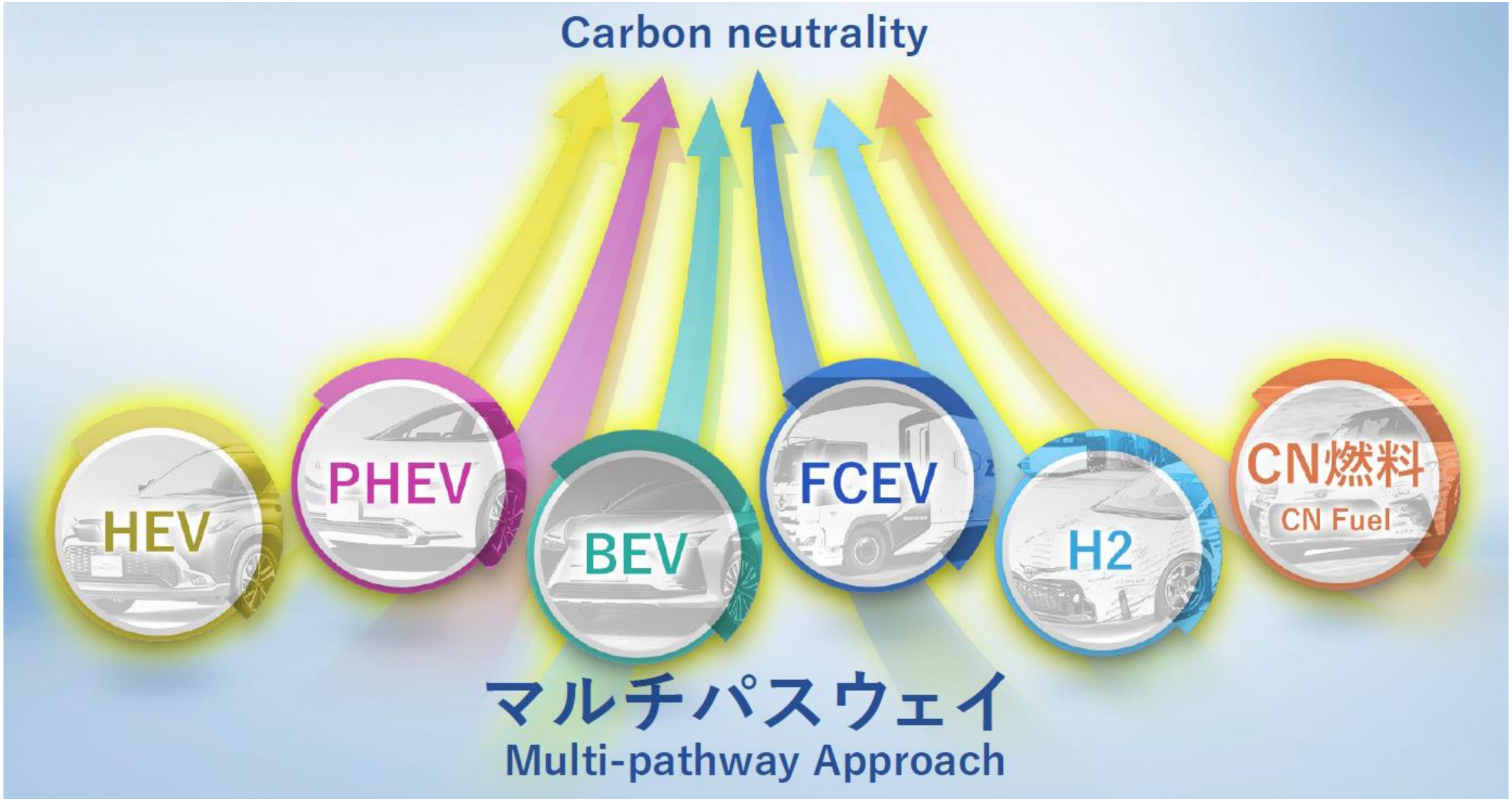


Toyota's Multi-pathway Approach towards Carbon Neutrality

India Energy Scenario

TOYOTA

India – Energy Self Reliance

India 100 Years 1947-2047

Energy Independency By 2047

Net ZERO by 2070

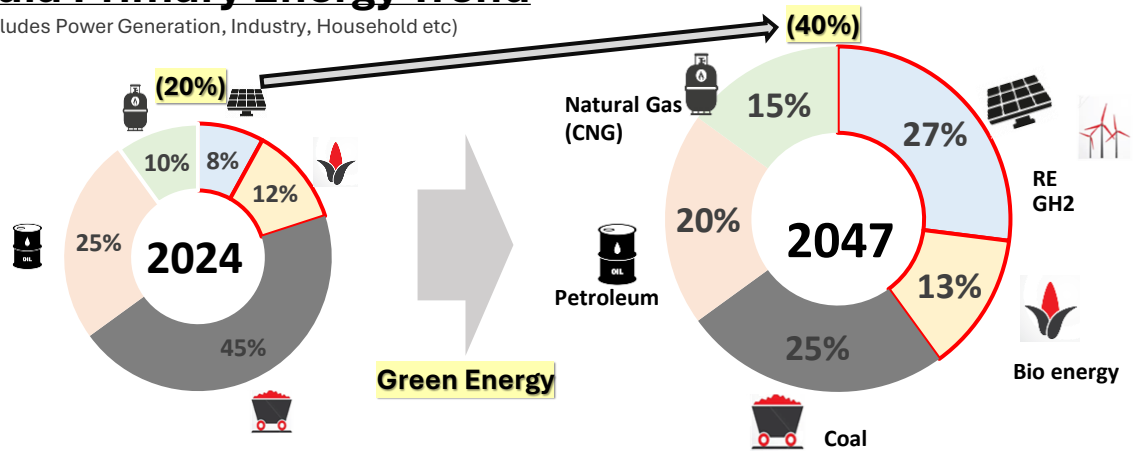
Electricity (RE)
- **RE Target. : 500 GW** by 2030
- **Global Solar Alliance** (Commitment to generate 100 GW *SE)

Bio-Fuel
- **Global Bio-fuel Alliance**
- **Mandate : E20** by 2025
- **CBG Target : 15MMT** by 2030

Green Hydrogen
- **National Hydrogen Mission** announced.
