen, Exajoule (EJ)

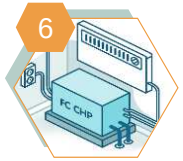


Power generation, buffering

Transportation



Industrial energy



Building heat and power

New feedstock (CCU, DRI)

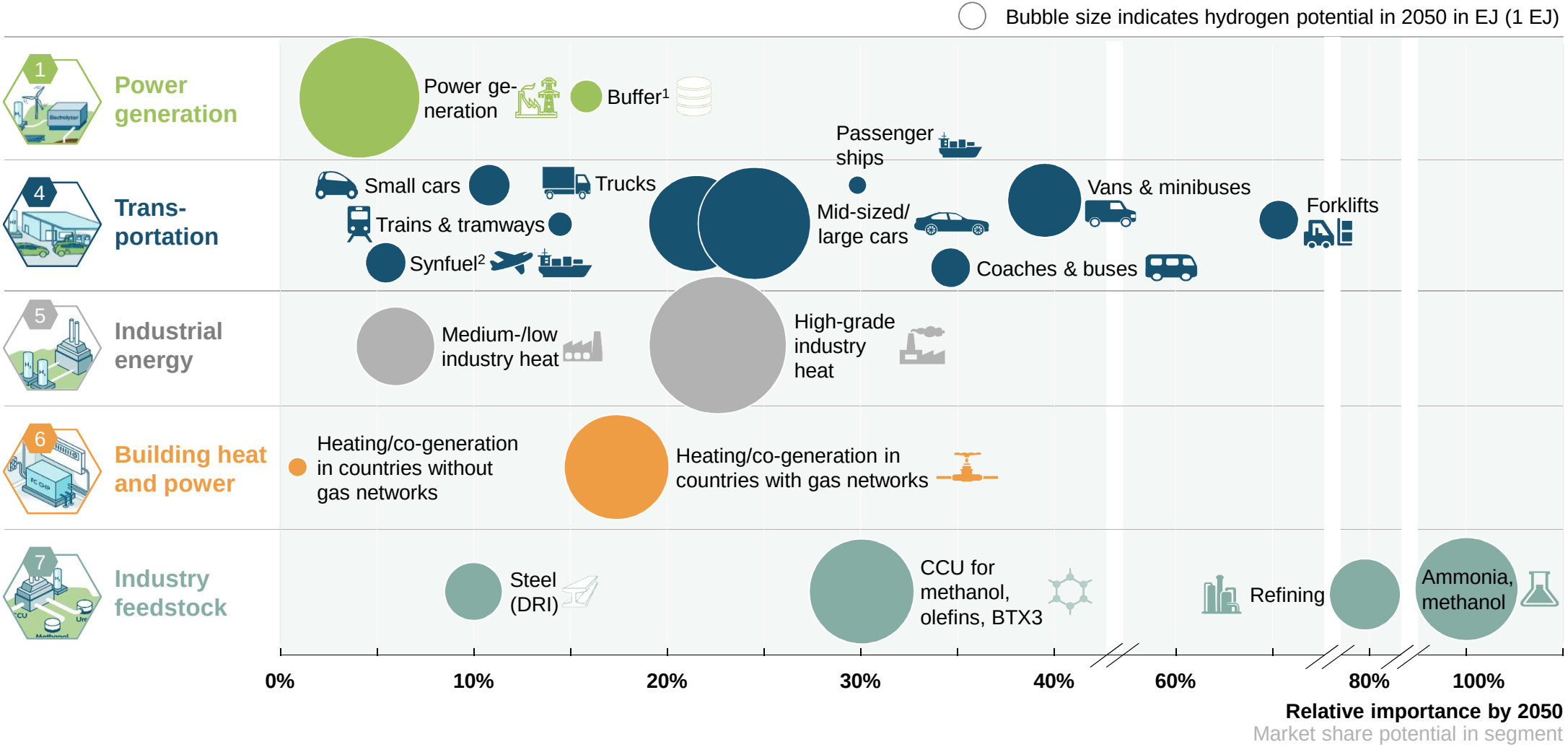
Existing feedstock uses

18%

of final energy demand

SOURCE: Hydrogen Council

Hydrogen has significant potential across all applications



1 Percent of total annual growth in hydrogen and variable renewable power demand

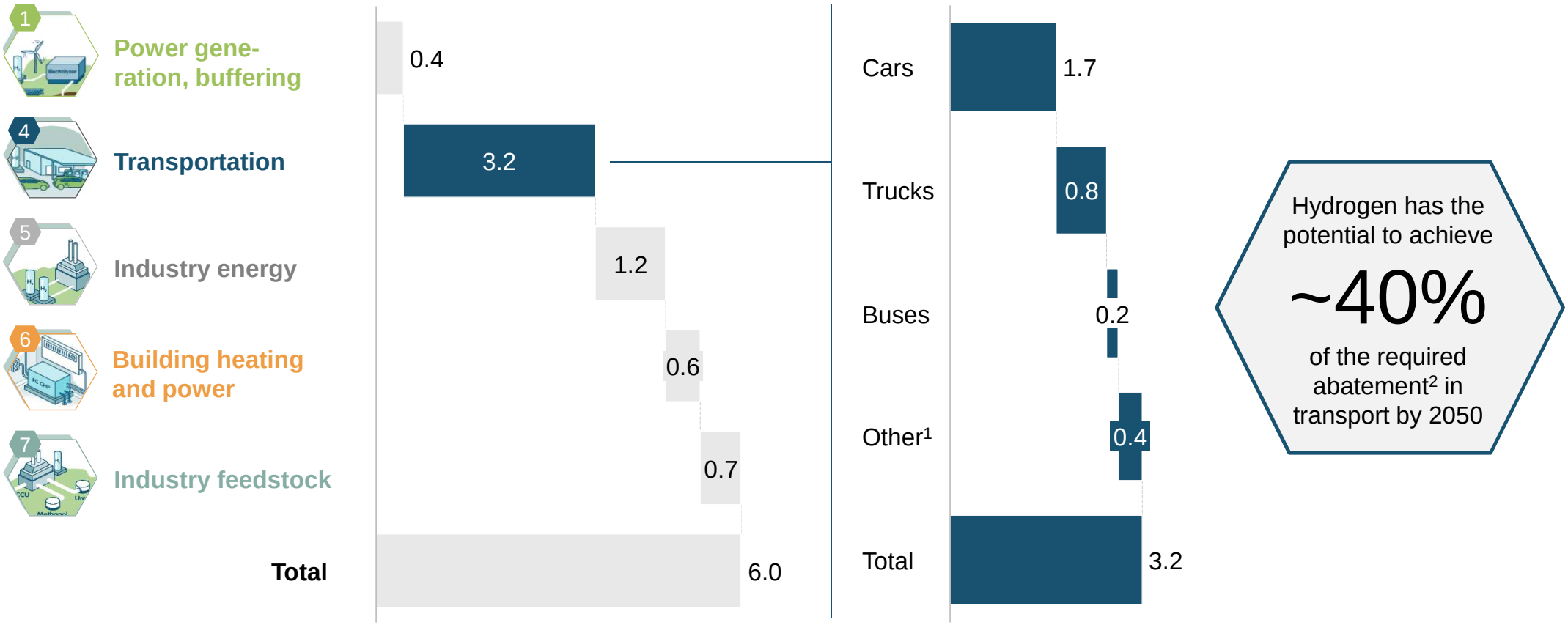
2 For aviation and freight ships

3 Percent of total methanol, olefin, BTX production using olefins and captured carbon

SOURCE: Hydrogen Council

