Toyota's View on the Future Powertrain

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Toyota Motor Europe

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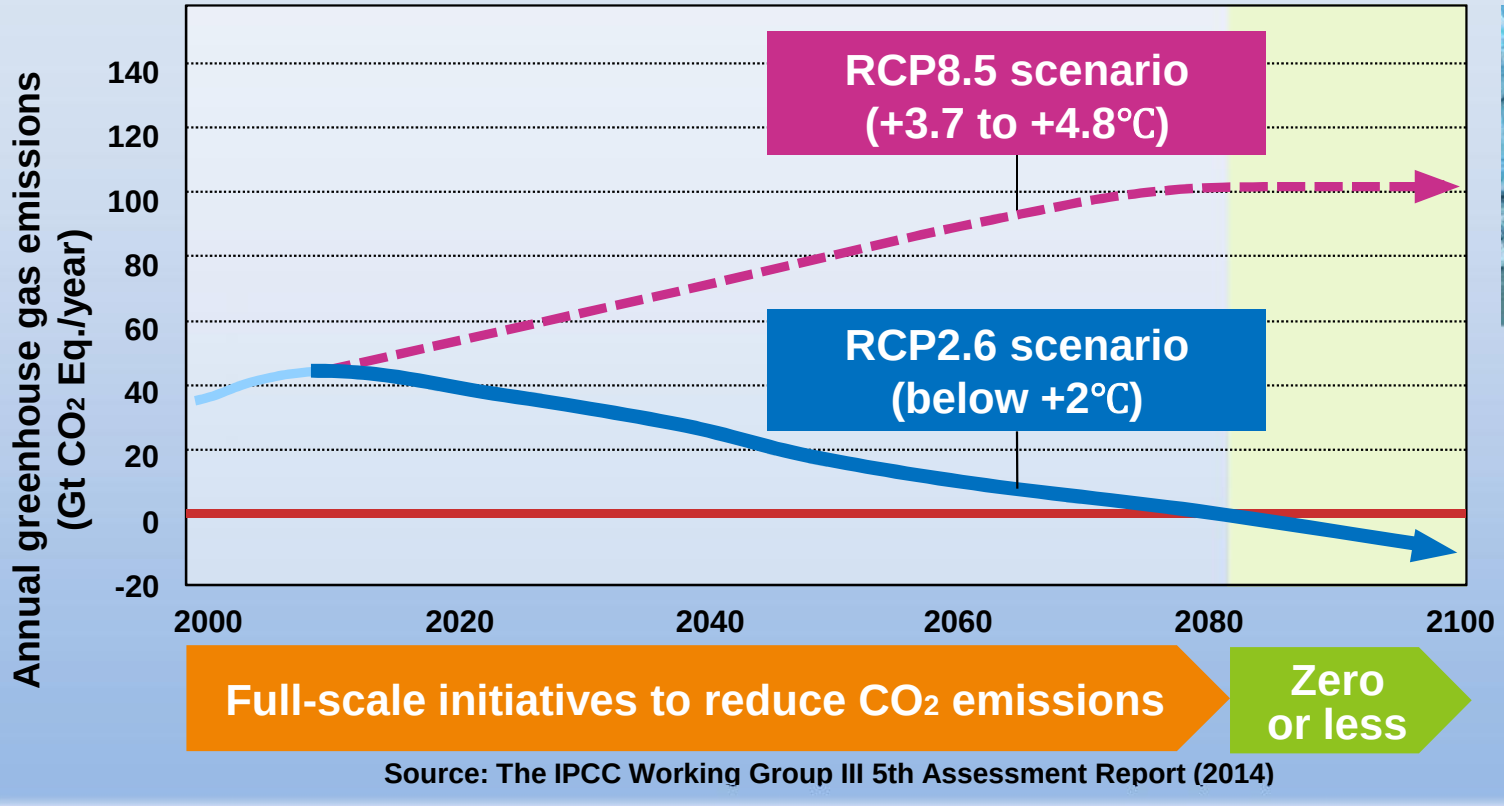
1. Toyota 2050 Environmental Challenge

The global environment seems to be getting worse rather than better.

Forecast of international climate change



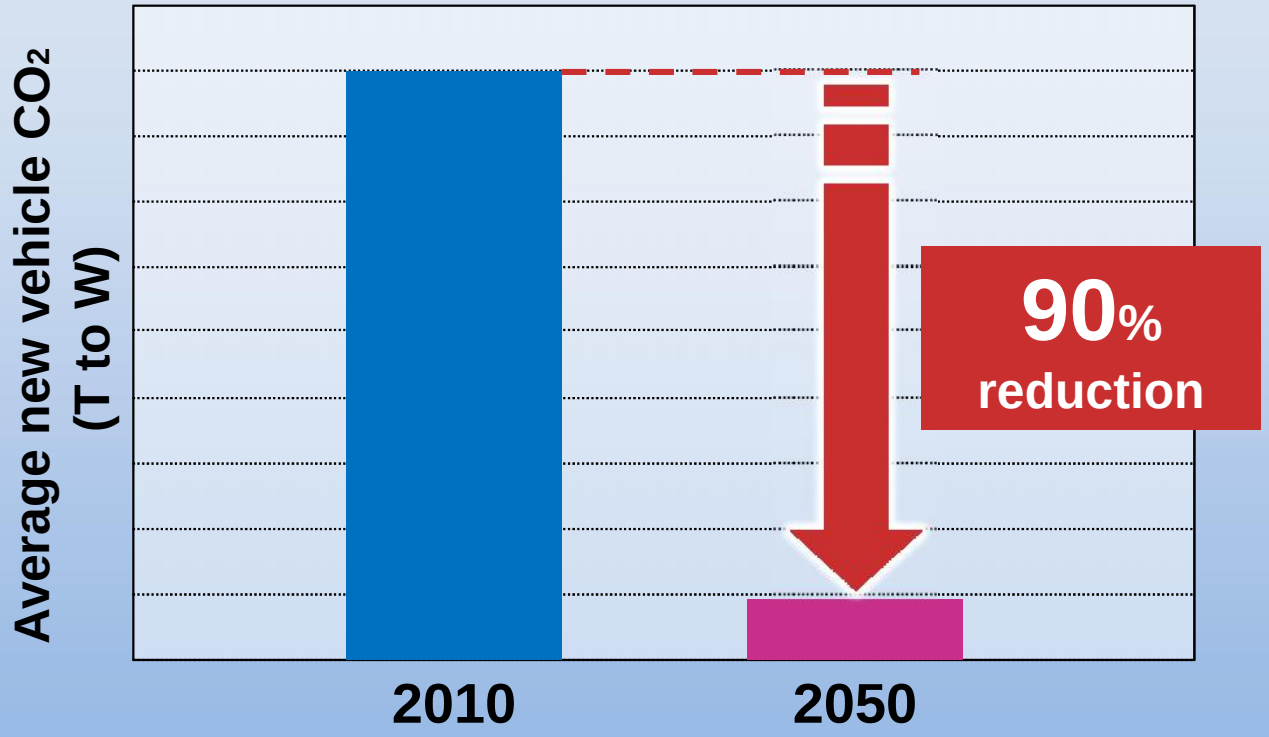
Source: The IPCC Working Group III 5th Assessment Report (2014)

*RCP: Representative Concentration Pathway

There is no time to lose for reducing Green House Gas emissions.

