

Towards Sustainability

Hydrogen

The current status and future outlook of fuel cell vehicles in Toyota



08/11/2018



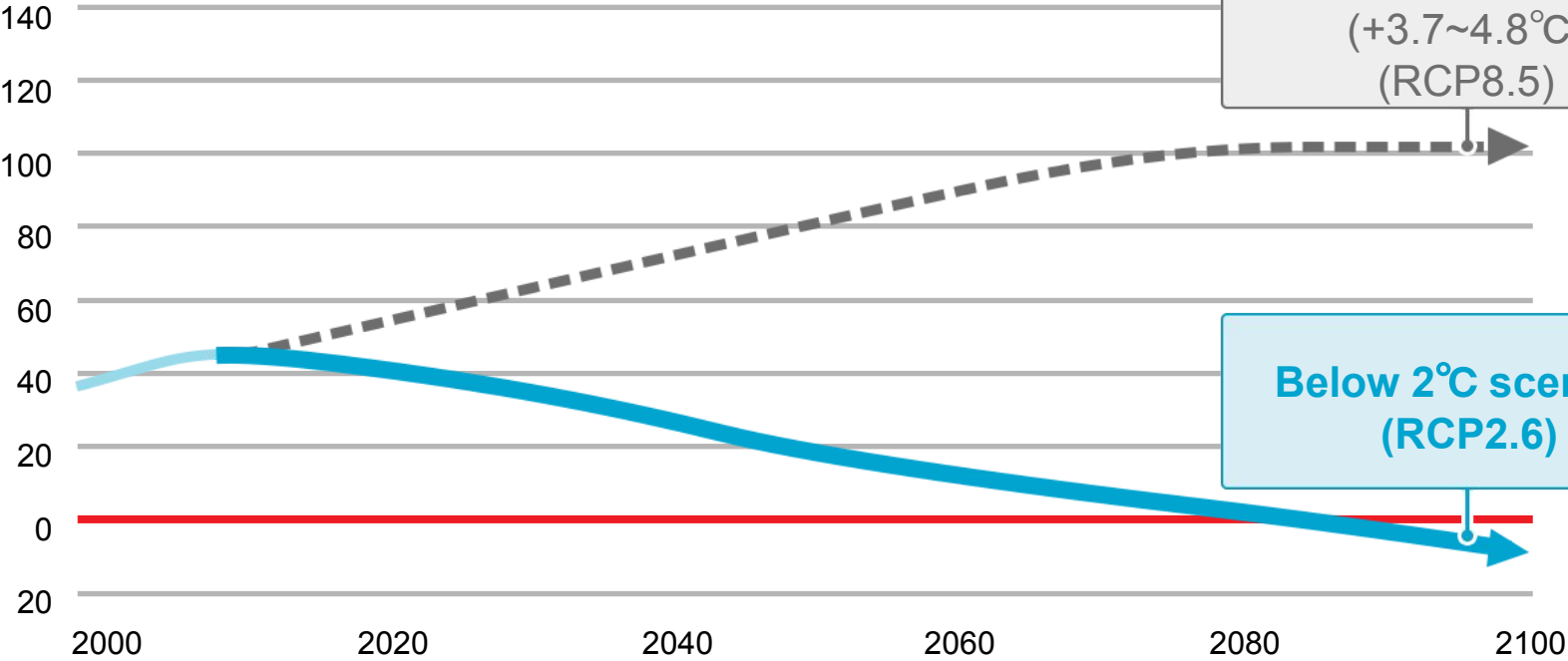
TOYOTA

World Leaders Agreement – COP21 Paris



Forecast International Climate Change

Annual greenhouse gas emissions
(1,000 Tg CO₂ Eq./year)



Baseline scenario
(+3.7~4.8°C)
(RCP8.5)

Below 2°C scenario
(RCP2.6)

Full-scale initiatives to reduce CO₂ emissions

Zero or less

Source: From the IPCC Working Group III 5th Assessment Report (2014)

Regarding GHG emissions, there is no time to lose

Toyota 2050 Challenge

TOYOTA ENVIRONMENTAL CHALLENGE 2050

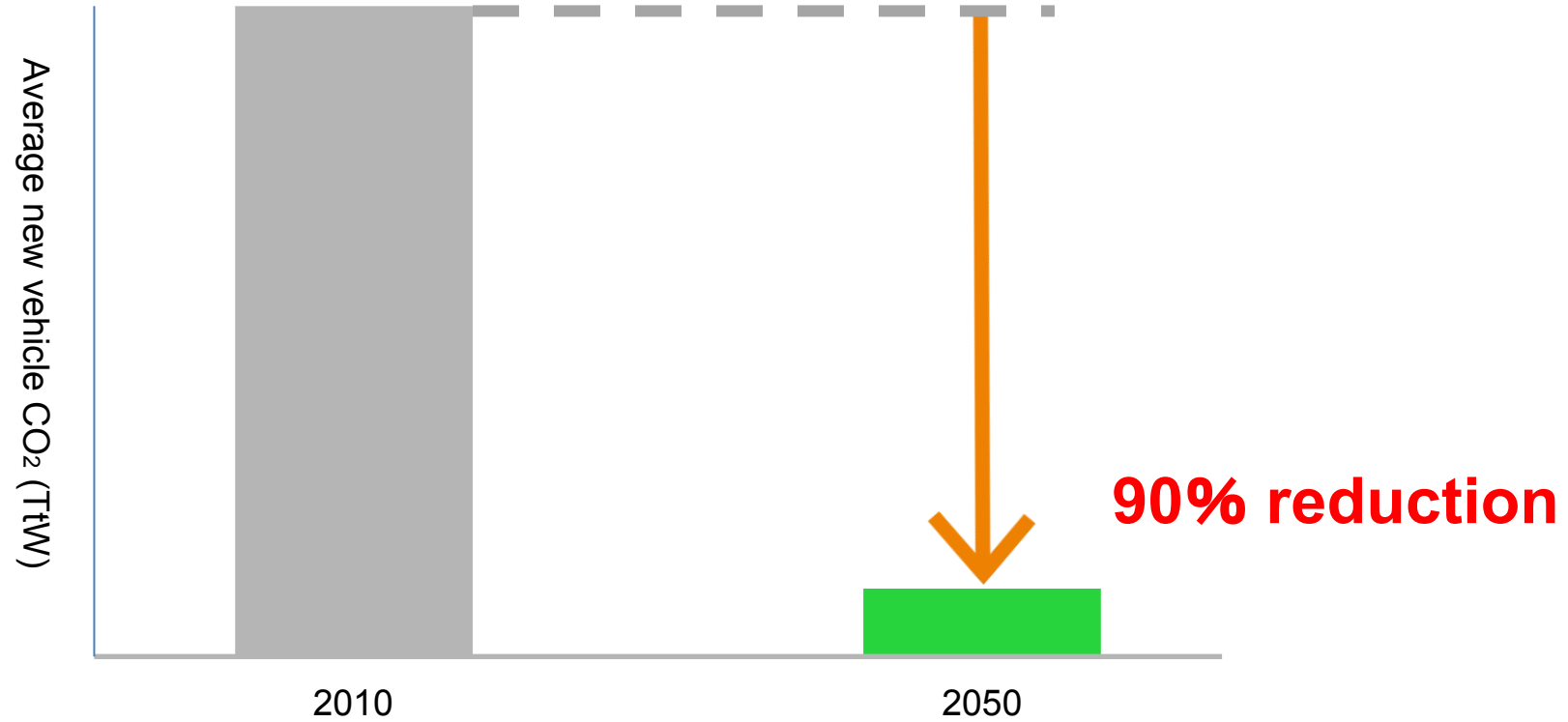


To go beyond zero environmental impact and achieve a net positive impact, Toyota has set itself six challenges. All these challenges, whether in climate change or resource and water recycling, are beset with difficulties, however we are committed to continuing toward the year 2050 with steady initiatives in order to realize sustainable development together with society.

