



**TOYOTA**

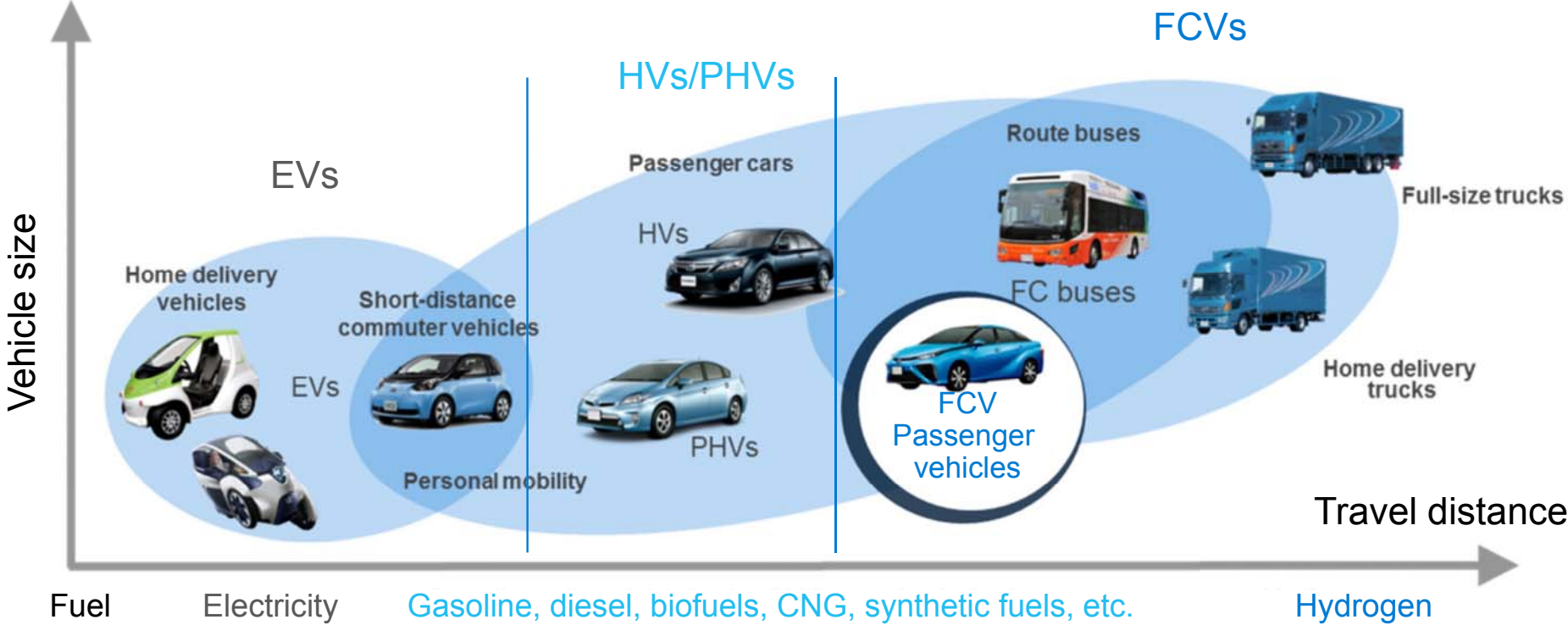
ALWAYS A  
**BETTER** WAY

# A concrete action: Toyota Mirai !

FUEL CELL

Gerald Killmann  
Toyota Motor Europe  
**HyVolution** 4<sup>th</sup> Feb 2016

# Mobility roadmap



EVs: Short-range      HVs & PHVs: Generale use      FCVs: Medium- to long-range

# Developing Hydrogen FCV for 20 years



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## FCEV Fuel

H<sub>2</sub> Stored in adsorbing alloy

1996



## FCHV-4 Fuel

Hydrogen stored in high-pressure tanks

2001



## FCHV

Toyota-made tanks, 1<sup>st</sup> FCV homologated

2005



## FCV-R Fuel

Mirai precursor

2011

## FCHV-3 Fuel

Hydrogen (adsorbing alloy)



1999

## FCHV-5 Fuel

Hydrogen generated on-board by reforming on gasoline



2001

2002

## FCHV-adv Fuel

New stack, stainless steel cells



2005

2009

## Mirai

Revolutionary Titanium stack, 3.1 kW/L world record



2011

2015

# MIRAI



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# Eco-car as easy as conventional car