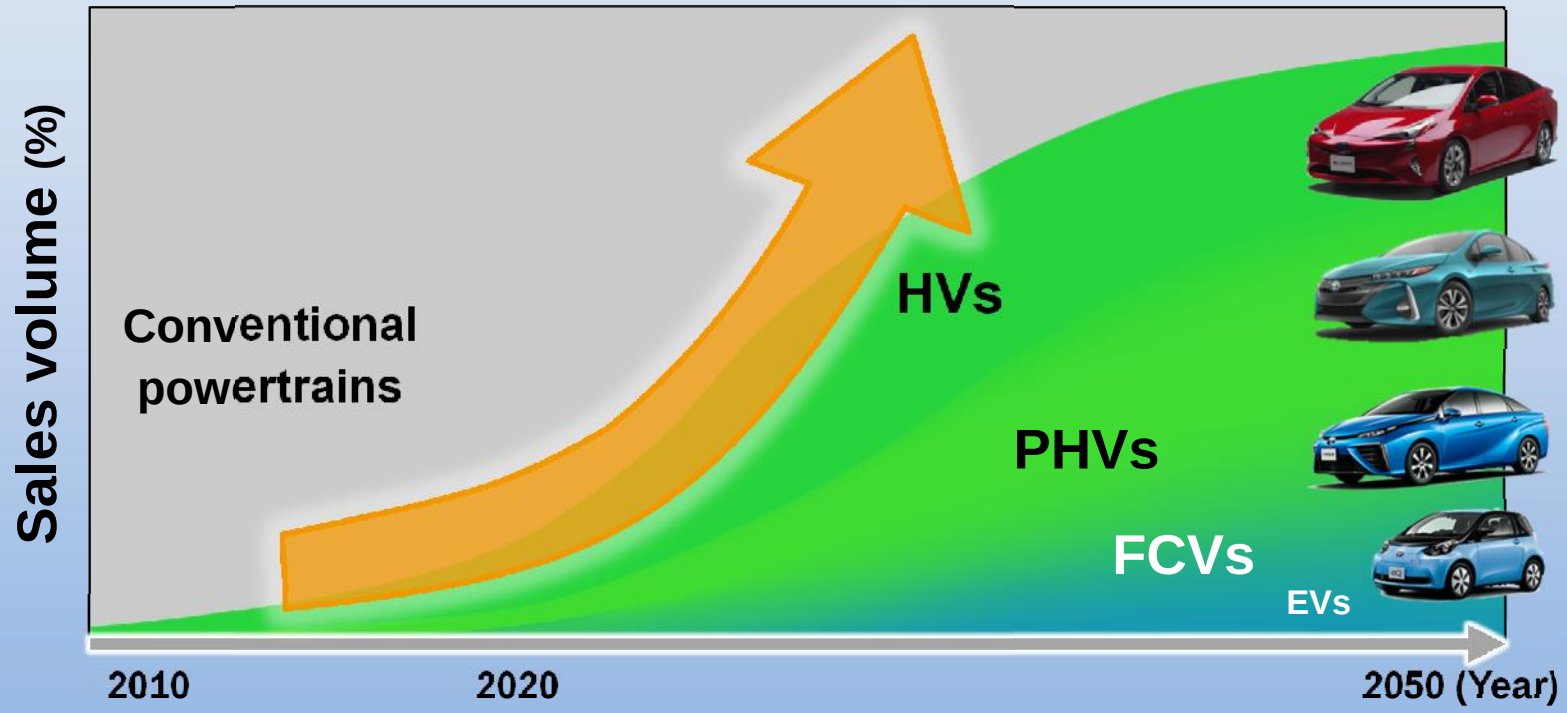
Specific challenges that Toyota is taking on

New vehicle zero CO_2 emissions challenge



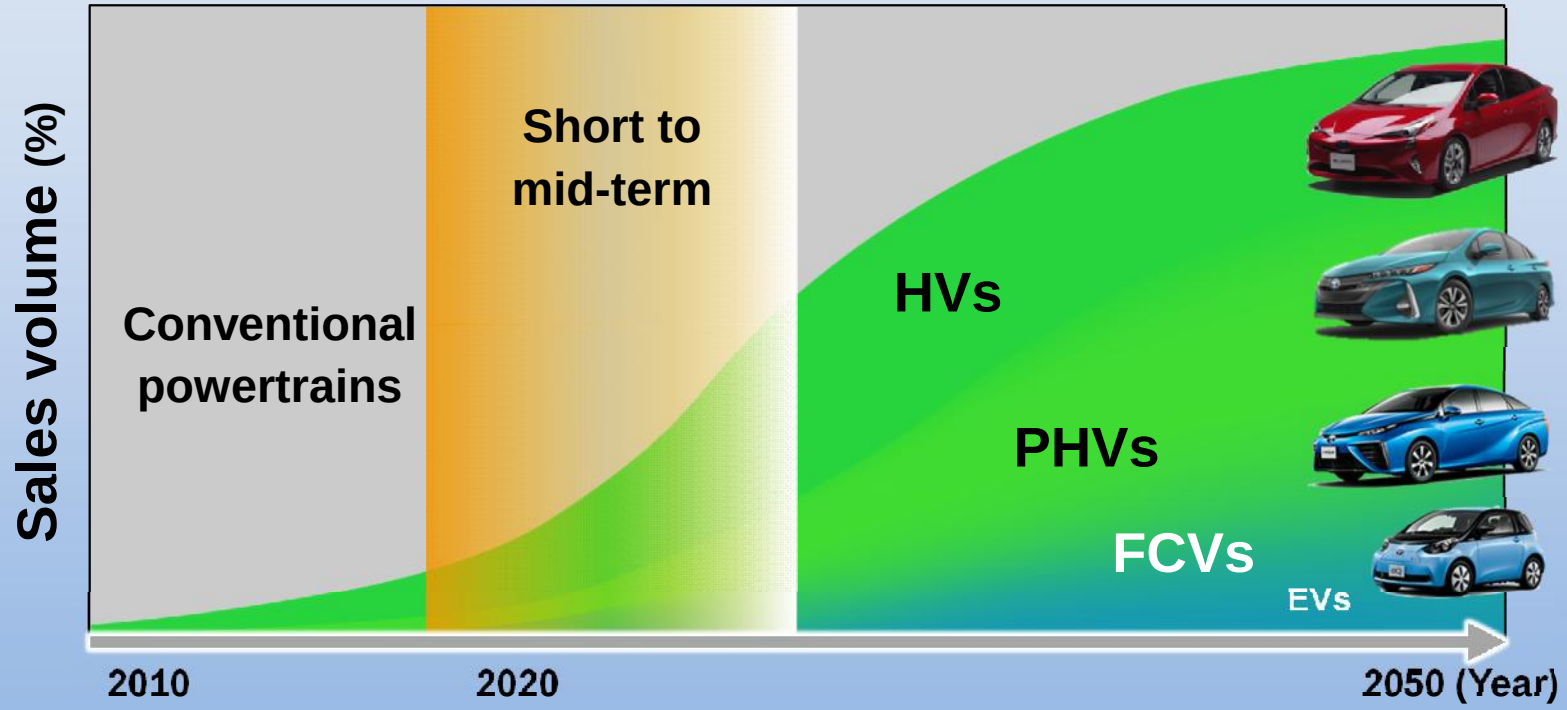
90% reduction in new vehicle CO_2 emissions by 2050 compared to 2010.

Development of next generation vehicles



**We will continue to launch more HVs,
while accelerating the development of next-generation vehicle technology.**

Development of next generation vehicles



Short to mid term: Enhance performance of the whole lineup, from conventional vehicles to PHVs. Key role for new generation TNGA powertrains: meeting CO2 targets, while boosting vehicle appeal.

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2. Enhanced Environmental Performance

TNGA Platforms

TNGA Powertrains

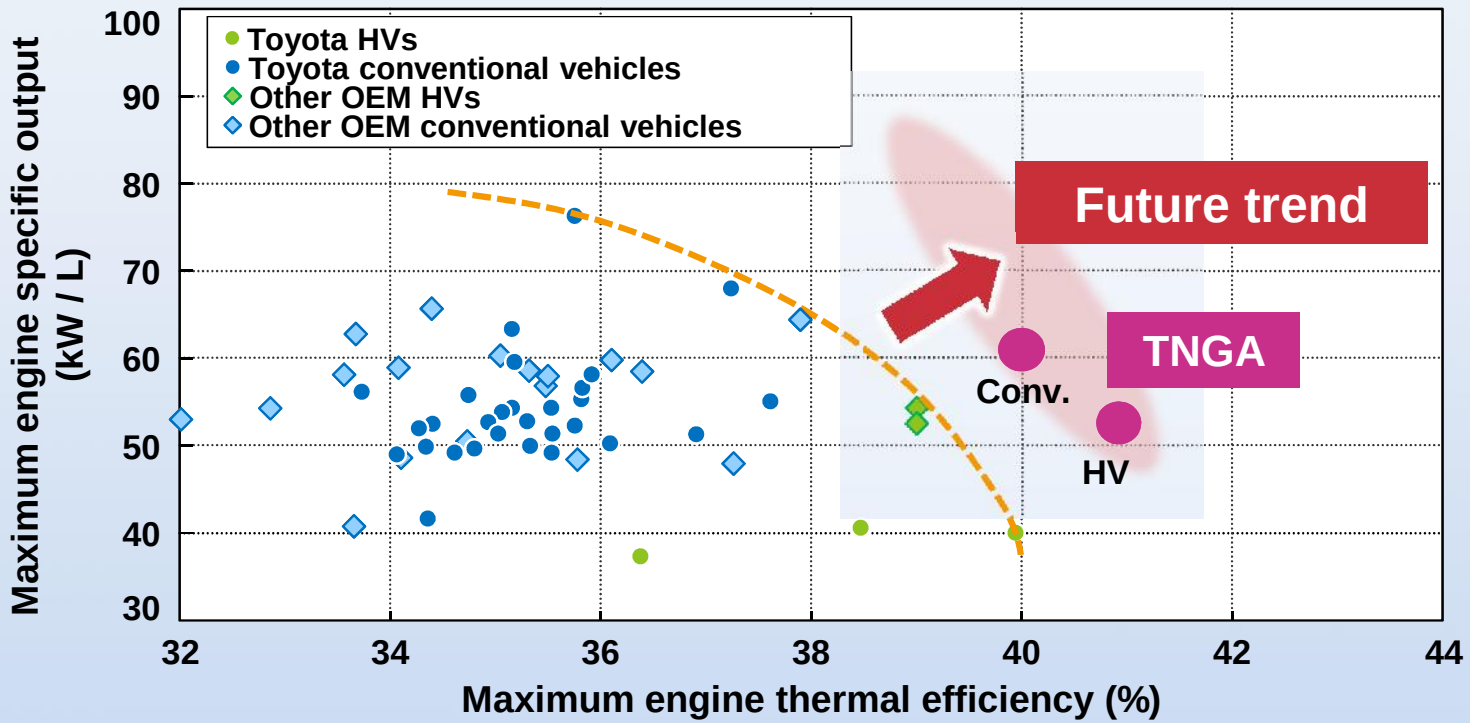
New engines

New transmissions

New hybrid systems

Improve basic performance by developing new platforms and powertrains.