- **National Green Hydrogen policy** [5 MMT by 2030].

India Primary Energy Trend

(Includes Power Generation, Industry, Household etc)



Max. Energy increase by Clean Energy (RE, Bio & GH2)

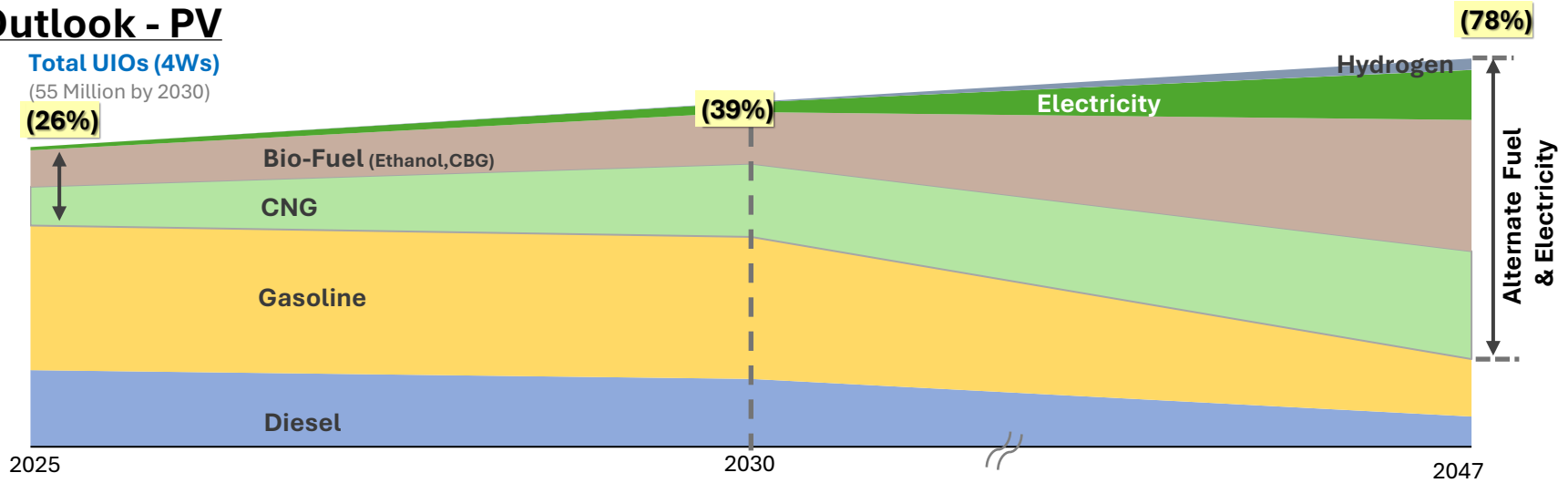
Source: NRI Report 2023

Automotive Fuel Outlook - PV

Drivers

- POLICY SUPPORT
- RAW MATERIAL AVAILABILITY IMPORT/DOMESTIC
- INFRASTRUCTURE
- SUPPLY CHAIN
- CUSTOMER ACCEPTANCE

Total UIOs (4Ws)
(55 Million by 2030)



UIO : Units in Operation
PV : Passenger Vehicles

Speed & Scale is Key !