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**0 emission**



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

**550 km\***



range

**3-5 min**



to refuel

\* : According to NEDC

# Eco-car as performing as conventional car



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154 hp

335 Nm  
torque

178 km/h  
top speed

9.6 s  
0-100 km/h

3 s  
40-70 km/h

# Toyota Fuel Cell System Components



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Ni-Mh Battery

Hydrogen tanks

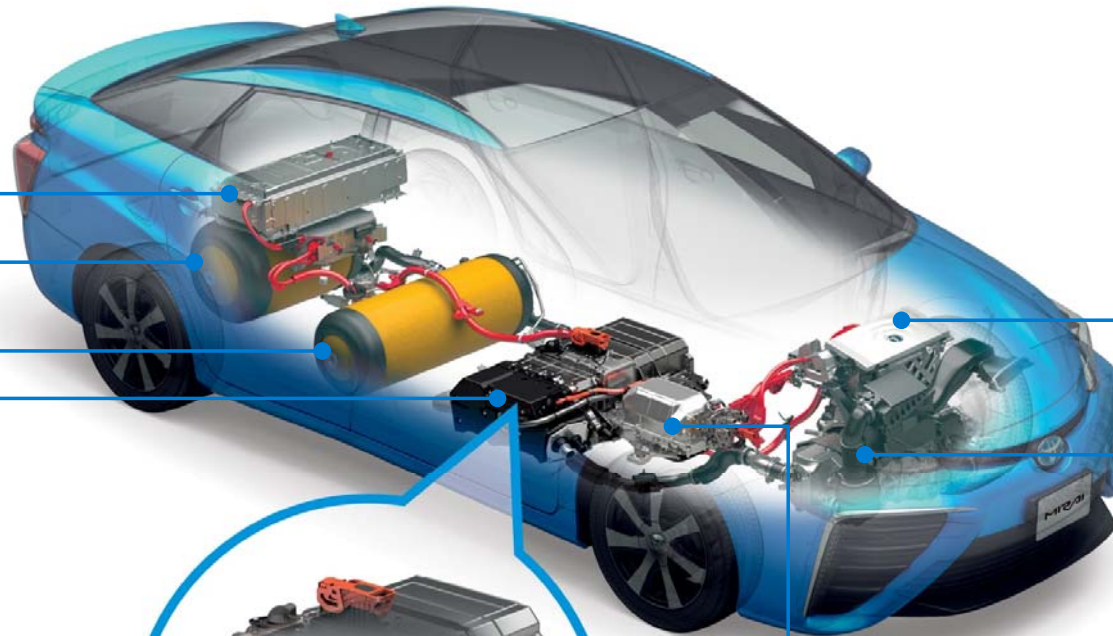
Fuel Cell Stack

Power Control Unit

Motor

Low  
center of  
gravity

Converter



# Advances in technology: efficiency



Volume  
**-43%**

Weight  
**-48%**

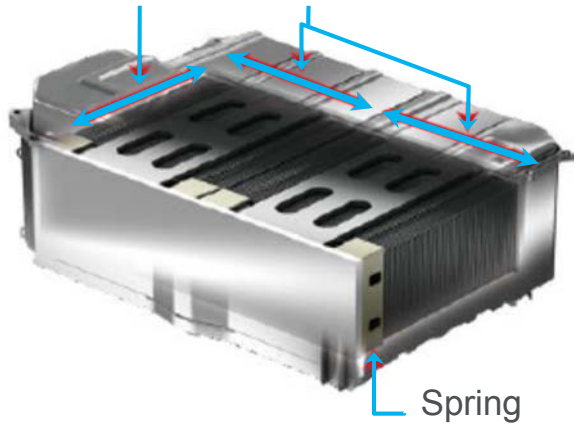
Power  
**+26%**

## 2008 MODEL FUEL STACK

**1.4 kW/L**

(Maximum output: 90 kW/volume: 64L; weight: 108kg)

200 cells x dual-line stacking = 400 cells

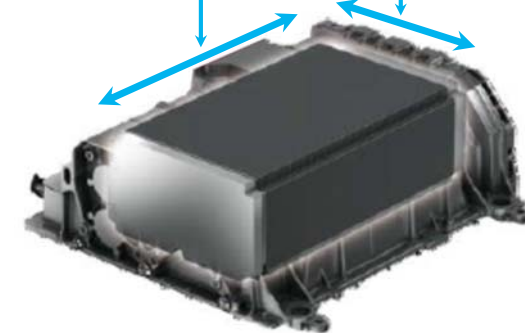


## MIRAI FUEL STACK

**3.1 kW/L**

(Maximum output: 114 kW / volume: 37L; weight: 56kg)

