

Decarbonization of Passenger Cars

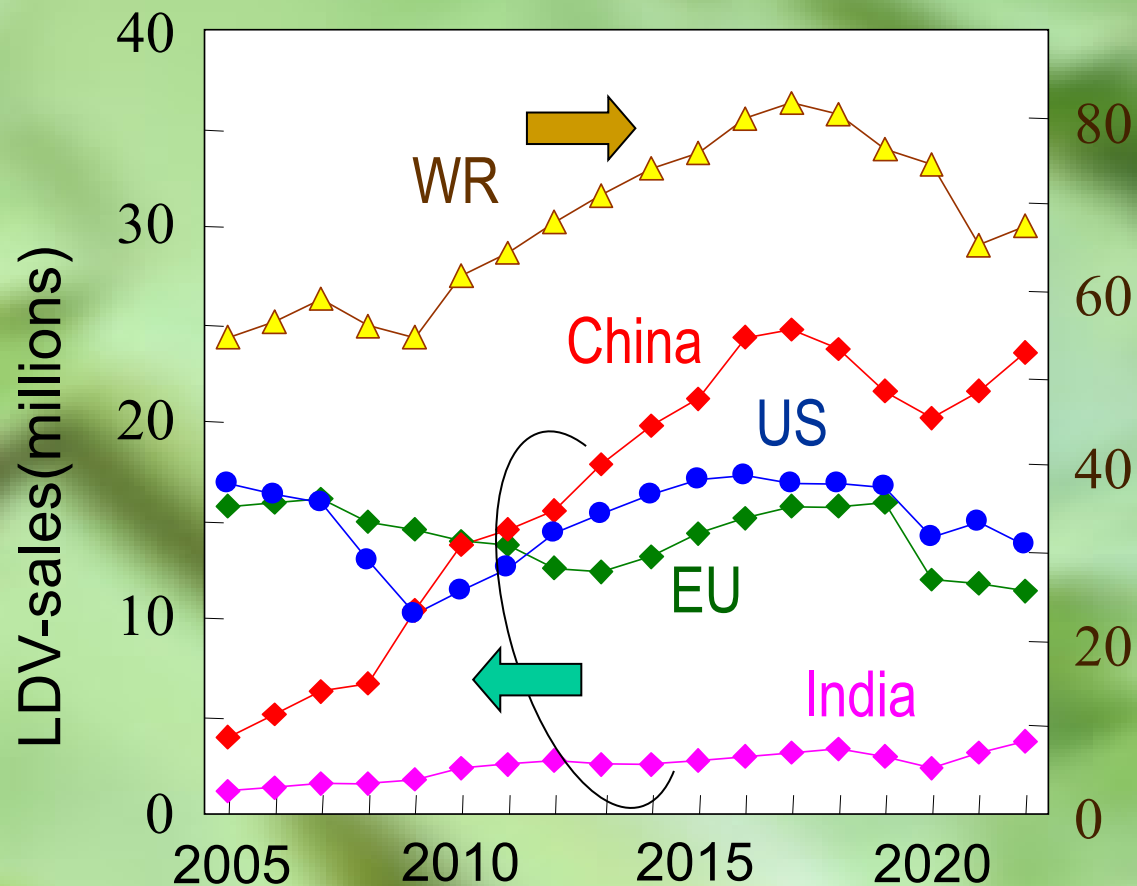
1. Trend of CO2 emissions in Transport Sector
2. CO2 reduction potentials: WTW analysis
3. Biofuel
4. Electrification
5. Summary



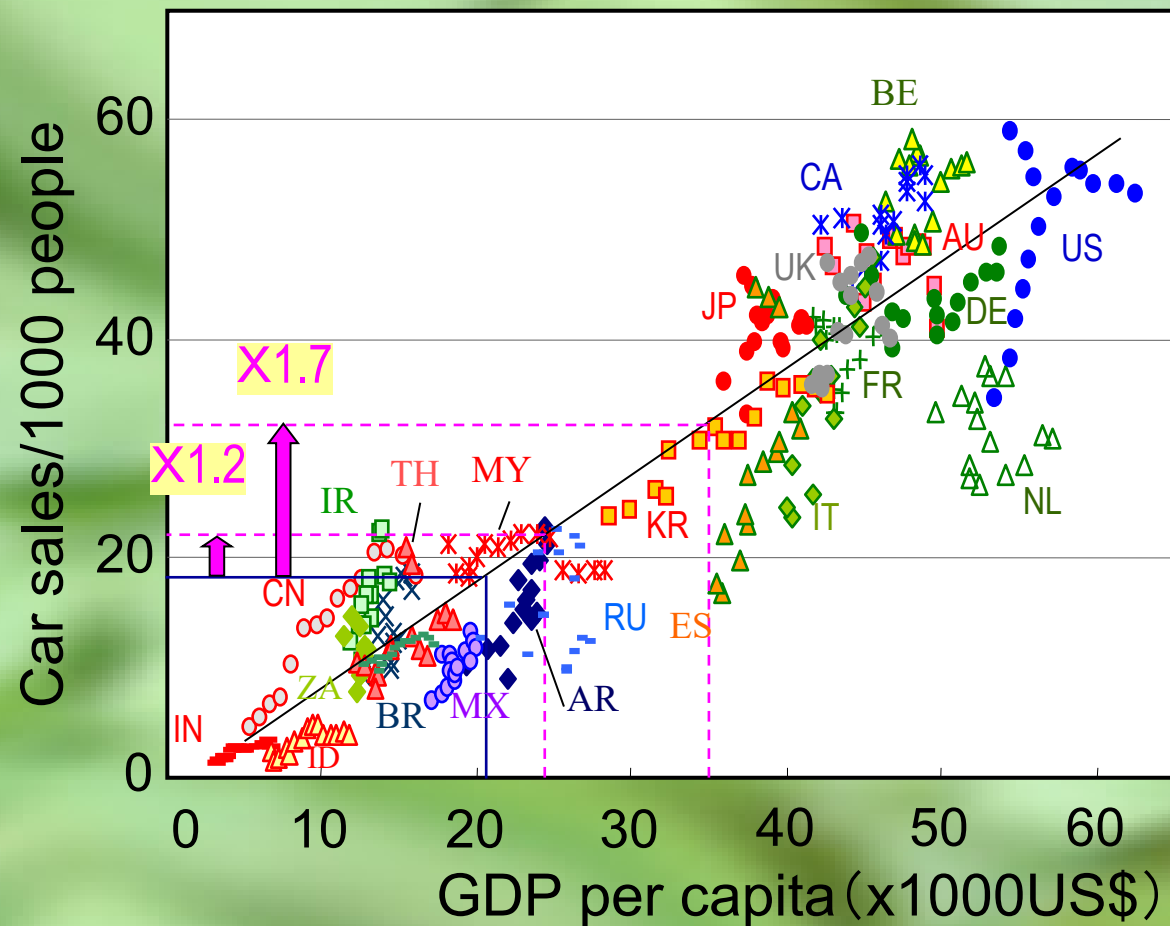
Shigeki KOBAYASHI
Transport Institute of Central Japan



