

Japanese Fuel Economy Regulation Review

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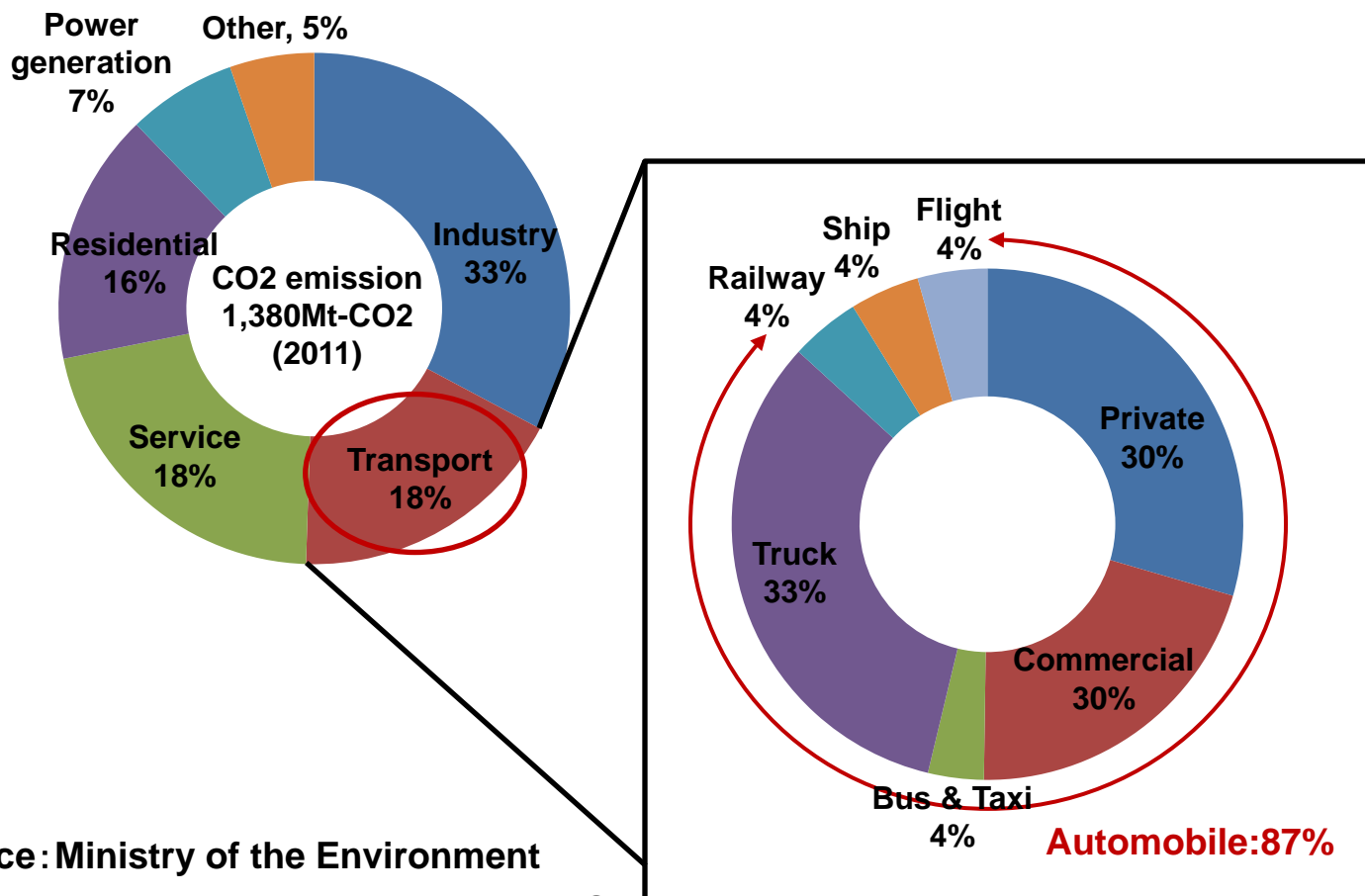
**Energy and Environment Research Division
Japan Automobile Research Institute**

- 1. Background of Fuel Economy Regulation (FER) Implementation**
- 2. FER Results Review (up to 2010)**
- 3. Influence of FER in the Future to Calculate CAMPATH (CO₂ Analysis Model for Passenger car Technologies)**
- 4. FER in Asian Countries**
- 5. Conclusion**

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Background of FER Implementation

- In Japan, around 20% of CO2 emission volume comes from the transportation sector.
- Automotive exhaust is around 90% of that.