Half of the total CO2 abatement potential will come from transport

CO2 avoidance potential 2050, Gigatons

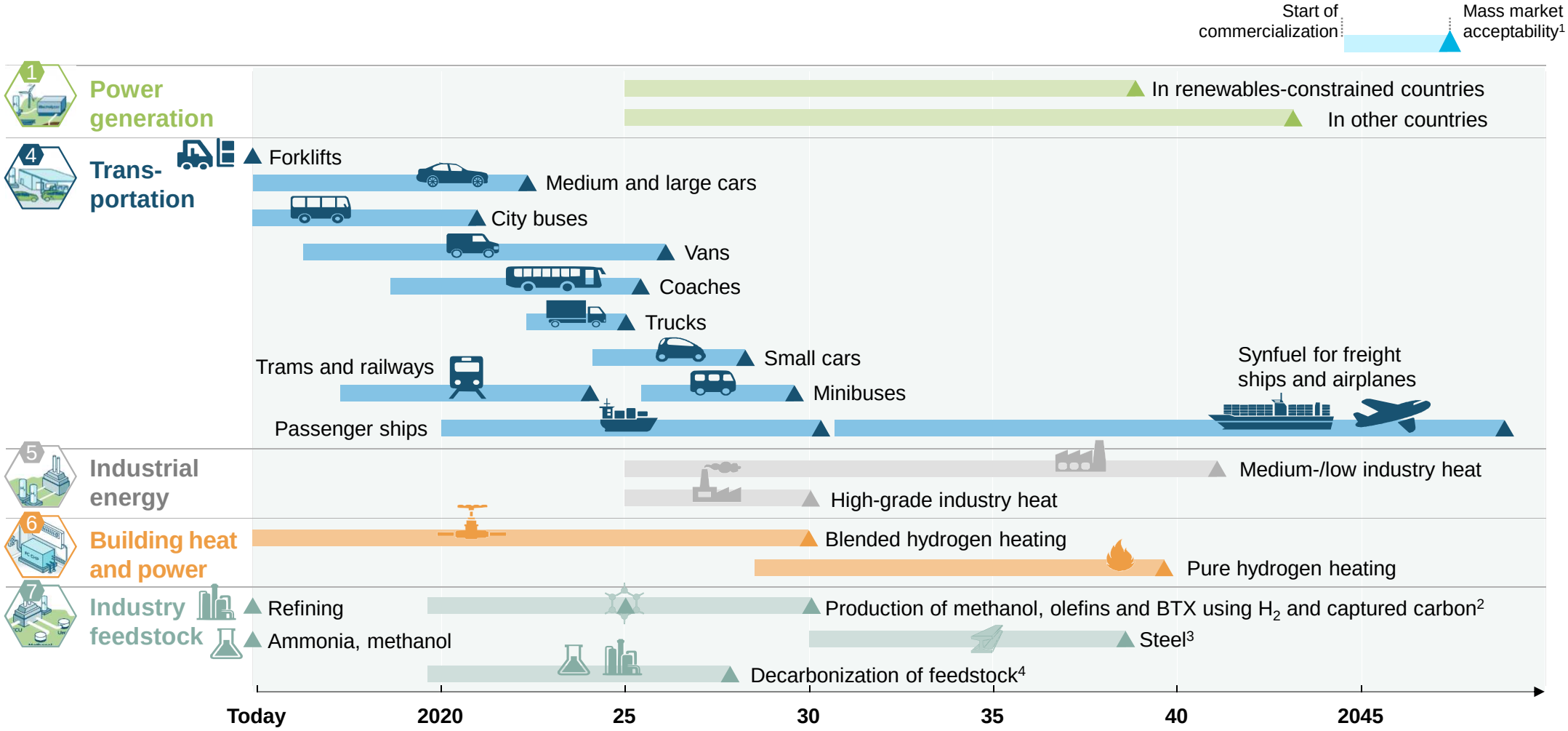


1 Aviation, shipping, rail, material handling

2 Difference between IEA Reference Technology and 2 degree scenario

SOURCE: IEA, Hydrogen Council

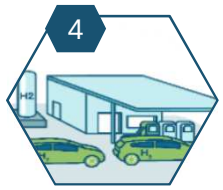
The technologies exist and are ready to be deployed



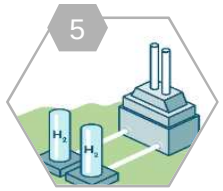
1 Mass market acceptability defined as sales >1% within segment in priority markets
2 Market share refers to the amount of production that uses hydrogen and captured carbon to replace feedstock
3 DRI with green H_2, iron reduction in blast furnaces and other low-carbon steel making processes using H2
4 Market share refers to the amount of feedstock that is produced from low-carbon sources

SOURCE: Hydrogen Council

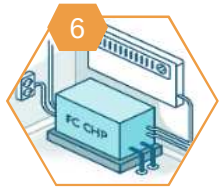
Important milestones already for 2030 to reach the 2050 vision



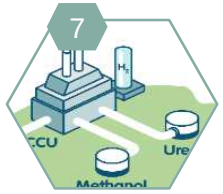
- **1 in 12 passenger cars sold** in early-adoption markets (Germany, California, Japan and South Korea) FCEVs



- **3.5 Mt** hydrogen used for **high-grade heat** in first large-scale projects



- **50 million households** connected to a network safely blending hydrogen and natural gas