LDV sales trend



Car sales vs Economic growth

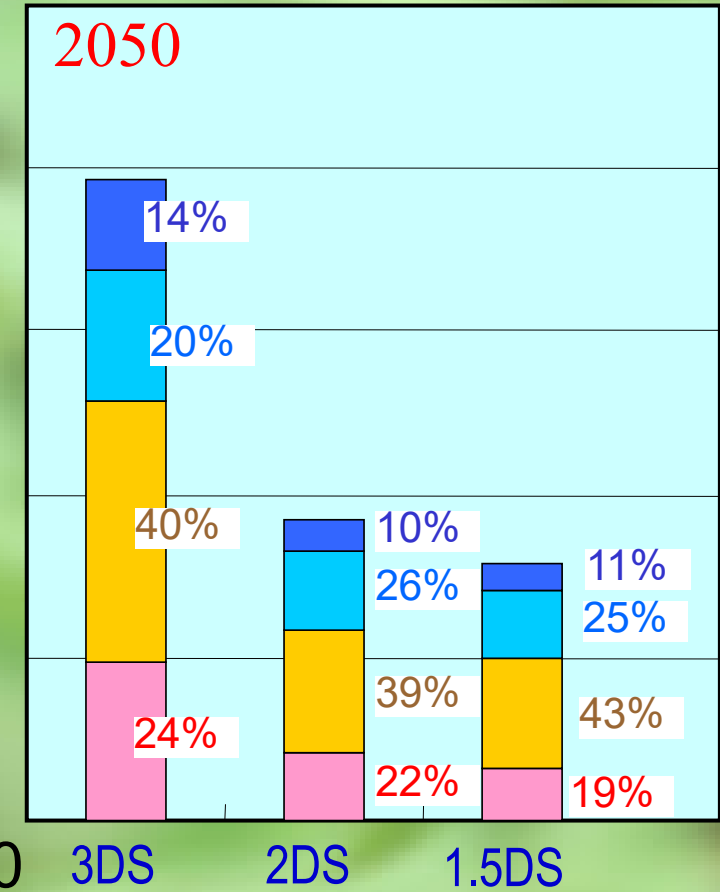
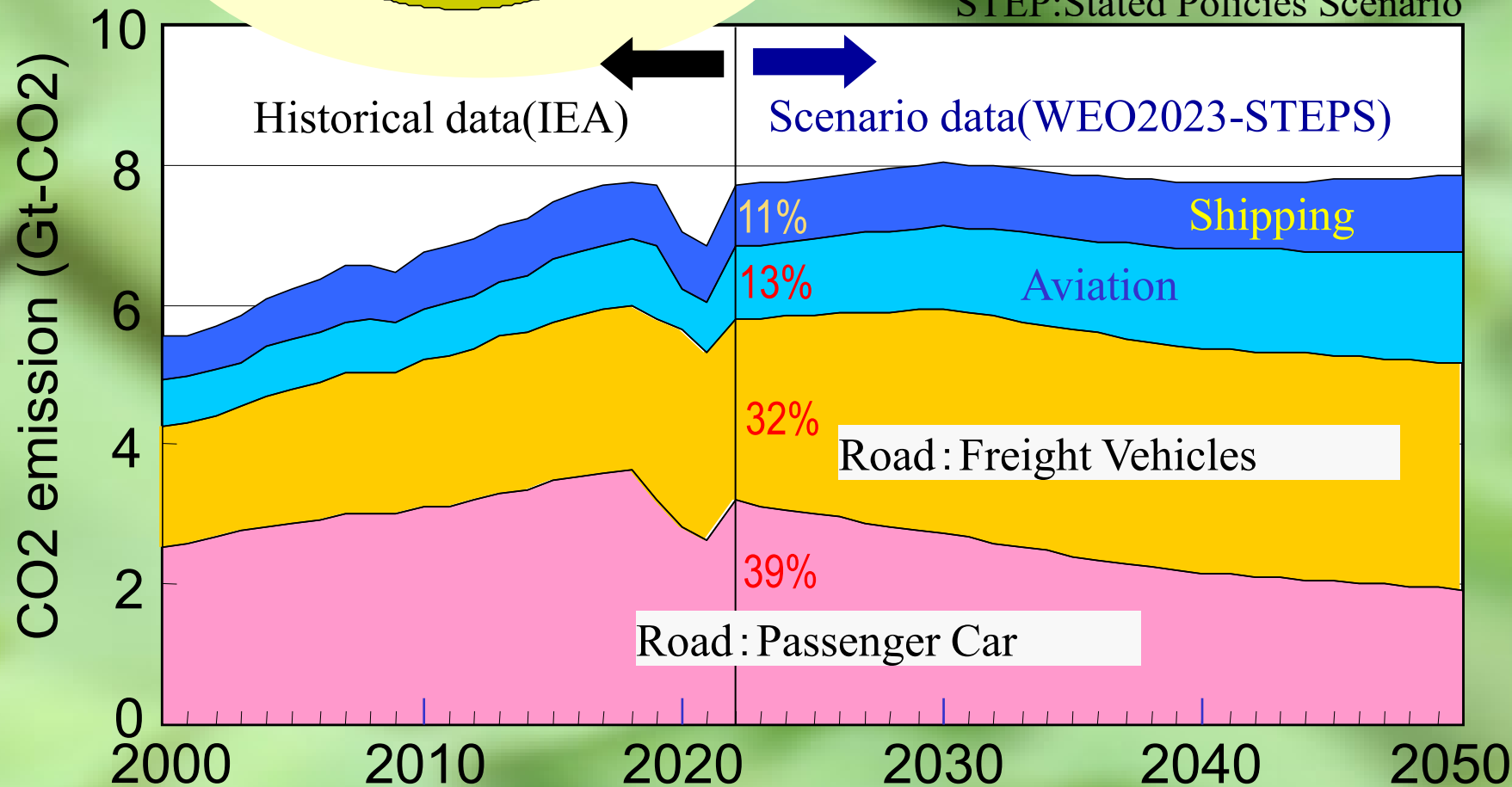