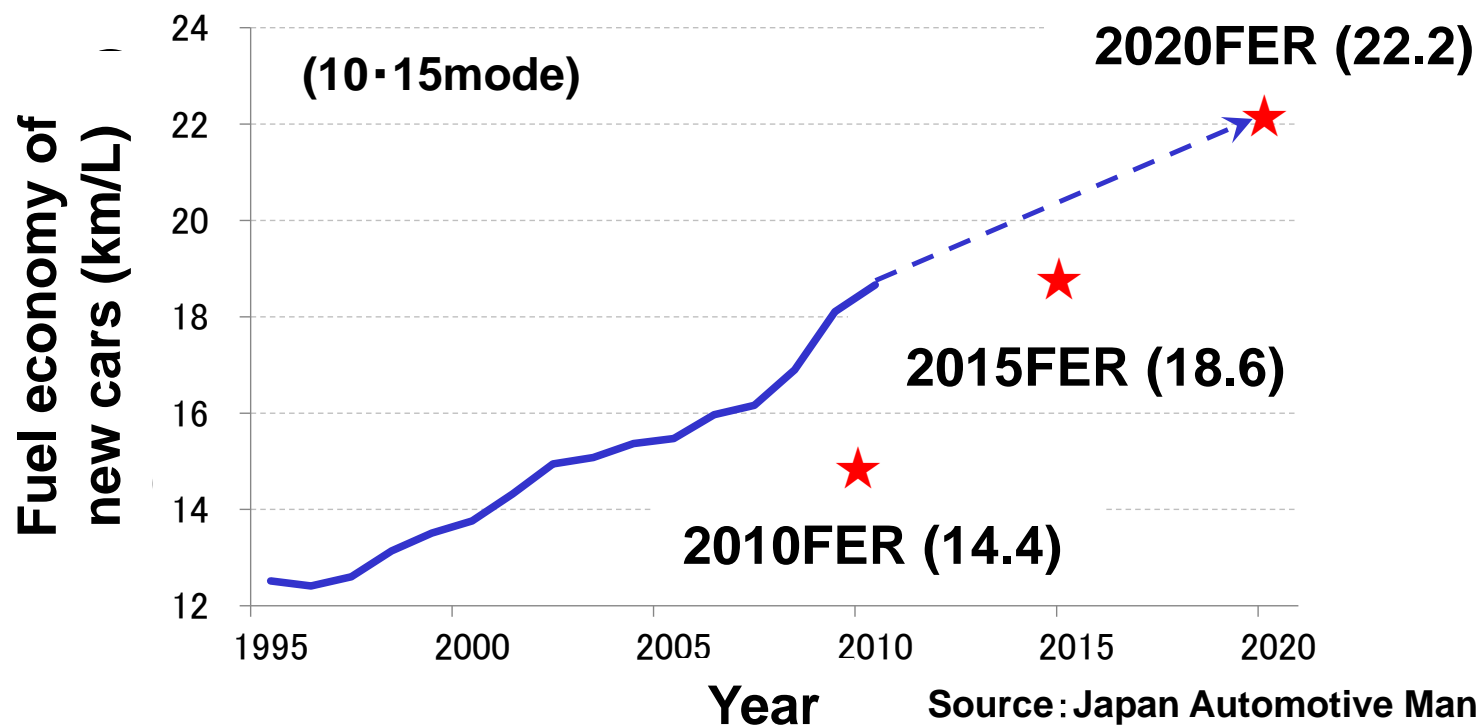
Source: Ministry of the Environment

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Process of Japanese FER Implementation