ICE → Alternate Fuel & Electrified Technology

Source: NRI Report 2023

With Multipath approach, India Energy Self Reliance can be faster

Sustainable Mobility

TOYOTA

Solar, Wind, Hydro, ...

Electricity

Hydrogen H_2

Power to Liquids

CO_2

E-fuel

Bio-fuel

Crude oil, Natural gas
(with Carbon capture)

CNG

Gasoline, Gas oil

Reduce consumption

RE

BEV

FCEV

H2-ICE

PHEV

BIO

HEV

Energy / Fuel

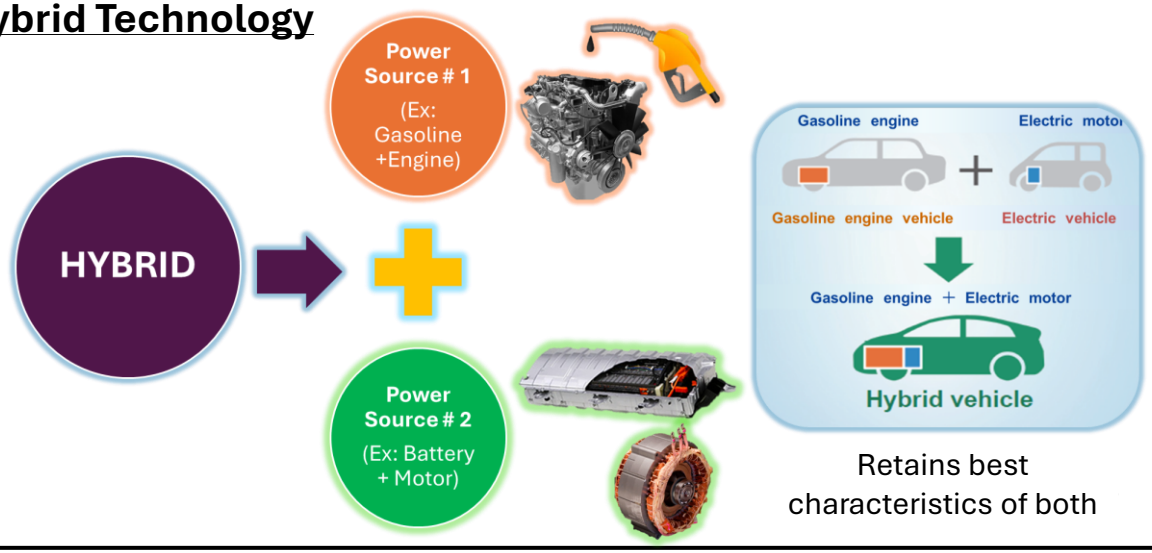
Vehicle

HEV: Hybrid Electric Vehicle, FFV : Flex Fuel Vehicle, PHEV: Plug in Hybrid Electric Vehicle, BEV: Battery Electric Vehicle, FCEV: Fuel Cell Electric Vehicle, H2-ICE: Hydrogen Internal Combustion Engine

Carbon reduction of Energy / Fuel are key for Sustainable Mobility

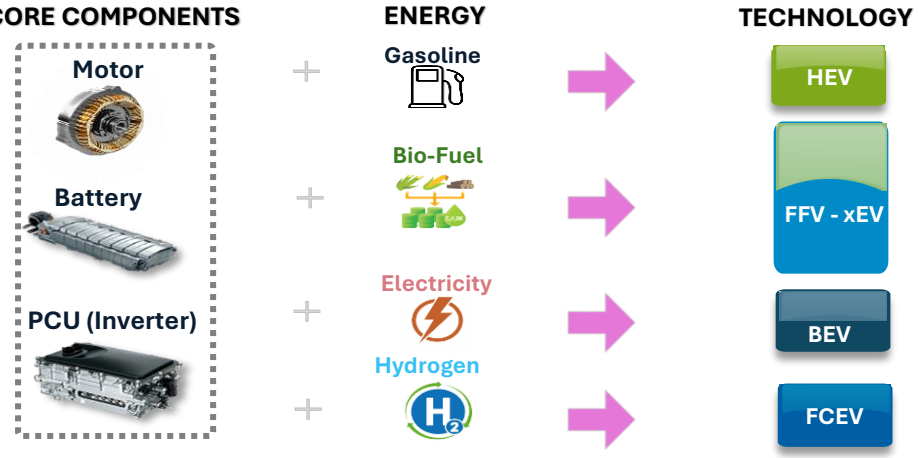
Hybrid Electric Vehicle (HEV) Technology