Global average

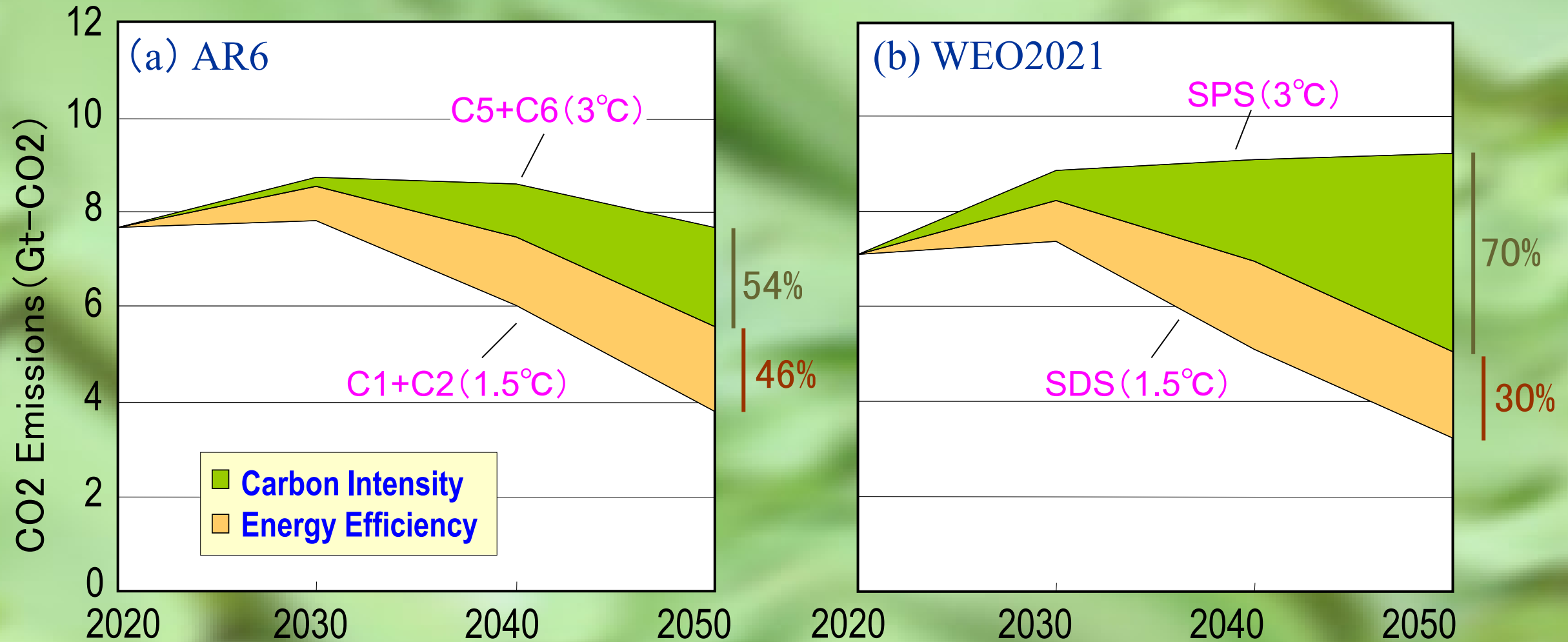
2022 2030 2050

CO2 Emission of Transport Sector by Transport Mode

Pkm 2050/2020 x2
Energy x1.2
CO2 -4%

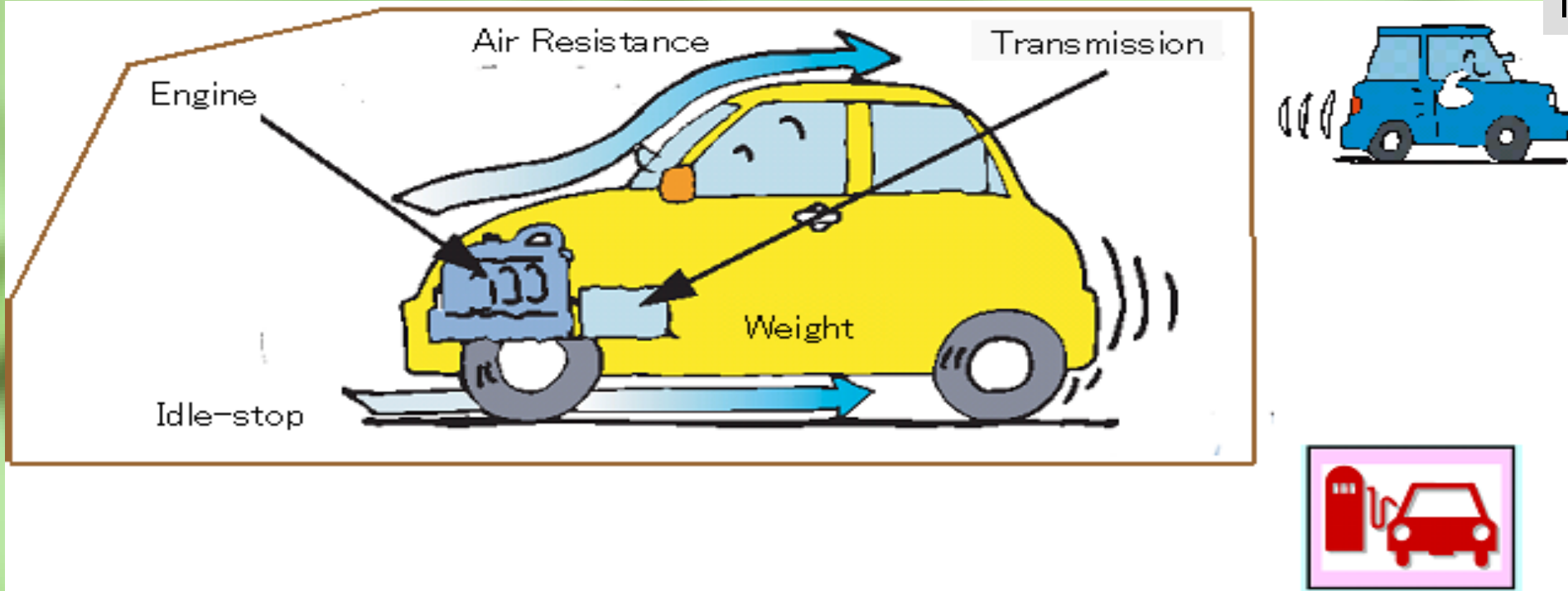


The Breakdown of measures for CO2 emission reduction from 3°C to 1.5°C



SPS: Stated Policies Scenario
SDS: Sustainable Development Scenario

Mitigation technologies and Practices - Road



ICE
Internal Combustion Engine



Powertrain

- HV
- EV
- Fuel Cell

Non-Technological Measures

- Modal Shift: public transport, NMT
- Eco Driving
- Traffic Control: ITS, road pricing

Gasoline
Diesel
CNG



Alternative Fuels

- Biofuels
- H2/Electricity
- Ammonia

Assessment of CO2 Emission Reduction

LCA(Life Cycle Analysis)

Material Production



Vehicle Manifectering



Scrapping/Recycle

Vehicle

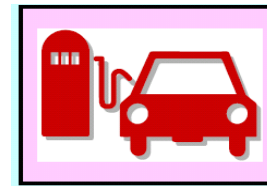
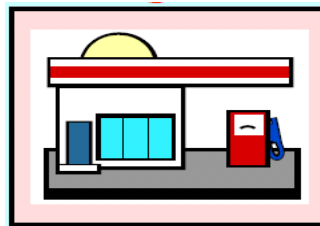
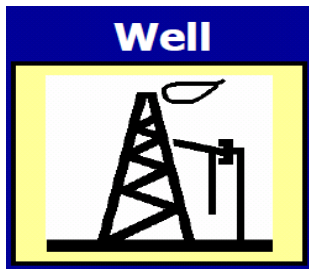
Feedstock
Production