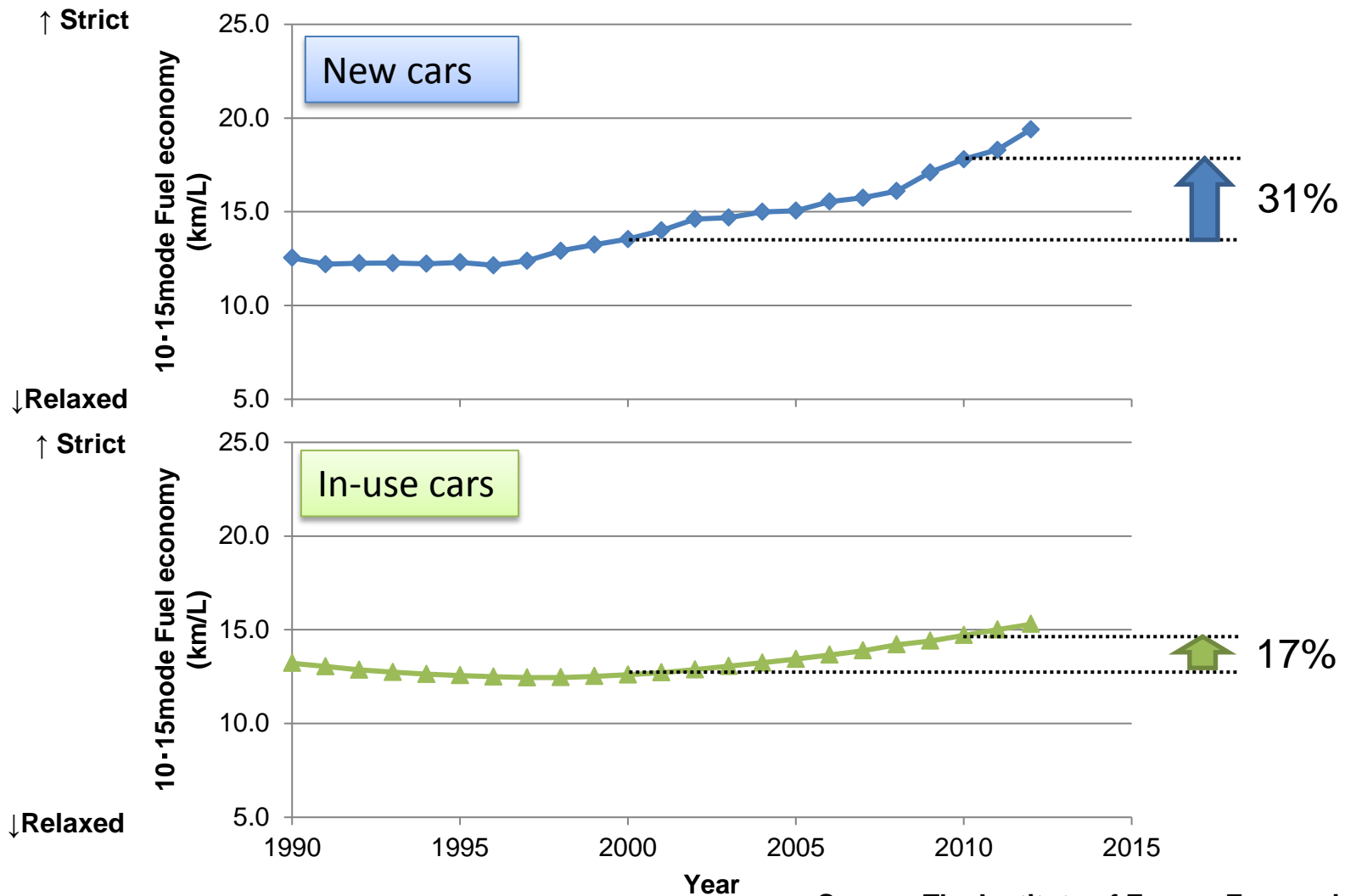
Japanese regulations have been updated many times:

	1980	1985	1990	1995	2000	2005	2010	2015	2020
Passenger cars		☆			☆	☆	☆	☆	☆
Trucks						★		★	