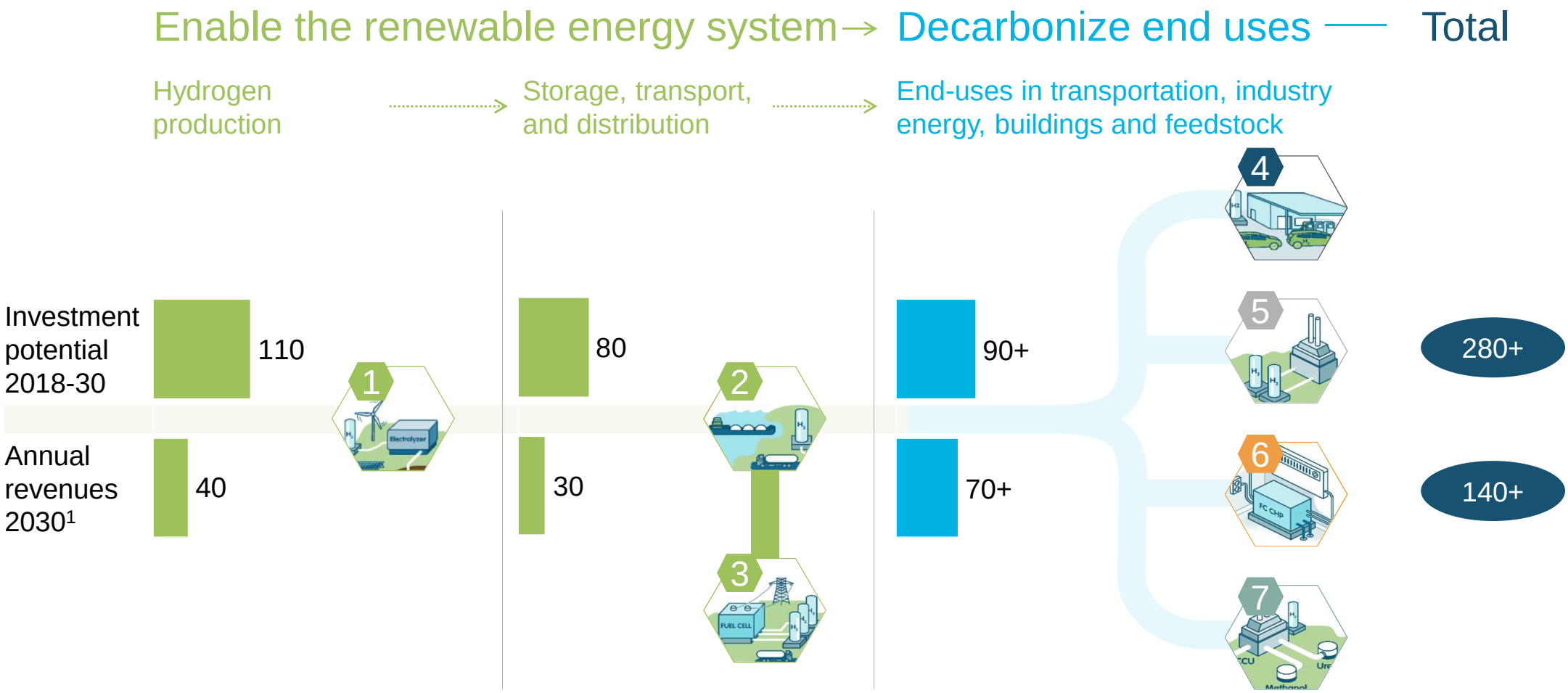


- **20 Mt CO_2** converted to chemicals and intermediates such as **methanol** using hydrogen

SOURCE: Hydrogen Council

Investments of $280bn until 2030 build $140bn+ annual market

$ billion[1]



1 Excluding existing feedstock uses, Considering only hydrogen value-added

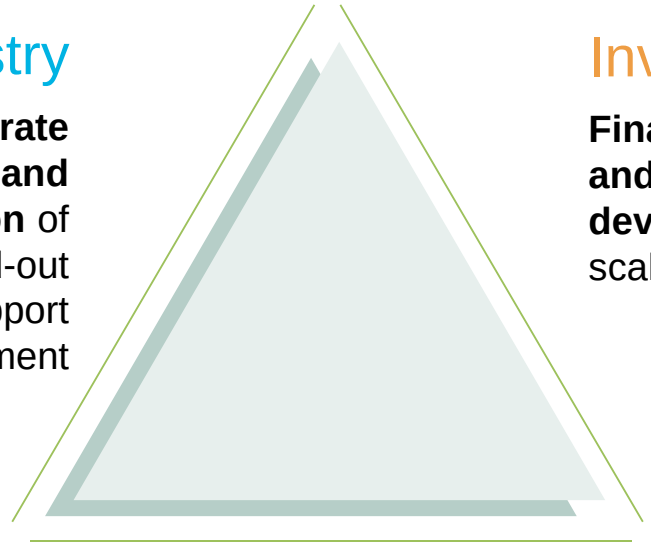
SOURCE: Hydrogen Council

The case for acting now: Large-scale deployment initiatives underpinned by long-term policy frameworks to attract investors