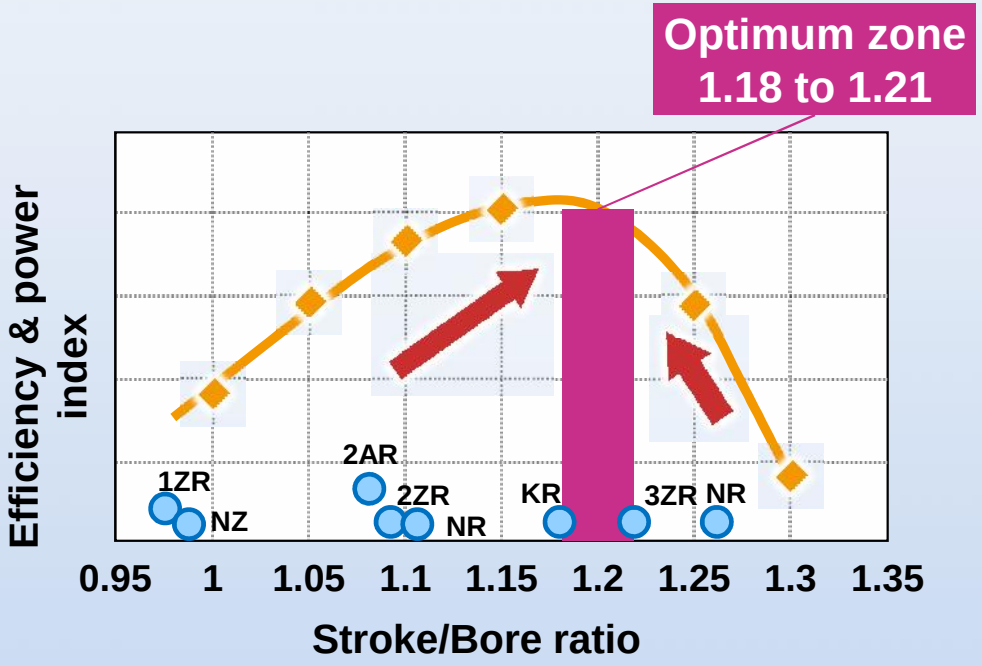
TNGA engines : Thermal efficiency and power



Overcome trade-off between thermal efficiency and output performance.

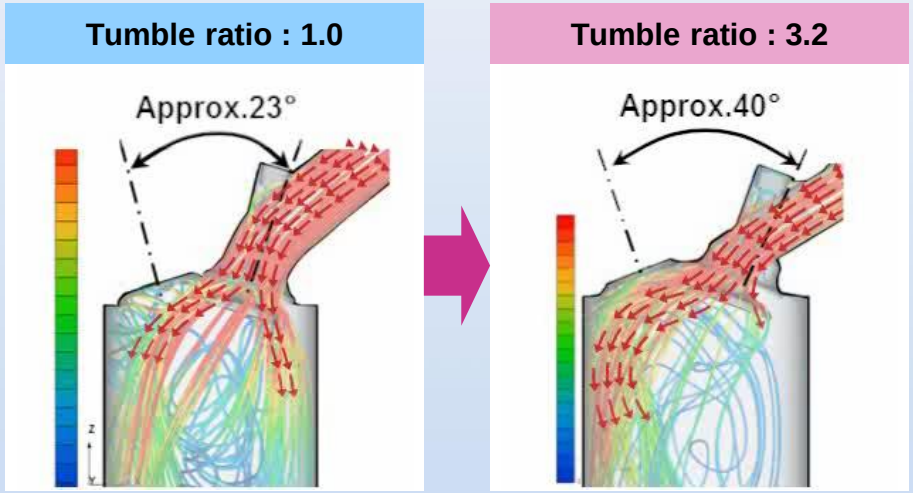
Achieved by revising basic engine specifications

Optimized bore / stroke ratio



Valve angle

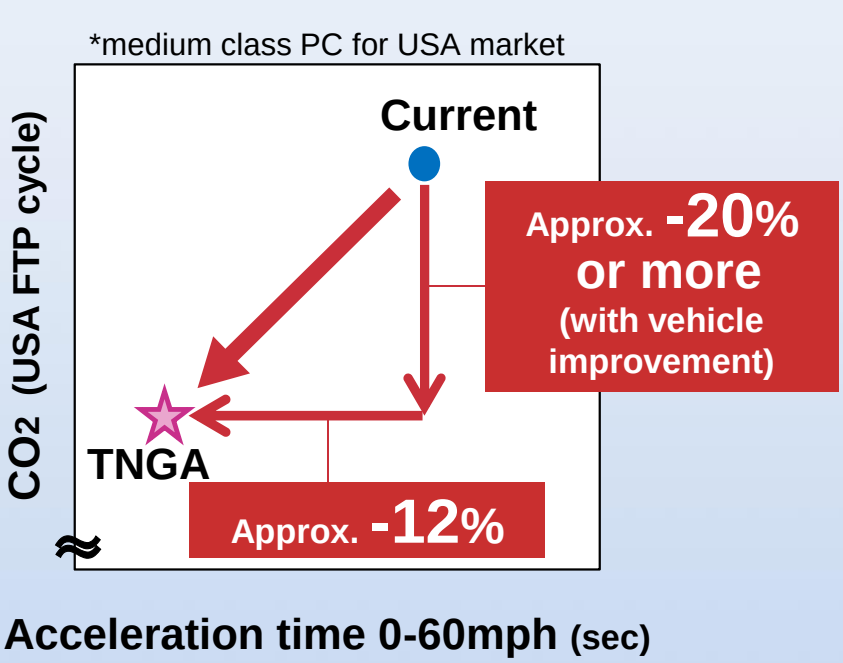
Increase intake flow + **Intensify tumble**

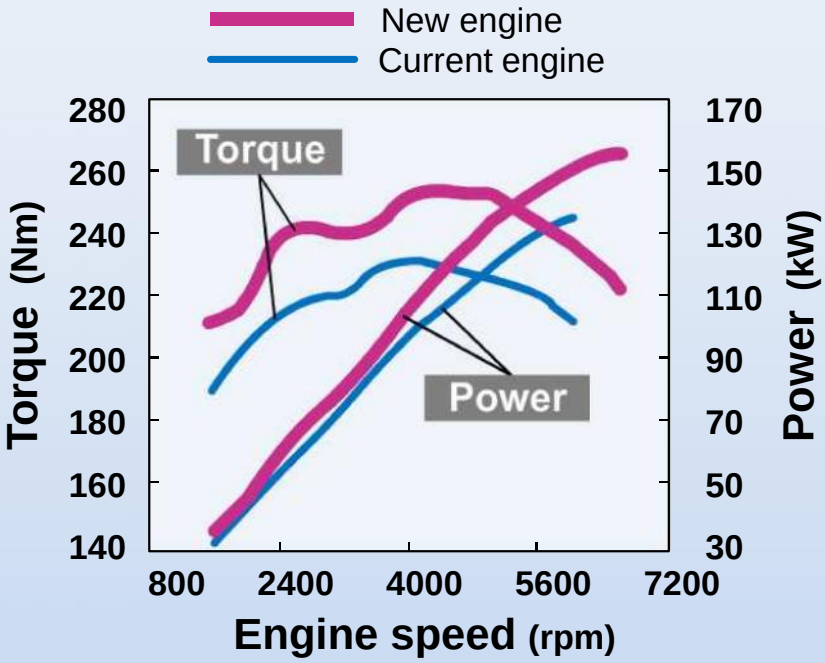


Basic engine specifications such as bore / stroke ratio and valve angle were optimized. Parts weight and size have been reduced.

