

Maximizing Freedom of Mobility Worldwide with Reducing CO₂ Emission

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TOYOTA

President, Powertrain Company
Toyota Motor Corporation

TOYOTA
RACING

Managing Director, Toyota Racing

We are all "car people"



Making better cars
with development and drive

Victory at WEC Fuji 2026
Motorsport is where we create ever-better cars

At Toyota, we are all car people, "Let's make ever-better cars"



01

A Mother's Hands

Sakichi watched his mother weave late into the night — tired hands that inspired one question: **how can I make life easier ?**

02

The Automatic Loom

He built a machine not to replace people, but **to assist them**. Technology began with empathy.

03

Automobiles

Kiichiro did not stop at looms. He turned to the next thing the era needed — **mobility for society**.

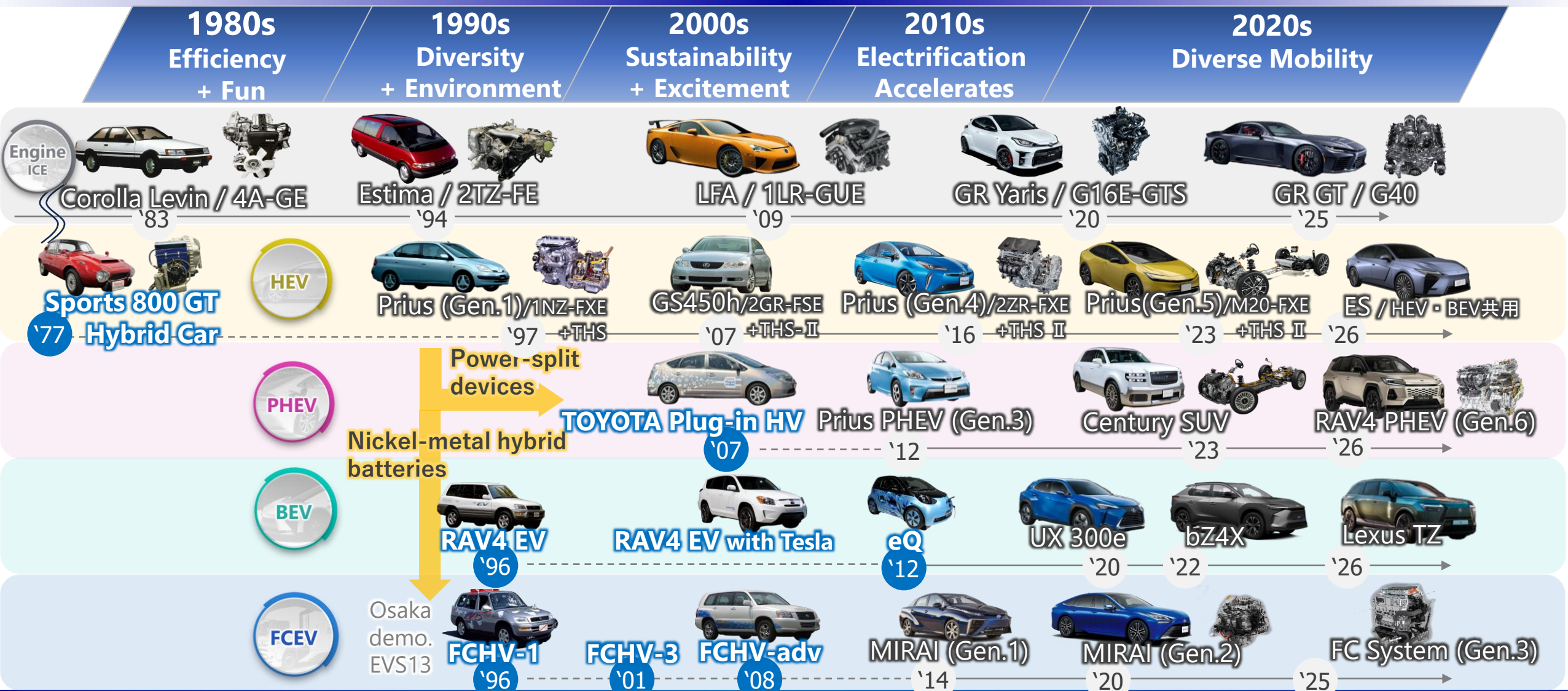
04

Many Pathways

Today that same mindset becomes HEV, PHEV, BEV, hydrogen, and e-fuels — **for any region, any road, any lifestyle**.

Toyota began with a desire to make life easier.
A diverse world needs more than one pathway.

Our Journey of Powertrain Development



Through continuous innovation,
we have provided products that address diverse customer needs.

Reducing Atmospheric CO₂ : LCA

The appropriate electrified powertrain depends on the regional energy mix

LCA segments

**Tank to
Wheel**



Driving

**Well to
Tank**



Fuel



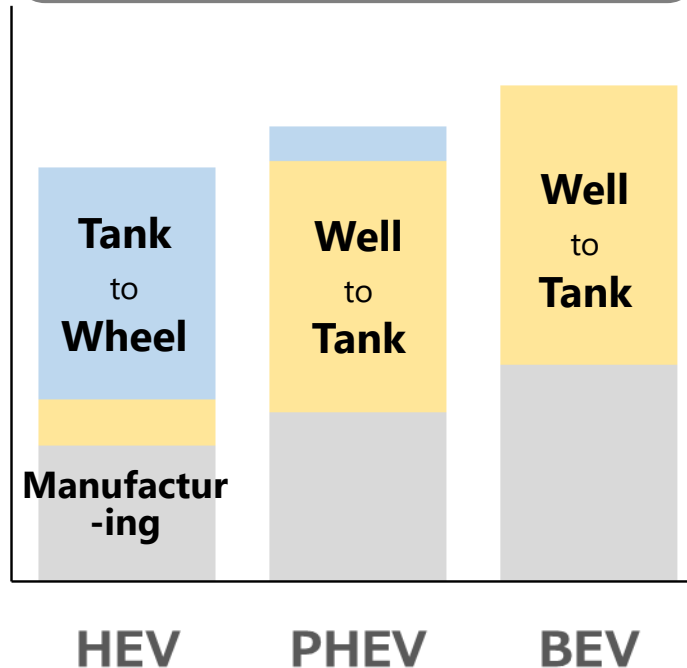
Electricity

**Manufactur-
ing**

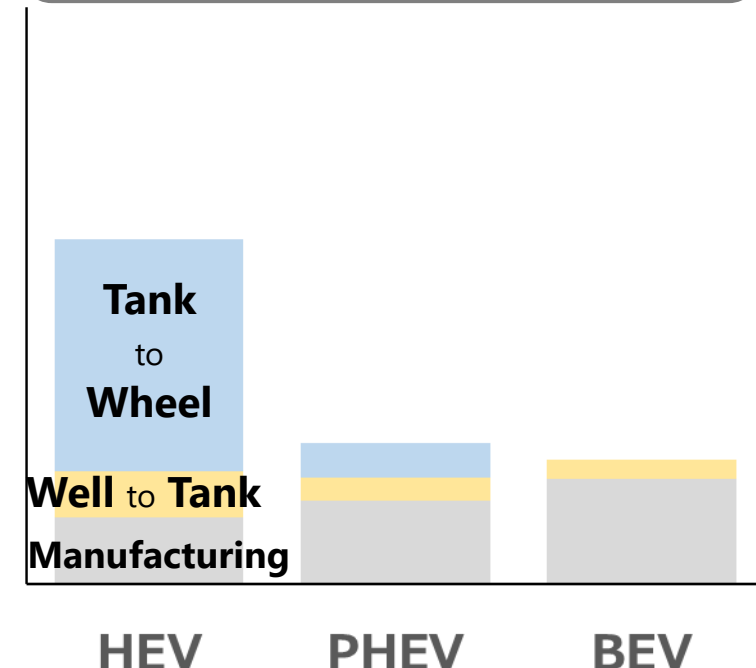


**Parts/Vehicles
/Materials**

Fossil based
Electricity



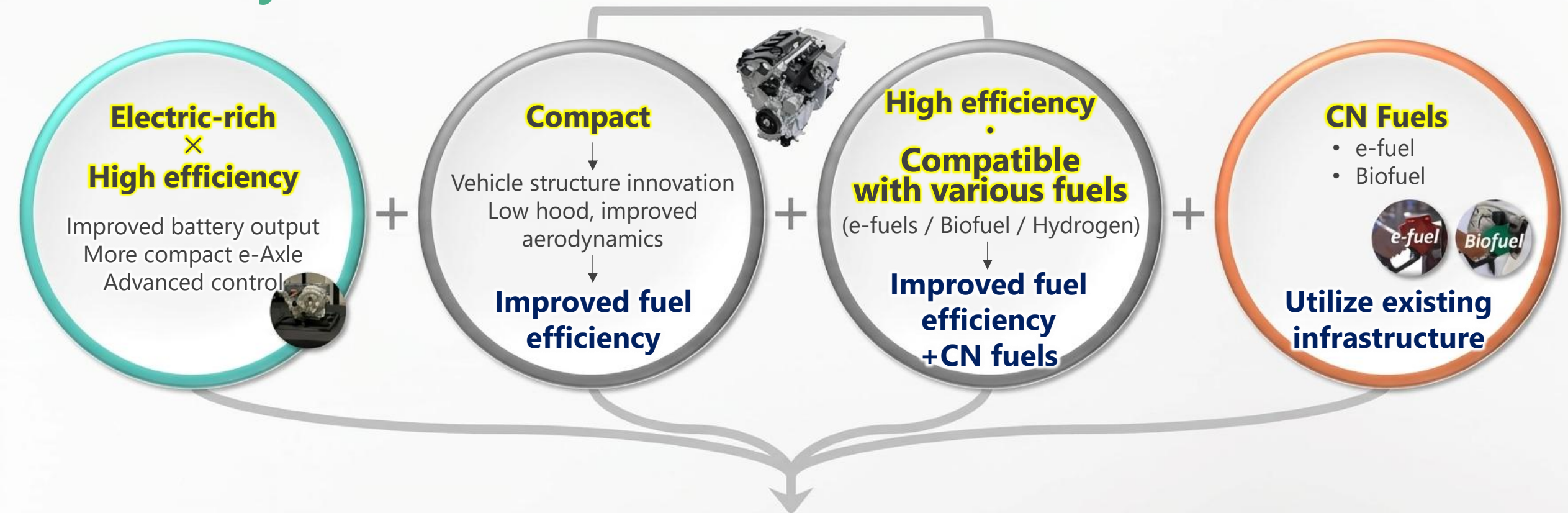
Renewable based
Electricity



Electrified system

ICE

Fuel



※ CN = Carbon Neutral / TCO = Total Cost of Ownership

Advanced technologies, xEVs and carbon-neutral fuels deliver both better environmental performance and lower TCO.



