Towards a Hydrogen Society

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TOYOTA

Toyota/Lexus, Daihatsu & Hino

AA — 1936

Corolla — 1966

RAV 4 — 1994

Prius I — 1997

Mirai — 2017

• Date of creation	1937
• Net revenues	€231.9 billion
• Employees	364.000 people
• Production CY 2016	10.17 million vehicles
• Sales CY 2016	10.37 million vehicles
• **Hybrid sales**	**11.2 million units since 1997**
• Commercialization	160 countries
• Industrial sites	63 sites out of 12 in Japan
• **R&D budget**	**€8.7 billion**

Sources : Fiscal Year ending March 31st, 2017 (1 Euro = 119 yens)

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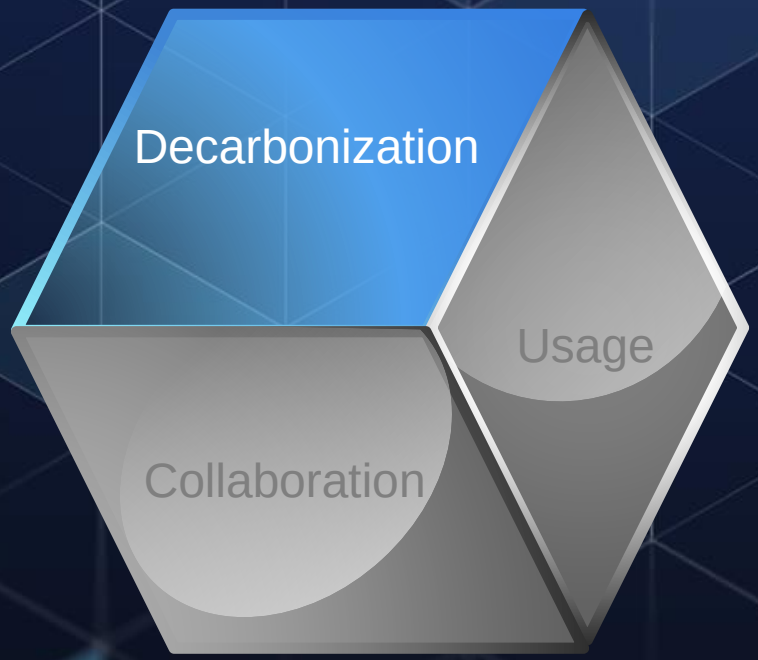
Environmental challenges

CLIMATE CHANGE

AIR QUALITY

ENERGY SECURITY



H2 instrumental to decarbonization

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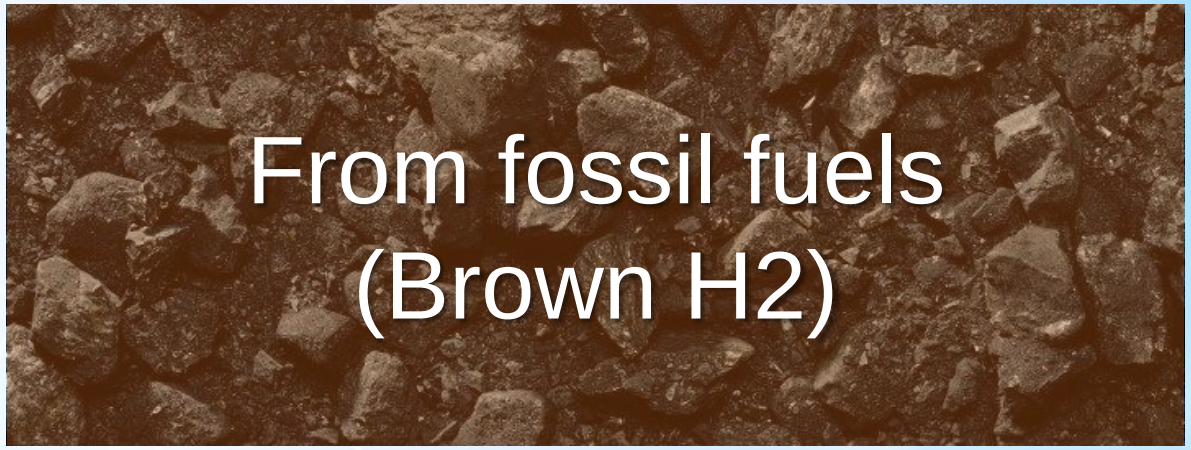
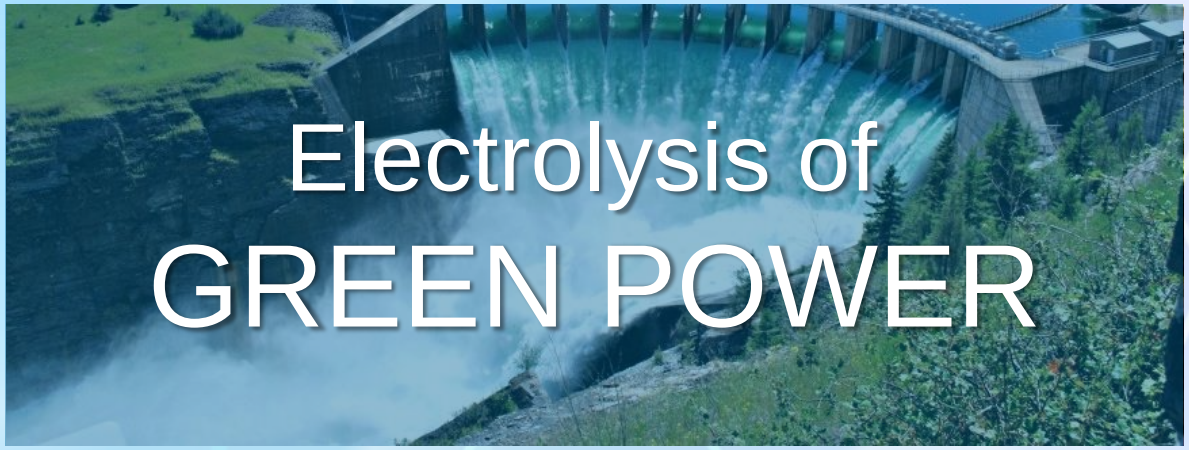
H2 can be produced by everything