The TNGA Powertrain achievement

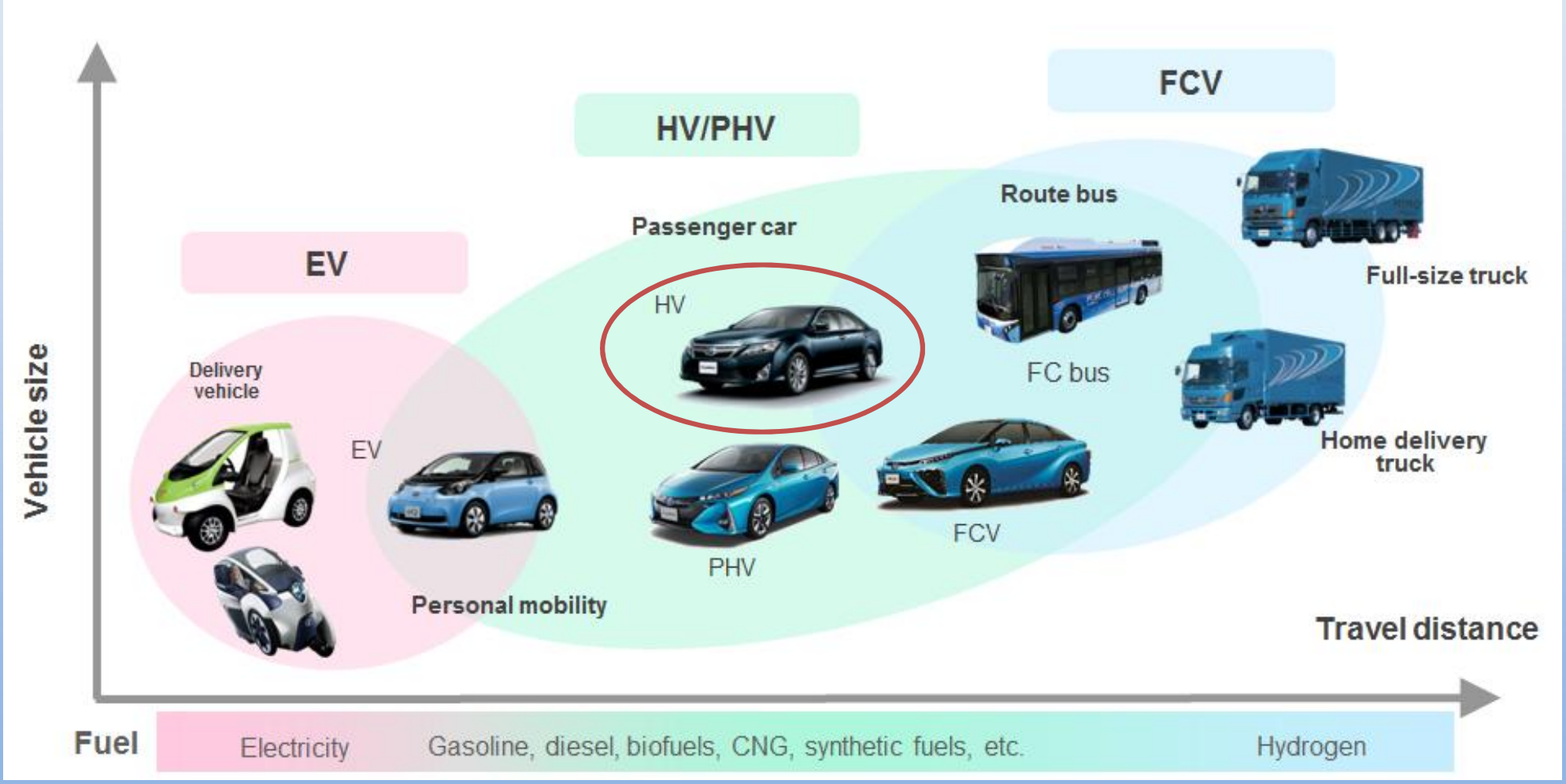
Economical and powerful





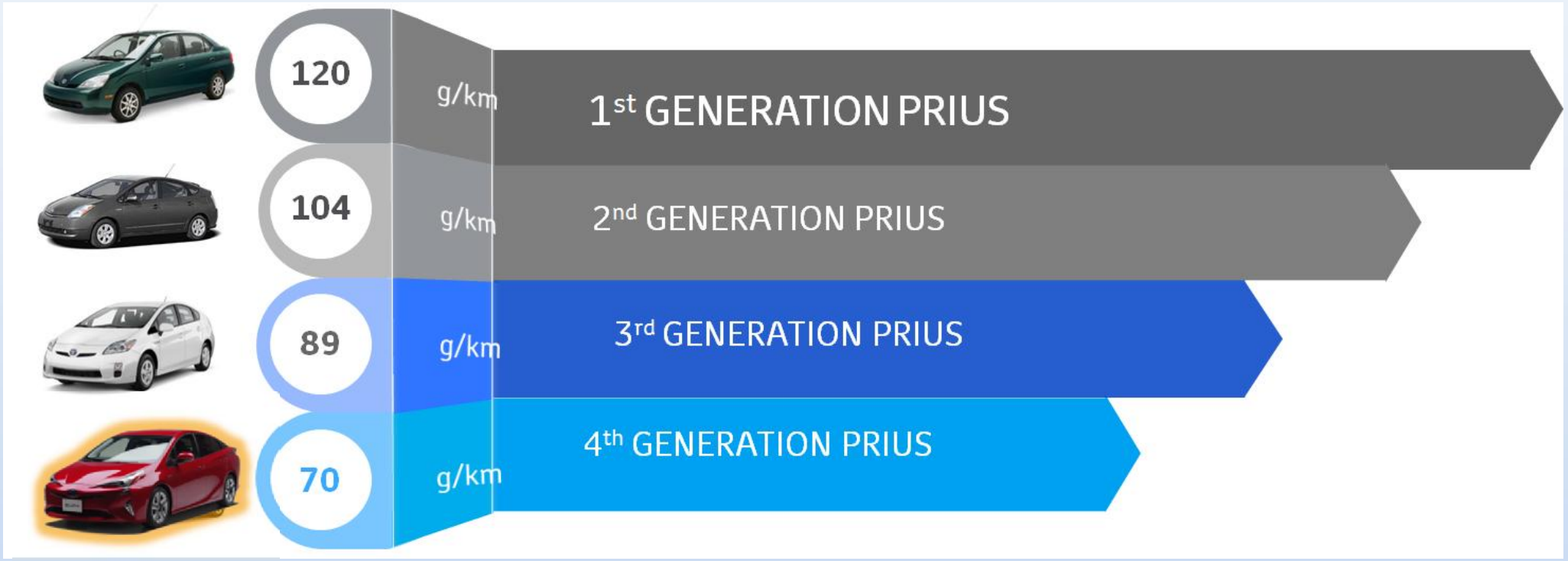
For an ever better driving feel, engine torque is improved in all range, while drastically reducing CO_2.