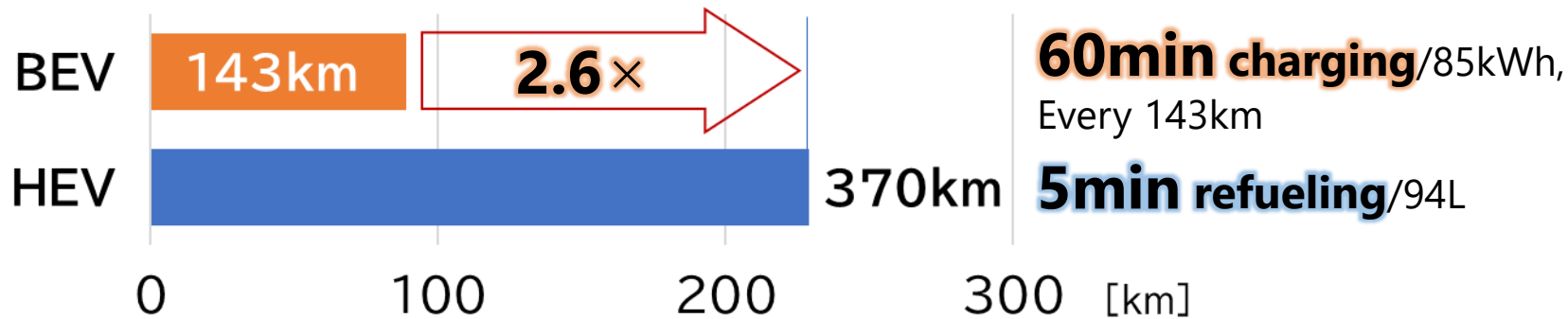
Value delivered only by ICE

■ Continuous high-load driving

Freedom of mobility with high-energy-density fuel



Range per tank (Gross Weight approx. 6,000 kg)



■ Harsh operating environments

Certainty of getting home on roads without infrastructure



Fuel is
efficient energy carrier



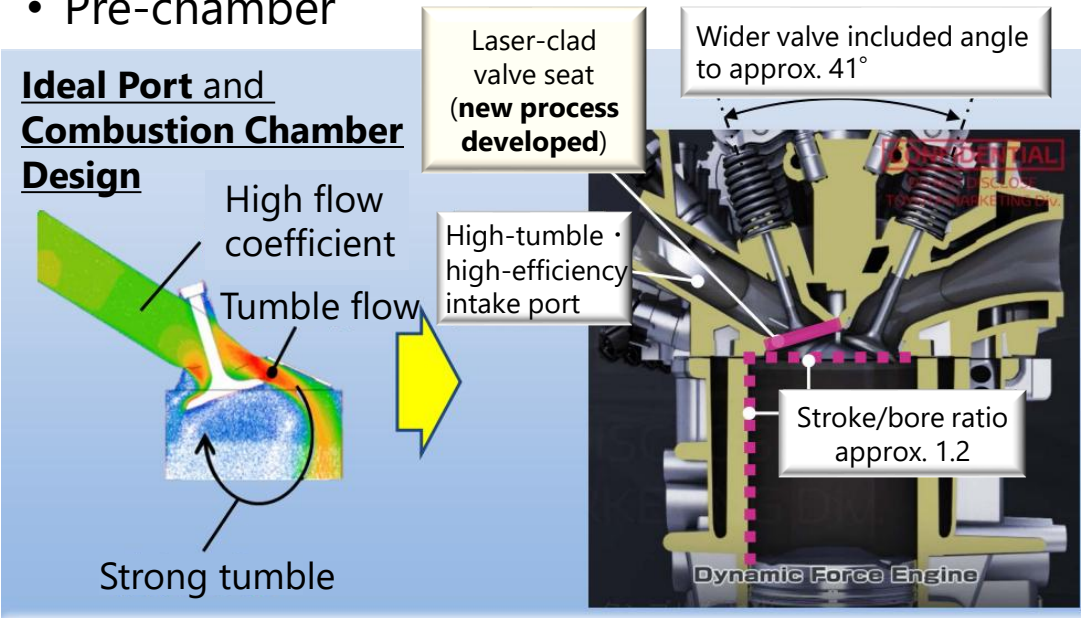
Extreme cold -40°C (Siberia)

ICE is the best solution for many situations

High speed combustion

- Long stroke
- Laser-clad valve seats
- Wider valve included angle
- Pre-chamber

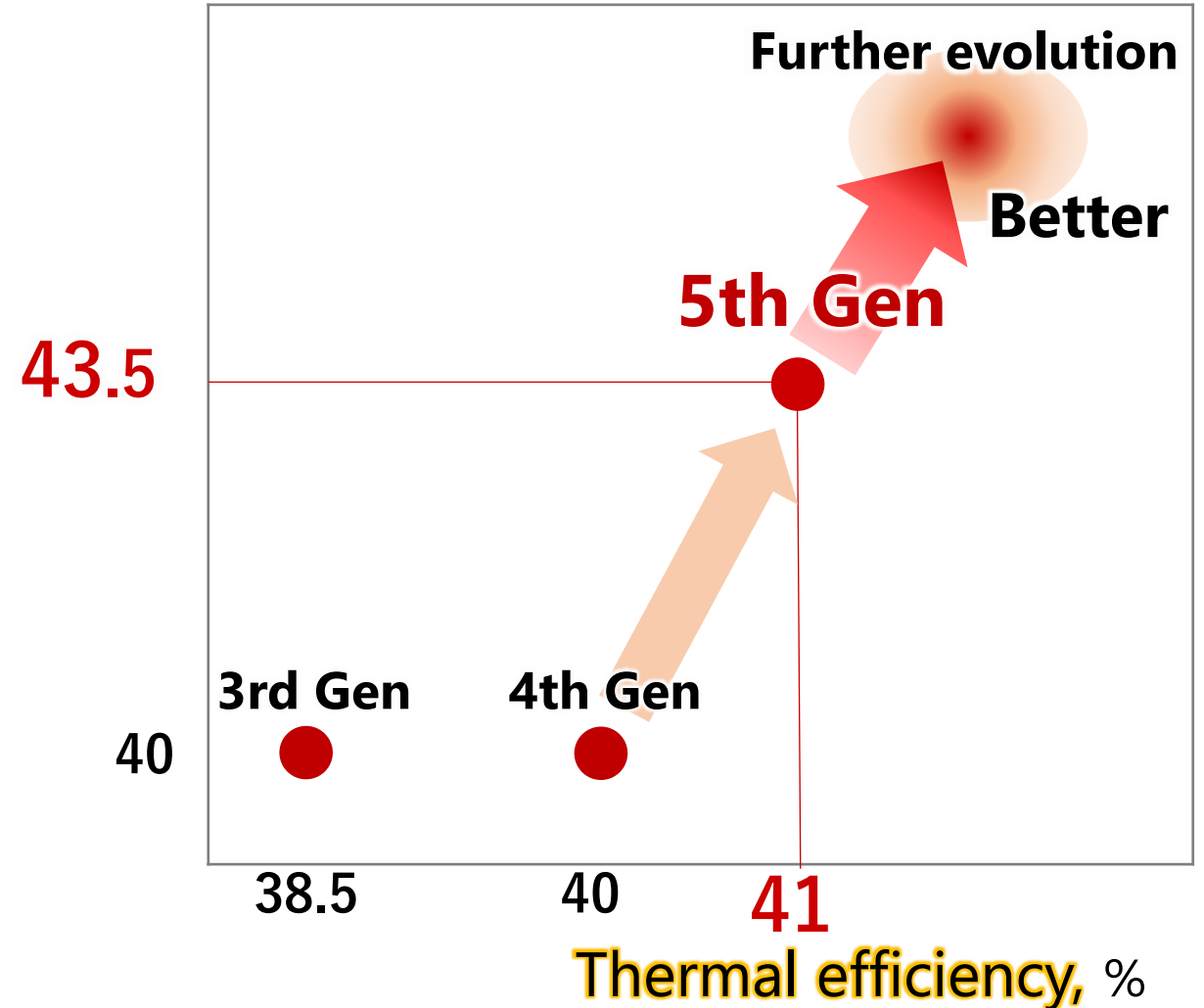
Ideal Port and Combustion Chamber Design