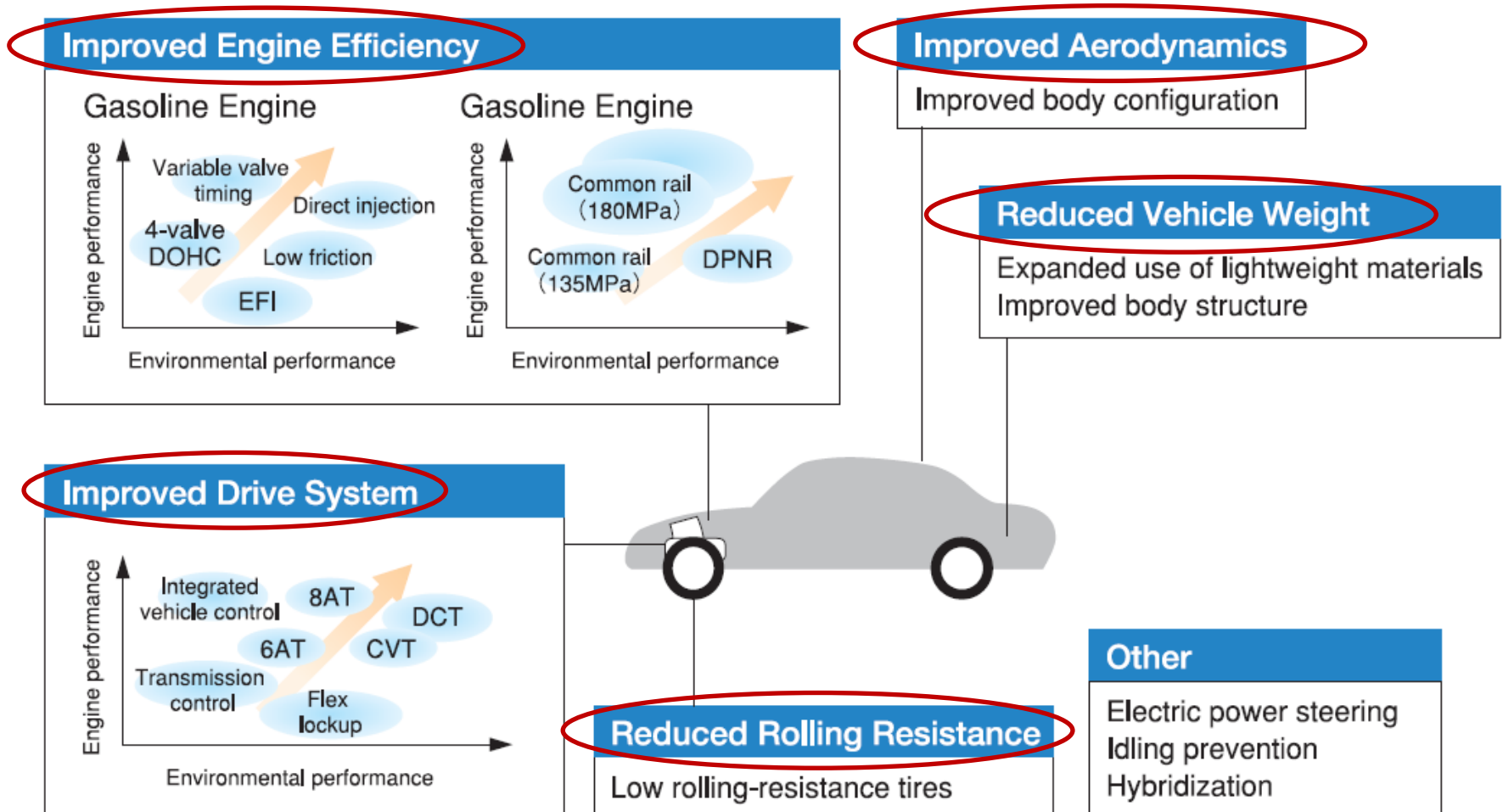
Recent Effects of FER Implementation

Implementation of regulations has led to improved fuel economy of both new cars and in-use cars.



Automotive Makers' Approach to Achieving FER





Automotive makers rapidly popularized improved fuel economy technologies.