Renewable energy – the way forward

Biomass

Hydro

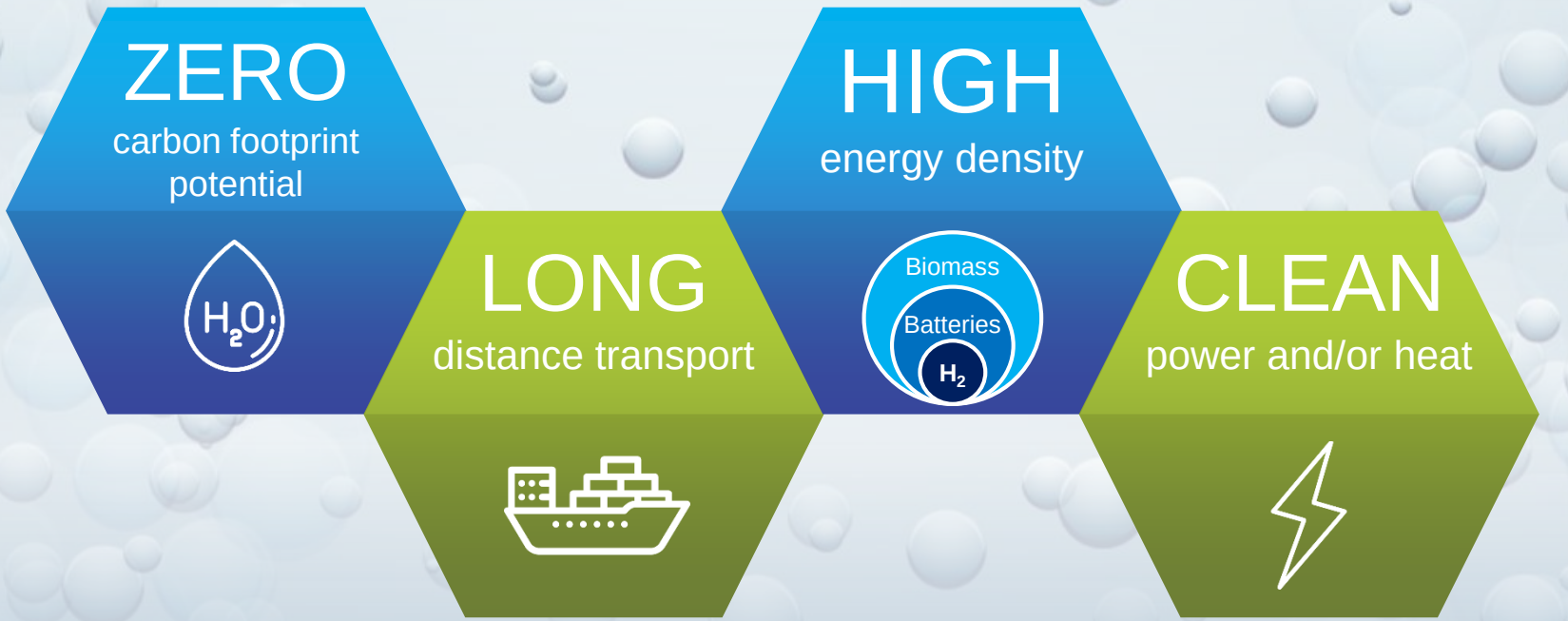
Controllable

Solar

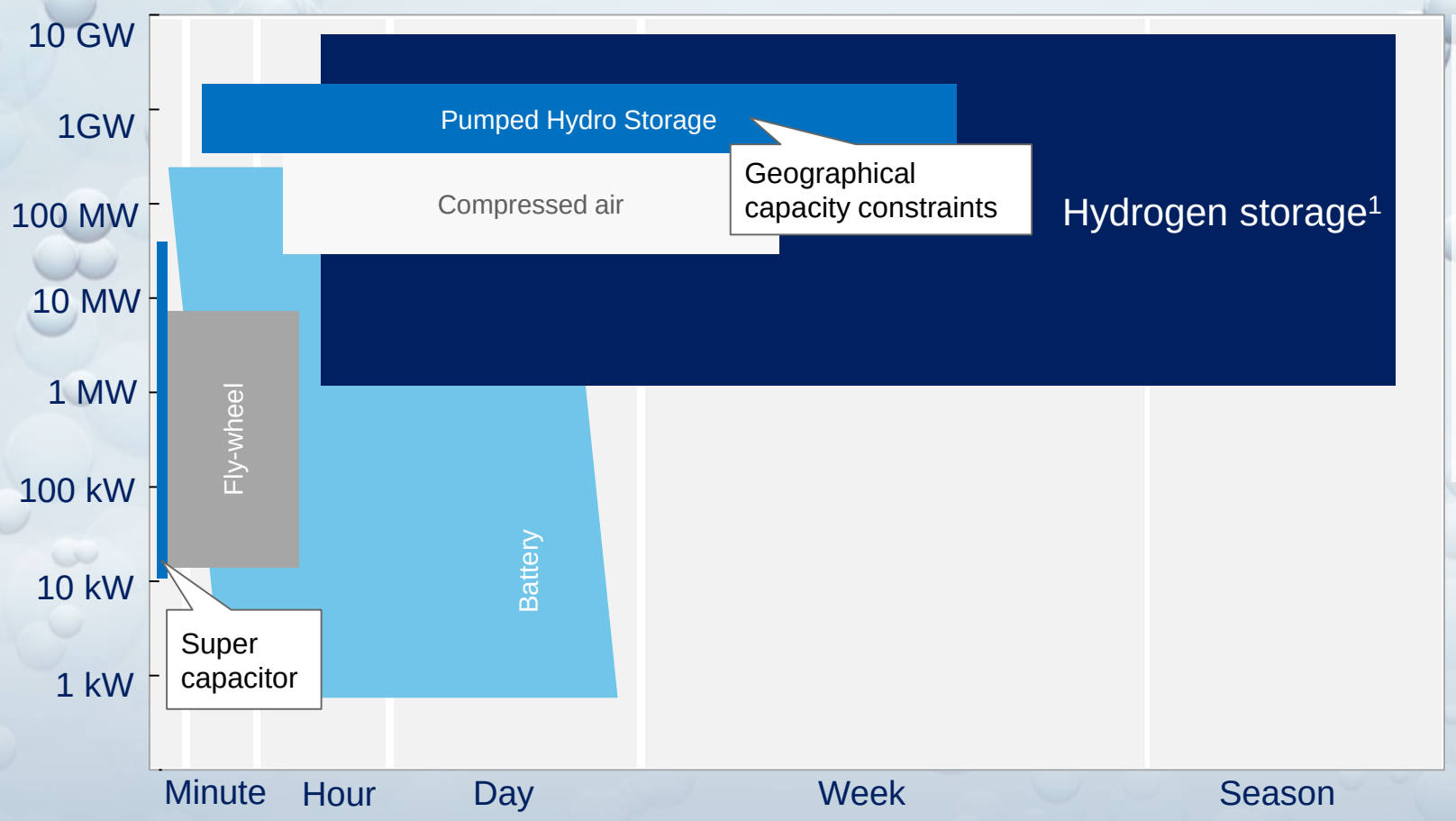
Wind

Fluctuates

Hydrogen: versatile, 0-emission energy carrier



H2 as a storage of 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

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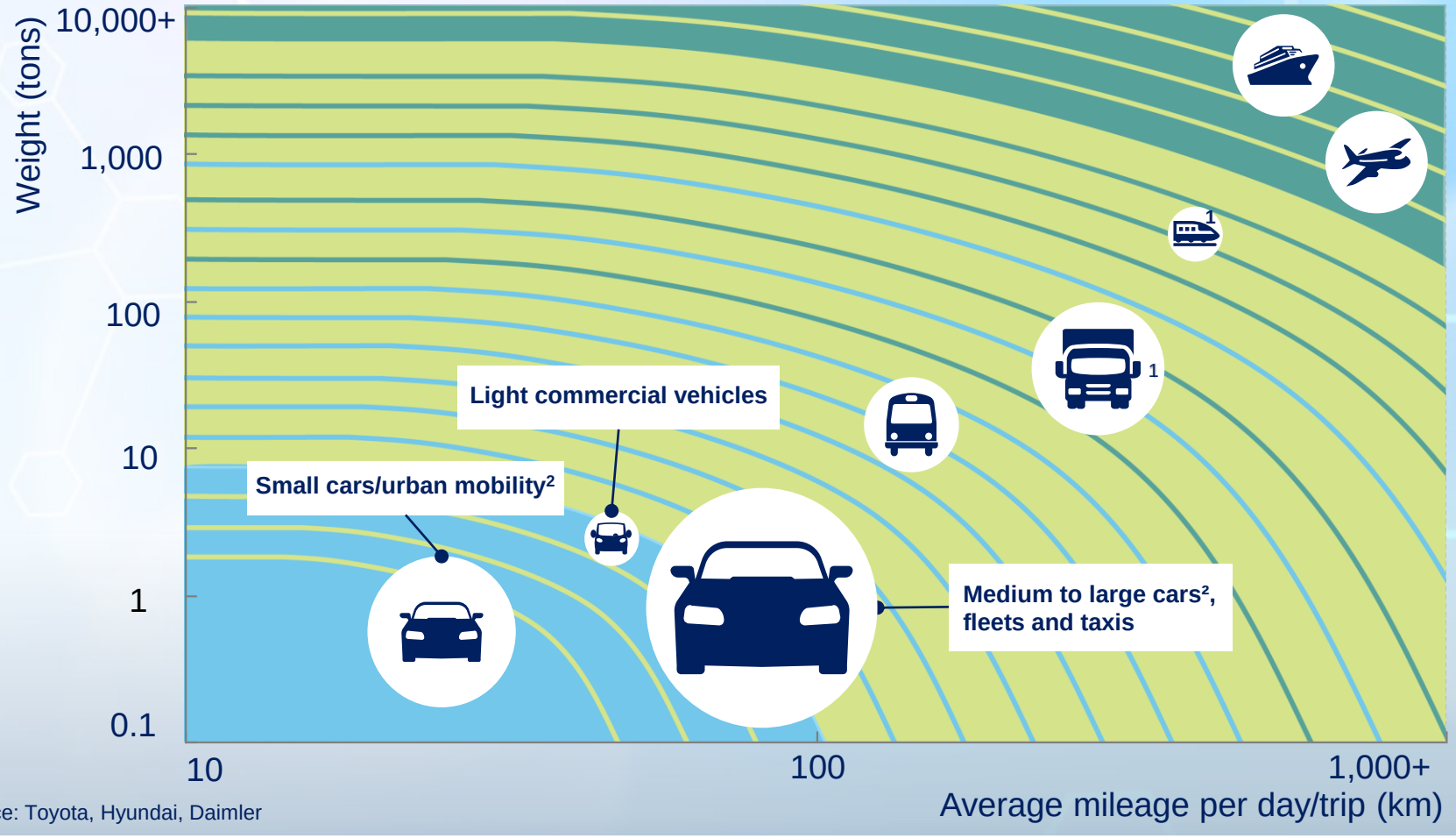
FCVs are essential for decarbonising transport



BEV

FCV

Bio- and (H_2-based) synthetic fuels

Bubble size represents relative annual energy consumption of this type in 2013