Enhanced EGR

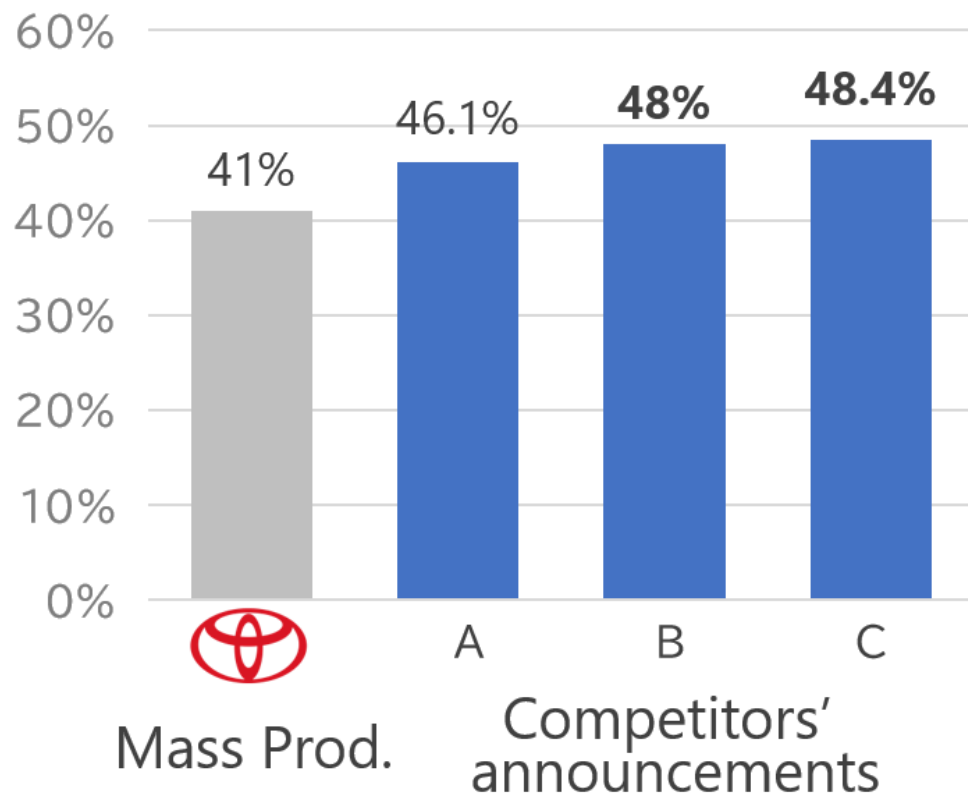
- Higher combustion robustness, stronger EGR cooling, lower pressure loss

Specific power ($\lambda=1$), kW/L

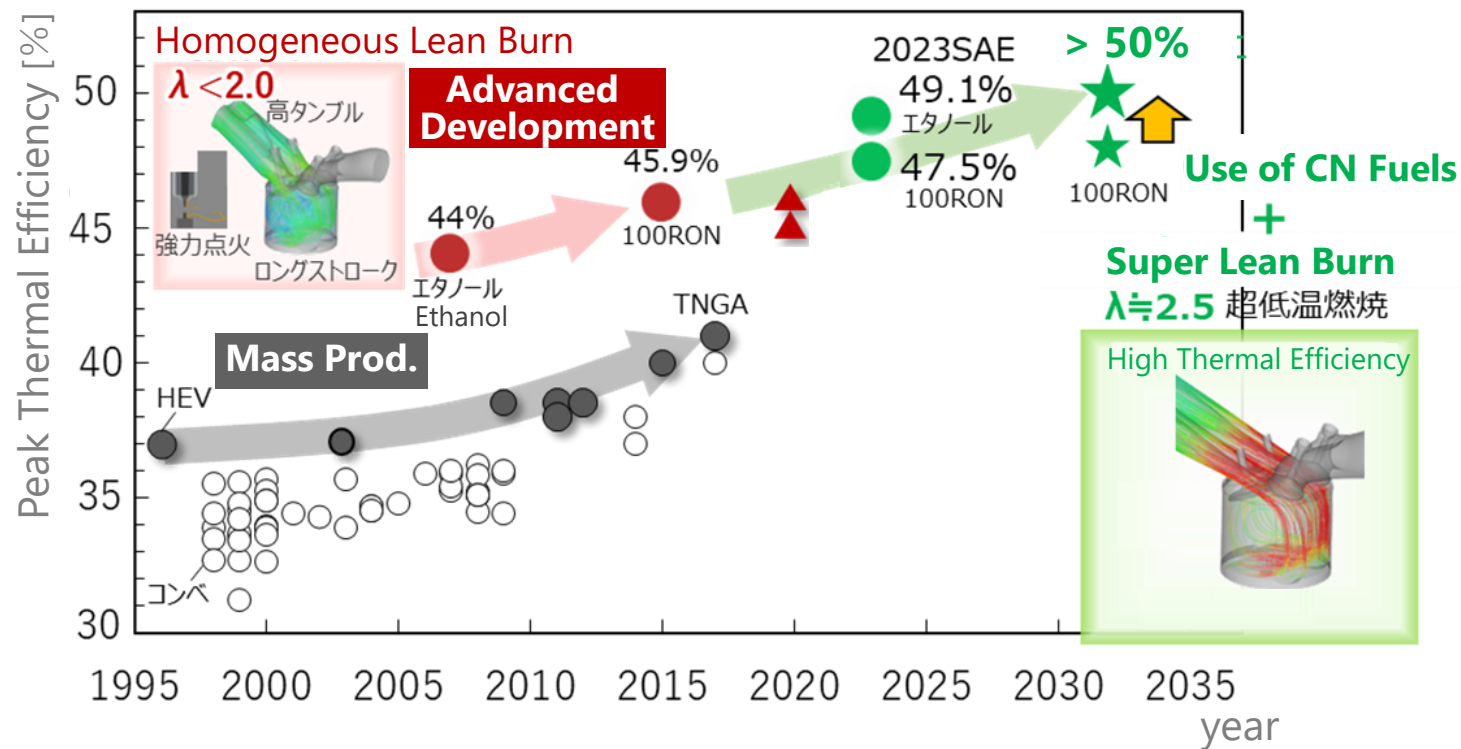


Evolving combustion technology improves both fuel efficiency and power.