Hybrid Technology



Retains best characteristics of both

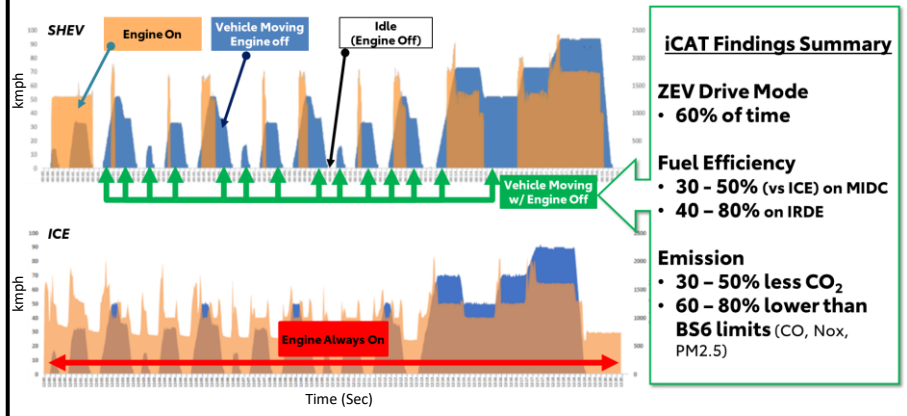
Core Components Strategy



Hybrids are building blocks of xEV Technology

Benefits of Hybrids

Test Findings : HEV in Actual Driving in India



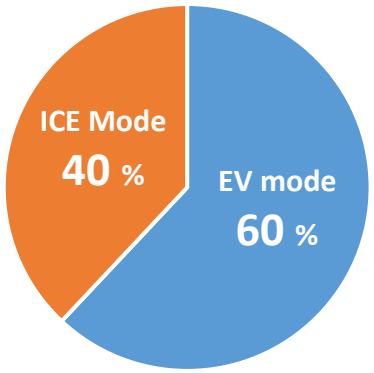
iCAT Findings Summary

ZEV Drive Mode
- 60% of time

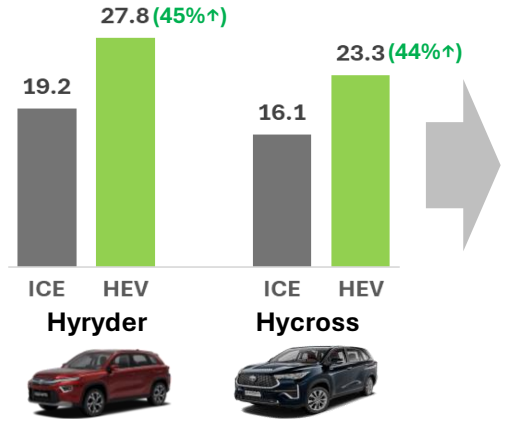
Fuel Efficiency
- 30 – 50% (vs ICE) on MIDC
- 40 – 80% on IRDE

Emission
- 30 – 50% less CO_2
- 60 – 80% lower than BS6 limits (CO, Nox, PM2.5)

Drive mode



Fuel Efficiency (kmpl)



As of March 2024, TKM has sold **1,06,000** Hybrid vehicles resulting in:

79 MILLION KG*

CO_2 reduction

*TKM Calculation

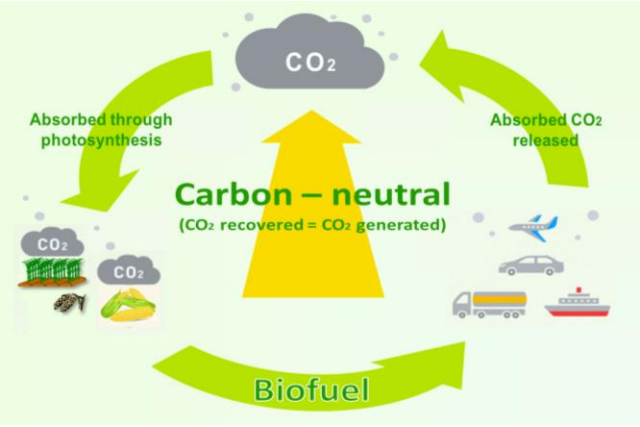
ICAT – International Centre for Automotive Technology | MIDC – Modified Indian Drive Cycle | IRDE – Indian Real Driving Emissions

HEV Technology is stepping stone for mass Electrification (xEV)

Flex Fuel Electrified Vehicle (FFV xEV) Technology

What is Ethanol?