370 cells Single-line stacking



**2.2 times  
better volume  
power density**



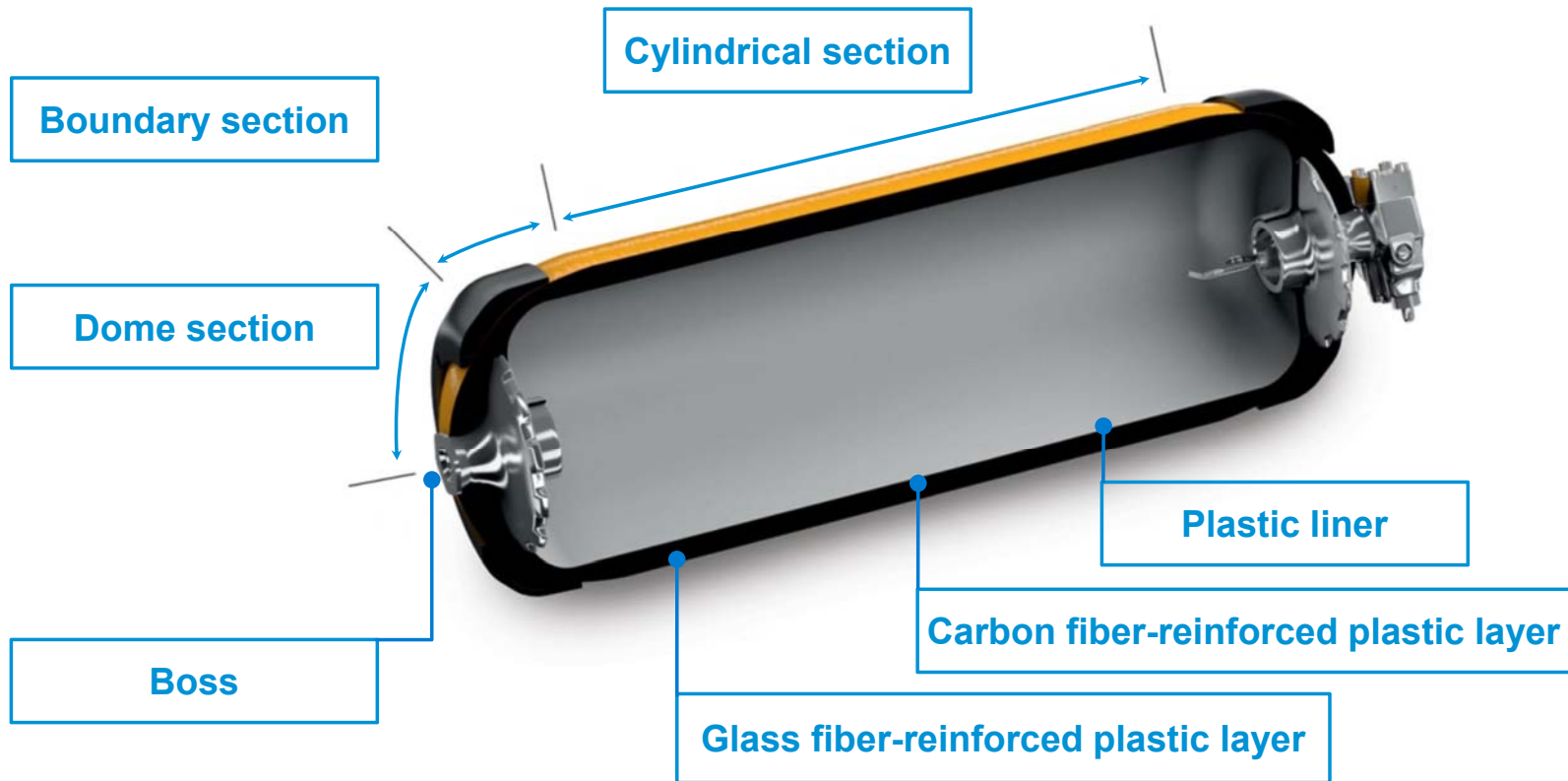


# State of the art H<sub>2</sub> tank technology



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700  
bar

# Why do we introduce Mirai now



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**Standardization**



**Infrastructure**

**Customer**



# Requirement for success



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**Infrastructure**

Standardization

**700 bar !**

Customer

**Main challenges:**

**Cost and  
capacity to  
manufacture**



# Towards a future hydrogen society



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THANK YOU