Peak thermal efficiency

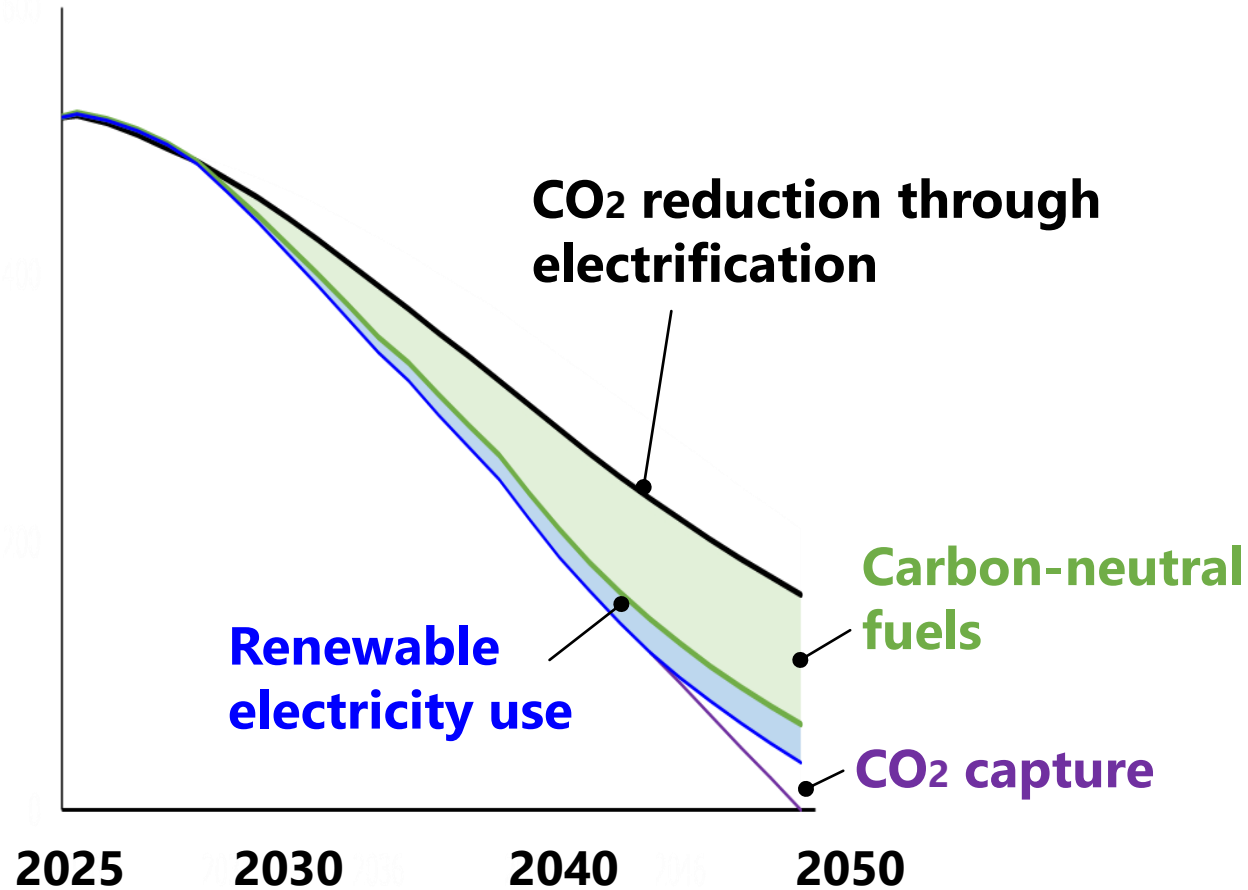


Target : >50% thermal efficiency

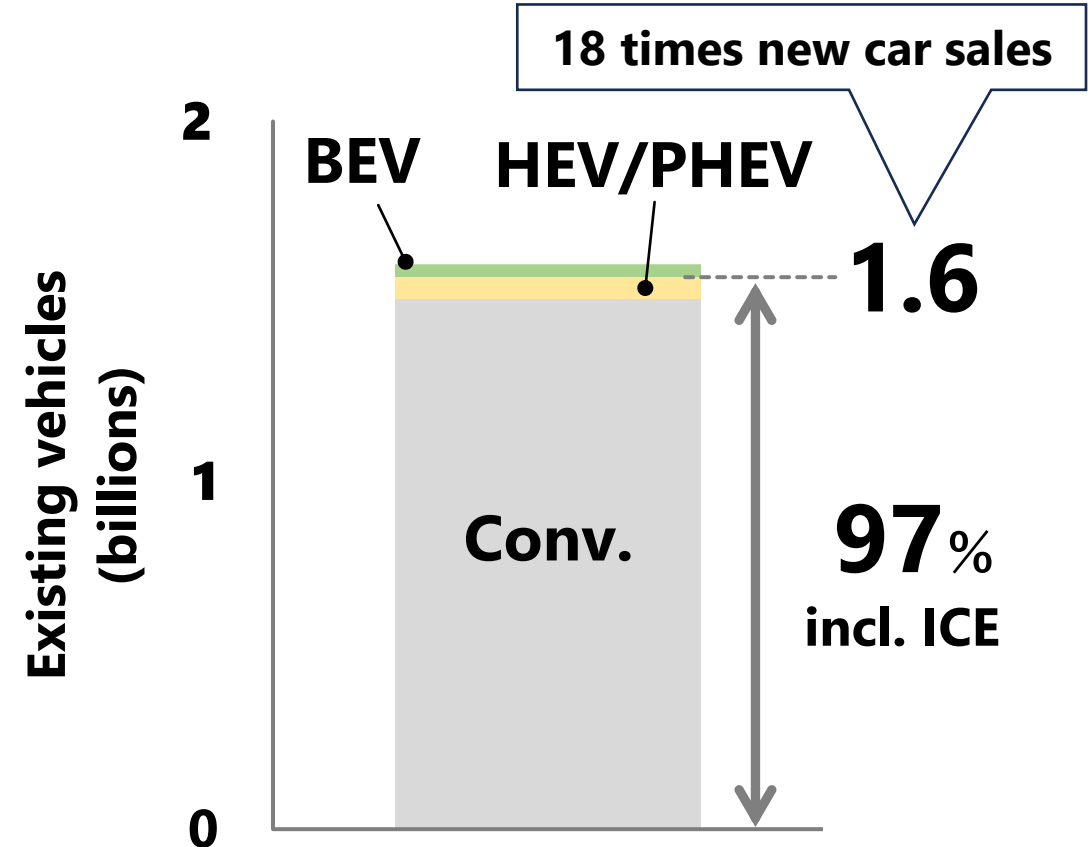


Focusing on combustion, reduction of each losses and CN fuels are expected to accelerate the realization of a 50% thermal efficiency

CO₂ emissions (Units in operation)



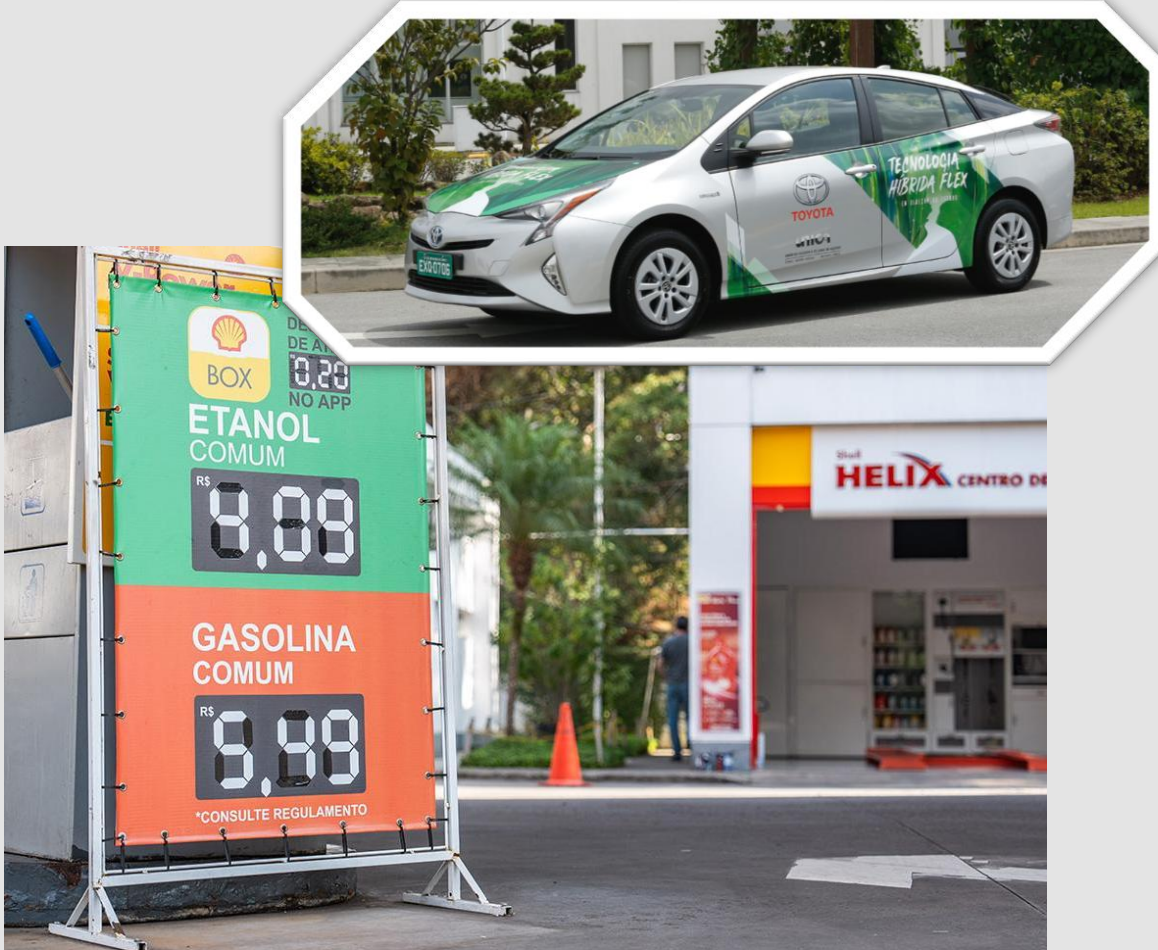
Existing vehicles (Global 2024)



Low-carbon fuels offer an immediate opportunity to reduce CO₂ emissions from vehicles already on the road.

Towards a Carbon-Neutral Society

Brazilian market



Reference: Toyota Times

EU demo fleet

TOYOTA

BMW
GROUP

BOSCH

repsol



20 vehicles

6 months

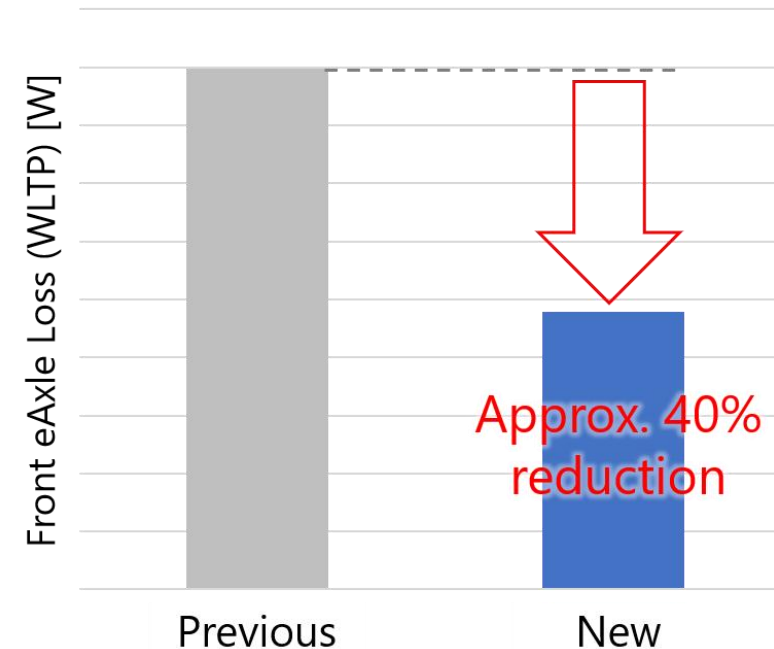
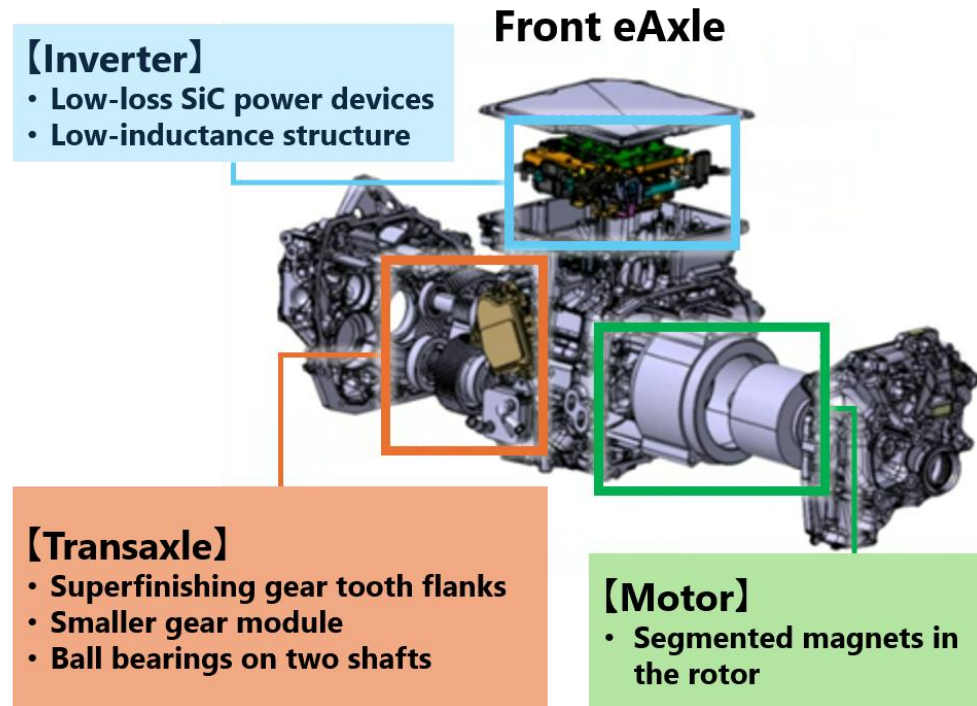
SPAIN

100% renewable gasoline

Accelerating the adoption of low-carbon fuels,
including e-fuels and biofuels.