Ethanol is a Biofuel & Green fuel as it is **produced** from **starch/sugar based agricultural products** (Sugarcane, Maize, surplus rice etc). Can produce Locally.

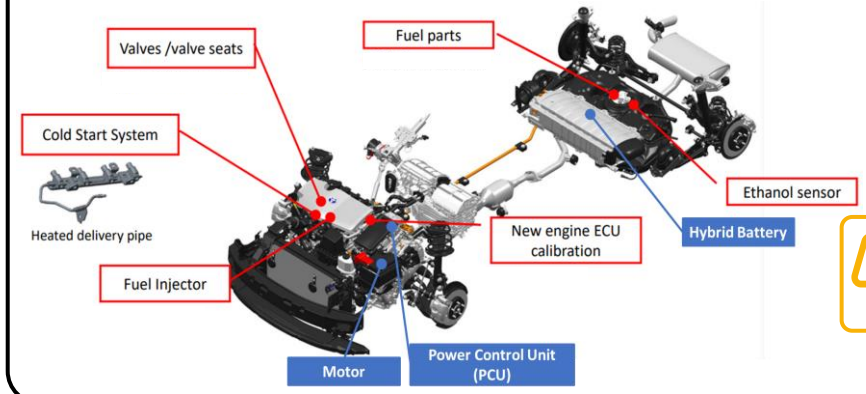


Ethanol (Biofuel)
↓
Carbon-neutral with Net "0" Emission

What are Flex Fuel & Flex Fuel Electrified Vehicles?

Flex Fuel technology allows an Engine to utilize higher percentage of **Ethanol blended in Petrol (Up to 100%)**.

FFV SHEV leverages the benefits of **both Biofuel and Electrification**.



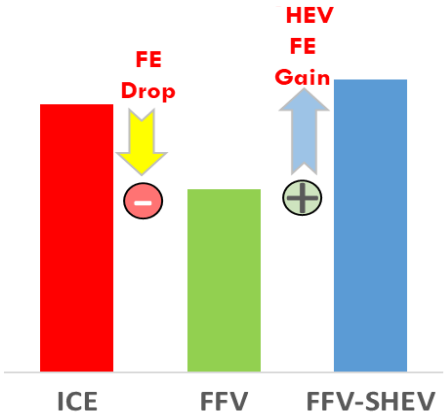
BIOFUELS

ELECTRIFICATION

Benefits of FFV-xEV

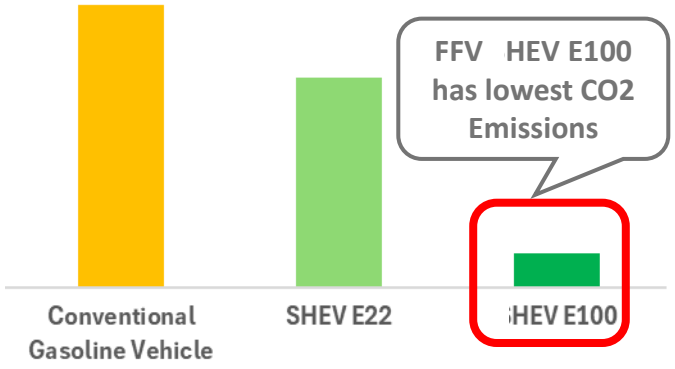
- **Higher Fuel Efficiency (FE)**
- **Lowest CO2 emission**
- **Promotes Electrification**

Fuel Efficiency (kmpl)



Well to Wheel CO2 emissions [g/km]

[With Current Energy Sources]



1445 Kg Weight Class

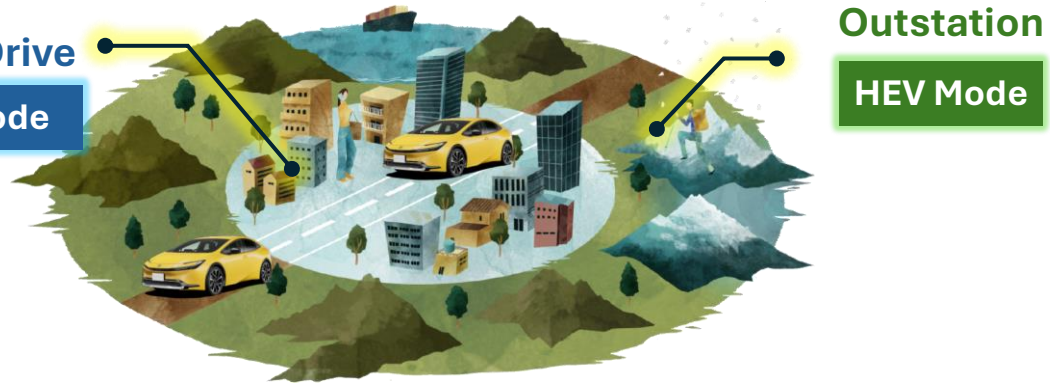
Source: IISc Study 2024 - Well to Wheel Analysis of Ethanol-Gasoline Flex Fuel Hybrid Vehicle

FFV-xEV is practical solution for Carbon Neutrality & Energy Independence

Plug-In Hybrids Electric vehicle (PHEV) Technology

What is PHEV?