Fuel
Production

Use in Driving

Fuel

← Fuel Production: **WTT Well-to-Tank** →

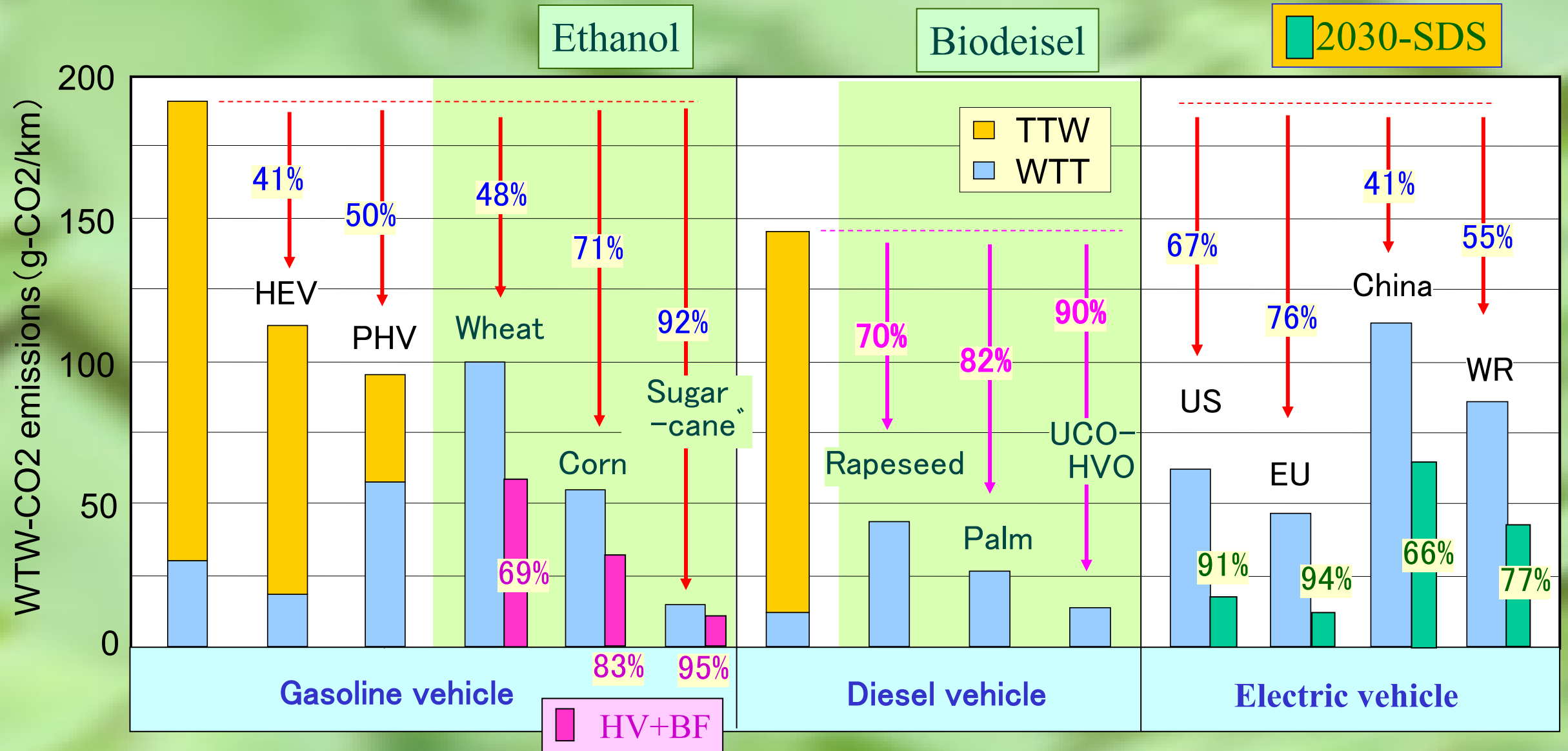


← Tailpipe: **TTW Tank-to-Wheel** →



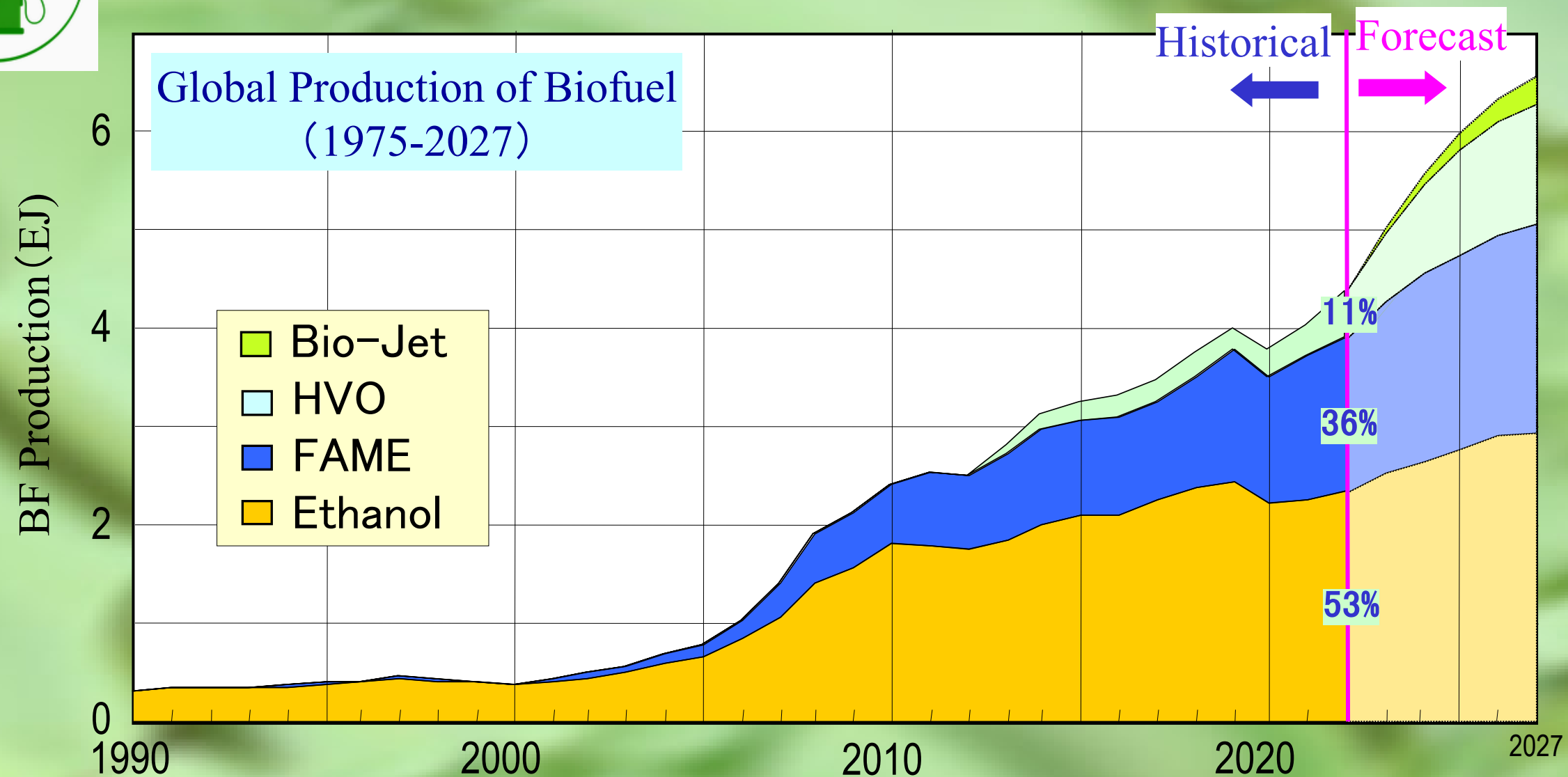
← **WTW Well-to-Wheel** →

CO2 reduction potential of Biofuel and Electrification





Production of Biofuel



FAME:Fatty Acid Methyl Ester, HVO:Hydrotreated Vegetable Oil

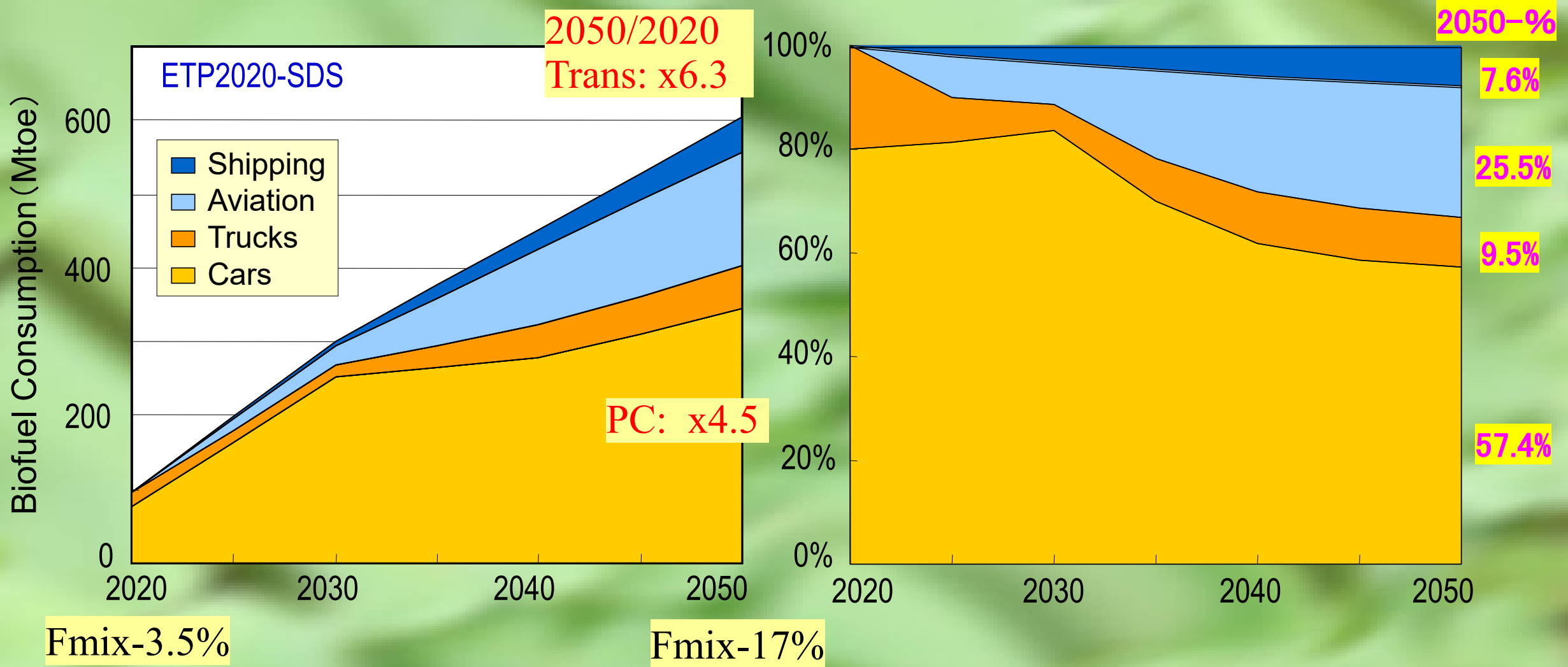
REN21, IEA

Current status of Biofuel consumption in Transport sector