Toyota 2050 Challenge



Challenge 1: New Vehicle Zero CO₂ Emissions Challenge



90% reduction of new vehicle CO₂ emissions by 2050 compared to 2010



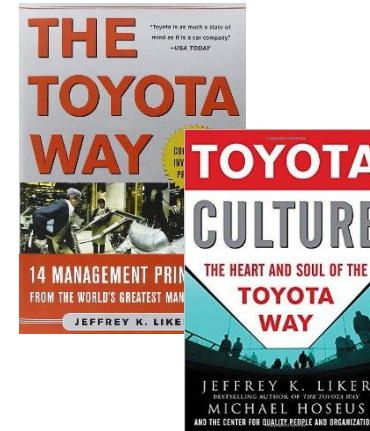
Mirai is not a car, it's a symbol



Mirai is not a car, it's a symbol

The Toyota Way

“Contribution to society through Monozokuri.”



Toyota Earth Charter (1992)

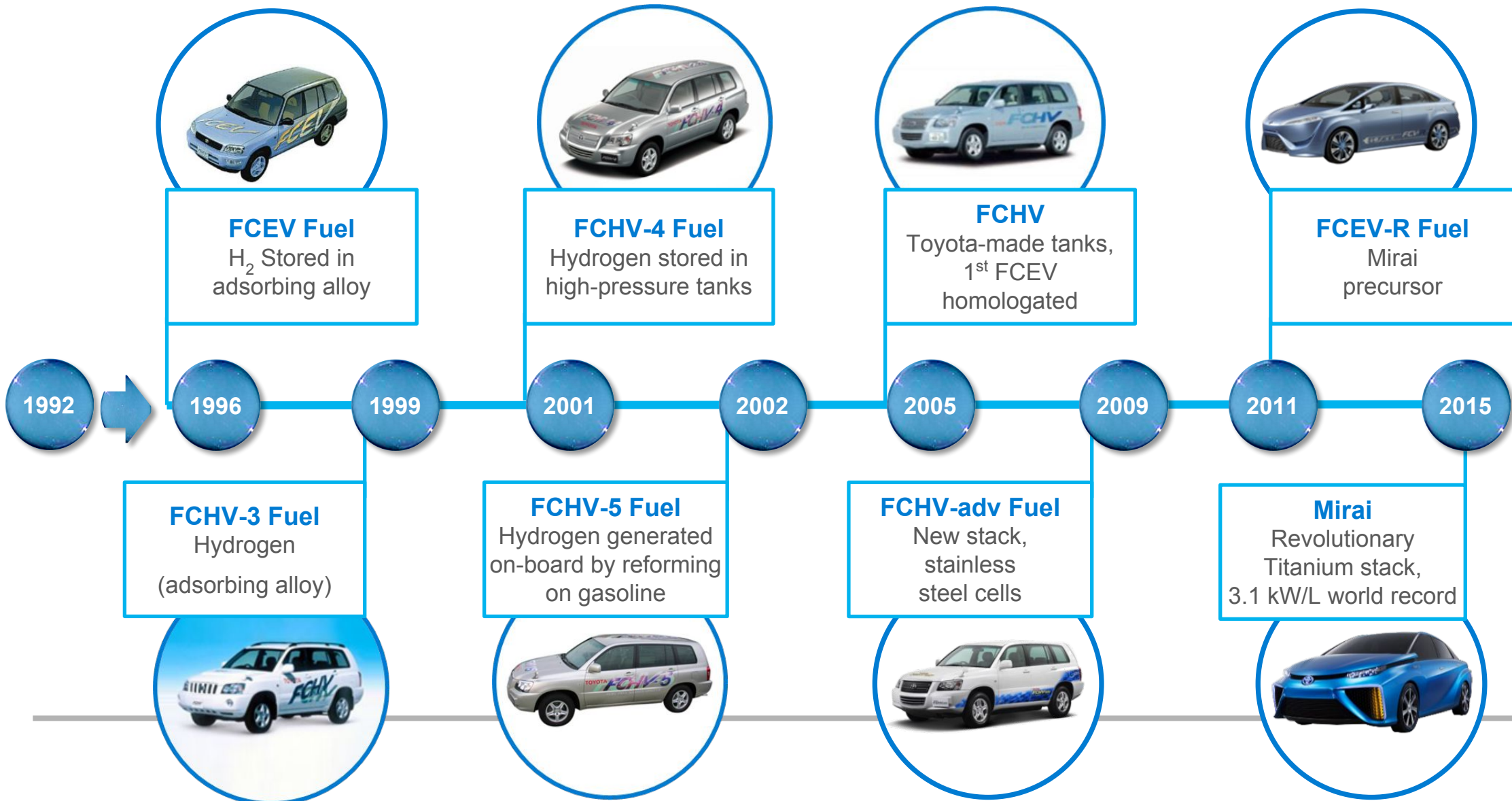


Prius at Tokyo Auto Show (1995)



FCEV-1 (1996)