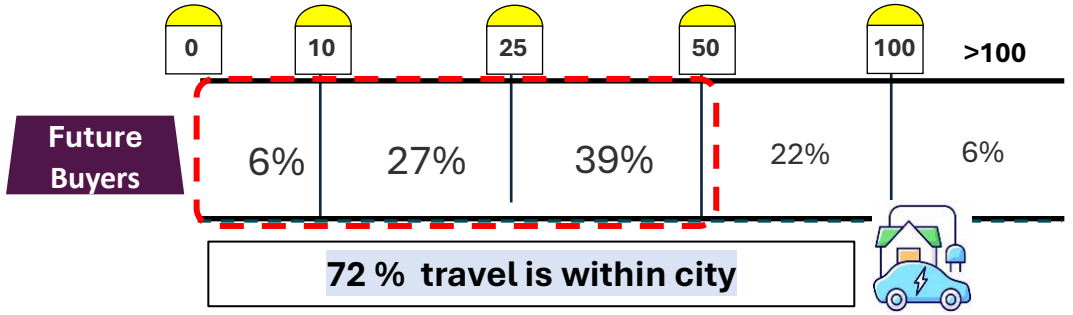
It is a fusion of the Electric vehicle and the Hybrid vehicle with Higher Battery Capacity.



PHEV technology is Best of both Worlds (BEV +HEV)

India Usage Scenario

Distance to travel in a day (in Kms)



PHEV works as BEV for daily city usage.
Home charging is feasible as Battery is smaller compared to BEV

Source : Deloitte Report 2024

Benefits of PHEV

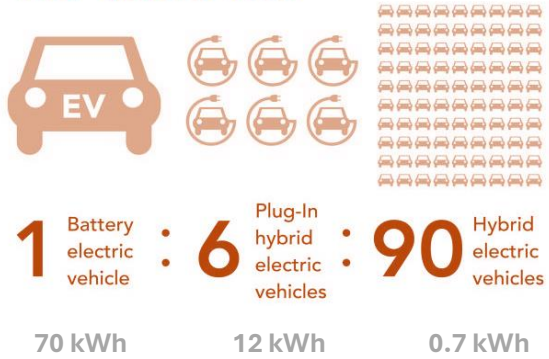
PHEV

- BEV without worrying Battery run out
- HEV with longer EV mode cruising range

1. Low running cost
2. Peace of mind
3. Dynamic Performance

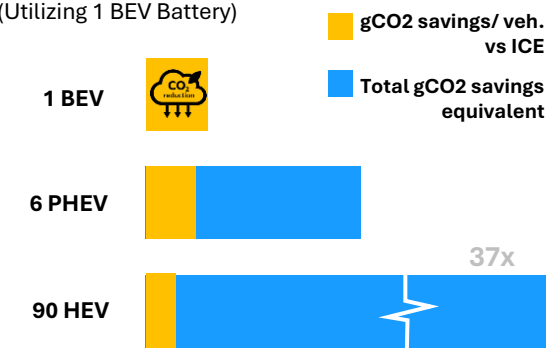
Optimum utilization across Tech for CO2 reduction

The 1:6:90 rule



Opportunity for Lifetime CO2 savings

(Utilizing 1 BEV Battery)