2. Enhanced Environmental Performance



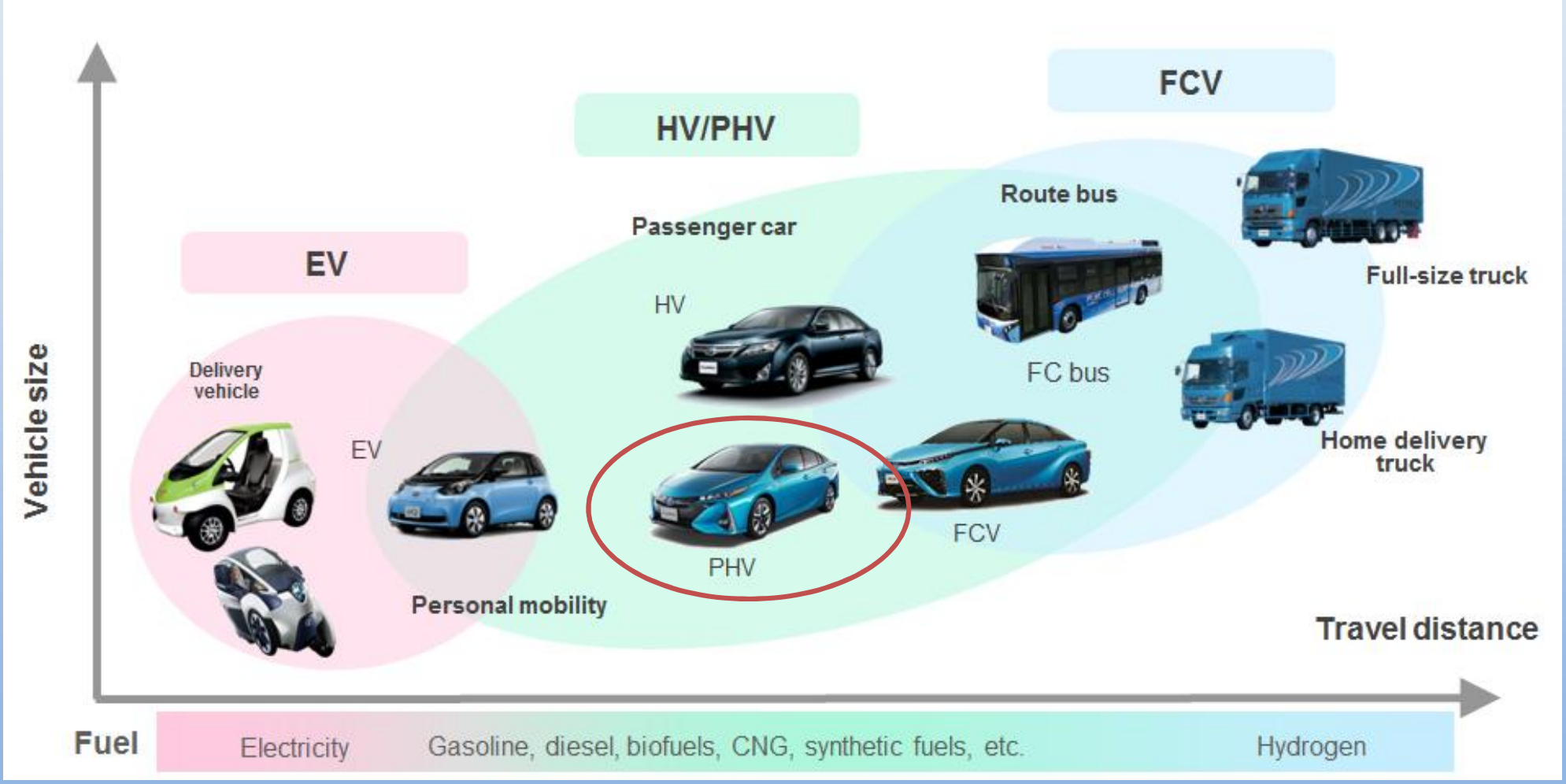
2. Enhanced Environmental Performance

Best fuel economy

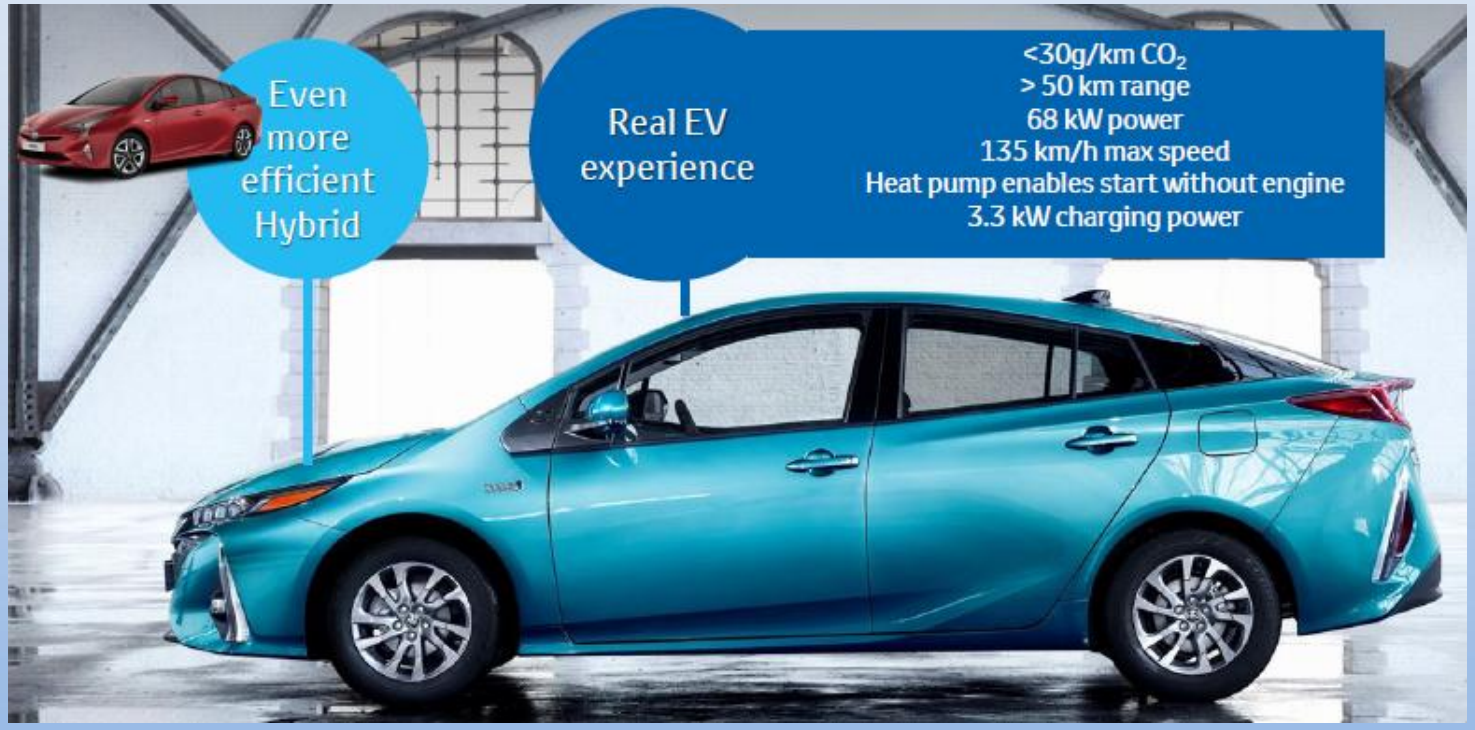


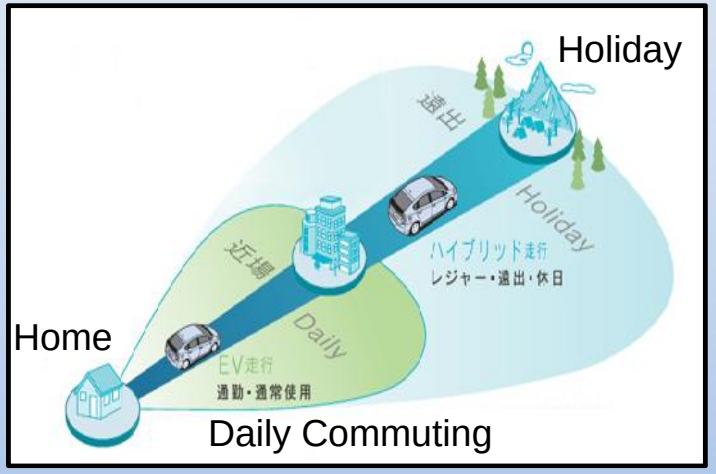
Continuous improvement of fuel efficiency by the TNGA powertrain.

2. Enhanced Environmental Performance



New Prius PHV

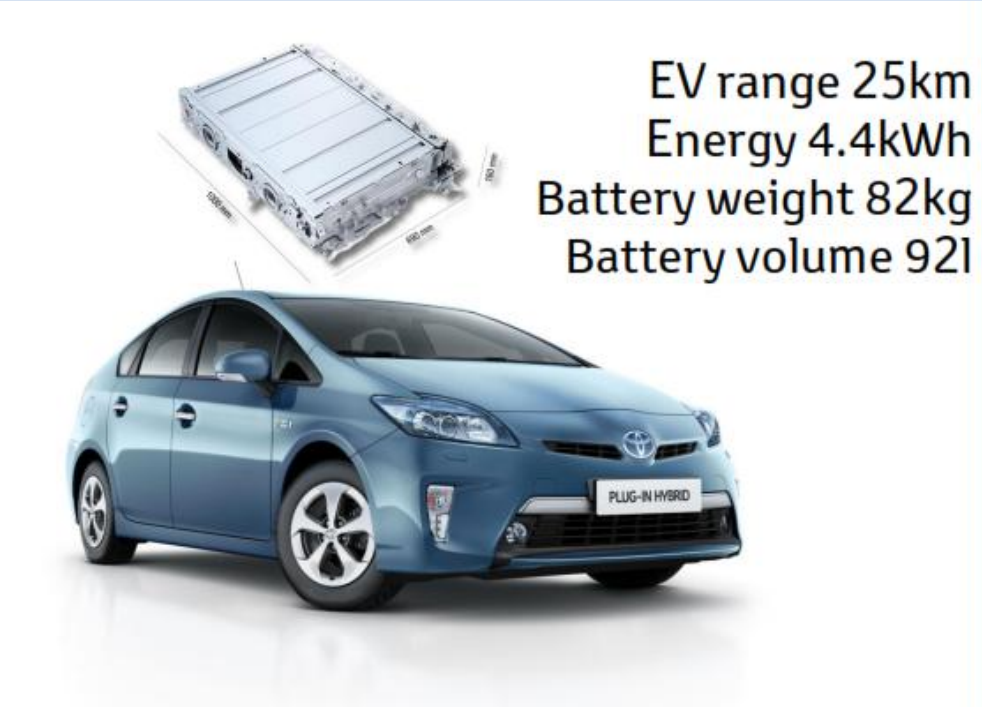




EV driving for daily commuting. No range anxiety

Allows to minimise the local production of emission and to drive in zero emission mode in dedicated location as cities