Urgency to initiate scale-up to meet **climate change targets**

Hydrogen technology proven in a wide range of applications

Momentum in the industry – Hydrogen Council is established



Industry

Accelerate development and commercialization of products and build-out infrastructure to support large-scale deployment

Investors

Finance infrastructure and value chain development for large-scale deployment

Policymakers

Collaborate with industry to build national strategies and roadmaps and put in place long-term policy frameworks

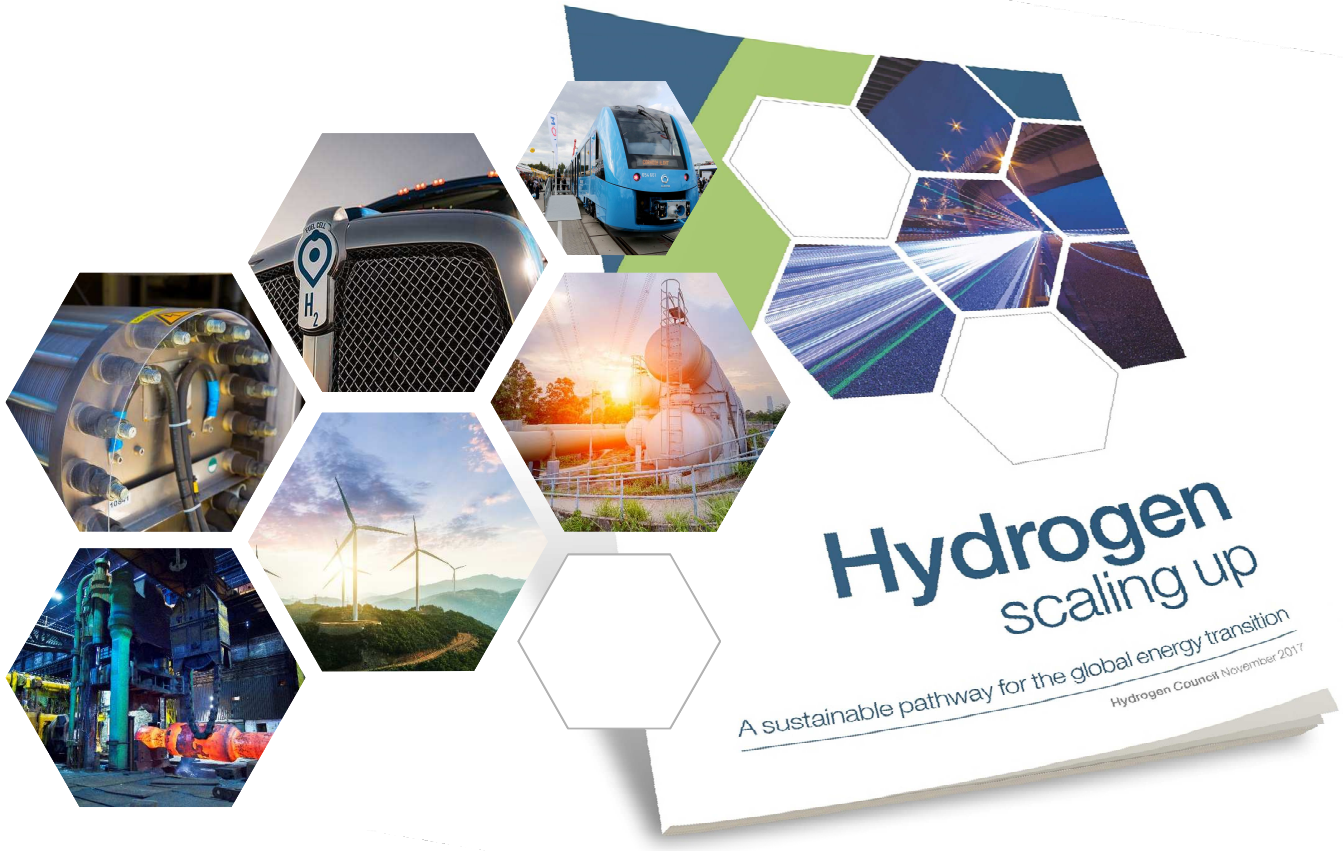
Hydrogen Council members have started investing and deploying

Enable the renewable energy system ⟶ Decarbonize end uses

Hydrogen Council Steering members

Supporting members

Thank you for your attention



http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf

SOURCE: Hydrogen Council