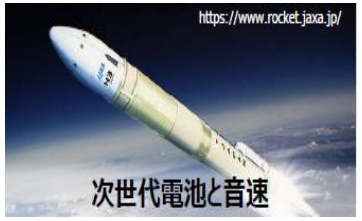


Intelligent distribution of Battery → Higher CO2 reduction

PHEV is an Optimum Electrified Solution for Indian Customer Daily Usage

Battery Electric vehicle (BEV) Technology

BEV expectation

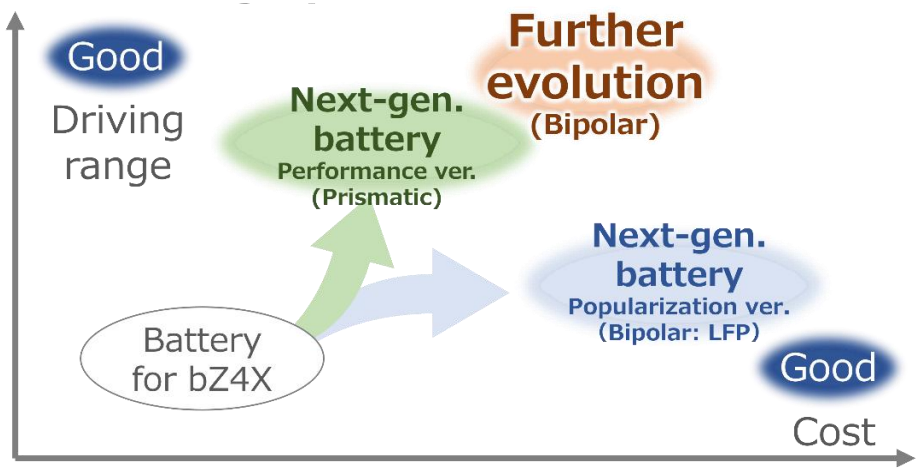


Cruising Range >1000 km

Stylish Design

Drive Customization

Advance Battery Technology



Innovating technologies to support TOYOTA's next Gen BEVs

Low - Cost Solutions

Half Processes

新モジュール構造 New modular structure

モノづくり Monozukuri (Manufacturing)

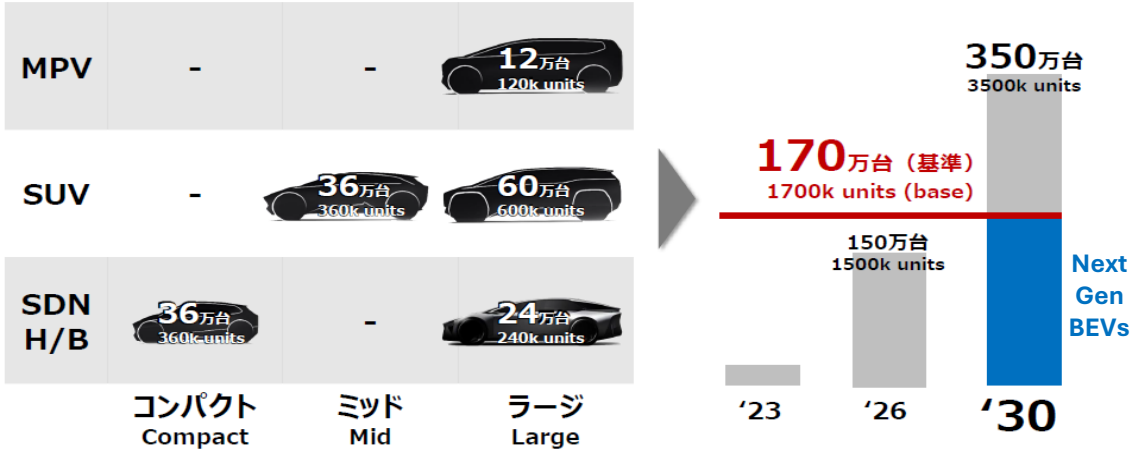
Giga Casting

Half Plant Investment

Half Production Prep Lead time

Work on both vehicle technology & manufacturing to make affordable BEV

Global Full Line-up



TOYOTA plans to roll out next-gen BEVs globally, as a full lineup

Affordable - Long range BEV is key for Customer acceptance

Fuel Cell Electric Vehicle (FCEV) Technology

TOYOTA

FCEV Features

a. Energy Diversification
- Hydrogen can be produced by various primary energy

b. Zero Emissions
- Zero CO_2 during driving

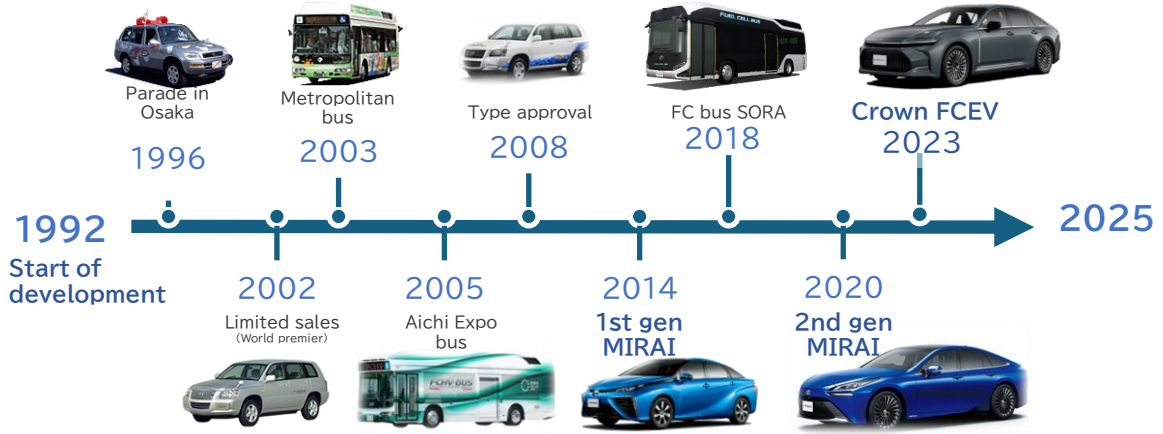
c. Fun to Drive
- Smooth & quiet drive feel
- Powerful acceleration