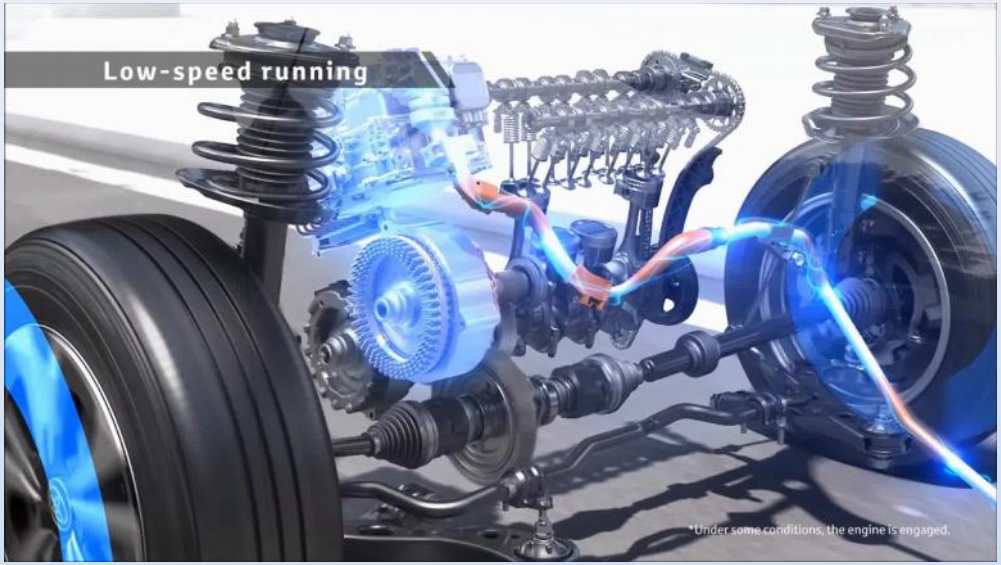
New Prius PHV



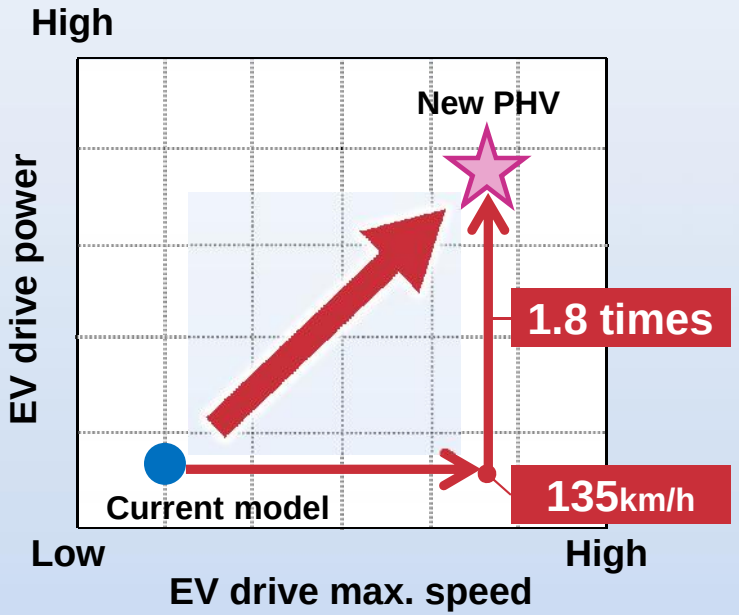
Innovations: Double driving range, by battery improvement.
Heat pump, battery warming.

New Prius PHV

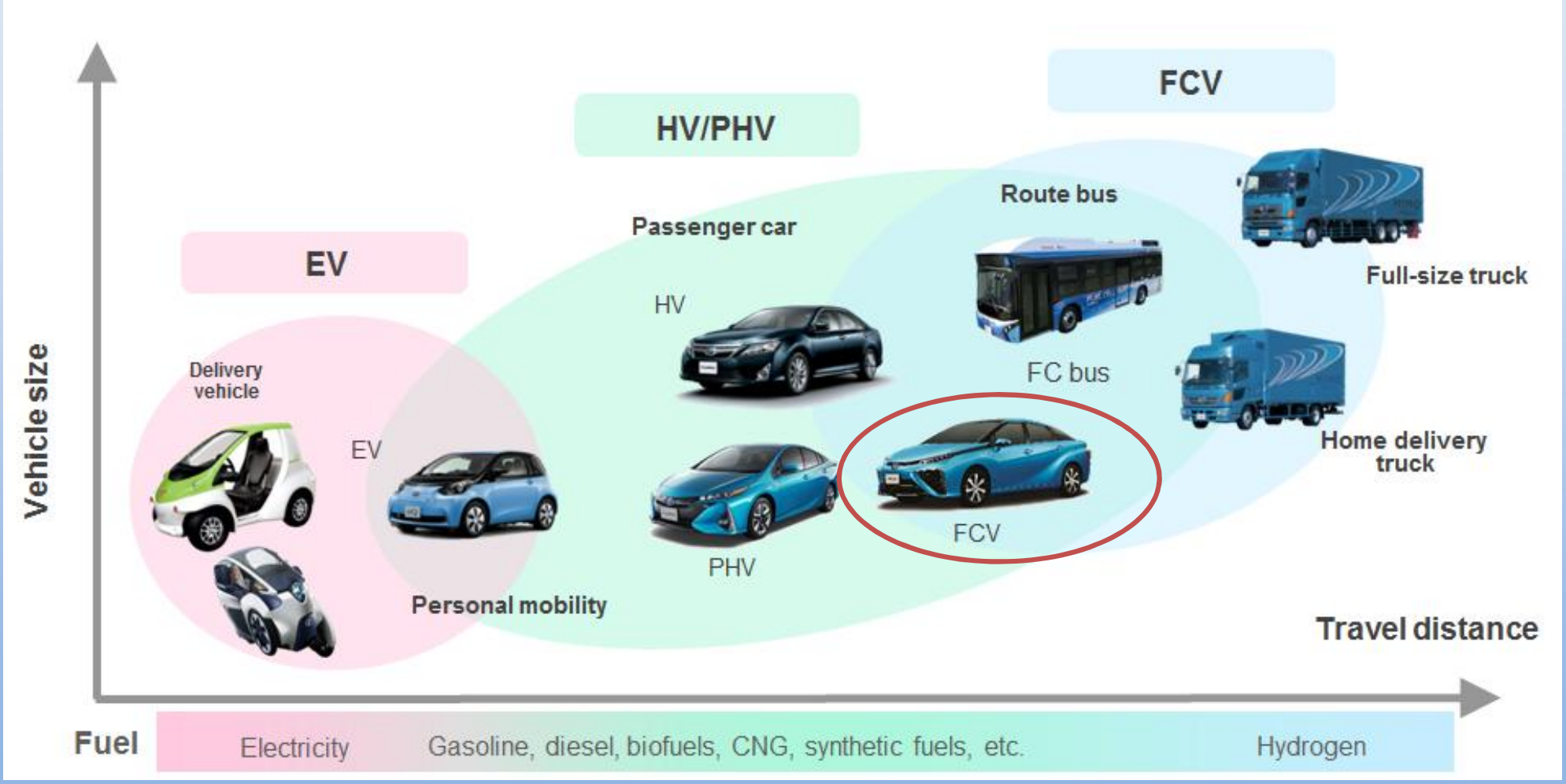
Improved environmental performance, while realizing better dynamic performance



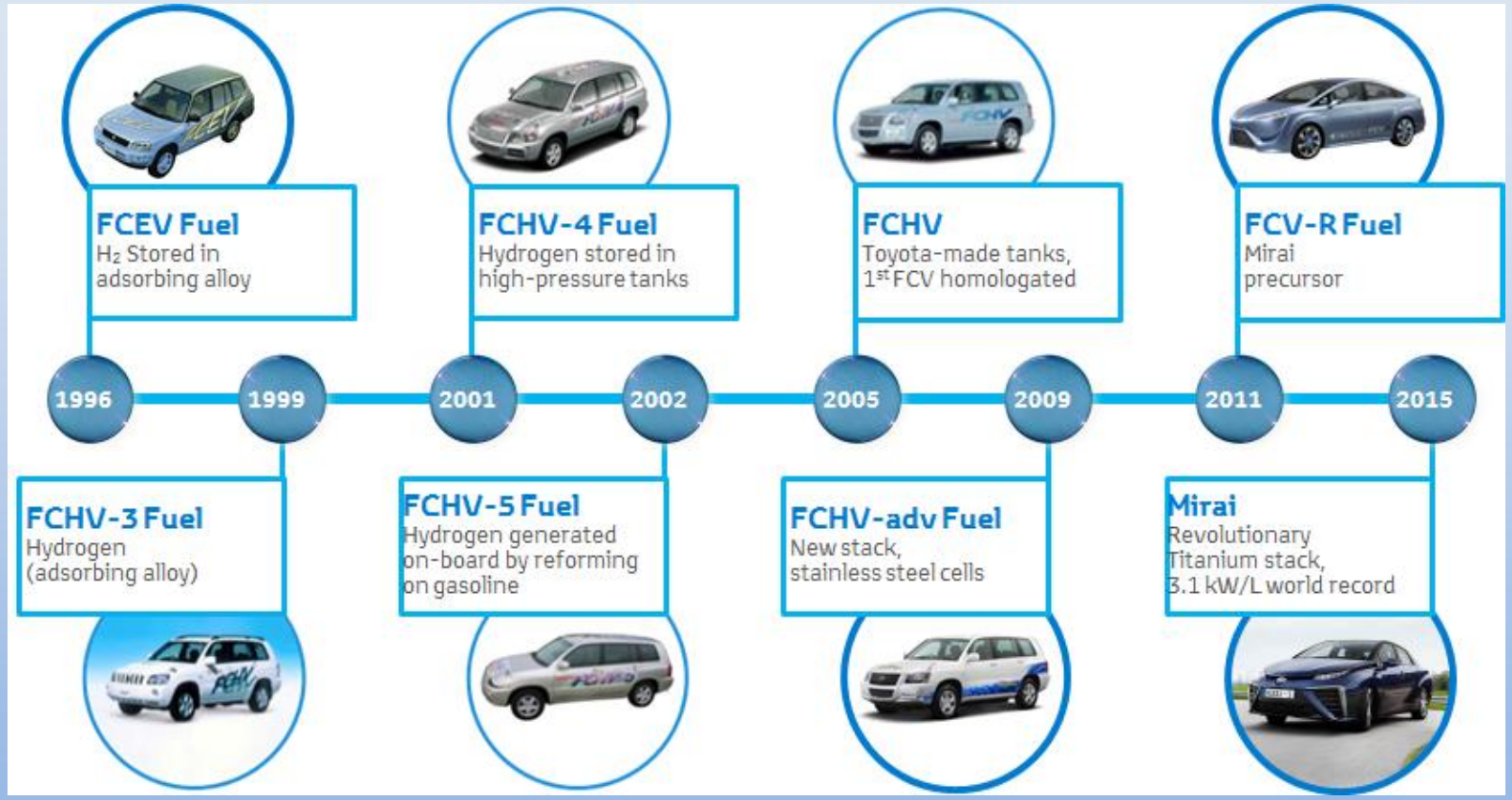
Utilize generator for strong acceleration