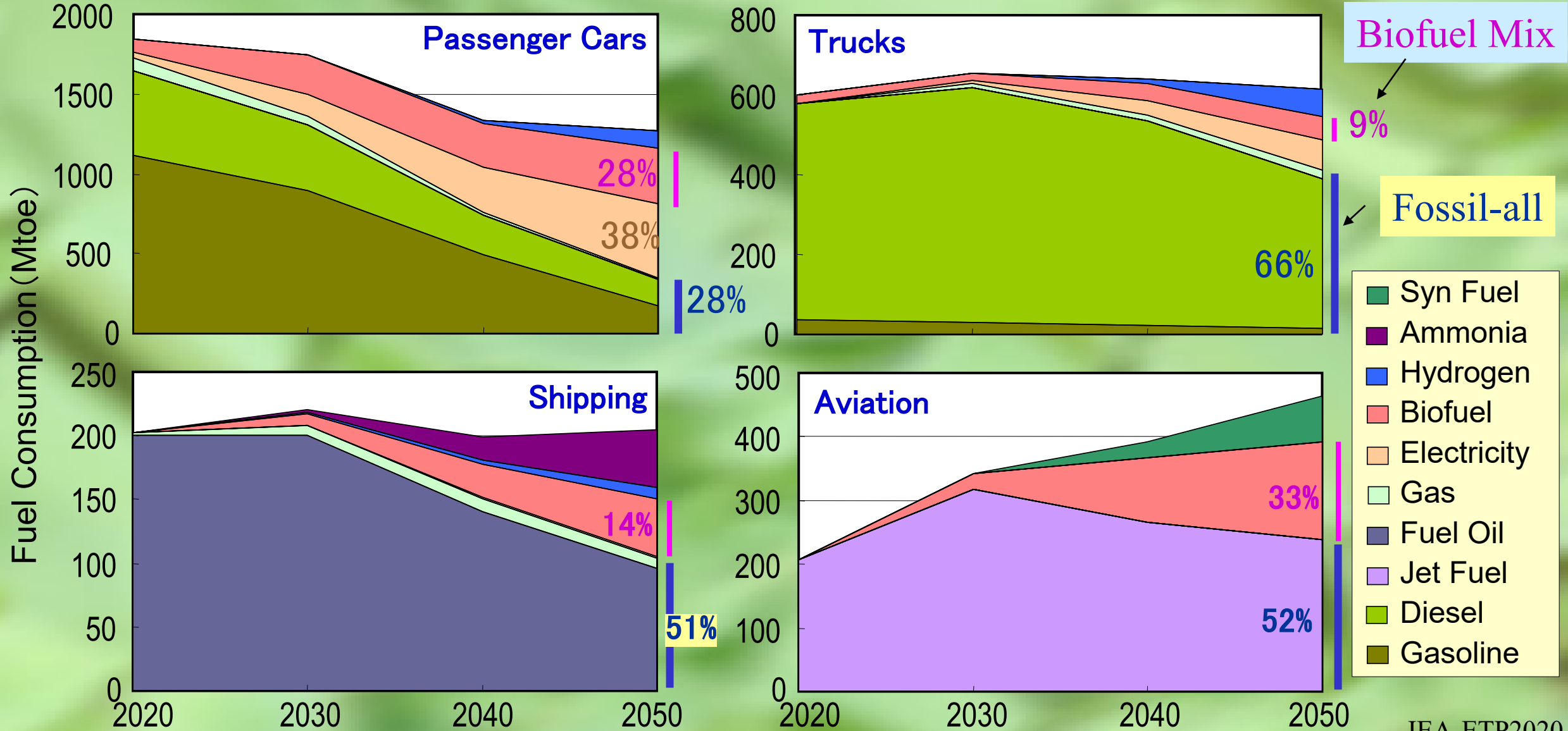
	Ethanol	Biodiesel	Share of Biofuel
World	107.3BL(2022)	58.1BL(2022)	3.5% 2022
US	50.4BL(2022)	13.2BL(2022)	6.5%
EU	6.3BL(2022)	18.4BL(2022)	7.0%
Japan	0.8BL (2022)	10.2ML(2021)	1.2% (E1.9%)
Brazil	29.6BL(2022)	6.3BL(2022)	19% (E38.4%)
Indonesia		10.4BL (2022)	15% (B32.3%)

The biofuel share in the transport energy is 3.5% in 2022, but in some countries such as Brazil, the share is already fairly high.