d. Good Usability
- Long range
- Short refueling time
- Good cold start

e. Power Supply
- Big supply power

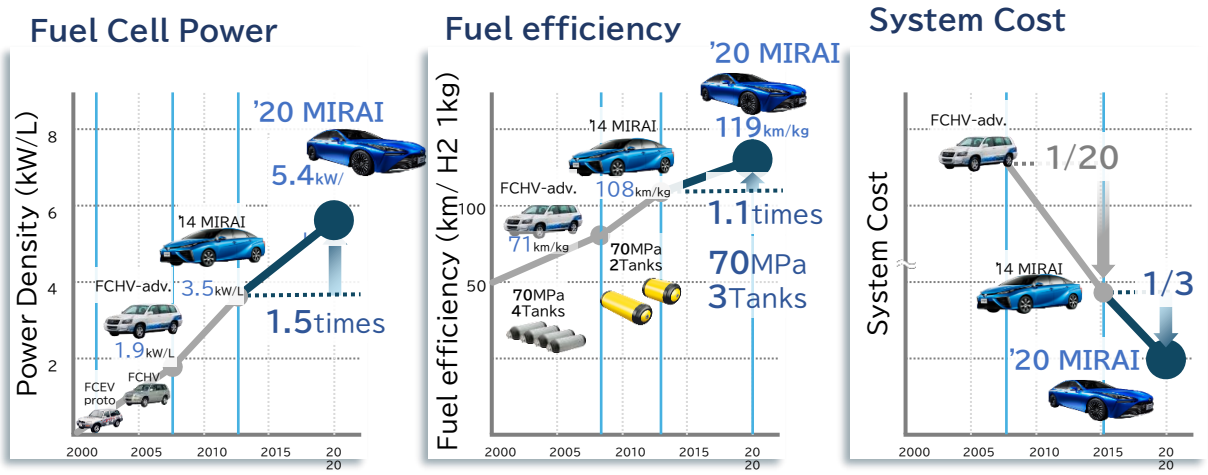
Toyota FCEV MIRAI

Fuel Cell (FC) development history



History of FC system development over 30 years

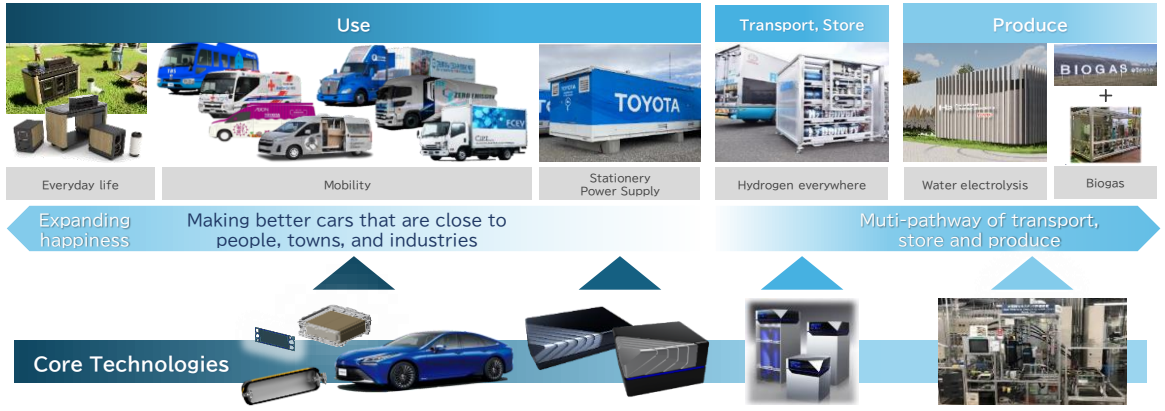
Evolution of Performance



Improving technology through continuous Innovation

Hydrogen value chain coverage by MIRAI's Tech

Items of hydrogen society (Produce, transport, store and use)



Utilizing Core Technologies to cover from "Produce" to "Use"

Diversified utilization is key for expansion of Hydrogen Society