The new Prius PHV uses two motors to achieve more powerful acceleration.


FCV
HV/PHV
EV
Route bus
Passenger car
Full-size truck
HV
Delivery vehicle
FC bus
EV
Home delivery truck
FCV
PHV
Personal mobility
Vehicle size
Travel distance
Fuel
Electricity
Gasoline, diesel, biofuels, CNG, synthetic fuels, etc.
Hydrogen

2. Enhanced Environmental Performance



Developing hydrogen FCV for over 20 years

Mirai – Advantages of Fuel Cell Vehicle

Energy diversity

H2 from a wide variety of primary energy

Fun to drive

Electric motor enables smooth, quiet driving.
Excellent acceleration at start to low/mid speed.

Zero emissions

Zero tailpipe CO2

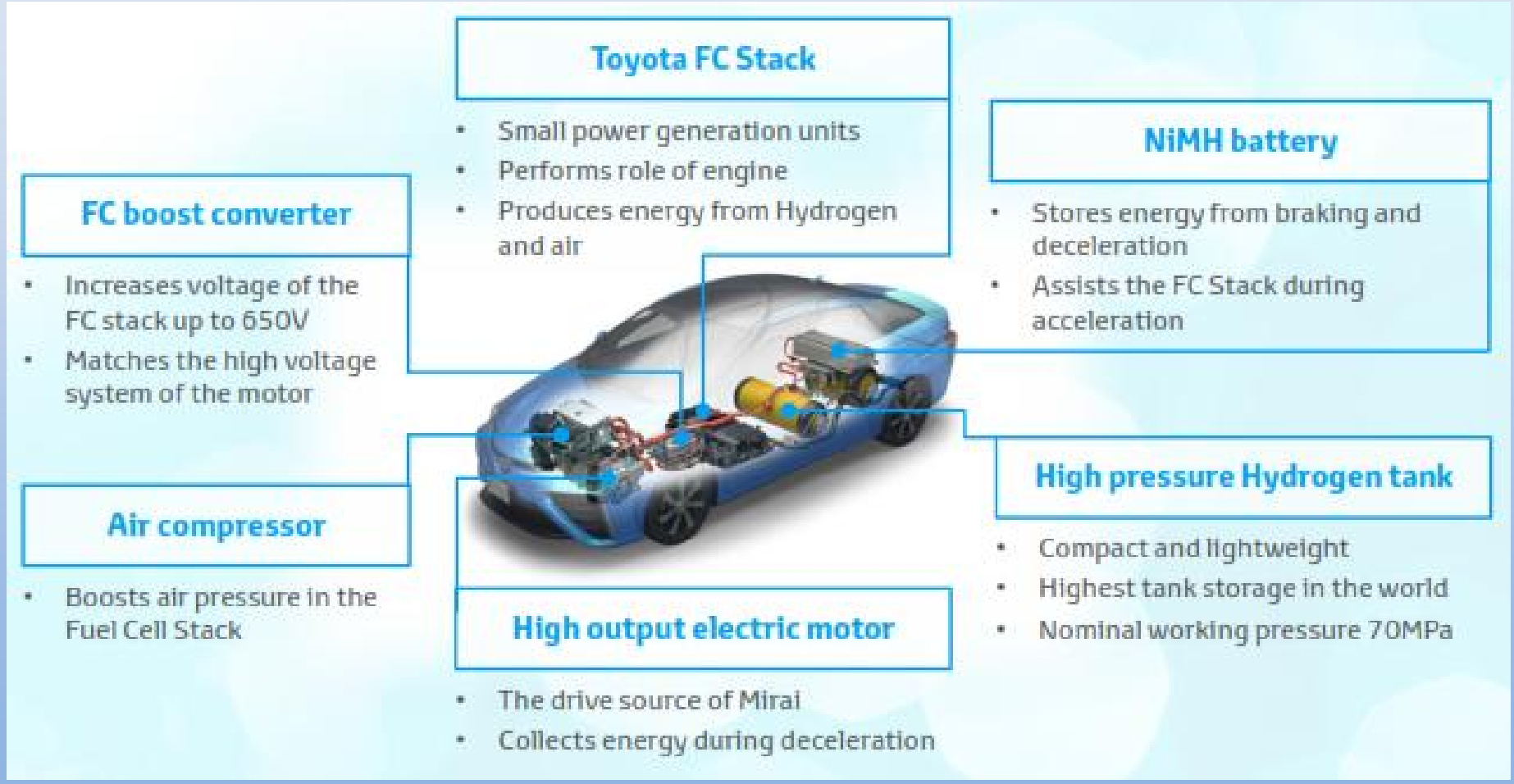
Usage

Range: gasoline equivalent

Maximum range	Power source	Max output	Max torque	FC stack output	Fuelling time
MIRAI  → 500 km*	Motor	113 kW (154 hp)	335 Nm (instant)	114 kW (155 hp)	3-5 min 

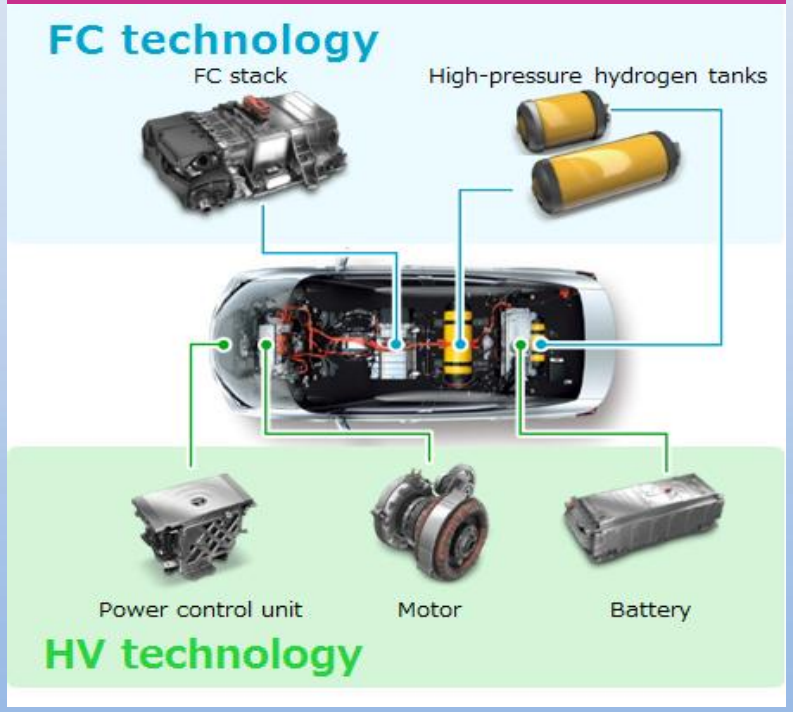
*Depending on operating conditions

Mirai – The Toyota Fuel Cell System



2. Enhanced Environmental Performance

Cost reduction thanks to commonisation with HV technology



Safety at the heart of the Mirai development

Toyota FC stack

Steel frame and fibre-reinforced plastic used in aircraft protect the FC Stack when driving on uneven roads.

Impact safety structure

Protects the FC Stack and Hydrogen tanks in the event of an accident.

Hydrogen sensors

Provide warnings and can shut off tank main stop valves.

High pressure Hydrogen tank

Made from reinforced carbon of the highest quality to prevent leaking of Hydrogen.