Developing Hydrogen FCEV for 20 years



Mirai

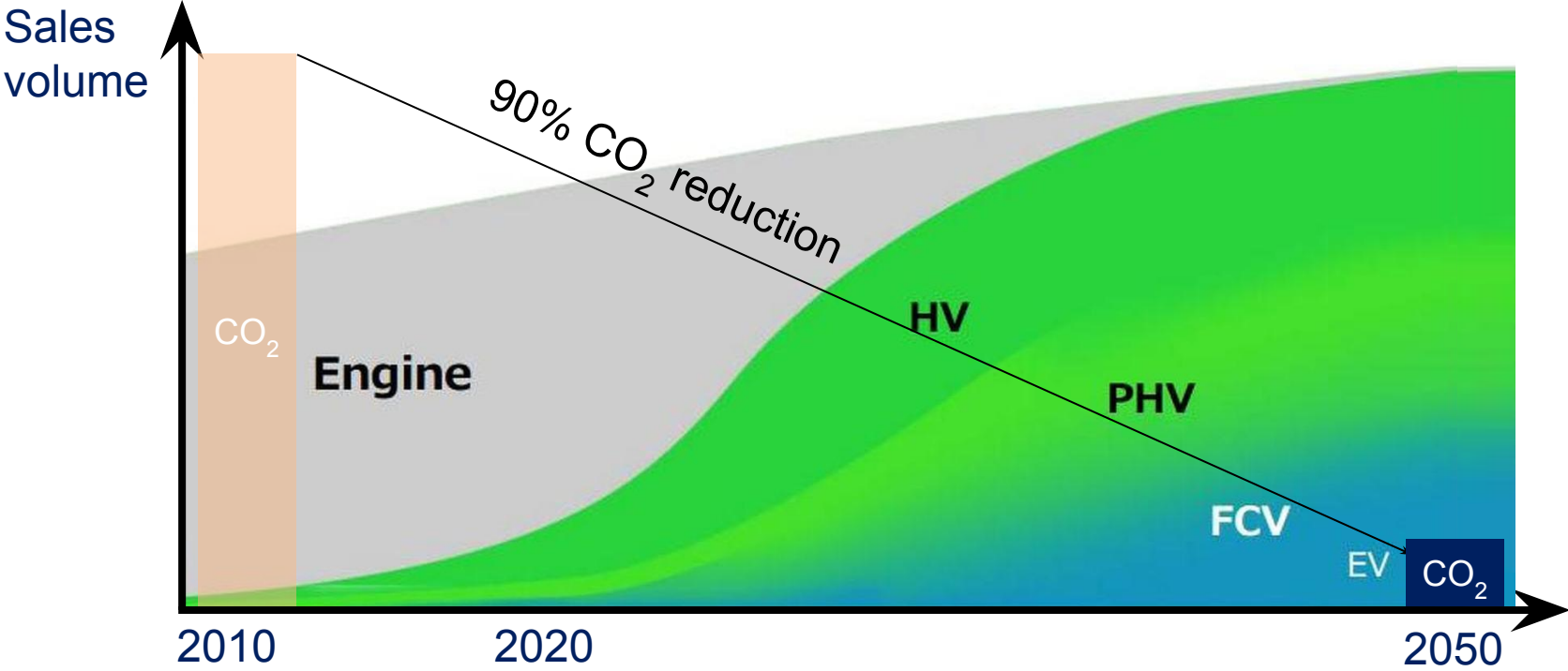
Mirai

= “Future” in Japanese

未来

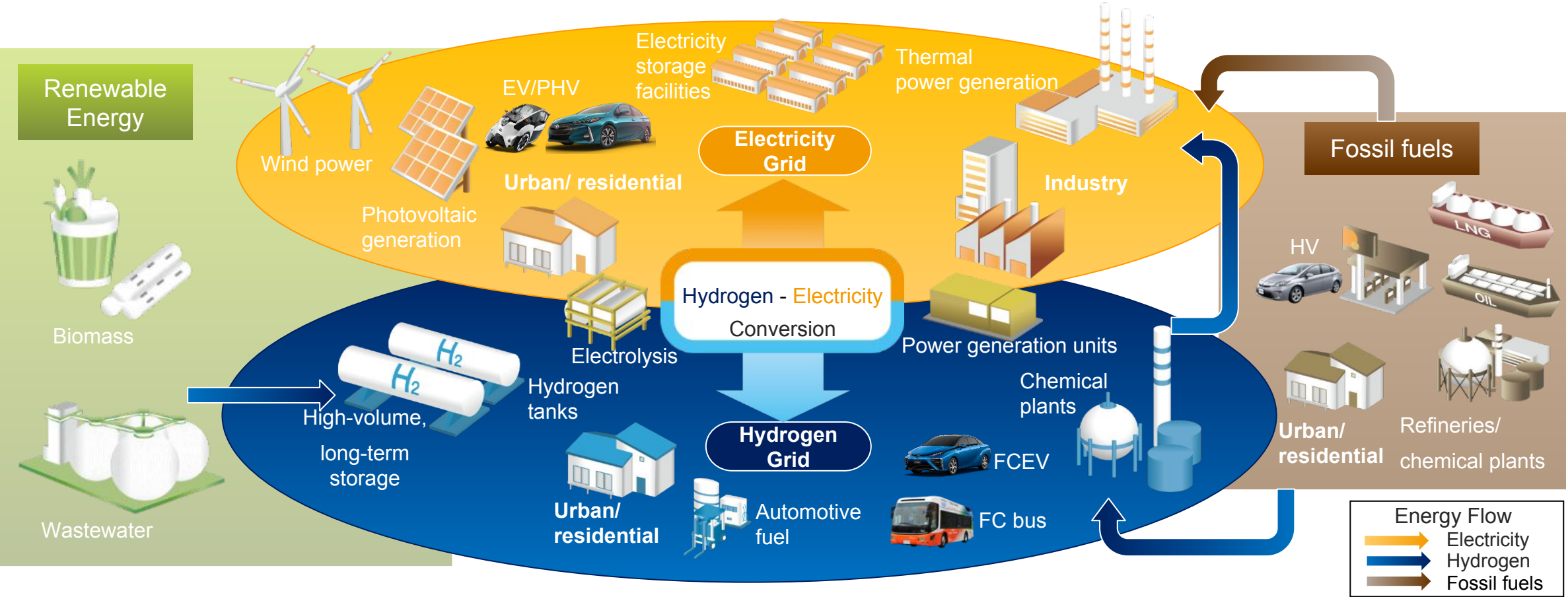


Mix of powertrains required to achieve 90% CO₂ reduction.



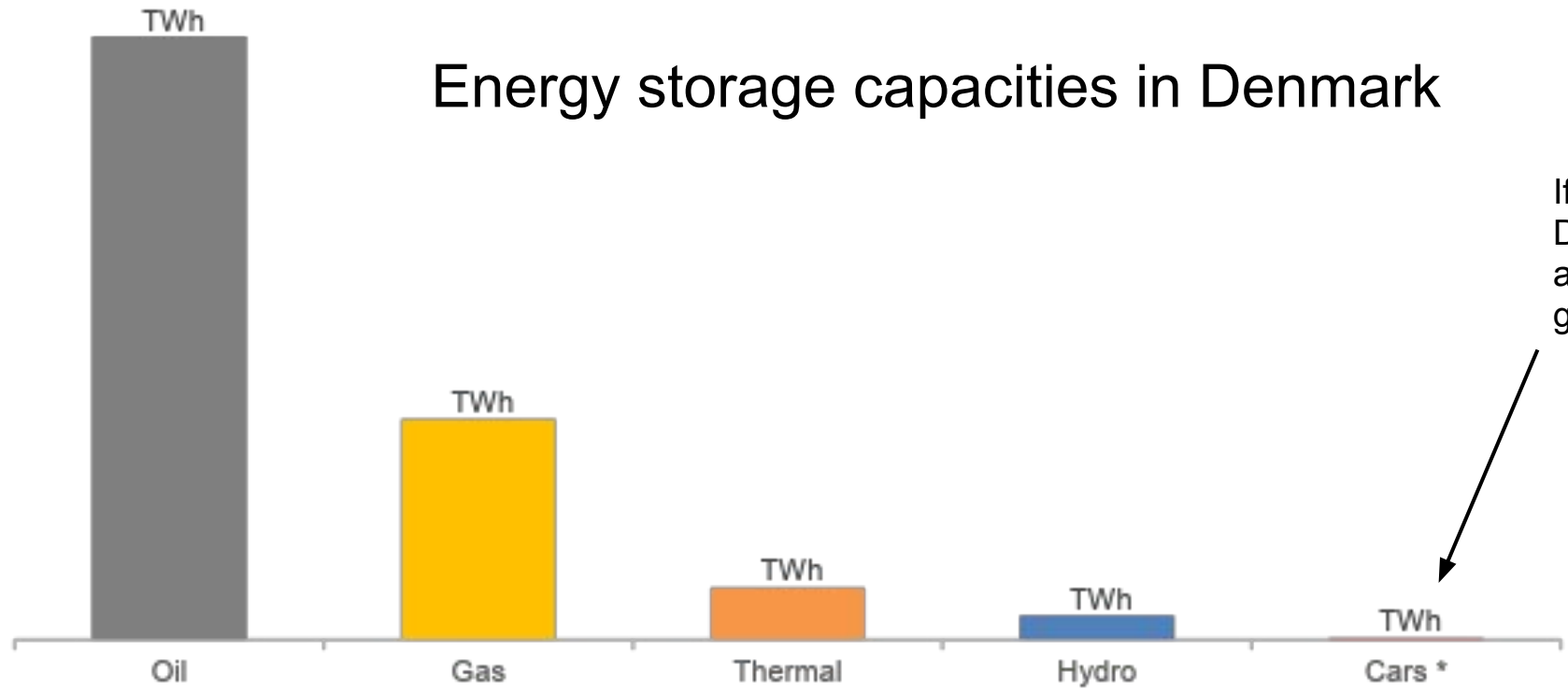
Electrification will increase dramatically after 2020