1 Battery-hydrogen hybrid to ensure sufficient power

2 Split in A- and B-segment LDVs (small cars) and C+-segment LDVs (medium to large cars) based on a 30% market share of A/B-segment cars and a 50% less energy demand

Source: Toyota, Hyundai, Daimler

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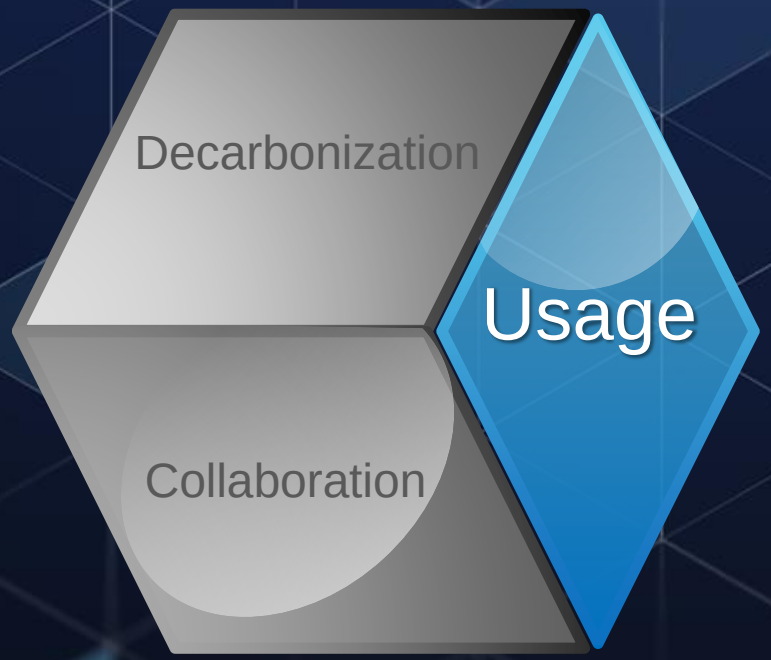


Hydrogen has a long history of mass production and usage

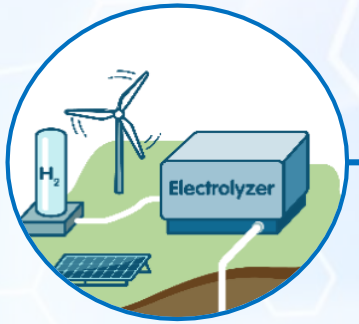
Wide use of Hydrogen

Every year, millions of tons are generated, stored and transported safely.