Source: JAMA

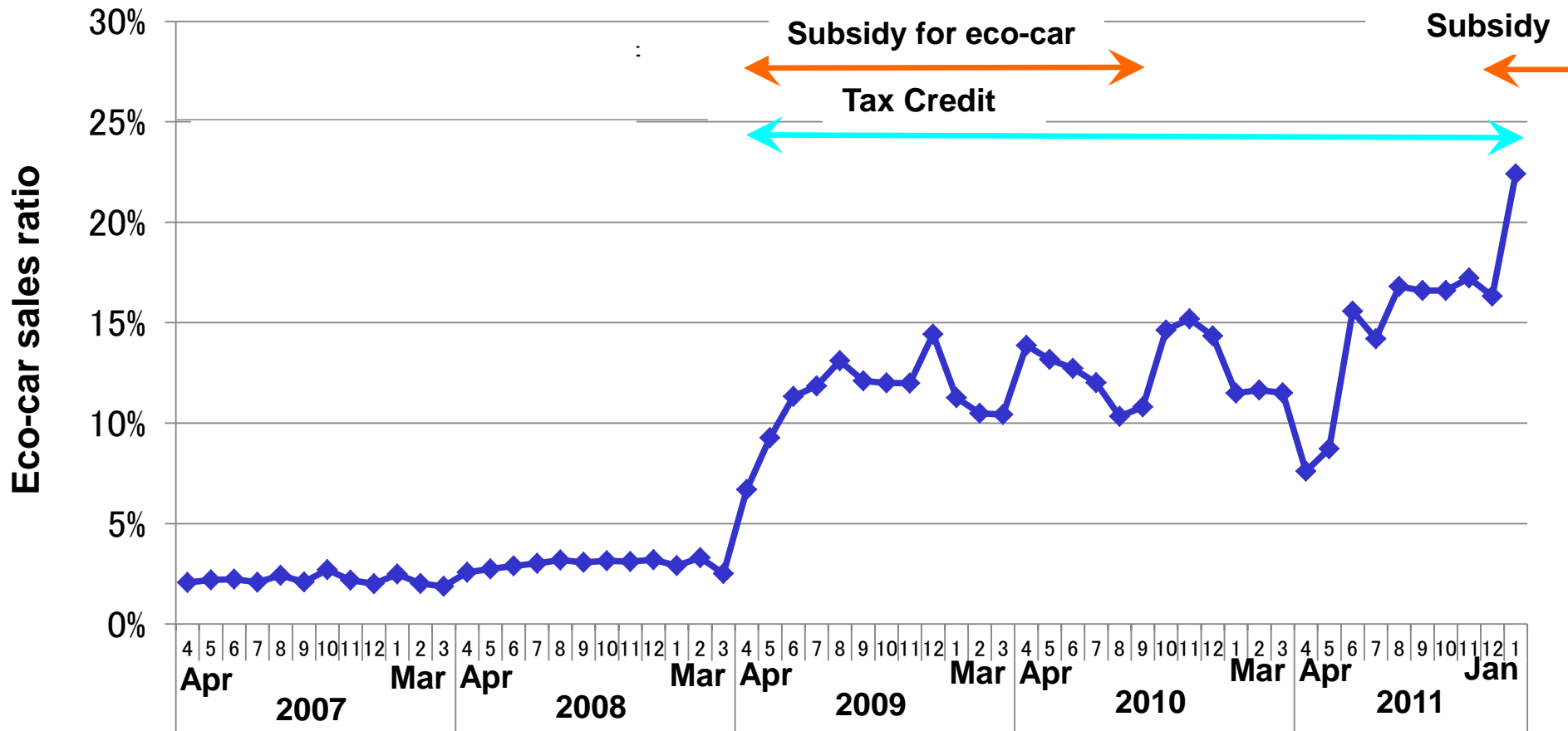
Government-led Approach to Achieving FER

The Japanese government implemented tax credits for cars meeting FER.

<p>Fuel economy (F.E.)</p> <p>Emissions</p>	 <p>Low emission 4 stars</p>
 <p>Cars achieving F.E. of 2015 regulations</p>	<p>Automotive tax: 50% reduction Acquisition tax: 60% reduction</p>
 <p>Cars achieving F.E. 10% higher than 2015 regulations</p>	<p>Automotive tax: 75% reduction Acquisition tax: 80% reduction</p>
 <p>Cars achieving F.E. 20% higher than 2015 regulations</p>	<p>Automotive tax: 100% reduction Acquisition tax: 100% reduction</p>

Government-led Approach to Achieving FER

The Japanese government implemented a subsidy for eco-cars. (Hybrid cars, clean diesel cars and electric cars, etc.)



Source: JAMA

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Concept of the CAMPATH Model

CAMPATH: CO₂ Analysis Model for Passenger car Technologies

- JARI developed the CAMPATH model.
- This model was developed based on a multinomial logit model.
- CAMPATH calculates the number of in-use cars (Mini, Small, Middle, Hybrid), average fuel economy and CO₂ emission by 2030.

