Mirai
Technological mobility solution

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Berlin Energy Transition Dialogue, March 2015
Fuel Cell: the trigger for low carbon society

Energy diversity
Hydrogen can be produced from multiple sources

Zero emission
No carbon emission from tailpipe

Driving pleasure
Smoothness & quietness
Rich low-end torque

Convenience
No range anxiety
Short charging time
Cold startability

Electricity supply
Supply capability of electricity in emergency
Eco-car as easy as conventional car

0 emission except water (7L/100km* = 1 droplet every 3m)

550 km* range

3-5 min to refuel

* : According to NEDC

Introduce in Europe in UK, Dk and Germany follow-up by other countries. Select regions where we can ensure quick & efficient service with customer follow-up.

Fuel cell Advanced technology fulfilling customer expectations
More than 20 Years of Development by Toyota

1996
FCEV
Fuel cell stack and metal hydride hydrogen tank

2001
FCHV-4
Testing begins on public roads in Japan & US

2001
FCHV-3
FC stack that achieves increased power output

2001
FCHV-5
Featuring an onboard Clean Hydrocarbon Fuel reformer

2002
Toyota FCHV
World-first sale in US & Japan

2001
FCHV-4
FC stack that achieves increased power output

2001
FCHV-5
Featuring an onboard Clean Hydrocarbon Fuel reformer

2008
Toyota FCHV-adv
Range and cold start capabilities improved

2011
FCV-R
Sedan version with 700 km of cruising range (JC08 test cycle)

2013
FCV Concept
Concept version of FCV model 2015
The size and cost of the systems have been reduced, while the characteristic benefits of FCVs has been increased.

**Fuel cell stack**
- Compact size with higher performance 3.1 kW/L

**Fuel cell boost converter**
- Newly developed in order to reduce the number of cells, for enabling the use of existing hybrid units.

**Elimination of humidifier**
- Internal circulation system adopted

**High-pressure hydrogen tank**
- Higher hydrogen storage density 5.7 wt%
- Number of tanks reduced from 4 to 2
High-capacity external power supply system

**DC power**
Household lighting, televisions, air-conditioning, and other electrical products can be used, maintaining nearly normal living conditions even during a power outage.

**AC power**
PCs and other electrical products can be used after connecting directly to the accessory outlet (AC 100V, 1500W).

Options depending on countries
## Toyota Open Its FCV Patents for Free Use

<table>
<thead>
<tr>
<th></th>
<th>Number of royalty-free patent</th>
<th>Royalty-free period</th>
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</thead>
<tbody>
<tr>
<td>FC stack</td>
<td>Approx. 1,970</td>
<td></td>
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<tr>
<td>High-pressure hydrogen tank</td>
<td>Approx. 290</td>
<td>Until 2020</td>
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<tr>
<td>FC system control technology</td>
<td>Approx. 3,350</td>
<td></td>
</tr>
<tr>
<td>Hydrogen station</td>
<td>Approx. 70</td>
<td>Indefinite period</td>
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Targeting "cooperation" for the early spread
Active participation in H$_2$ projects (EU examples)

German initiative, established in 2002
Testing the suitability of hydrogen as an alternative fuel
Toyota provided 5 cars (FCHV-adv) for testing

UK initiative, established in 2012
Study what is required to enable commercial deployment of fuel cell cars by 2015

Combining hydrogen initiatives in Norway, Denmark and Sweden

European project to deploy 110 fuel cell vehicles in 3 European regions, including the creation of infrastructure
World-wide location of hydrogen stations

USA
- Established H2USA
  - Aiming to construct infrastructure by DOE and private companies

Northeast states
- Project started, aiming for 100 sites by 2020

California
- 37 sites by 2014 (plans for 68 sites in 2015)

UK
- UKH2Mobility: Plan for 65 sites

Nordic MOU
- Developed hydrogen promotion program in Nordic countries

USA
- Established H2USA
  - Aiming to construct infrastructure by DOE and private companies

Germany
- 50 sites by 2015
  - [public-private basic agreement in 2012]
  - 400 by 2023 H2 mobility

Northeast states
- Project started, aiming for 100 sites by 2020

Japan
- Started 19 sites construction in 2013
  - Approx. 100 sites by 2015

USA
- Infrastructure is expanding and support technology deployment

Areas where infrastructure development can be expected from early 2015
- California
- Germany

Areas where infrastructure development can be expected after 2015
- Northeast states
- Japan

Infrastructure is expanding and support technology deployment
Hydrogen has been already mass-produced for an industrial use. Hydrogen is able to produce from various primary energy sources.
Fuel cell vehicles in the Future

FCHV-adv 2008

Costs down to 1/20 or less of FCHV-adv costs (by 2015)

Limited sales

Market entry

Widespread use

Resolve technical issues

Reduce cost

Design Production technology

Mass production
Cooperation with stakeholders

New Vehicle Zero CO₂ Challenge in cooperation with stakeholders
1. Hydrogen is an important energy from the view point of zero CO$_2$
   Can be produced from a variety of energy sources

2. Toyota introduced FCV ”MIRAI” into the market in Dec. 2014.
   It is the result of over ten years of experience
   It provides customer delight & new experiences

3. Fuel cell products, hydrogen infrastructure, available & sustainable
   hydrogen are important to be developed in parallel
Thank you