- Higher-capacity battery and low-loss power module drastically increase driving range
- Redesigned battery pack and thermal system significantly shorten charging time even in cold-weather

eAxe: Key Technologies for Loss Reduction



Inverter, motor, and transaxle improvements reduce losses by approx. 40%

A fully redesigned BEV system for better core performance.



Updated bZ



C-HR+



Urban Cruiser



LEXUS RZ



bZ Touring

Developed
Markets

Strengthen the bZ Series and expand the lineup

China

Add two locally-developed
models in 2024–2025

U.S.

Local production of a three-
row SUV in 2026 / Expand
battery production capacity



bZ3X



bZ5

Emerging
Markets

Meet diverse needs with BEV
pickup trucks and compact BEVs



Hilux



LEXUS ES



bZ7

Source : Toyota press release

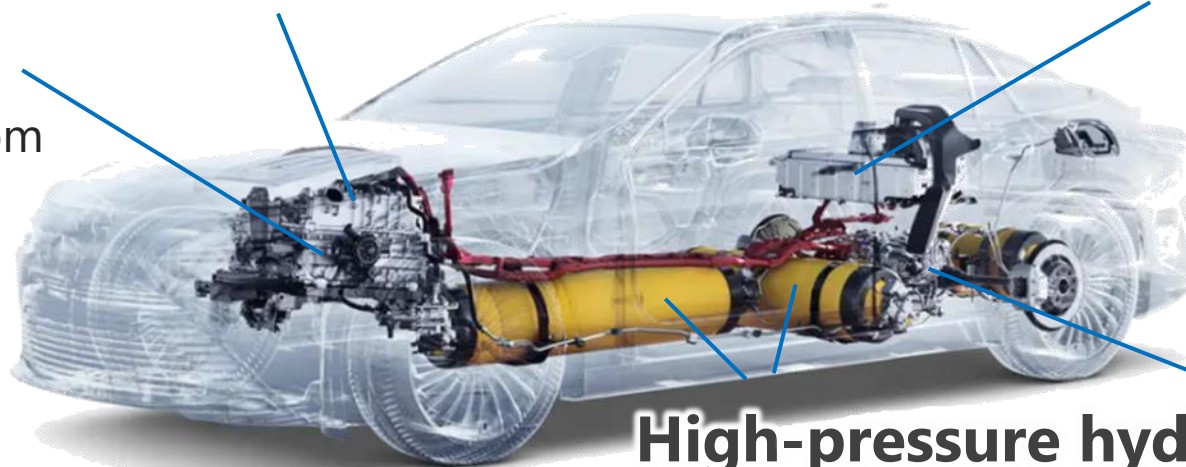
Expanding our BEV lineup through the Multi-Pathway approach.

Fuel cell stack

Generates electricity from hydrogen and oxygen

Boost converter

Traction battery



Motor

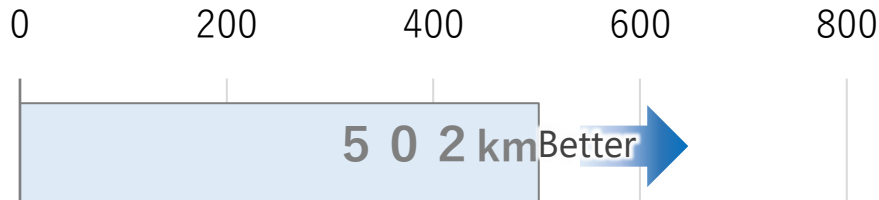
High-pressure hydrogen tanks

Stores hydrogen at 70 MPa (700 bar)

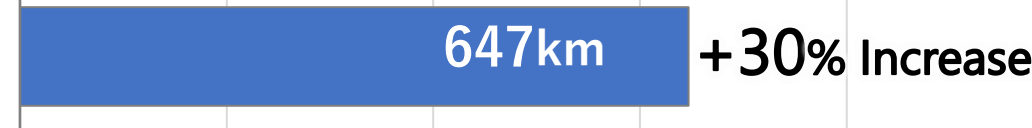
【Driving range】

※U.S. EPA Cycle

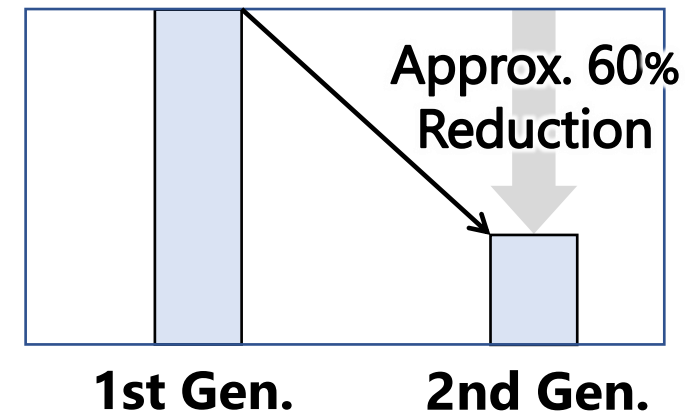
1st Gen.



2nd Gen.

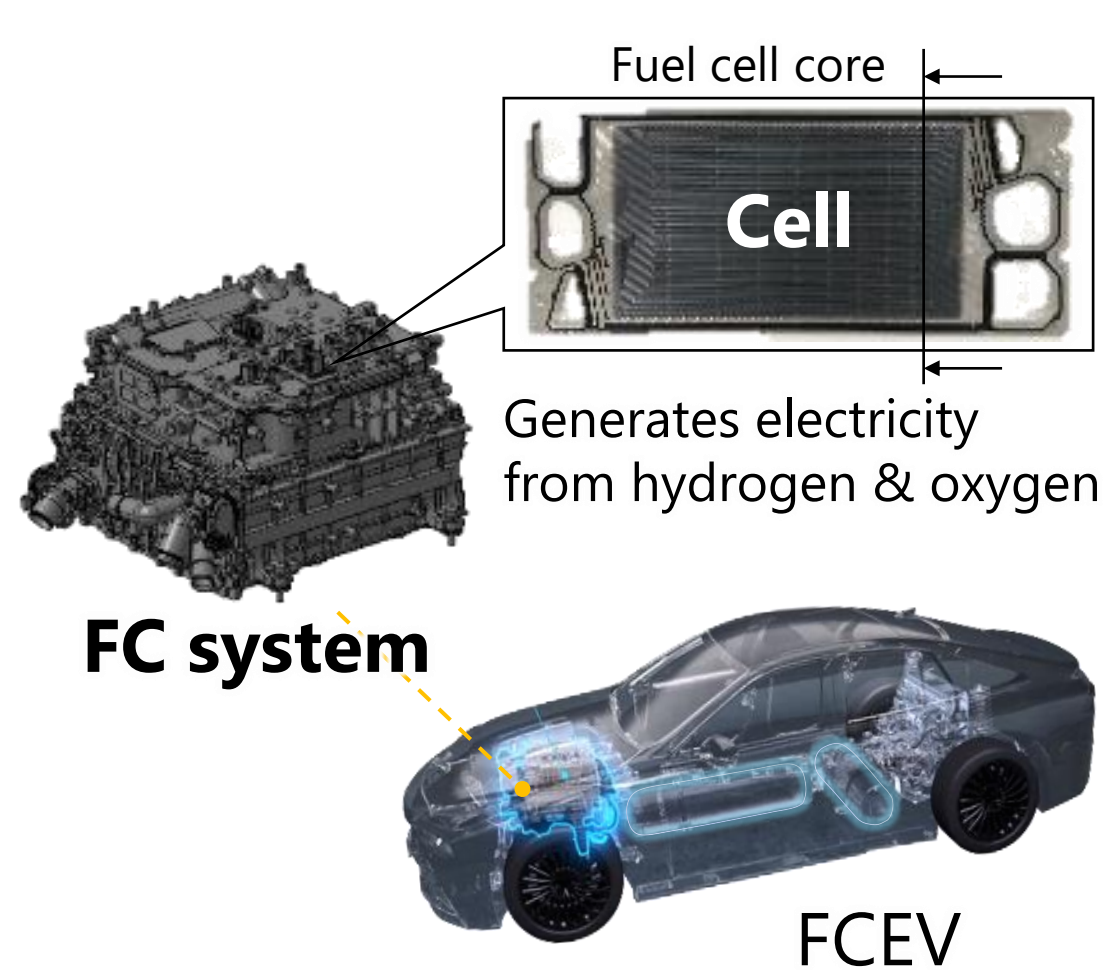


【Fuel cell stack cost】

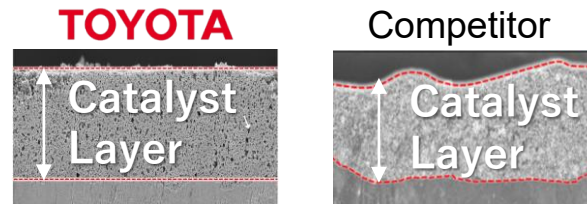


30% longer range and 60% lower cost than the first generation.