Future Vision: HyGrid (Hybrid Hydrogen – Electricity Grid)

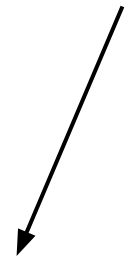


Source: HyGrid Study Group HP

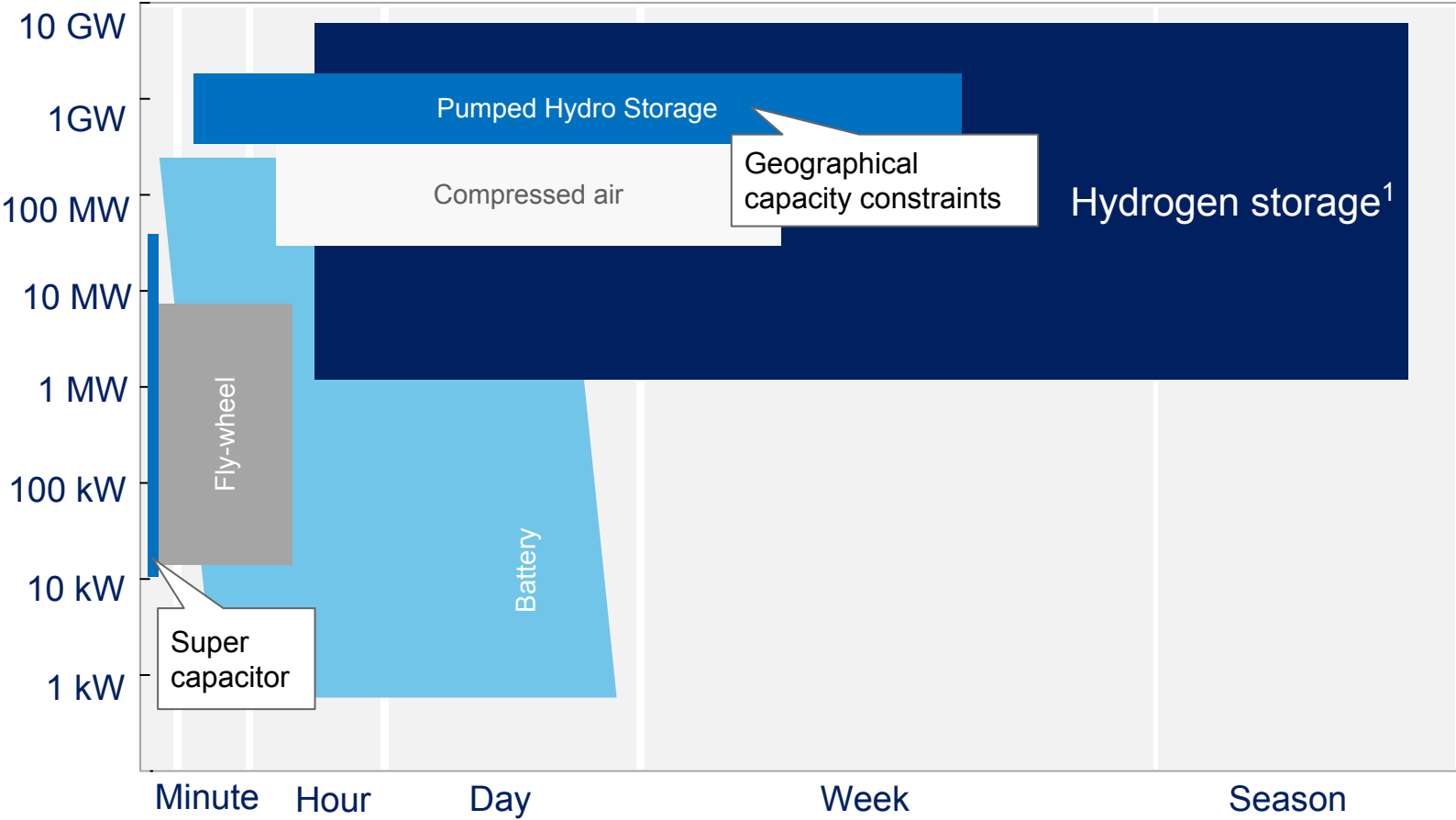
Using Hydrogen as a Storage for Renewables



If all current vehicles in Denmark would be BEV and connected to smart grid at the same time.