Hydrogen to play a bigger role in the future

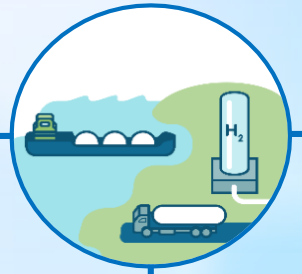
Sources of energy

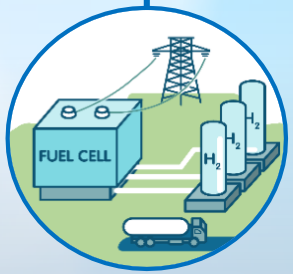
1. Enable **large-scale, efficient renewable energy** integration



Energy system

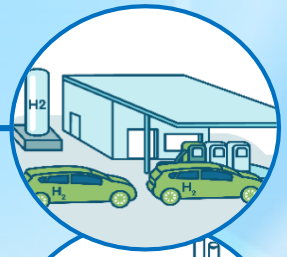
2. **Distribute** energy across sectors and regions



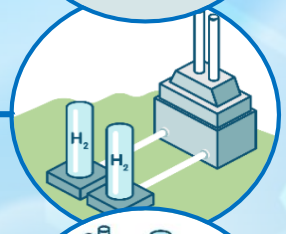


3. Act as a **buffer** to increase system resilience

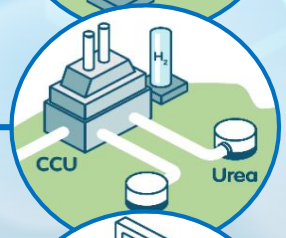
End uses



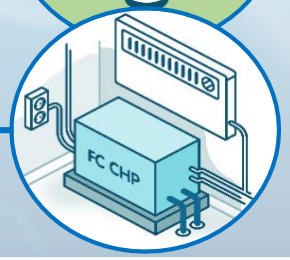
4. Decarbonize **transport**



5. Decarbonize **industry energy** use



6. Serve as **feedstock** using captured carbon



7. Help decarbonize **building heating**

Source: Hydrogen Council

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Hydrogen in transport - FCV

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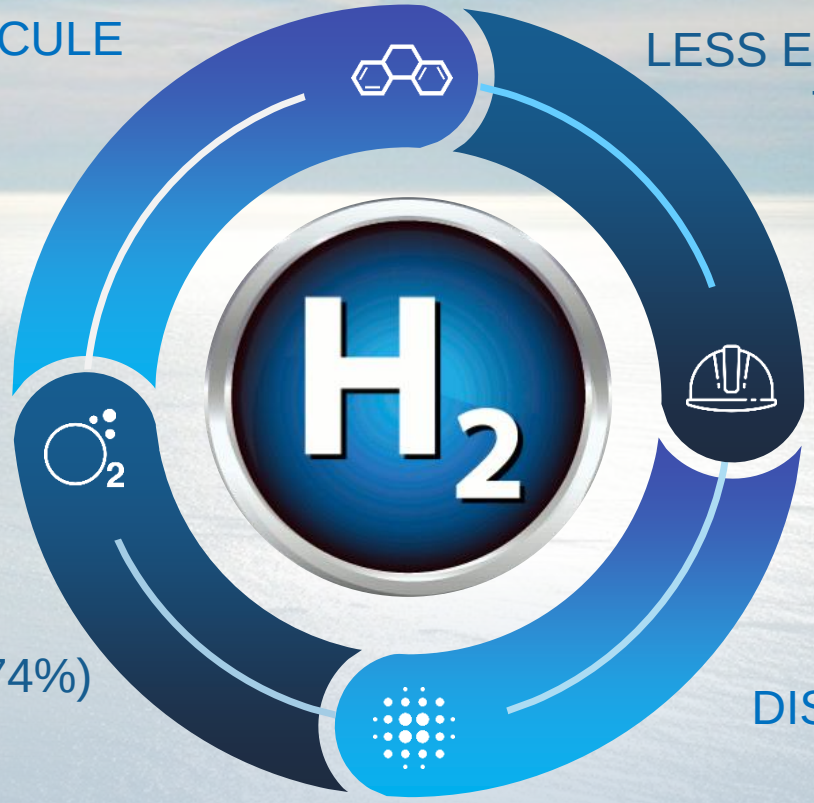
And hydrogen is safe

01 STABLE MOLECULE

LESS ENERGY CONTENT THAN LPG or CNG 02



04 NEEDS O2 (4-74%) TO COMBUST

DISPERSES QUICKLY 03

Source: www.mathesongas.com/pdfs/products/Lower-(LEL)-&-Upper-(UEL)-Explosive-Limits-.pdf

Needs cooperation

New “Hydrogen Council”

Air Liquide ALSTOM AngloAmerican BMW GROUP DAIMLER ENGIE HONDA HYUNDAI Kawasaki THE LINDE GROUP TOTAL TOYOTA

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Cooperation to create H2 society

Zero CO_2 Challenge in cooperation with stakeholders

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Hydrogen vision for 2050: CO_2 reduced by 20%

SOURCE: Hydrogen Council;