■ Fuel cell architecture



Highly uniform catalyst layer



- **Maintenance-free**
- **Lower cost**
- **20% better fuel efficiency**



Standardized cells for passenger and commercial vehicles on the same production line → Lower cost

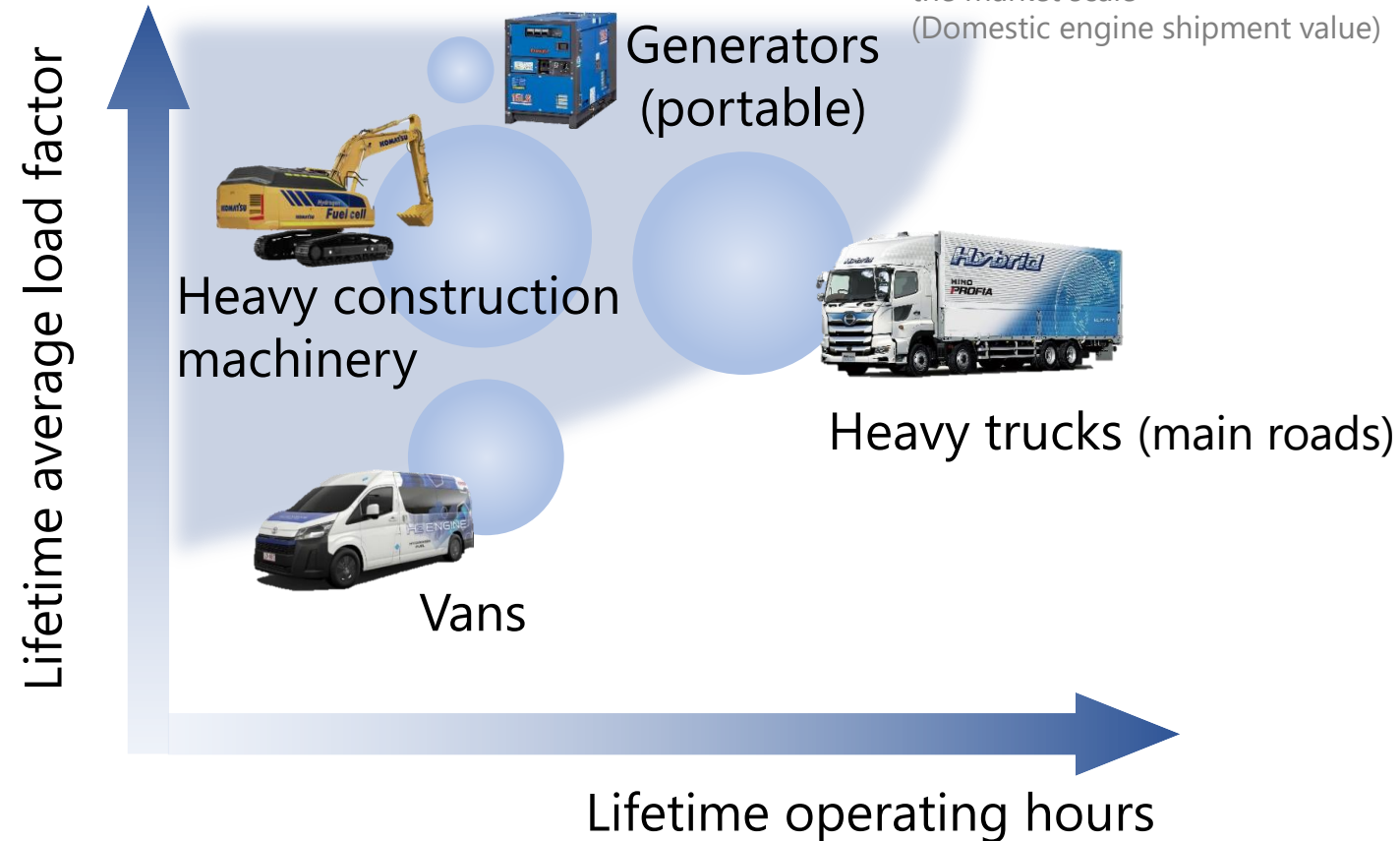
Further developing our core strength – the Fuel Cell, enabling maintenance-free operation.



The evolution and challenges of hydrogen engines

Strengths and specialized applications of hydrogen engines

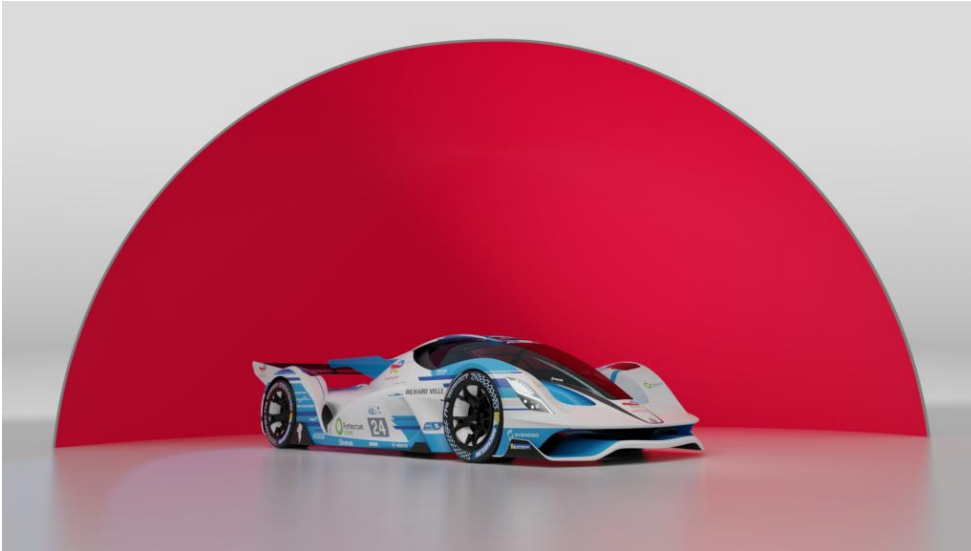
The size of the circle represents the market scale (Domestic engine shipment value)



Hydrogen ICE are suitable for continuous use in high-load conditions.
 Applications extend beyond the automotive sector.



ACO and TOYOTA released that TOYOTA will supply ICE for Mission H24 in last week



September 26, 2026, at Fuji Speedway marks a new chapter in the history of MissionH24.

FIRST

external supply of a
Toyota hydrogen engine

3.5L V6

hydrogen combustion
engine + hybrid

650 kW

≈870 PS system output
(target)

2028 → 2030

H24EVO first run (target)
→ hydrogen class at Le Mans

Sources: TOYOTA RACING / ACO press conference, 26 Sep 2026 (as reported). 2028 schedule is MissionH24's ambitious target.

Hydrogen. Proven on track. Shared with partners.

FCEV

BEV

PHEV

HEV

Which Powertrain is the most helpful at disaster

Experience of life support after Typhoon in Chiba — 2019

■ PHEV support activities



"Food, water and bathing support arrived, but we still had no electricity. **We were finally able to do laundry for the first time since the disaster.**"
 "Even with one vehicle per community everyone could benefit by sharing."

Power supply for private homes



Serviced appliances (vacuum cleaners, washing machines, refrigerators, electric fans, smartphones, lights, microwave ovens, groundwater pumps)



★ Base Camps



【Residents of Kamogawa City】

In September 2019, Typhoon Faxai caused a major power outage in Chiba Prefecture.

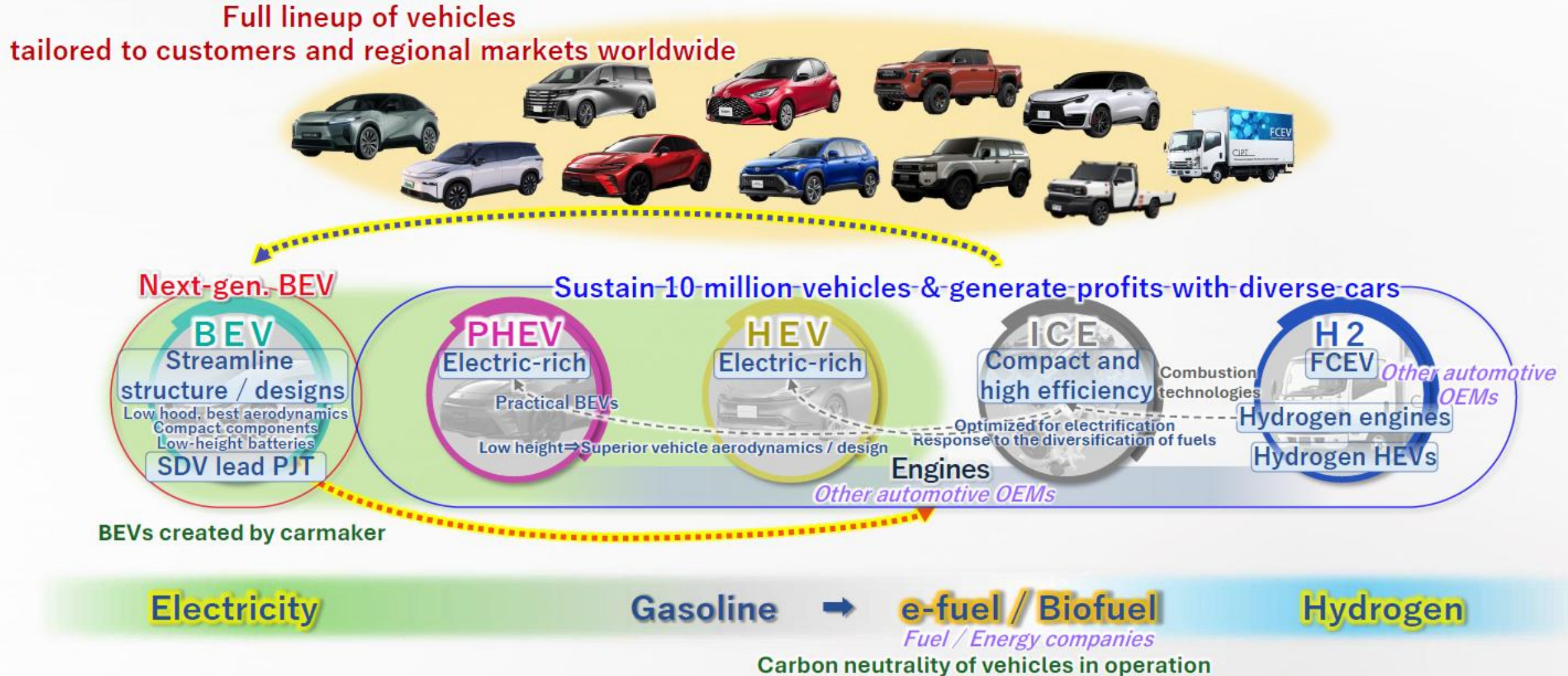
Toyota transported electrified vehicles from its headquarters in Aichi and sent engineers to the affected area.