Using Hydrogen as a Storage for Renewables



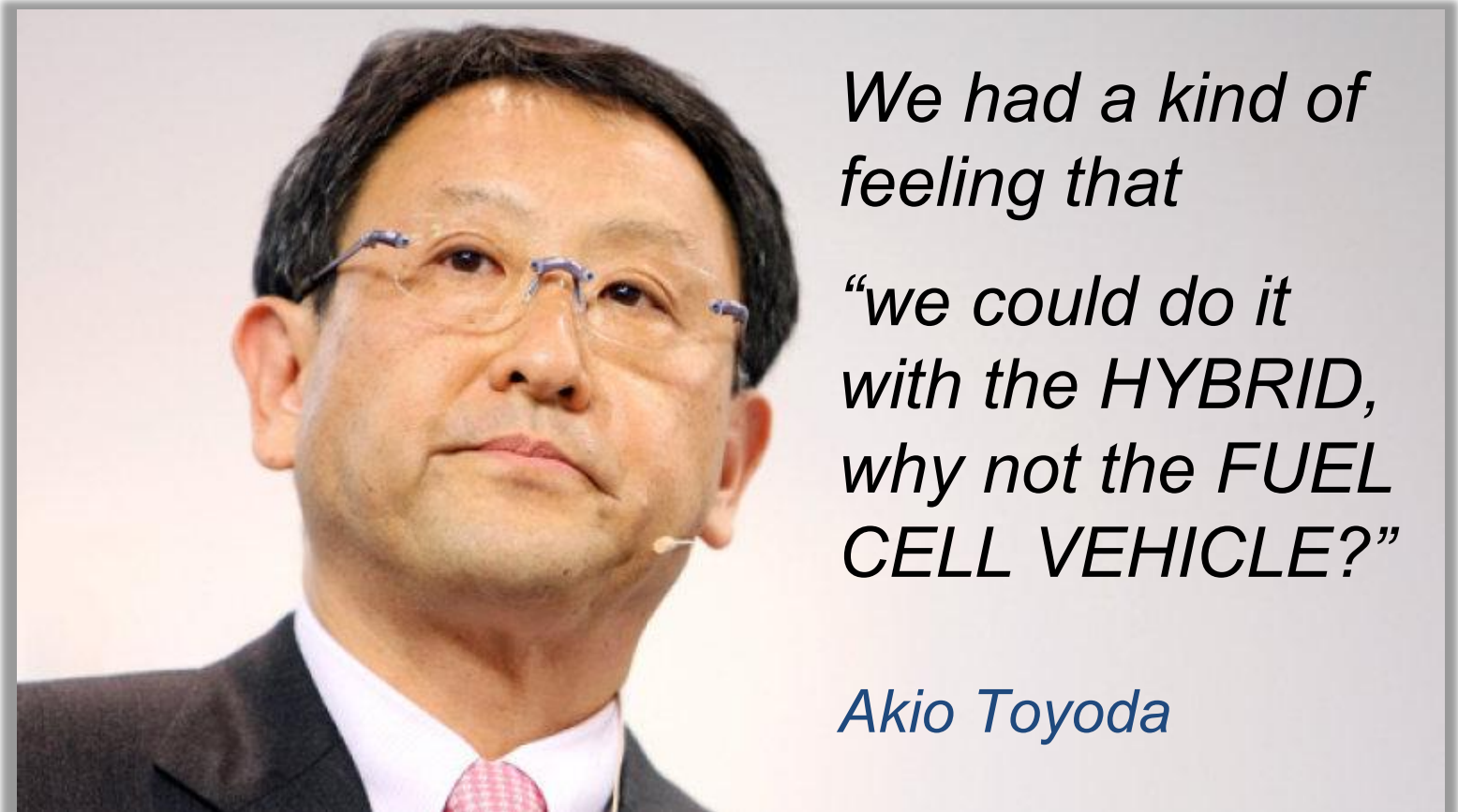
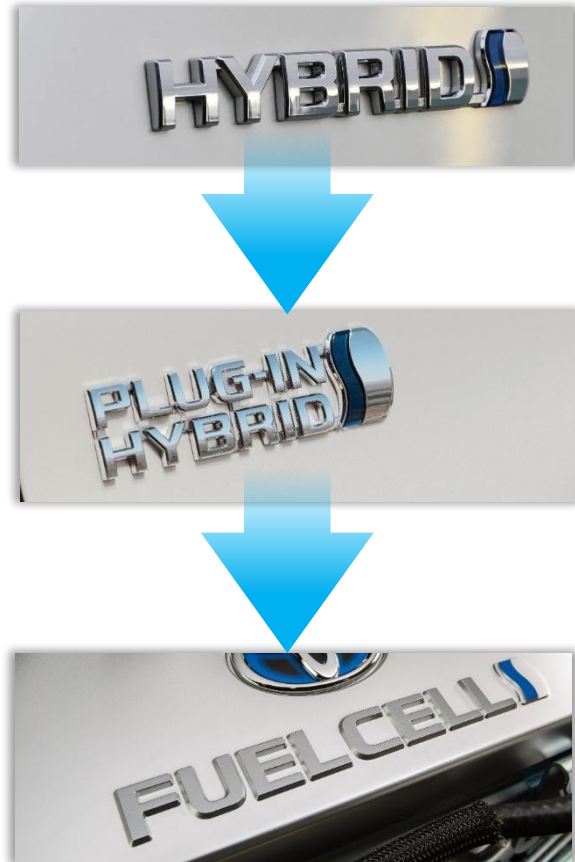
Hydrogen is most promising for long-term and carbon-free seasonal storage

¹ IEA data updated due to recent developments in building numerous 1MW hydrogen storage tanks

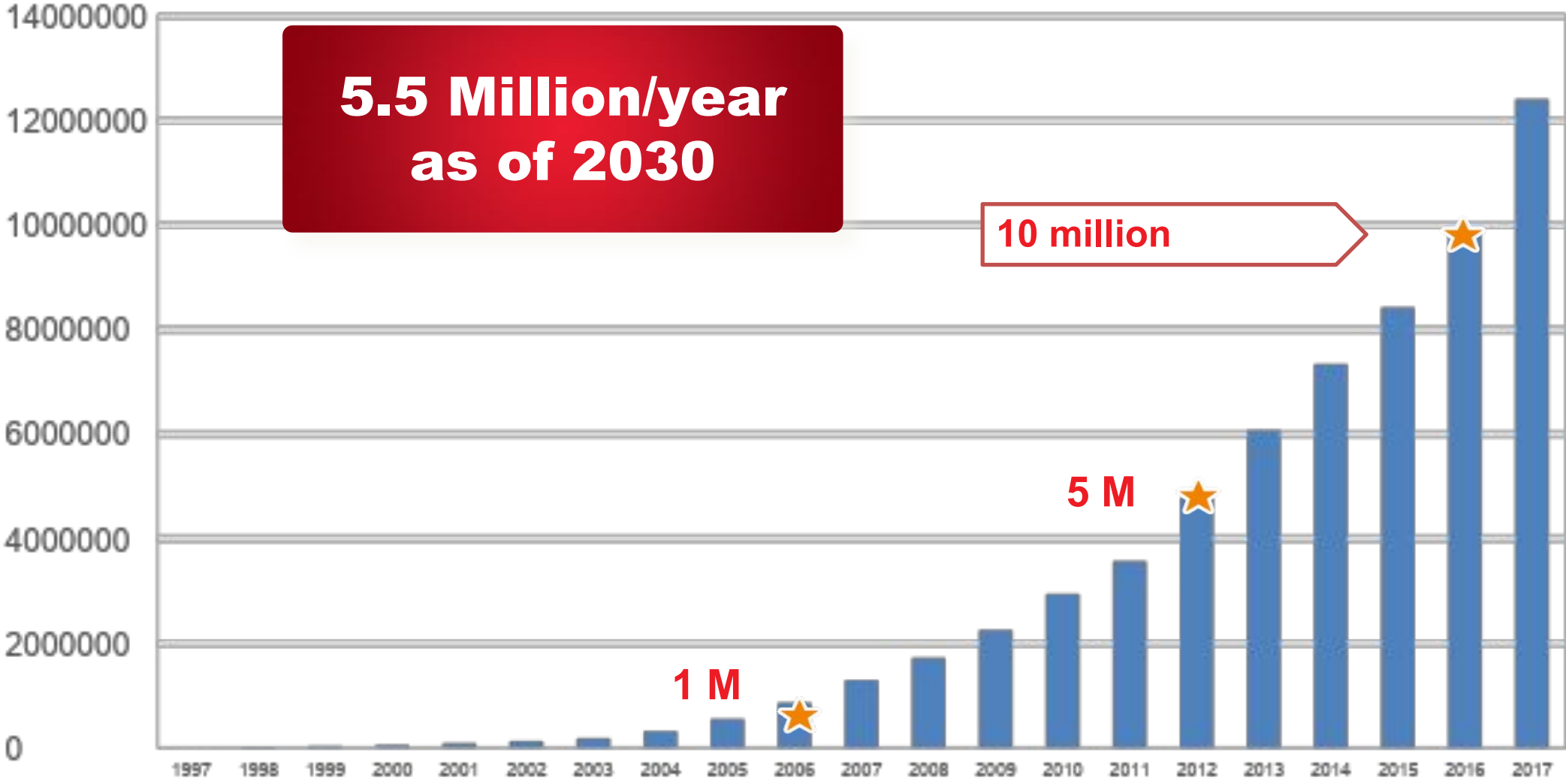
Source: IEA Energy Technology Roadmap Hydrogen and Fuel Cells, JRC Scientific and Policy report 2013