Biofuel consumption in the IEA Scenario-SDS (1.5DS)



Fuel Mix of each Transport Mode in IEA-SDS (1.5DS)





Electrification of Vehicle

Hybrid Vehicle



Fuel Cell Vehicle



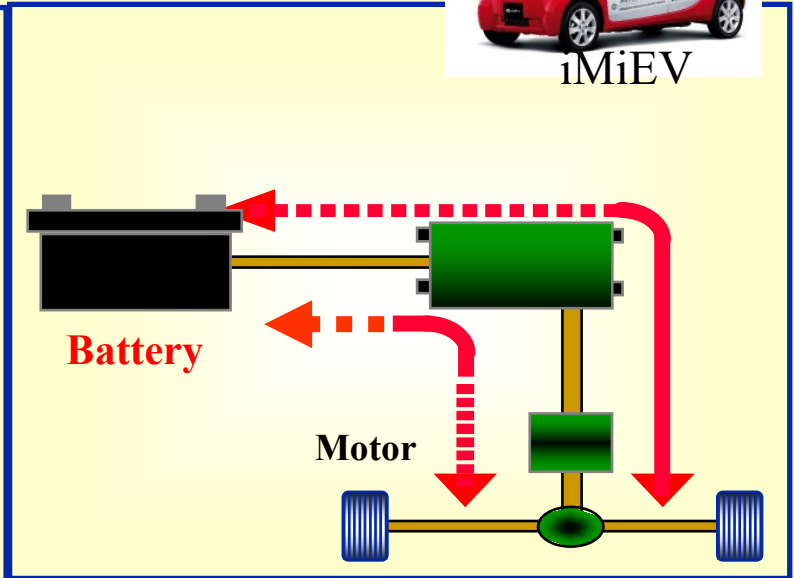
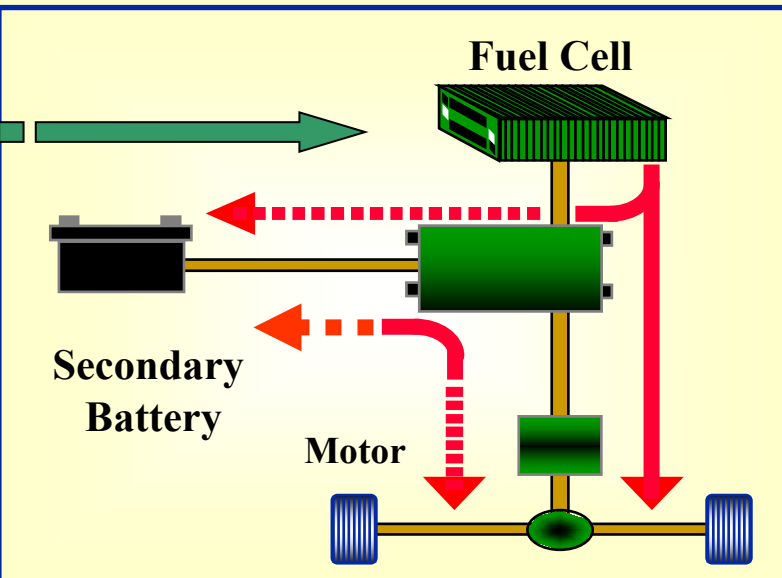
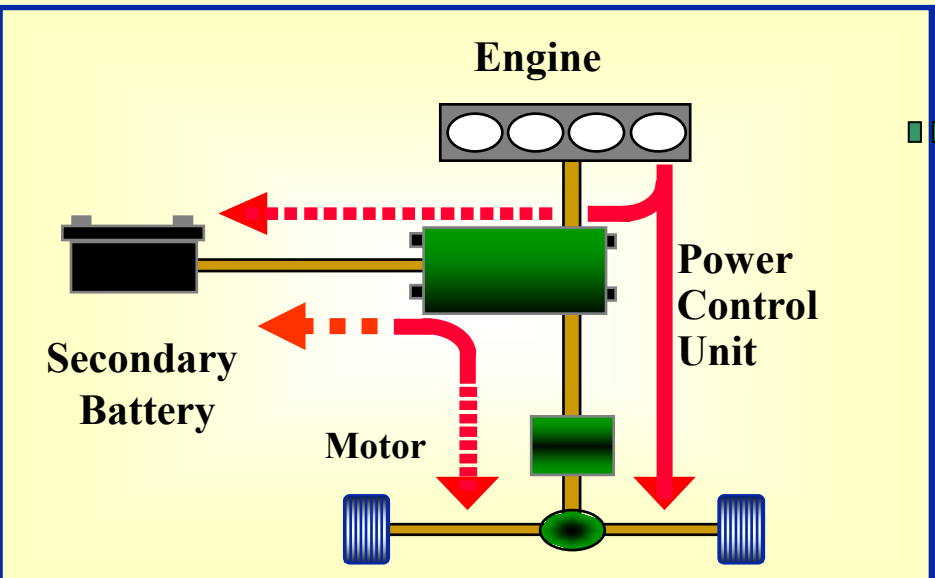
Electric Vehicle