Toyota vision

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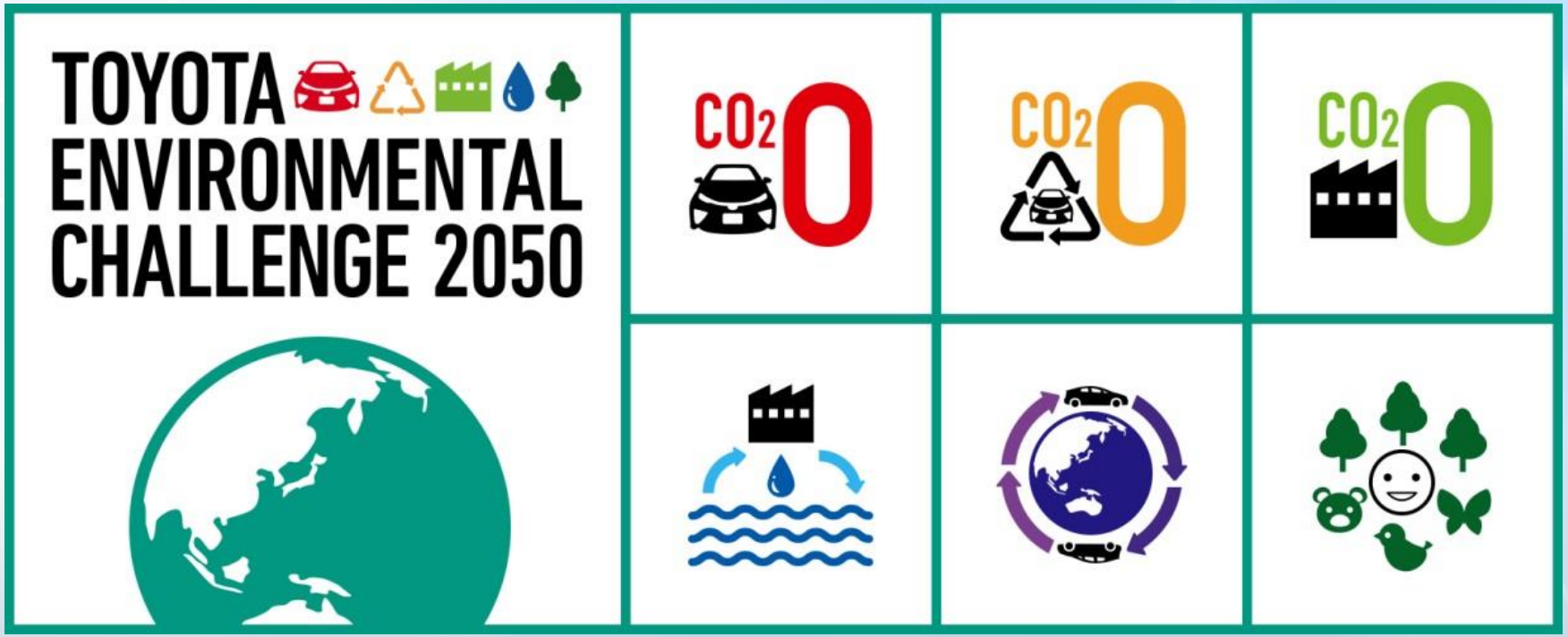
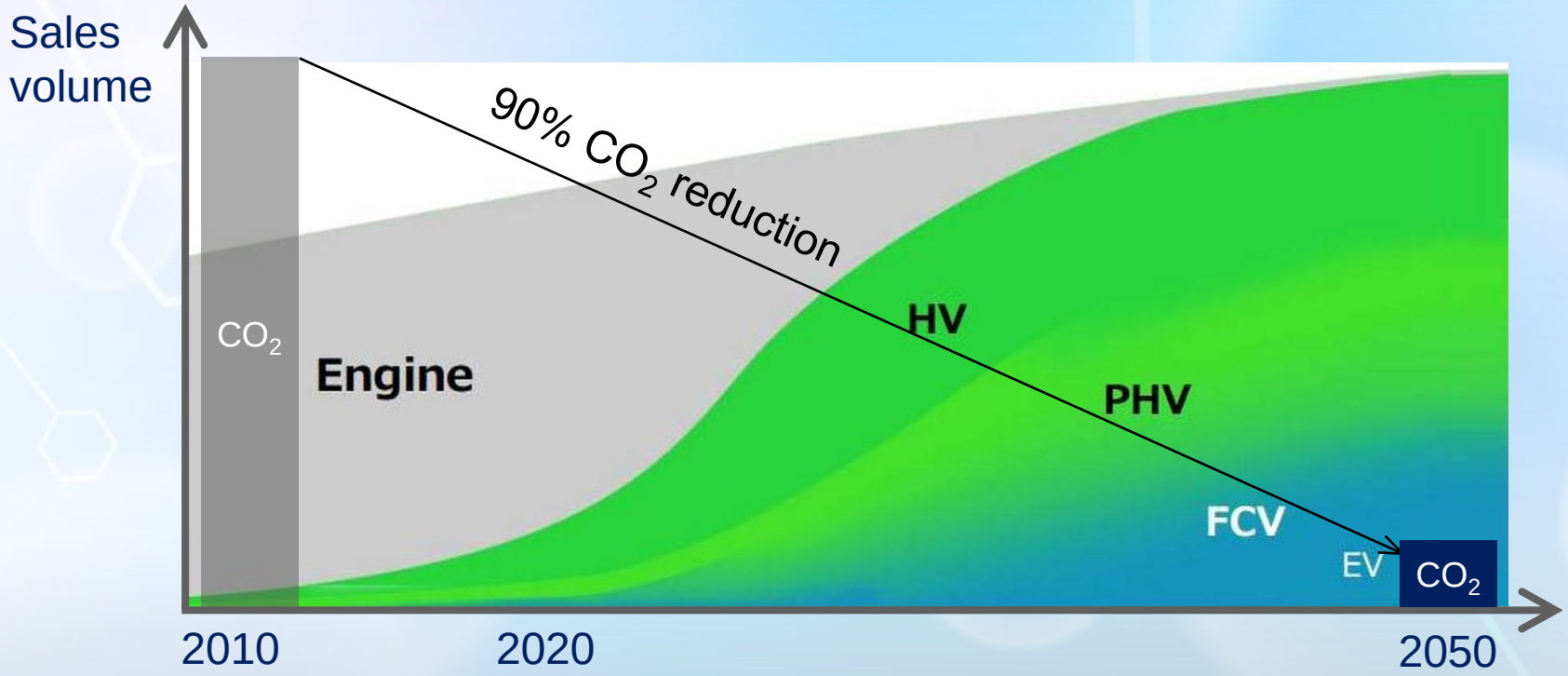
Toyota’s challenging environmental targets