Toyota's Answer – Mirai, the obvious next step

未来



Hybrid Global Sales



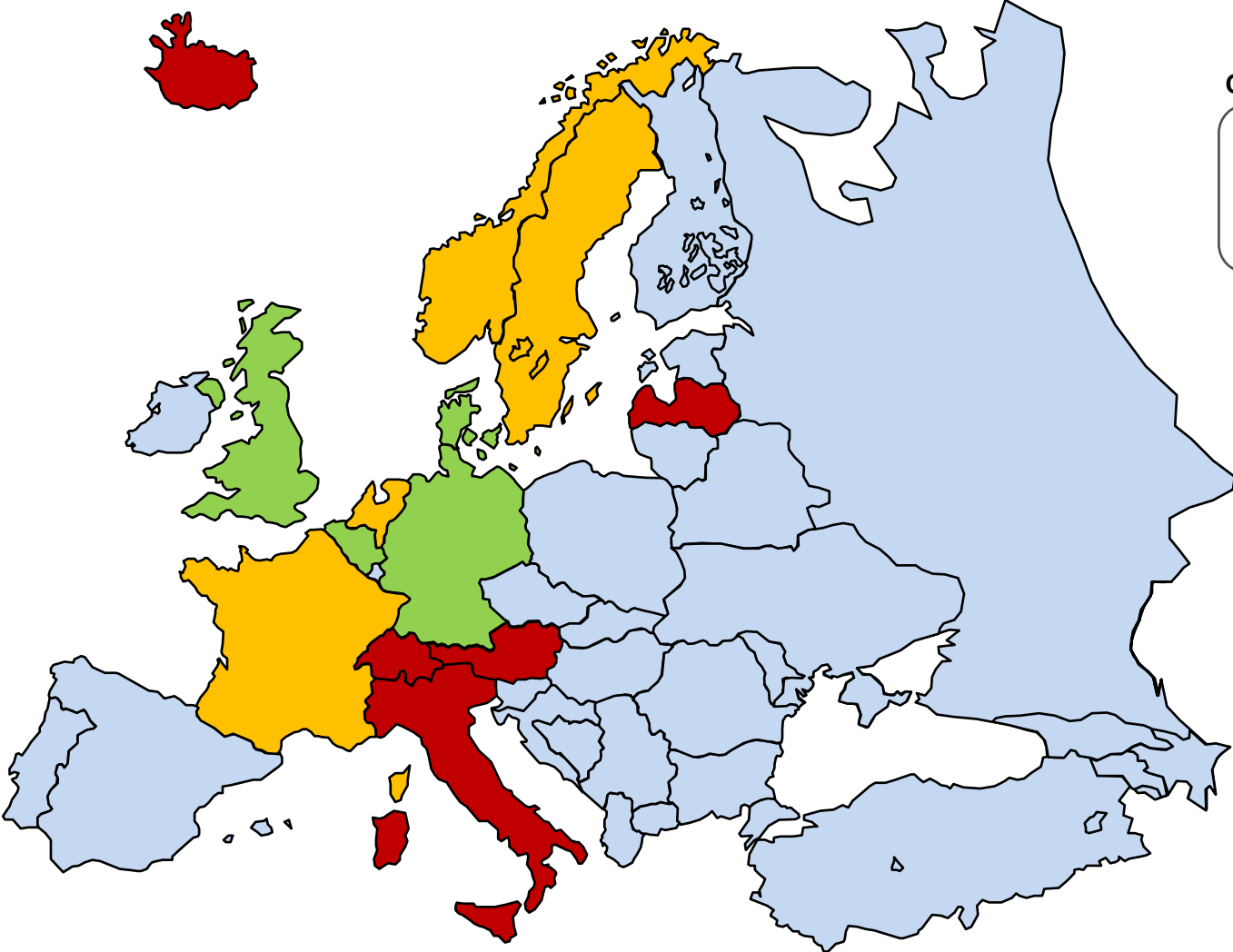
Toyota FCEV sales plan in 2020



2015: 700 vehicles/year
2016: ~2,000 vehicles/year
2017: ~3,000 vehicles/year
2018: ~3,000 vehicles/year
2019: ~3,000 vehicles/year
2020: ~3,000 vehicles/year

GLOBAL TARGET: More than 30,000/year as of 2020

Mirai Sales Distribution in Europe



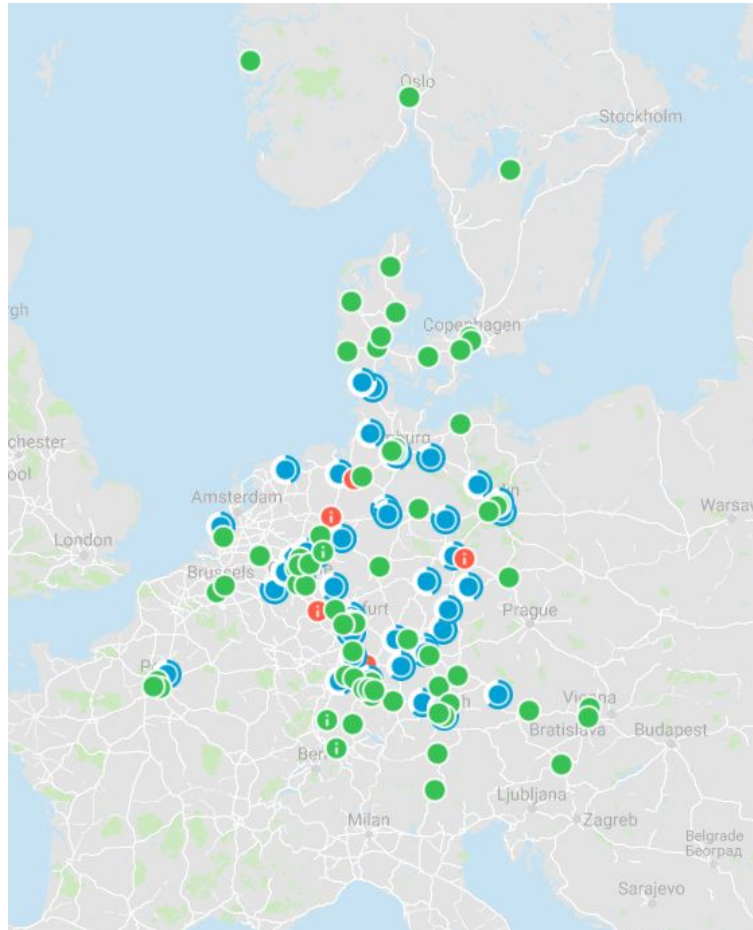
Countries introduction time

2015	2016	2017	2018
23	62	135	>200

September 2018:

Japan: 2608
USA: 4099
EU: 345
TOTAL: 7052

Hydrogen Refuelling Infrastructure



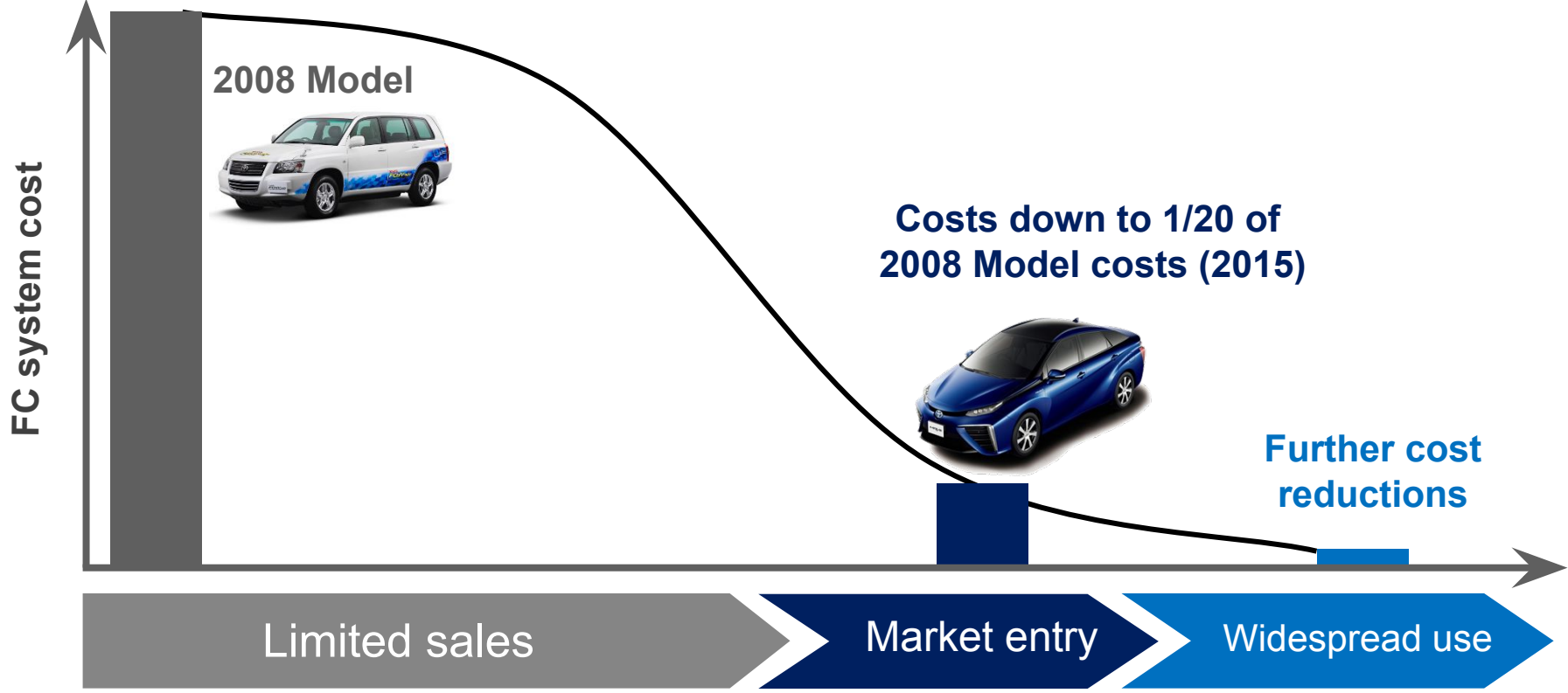
<http://h2.live/en>

700 bar station		2018 ACTUAL
Germany		52
UK		9
Denmark		10
Norway		7
Sweden		3
Netherlands		2
Belgium		2
France		3
Italy		1
Iceland		2
Austria		5
Switzerland		1
Latvia		1
TOTAL		98

END 2019



Huge potential for cost reduction



Fuel Cell Components

★FC stack

- Innovative flow channel structure and Electrodes of cells for higher output
Output/volume; 3.1kW/L

Humidifier less

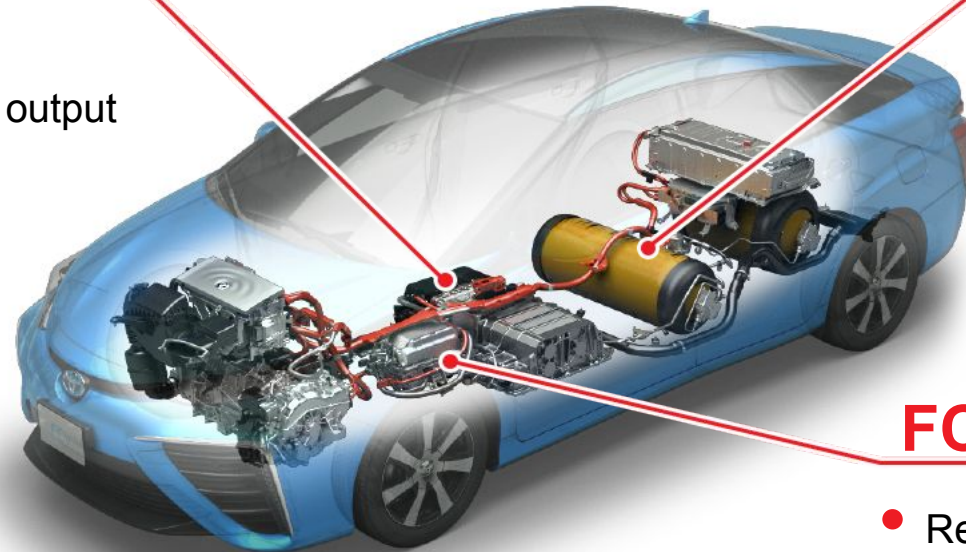
- Internal circulation

★High pressure hydrogen tank

- The light weight structure of carbon fiber reinforced plastic enabled
Storage; 5.7 wt%*