Teams and vehicles were assigned to base camps to support local communities.

Provide disaster relief with power from electrified vehicles.

Multi-Pathway Overview

Pursue carbon neutrality through multiple options, that reflect the realities of a diverse energy future



Next-Generation Development Strategy Through the Integration of Simulation and AI

Progress of Model-Based Development

4Xkm/L

Fuel economy target

1st-Generation of Prius C

※10 · 15 Test Cycle



Simulation accuracy

1st-Generation AQUA

※Based on fuel economy testing of the
first prototype



Approx. **40%**



Simulation accuracy

4th-Generation Prius



Approx. **80%**

- Logic mismatch between vehicle and simulation
 - ➔ Some controls did not work
- Insufficient data for simulation



MBD environment

- Control model development
- Automatic code generation and testing
- High-precision physical models

Stronger MBD enables more accurate simulations.

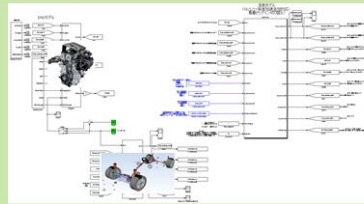
Model-Based Development → AI-Integrated Development

TOYOTA

Conventional Development

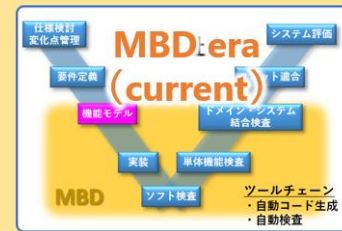
Control MBD

Model-Based Function Development and Design



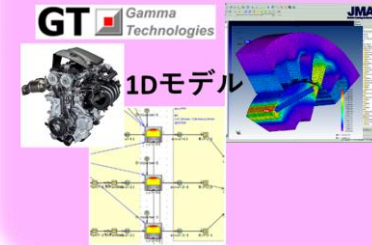
Automatic Code Generation and Testing

Automated In-House Software Development

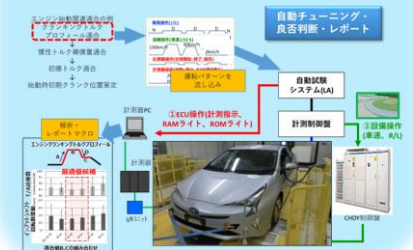


High-Precision Physical Models

Model-Based Parameter Design



Tuning and Final Validation (Automated Testing)



AI-Integrated Development

Generative AI

Automates code generation and report writing

AI Control Expert

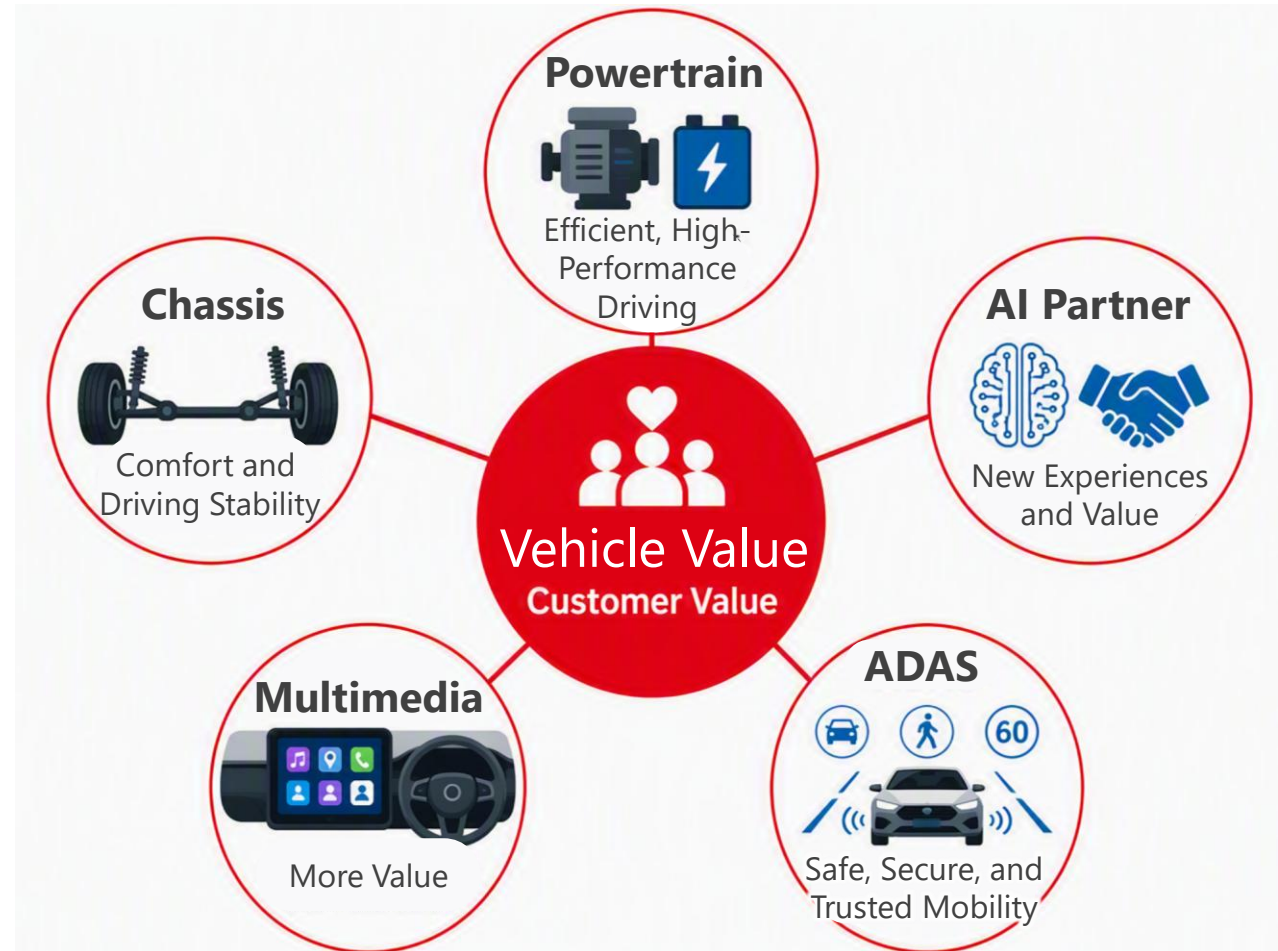
≡ AI with expert-level control knowledge

Supports control design and multidimensional optimization

Engineers can focus on defining requirements and constraints

Place Customer Value at the Center

Cross-domain integration maximizes value across the entire vehicle



Unlock greater vehicle value, by integrating capabilities across all domains.

For
the Engineering
Race

TOYOTA
RACING

24h
LE MANS
WINNER
2026

DENSO

FUJITSU

AISIN

RAYB

JFE

MAEDA

JTEKT

SENTEX

Mobil

HARELLI

ZENT

HAYASHI

NSK

DAIHATSU

DAIHATSU

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To every rival who has pushed us - and always will - thank you.

THANK YOU

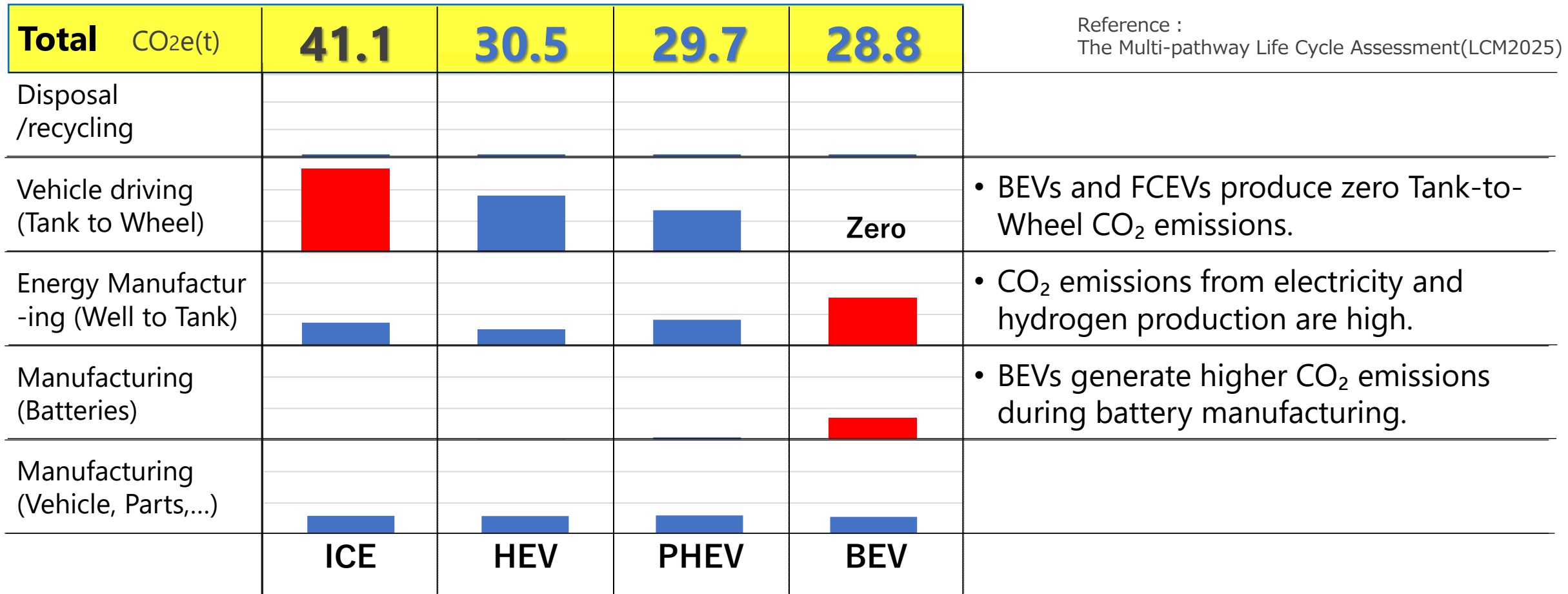
Many pathways for Everyone.



