Towards a Hydrogen Society

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Toyota/Lexus, Daihatsu & Hino

- **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)
Environmental challenges

- Climate Change
- Air Quality
- Energy Security
H2 instrumental to decarbonization
H2 can be produced by everything

- From fossil fuels (Brown H2)
- Electrolysis of GREEN POWER
- Industry By-Product (Yellow H2)
- From BIO-MASS
Renewable energy – the way forward

- Biomass
- Hydro
- Solar
- Wind

Controllable

Fluctuates
Hydrogen: versatile, 0-emission energy carrier

- ZERO carbon footprint potential
- HIGH energy density
- LONG distance transport
- CLEAN power and/or heat

Biomass
Batteries
H₂
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

FCVs are essential for decarbonising transport

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
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
Hydrogen in transport - FCV

Buses

Planes

Trains

Cars

Trucks

Ships
And hydrogen is safe

01 STABLE MOLECULE

02 LESS ENERGY CONTENT THAN LPG or CNG

03 DISPERSES QUICKLY

04 NEEDS O2 (4-74%) TO COMBUST

Source: www.mathesongas.com/pdfs/products/Lower-(LEL)-&-Upper-(UEL)-Explosive-Limits-.pdf
Needs cooperation
New “Hydrogen Council”

Hydrogen will play an important role in the low carbon sustainable society
Cooperation to create H2 society

Carbon-free Mobility & Society

Zero CO₂ Challenge in cooperation with stakeholders
Hydrogen vision for 2050: \( \text{CO}_2 \) reduced by 20%
Toyota vision
Toyota’s challenging environmental targets
Mix of powertrains required to achieve 90% CO₂ reduction (challenge 2050)

Electrification will increase dramatically after 2020
Towards a sustainable mobility

Sustainable Mobility

Energy diversity  CO₂ reduction  Air quality

Hybrid technology

Gasoline, diesel  Gaseous fuels  Biofuels  Synthetic fuels  Electricity  Hydrogen
Hybrid central to our technology roadmap

Using hybrid technology for Plug-In, EV and Fuel Cell
MIRAI: first mass-production Fuel Cell sedan

- Launch in Japan: 2014
- Launch in US and Europe: 2015
- 2,000 Mirai/year: 2016
- 3,000 Mirai/year: 2020+
- +3500 sold globally
- 230 sold EU
- 2020+: 30,000 Mirai/year
FCV benefits for our customers

- Fun to drive with powerful acceleration
- 3-5 min refueling 500km* range
- Zero tailpipe CO₂ emissions
- Smooth, quiet driving (Electric motor)

*Depending on driving style
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
Advantages of FC Bus

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

**Zero emissions**
- Zero CO₂ emissions during driving

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

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

**Large power supply capability for emergencies**
- Approximately 4.5 days at evacuation center

* City area driving pattern
  Toyota measurements
### Update in France

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

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<th>700 bar planned stations for 2018 – 2021</th>
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<tr>
<td><strong>Air Liquide</strong></td>
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<td><strong>Zero Emission Valley</strong></td>
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<td><strong>McPhy</strong></td>
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**Stations in operation in 2017: needs 700 bar HRS**

- **350 bar:** 15
- **700 bar:** 3

- Paris-Alma, Paris-Orly and Paris-Versailles

**Today:** Hype taxi fleet @Paris city

**2024:** Paris Olympics & Paralympics

**2030:** Paris to ban diesel & petrol vehicles
Requirement for success

Infrastructure

700 bar!

Main challenges: Cost and capacity to manufacture
Towards a future hydrogen society
THANK YOU