Leaf



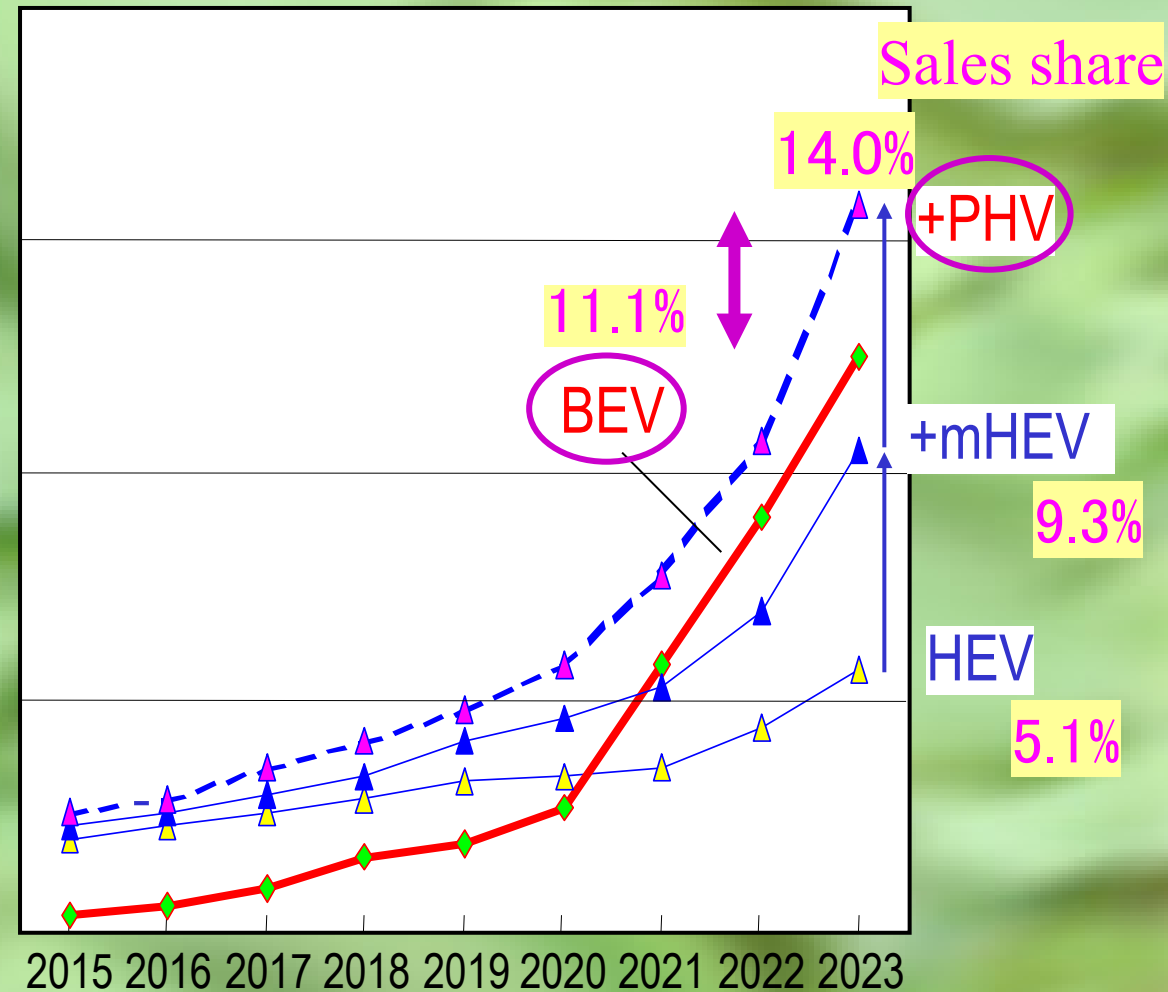
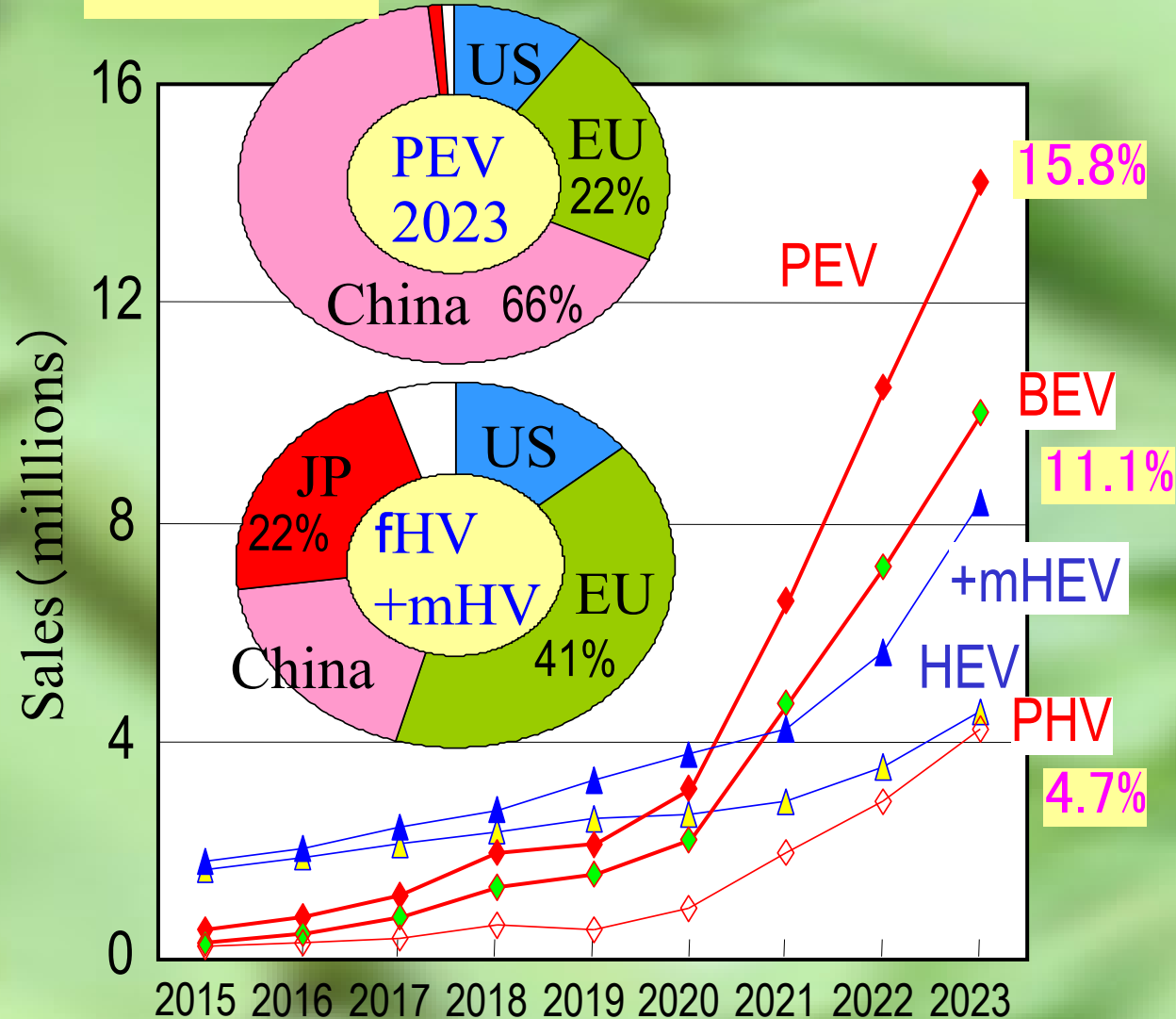
iMiEV