FC boost converter

- Reduced number of cells in FC stack
- Common use of hybrid units



*Hydrogen mass/Tank mass

**FC main components developed in-house
to achieve world leading performance**

Other developments



Caetano Fuel Cell Bus



Sora Fuel Cell Bus



Tundra Fuel Cell Pizza delivery



Project Portal Fuel Cell Truck



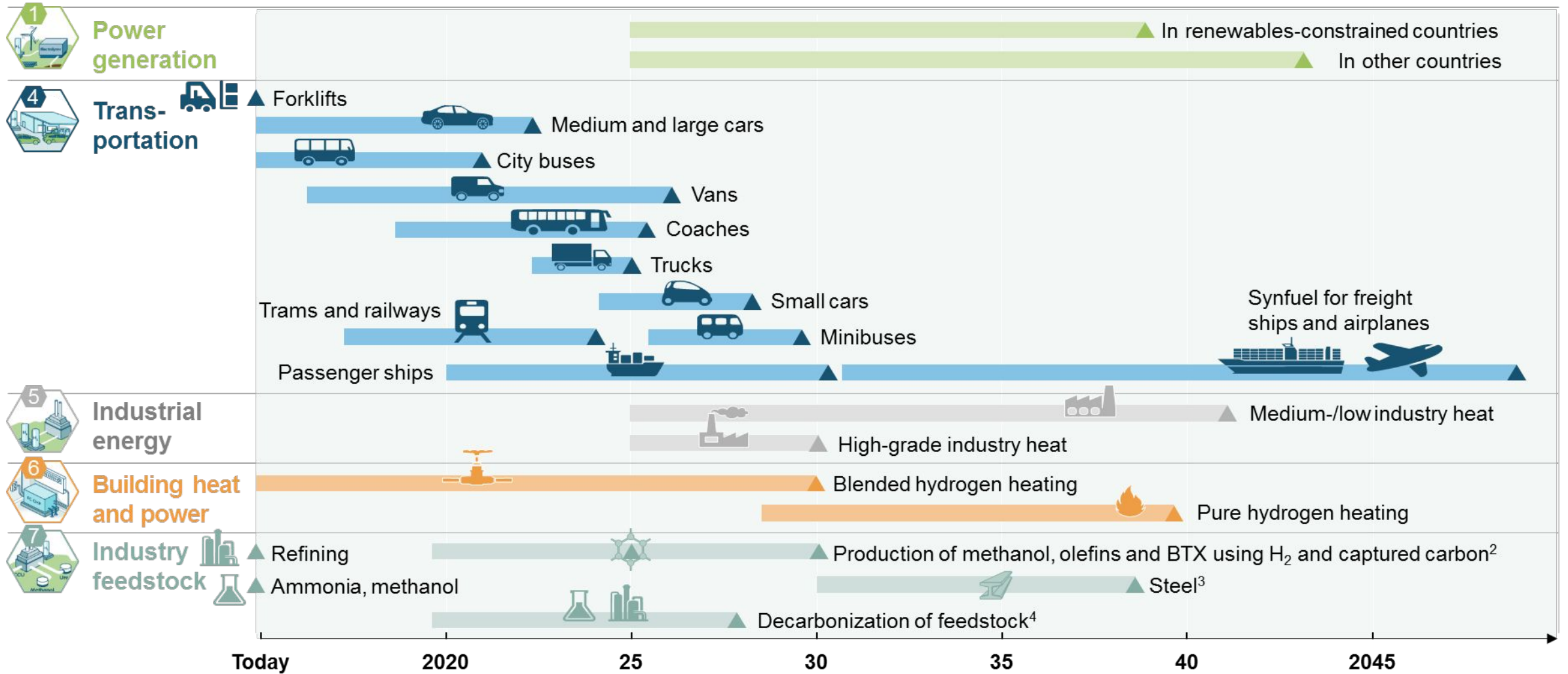
Toyota Fuel Cell Truck



Toyota Fuel Cell Forklift

Hydrogen Council Roadmap

Start of commercialization Mass market acceptability¹



Warranty Period like any other

Toyota hybrid

**3 years /
100,000 km**

Standard warranty
for all general parts
and components



**5 years /
100,000 km**

Extended warranty
for all hydrogen and
high voltage parts



- Fuel tank
- FC stack
- HV battery
- Drive motor
- HV Inverter
- HV booster

Durable under intense EU driving style

Challenge:

clocking up 200,000 kilometres in just over 250 days

Driving style:

City traffic (Hamburg)

High speed driving (Germany)

Cold conditions down to -20°C (Norway)

Uphill-downhill in summer up to +37°C (Alps)



The Mirai operated with 100% reliability

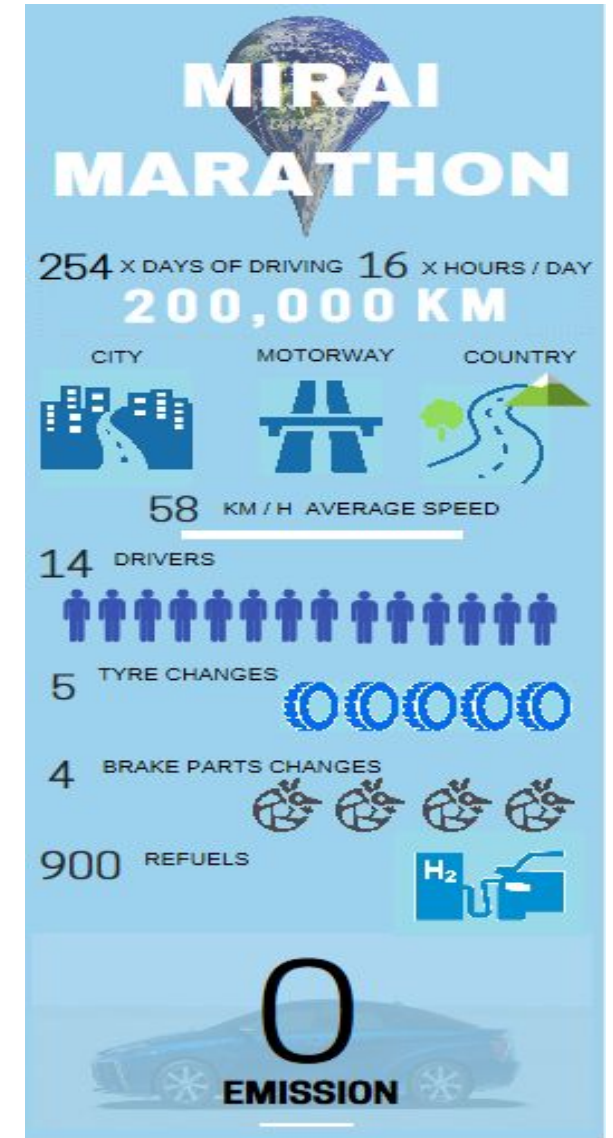
Meaning for Europe:

Records like this brought by OEMs can build confidence and customer satisfaction.

Condition

Excellent
H₂ Quality

ISO 14687-2
EN 17124





TOYOTA

ALWAYS A
BETTER WAY

Thank You

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