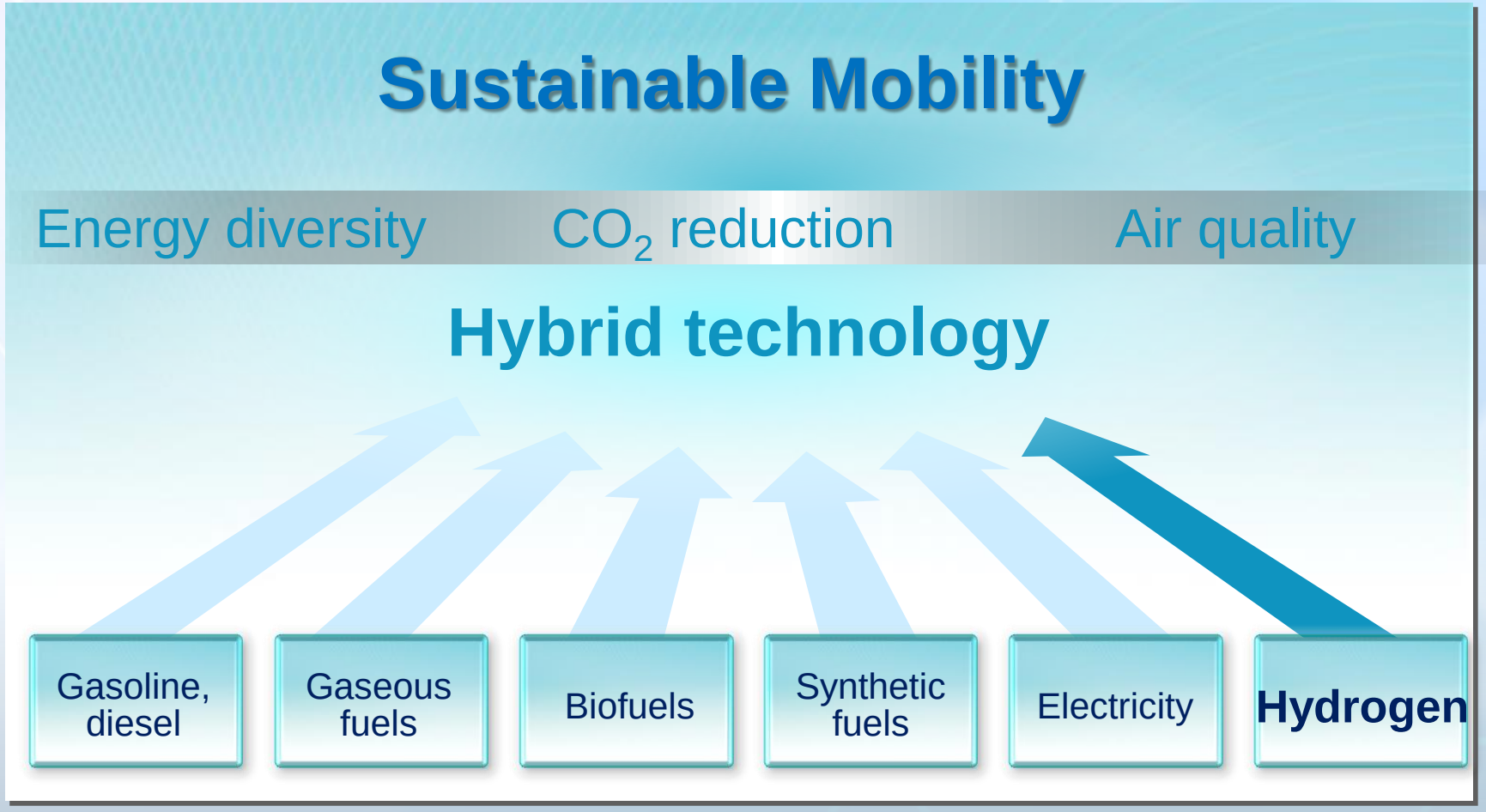


Mix of powertrains required to achieve 90% CO_2 reduction (challenge 2050)



Electrification will increase dramatically after 2020

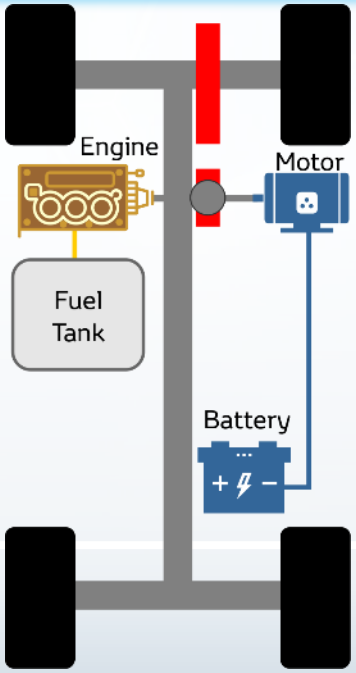
Towards a sustainable mobility



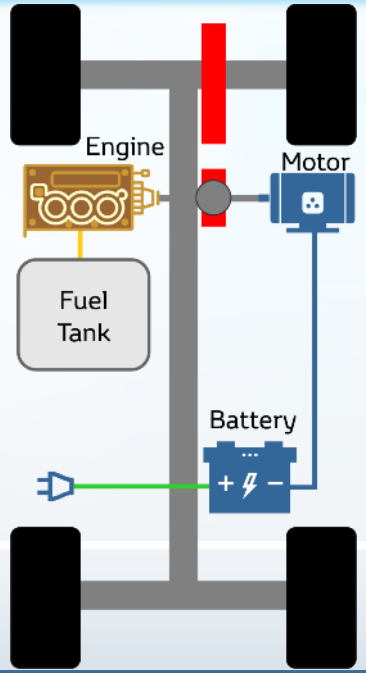
Hybrid central to our technology roadmap