Toyota

Current Market Trend of Electrified Vehicles

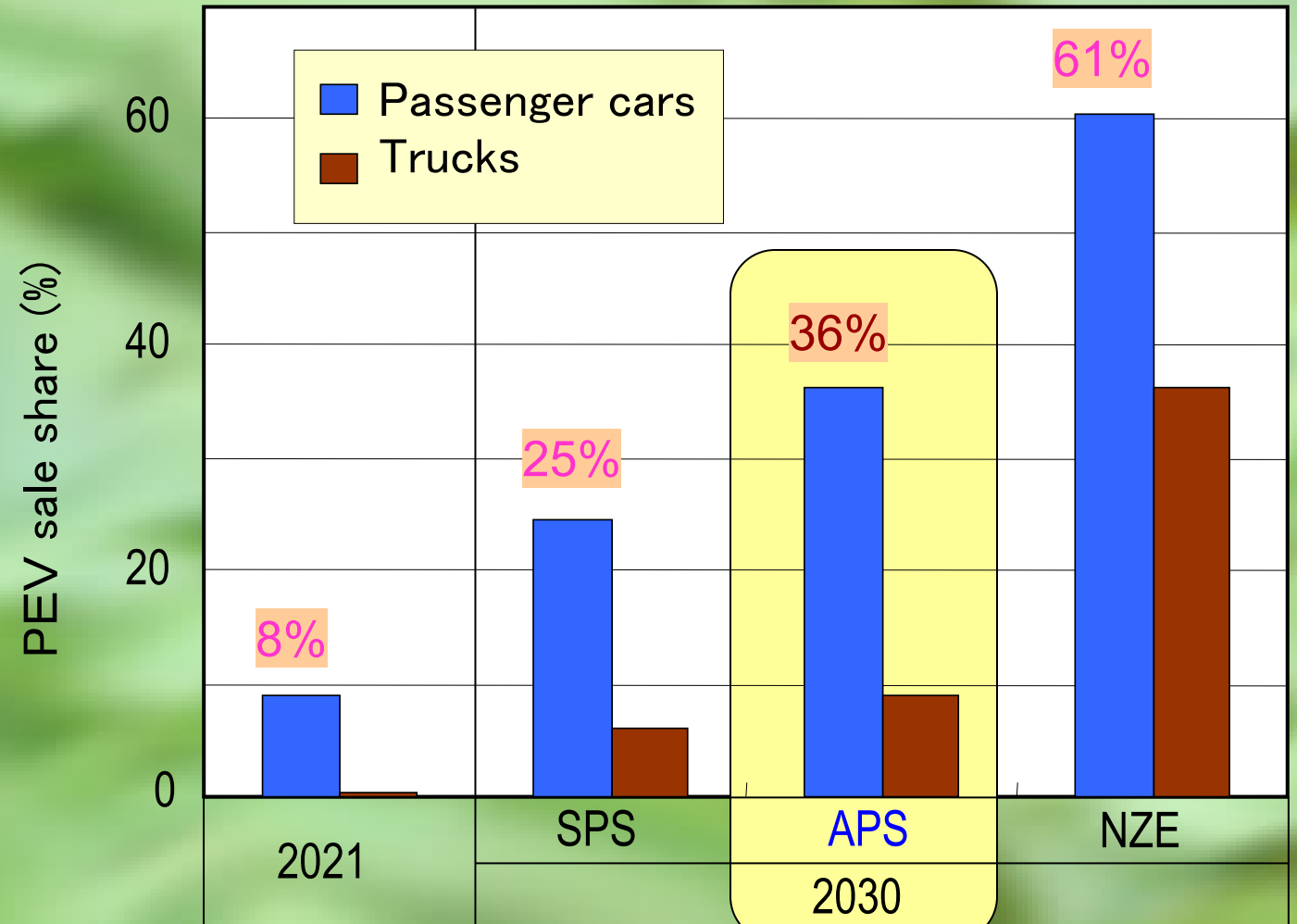
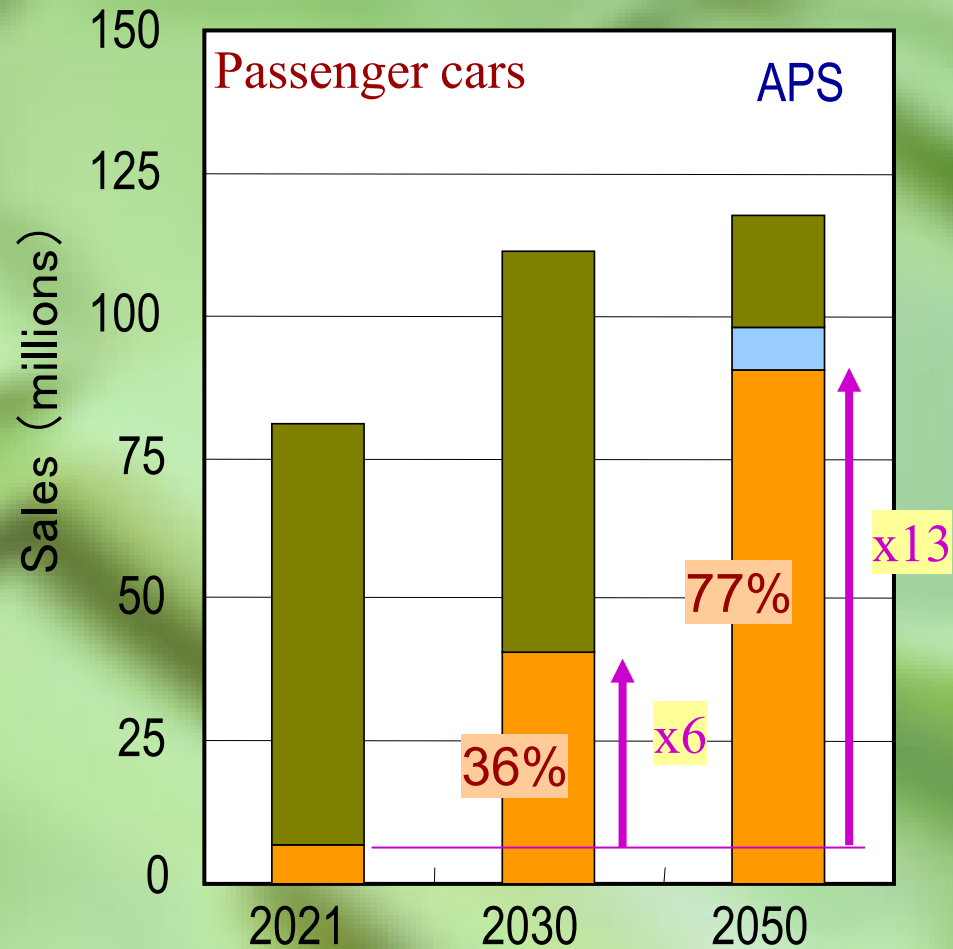
2023 Market



PEV: Plug-in EV = BEV (Battery-powered EV) + PHV (Plug-in HV)

HEV = full-HEV, mHEV: mild HEV

Sales of PEV and Sales Share in IEA-Scenarios



3DS

2DS

< 1.5DS

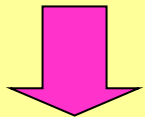
Summary

Biofuel

1. Fuel mix of biofuel in the whole transport energy is 3.5% in 2022
2. In 1.5DS, the amount of biofuel in 2050 should be increased 4.5 times higher than the current level, and the fuel mix will be 17%.

Challenges:

- +Cost
- +Sustainable supply



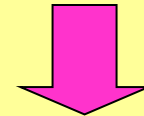
New process technology←R&D
New type of Feedstock (Algae, Cellulose)

Electric Vehicle

1. The market share of PEV is 16% in 2023.
2. PEV sales in 2030 should be increased 6 times higher than the current level, and the market share will be 36% (2DS).

Challenges:

- +Driving range, Cost←battery
- +Charging station
- +Sustainable supply of Battery
←Critical metals



New type of Battery←R&D
More charging stations



Thank you for your kind attention!!

ご静聴 ありがとうございました



TOYOTA CRDL, INC.