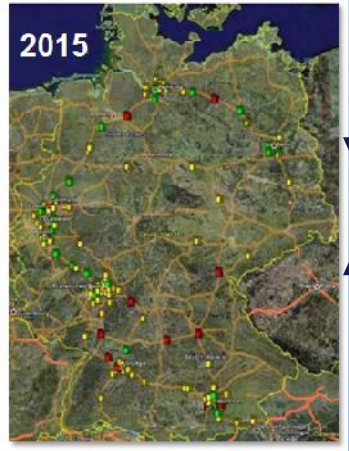
Hydrogen related parts

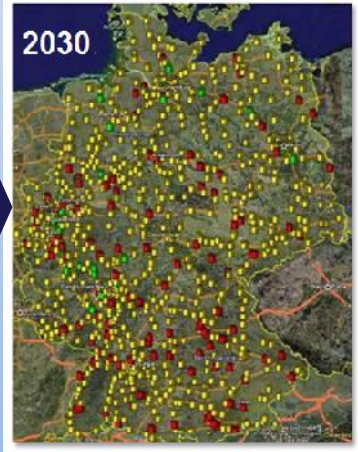
Located outside the cabin.

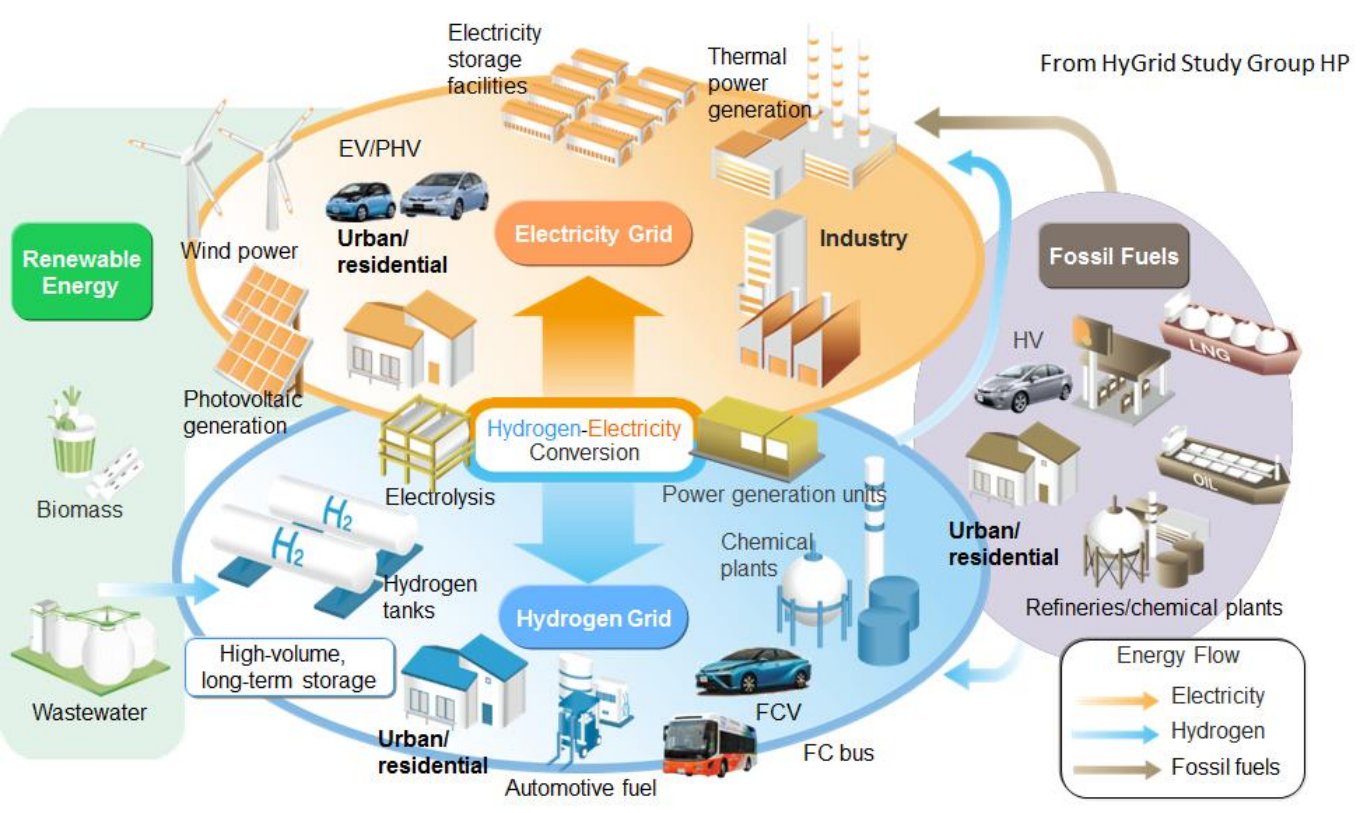
Start of mass production and gradual introduction to the market possible thanks to maturity of technology and cost reduction.

H2 Infrastructure

Increasing number of initiatives
E.g. Clean Energy Partnership in Germany: 400 stations by 2023







Road to carbon-free hydrogen society requires involvement of many stakeholders: authorities, manufacturers, energy suppliers and customers.

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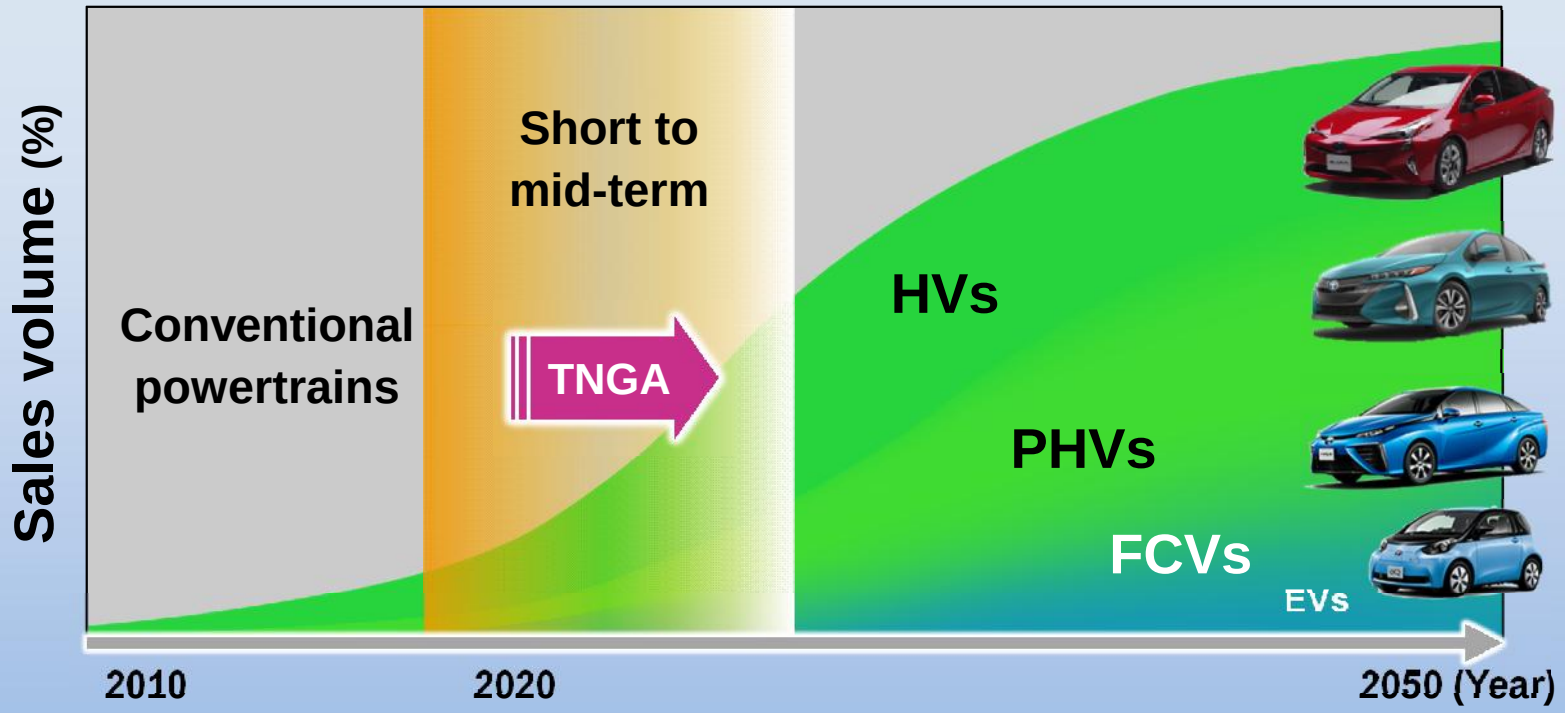
3. Summary



- Toyota introduces several powertrain technologies, towards zero CO2.
- TNGA powertrains are key to reduce CO2 in short to mid-term.
- Achieving a carbon-free hydrogen society in the long term, is a collaborative effort.


Thank you
for your kind attention