Using hybrid technology for Plug-In, EV and Fuel Cell

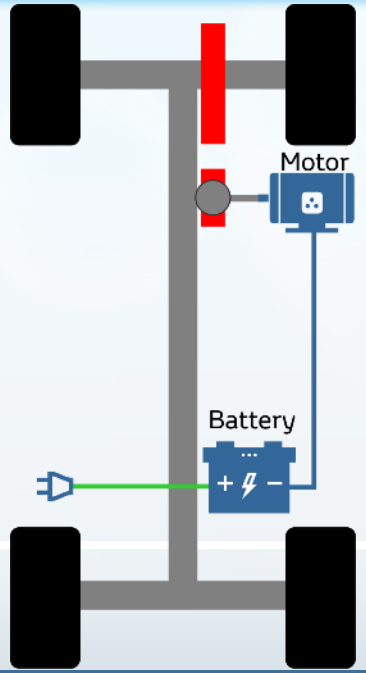
HYBRID



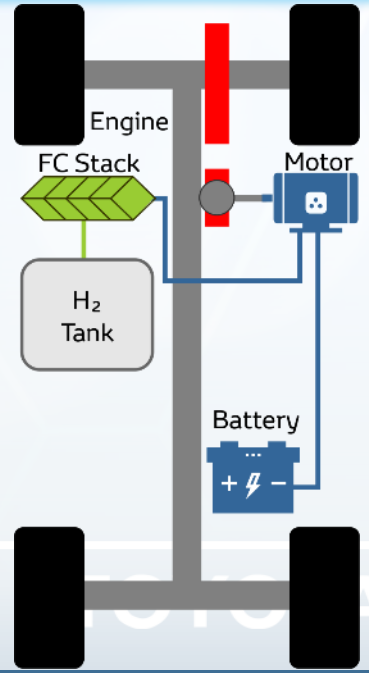
PLUG-IN HYBRID



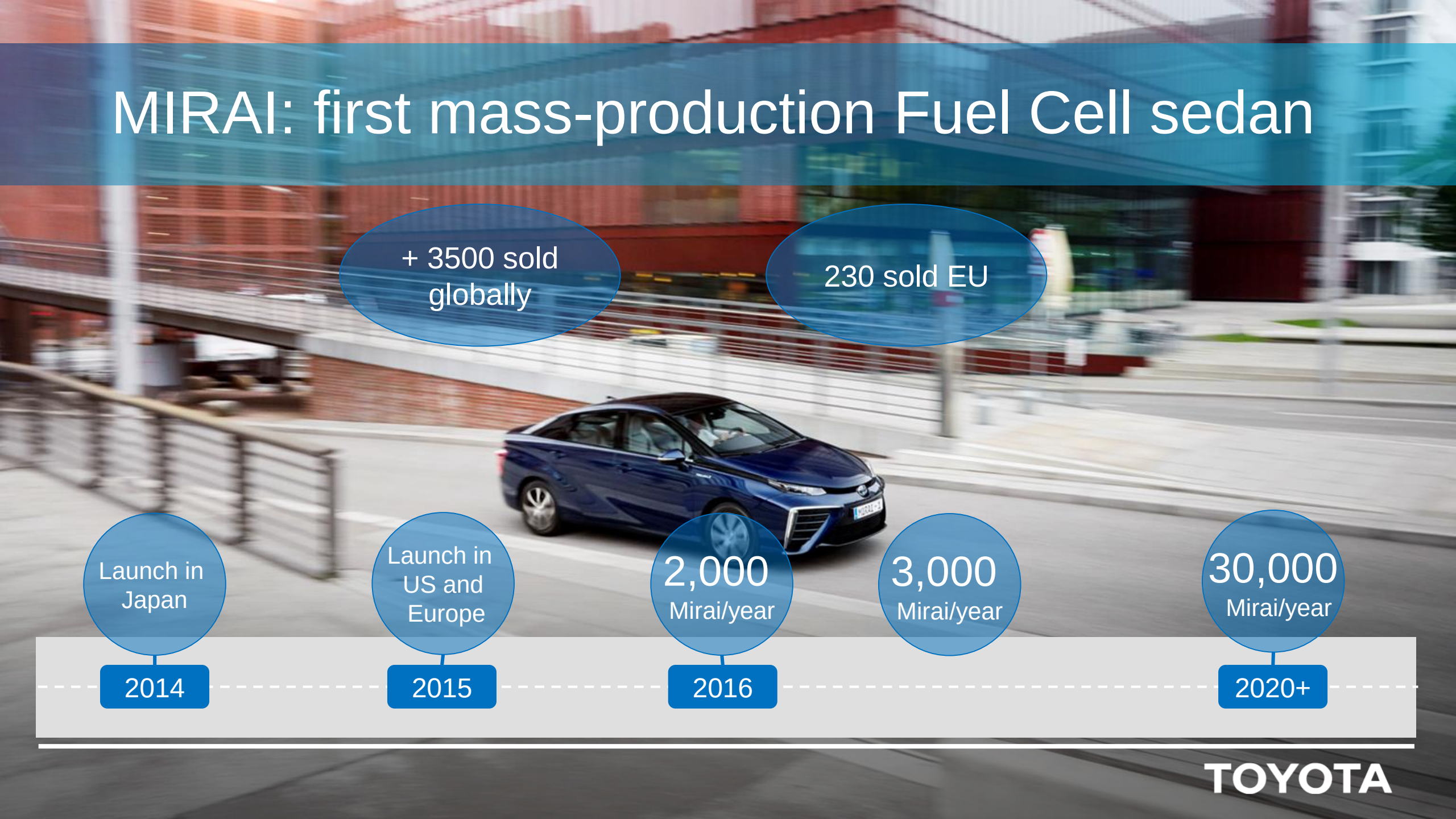
ELECTRIC



FUEL CELL



MIRAI: first mass-production Fuel Cell sedan



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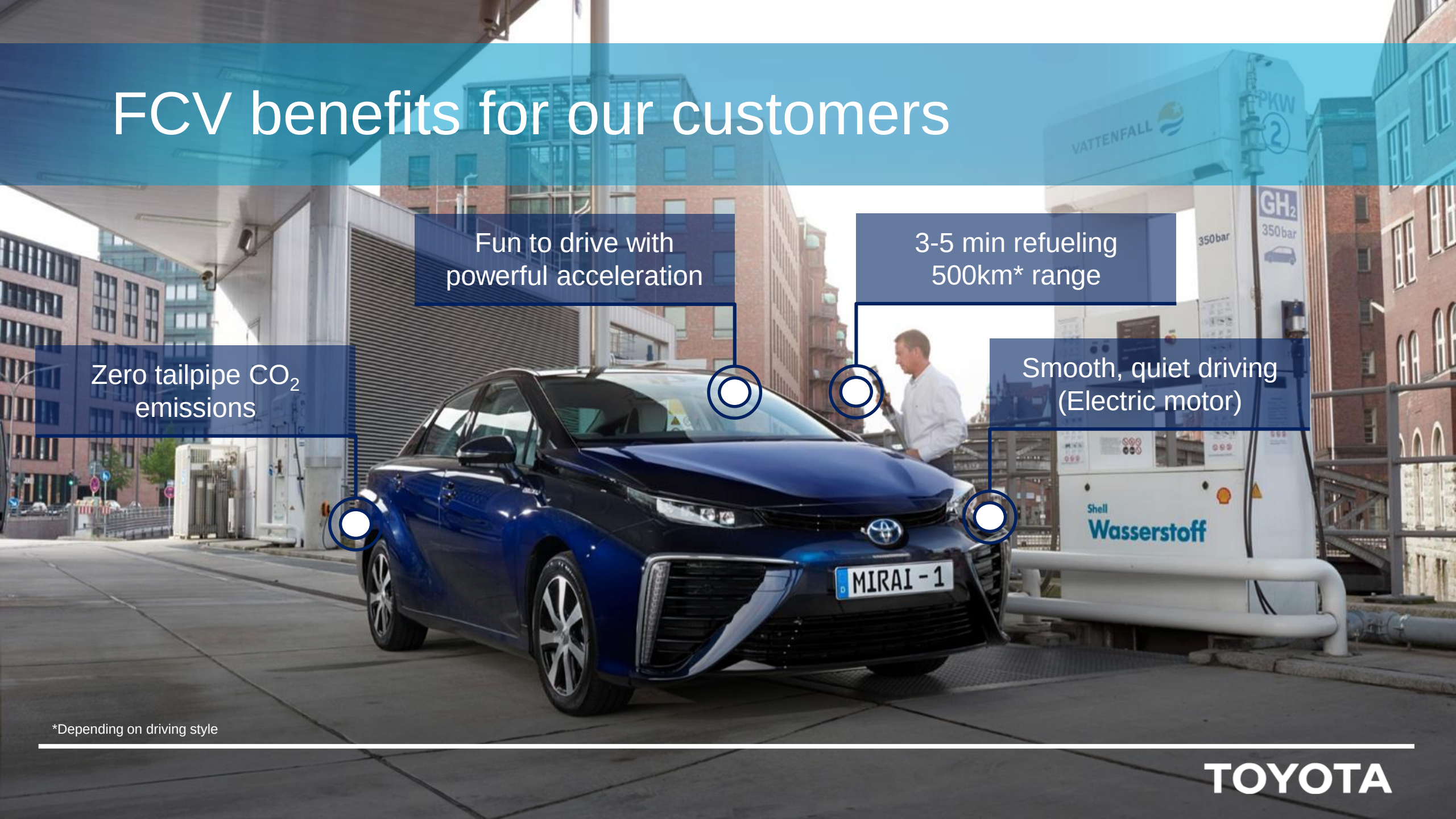
FCV benefits for our customers