Life-Cycle CO₂ Emissions by Powertrain (from manufacturing to use)

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■ U.S. midsize SUV life-cycle CO₂ emissions



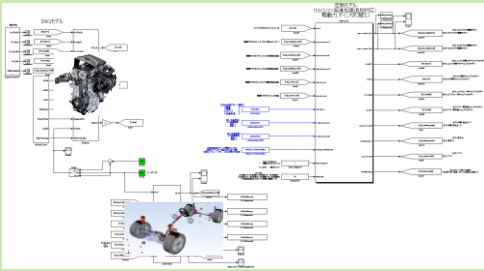
Calculation Assumptions : Argonne National Laboratory's GREET 2023 model, Grid carbon intensity : 0.41 kg-CO₂/kWh (U.S. average), Vehicle class: RAV4-class SUV
 Lifetime mileage : 100,000 km, Battery capacity : 109 kWh for BEV ; 11 kWh for PHEV

Until renewables become widespread,
 HEVs, PHEVs and BEVs have comparable life-cycle CO₂ emissions.

Model-Based Development Technologies

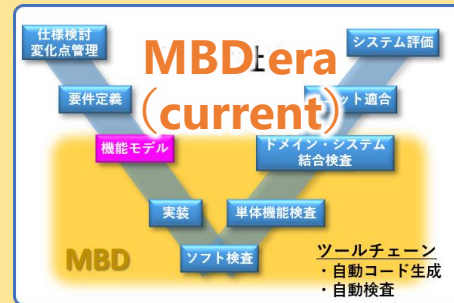
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Model-Based Function Development and Design



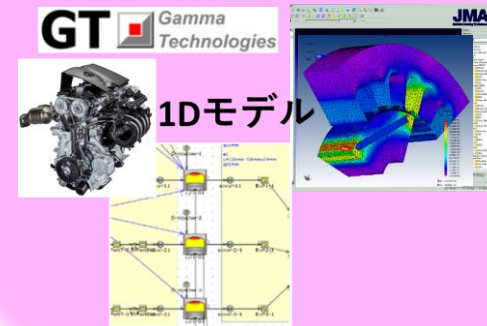
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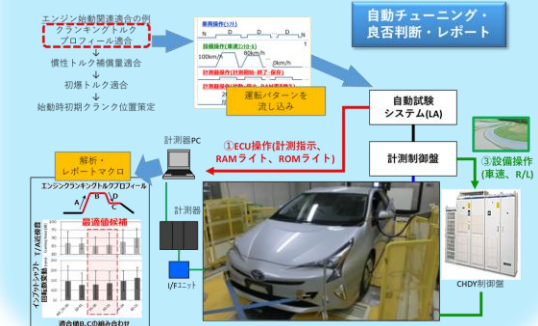


High-Precision Physical Models

Model-Based Parameter Design



Tuning and Final Validation (Automated Testing)

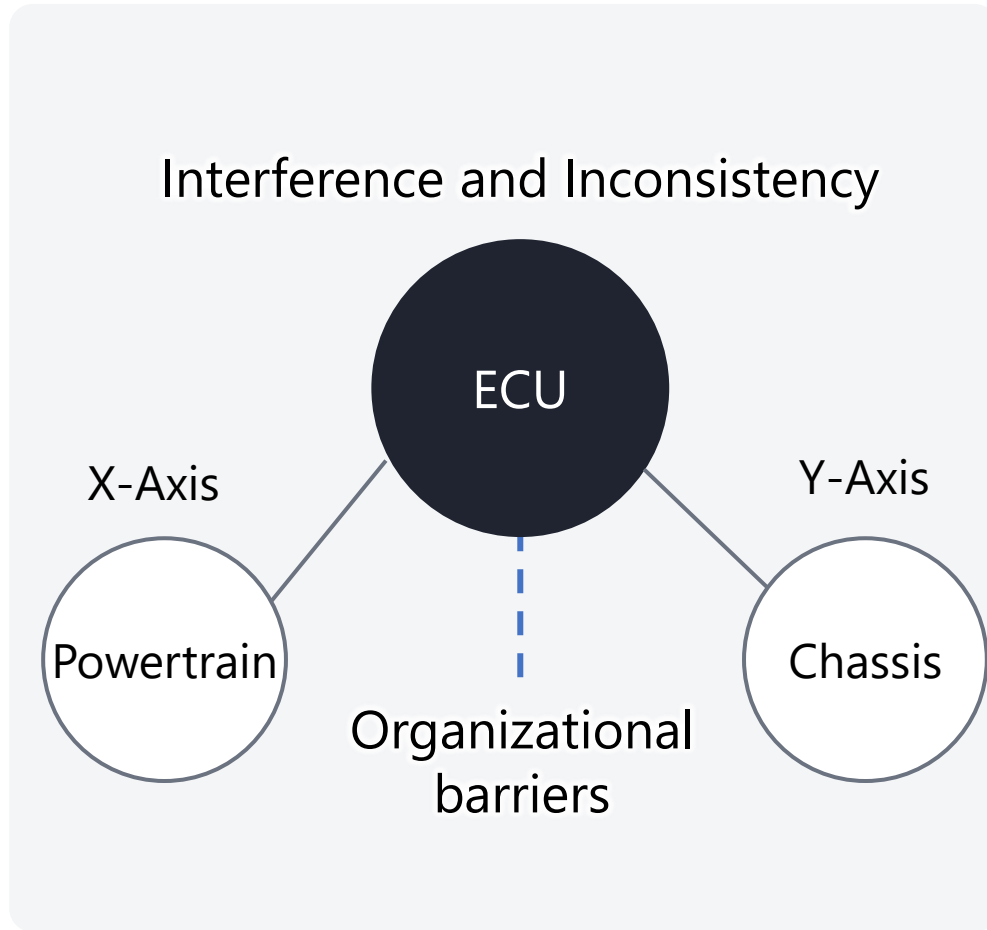


Engineering workload: **70%** reduction, **Prototype vehicles: 50%** reduction

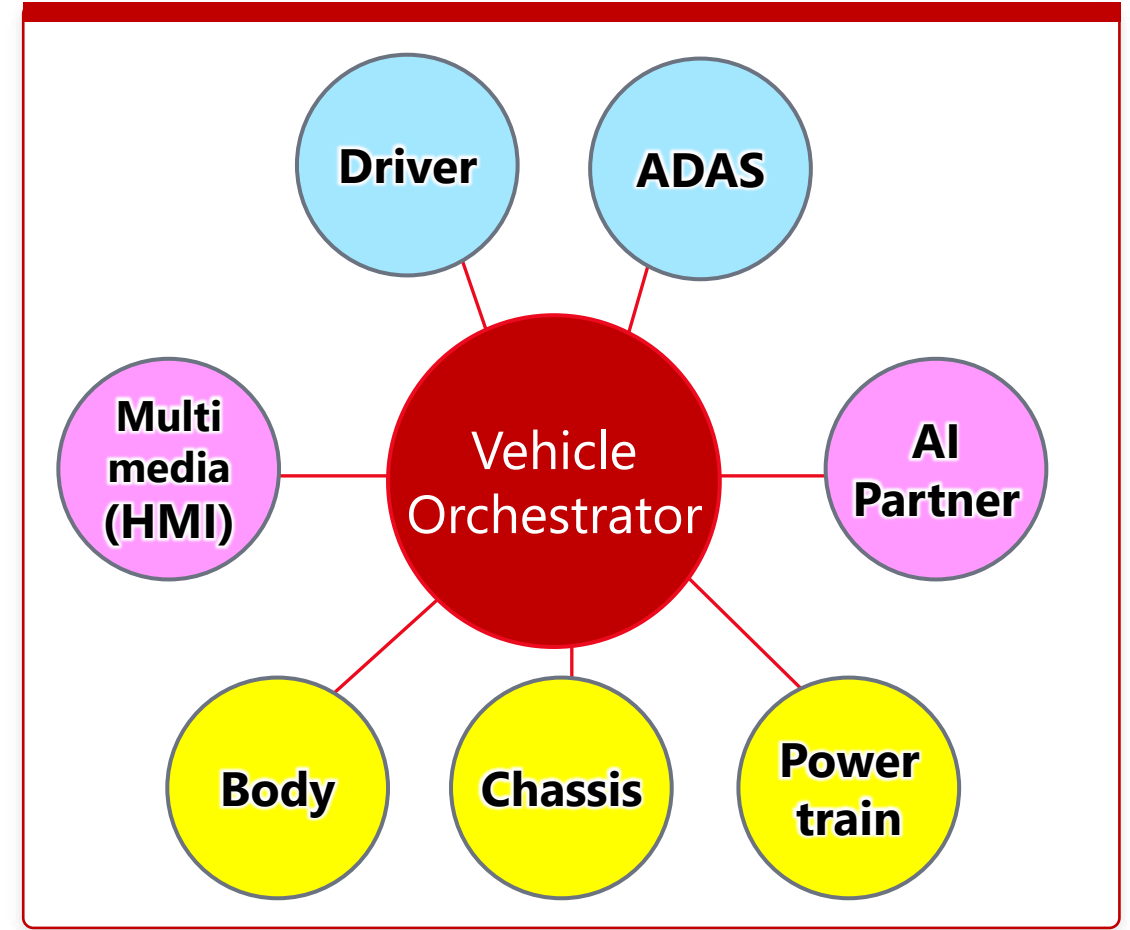
Predict vehicle performance before physical prototyping, validate control strategies, and improve early-stage development accuracy.

Evolution of Vehicle Control

Conventional vehicle development



Future



The Vehicle Orchestrator integrates all vehicle controls

Let's Make Ever-Better Cars

AI starts to help our development faster,
but, we still insist on real driving feeling on trucks



“Simulation did not tell
us everything.

Human senses and judgment are essential.

4th-GENERATION PRIUS - TRACK VALIDATION

Ultimately, we drive, experience and refine the actual car.