*Depending on driving style

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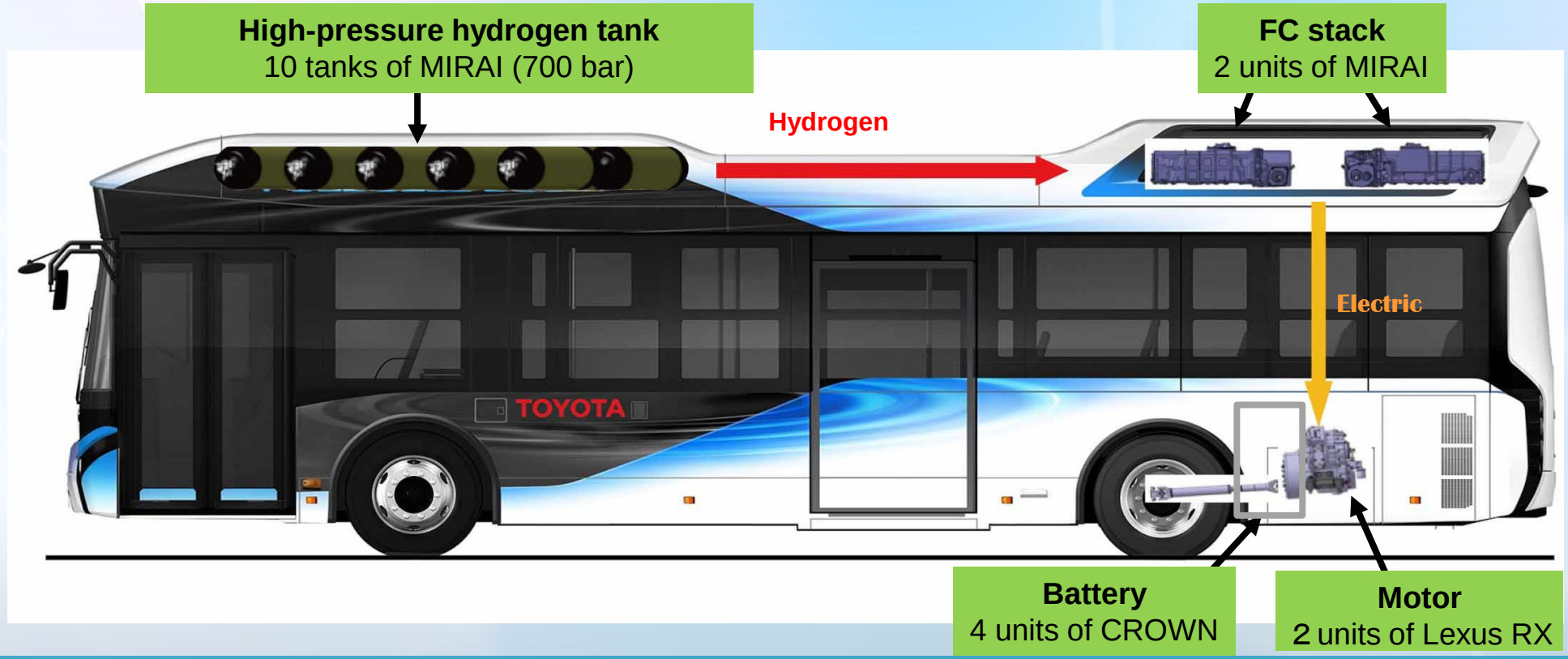
Toyota FC Bus Introduction

To start from February 2017 for Tokyo, with a minimum 100 units by 2020 for Tokyo Olympics/Paralympics



The FC bus was developed using a unit of MIRAI.
Cruising range is approximately 200km

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Advantages of FC Bus

Energy diversification

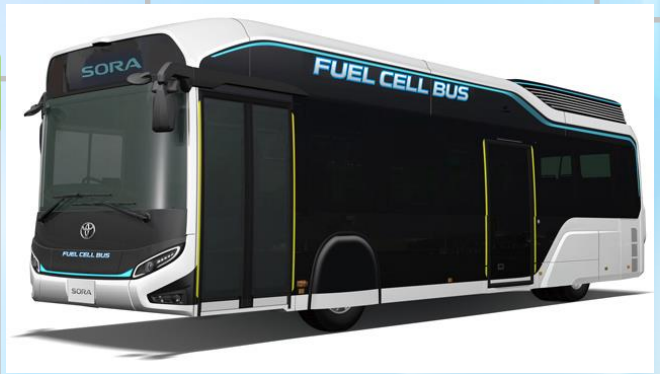
- Hydrogen can be produced using a wide variety of primary energy sources

Zero emissions

- Zero CO_2 emissions during driving

Comfort

- Smooth and quiet operation
- Smooth start and good acceleration at low and medium speeds



TOYOTA FC BUS concept model ‘SORA’

Performance

- Range approx. 200km*
- Refuels in approx. 10 minutes

* City area driving pattern
Toyota measurements

Large power supply capability for emergencies

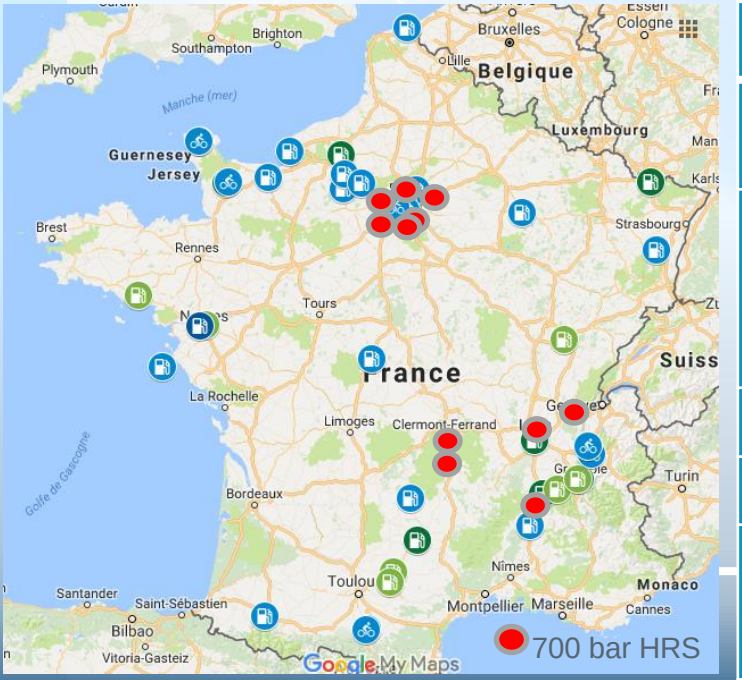
- approximately 4.5 days at evacuation center

Update in France

France: H2 development through “clusters”, based on the demand for FCV

Stations in operation in 2017: needs 700 bar HRS

- 350 bar: **15**
- 700 bar: **3** Paris-Alma, Paris-Orly and Paris-Versailles



700 bar planned stations for 2018 – 2021		
Air Liquide	Paris Roissy Paris Grenelle	Q2’18 2021
Zero Emission Valley	Lyon Clermont-Ferrand Grenoble	3 by 2018 15 by 2020
McPhy	Grenoble	1 Jan ’18
Atawey	Chambéry	1 Q1 ’18
ENGIE	Paris La Défense Paris Rungis Paris St Denis	S1 ’18 Q1 ’19 Q3 ’19

- Today: Hype taxi fleet @Paris city
- 2024: Paris Olympics & Paralympics
- 2030: Paris to ban diesel & petrol vehicles

PARIS 2024

Requirement for success

Infrastructure

Standardization

700 bar !

Customer

Main challenges:
Cost and capacity to manufacture

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Towards a future hydrogen society

THANK YOU

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