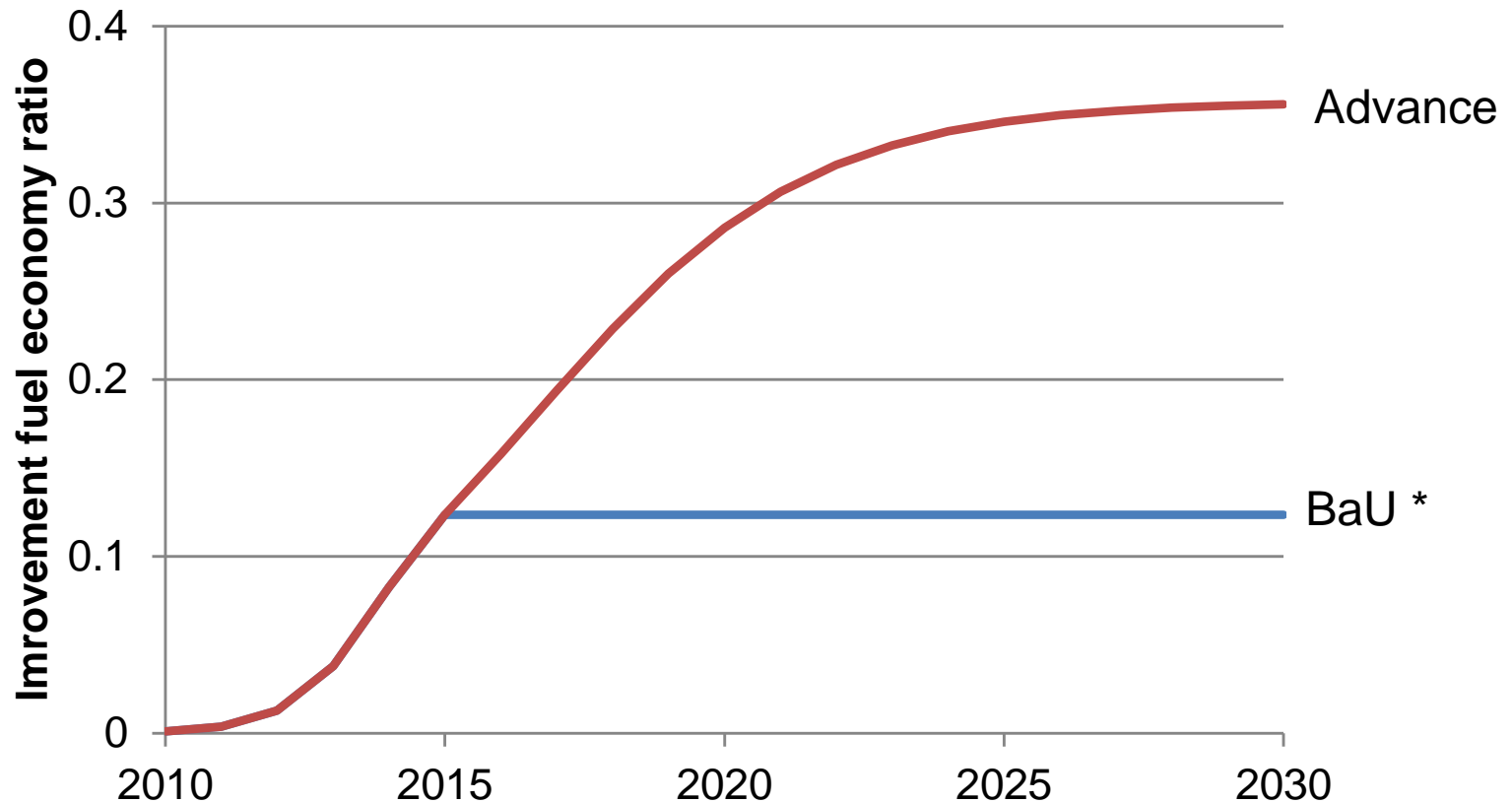
$$U_i = \alpha \times \frac{Cost_i}{Inc} + \beta \times \log(M_i) + \gamma \times Y_i \quad \dots(1)$$

$$P_i = \frac{\exp(U_i)}{\sum(\exp(U_i))} \quad \dots(2)$$

P: Penetration, i: Target car, **U: Utility**, **Cost: Annual total cost**
 Inc: Annual income, **M: Number of model**, Y: Year's type
 α, β, γ: Coefficient

Assumptions of our model (Improving Fuel Economy for New Cars)

- This study has 2 cases: the "BaU Case" and the "Technology Advance Case".

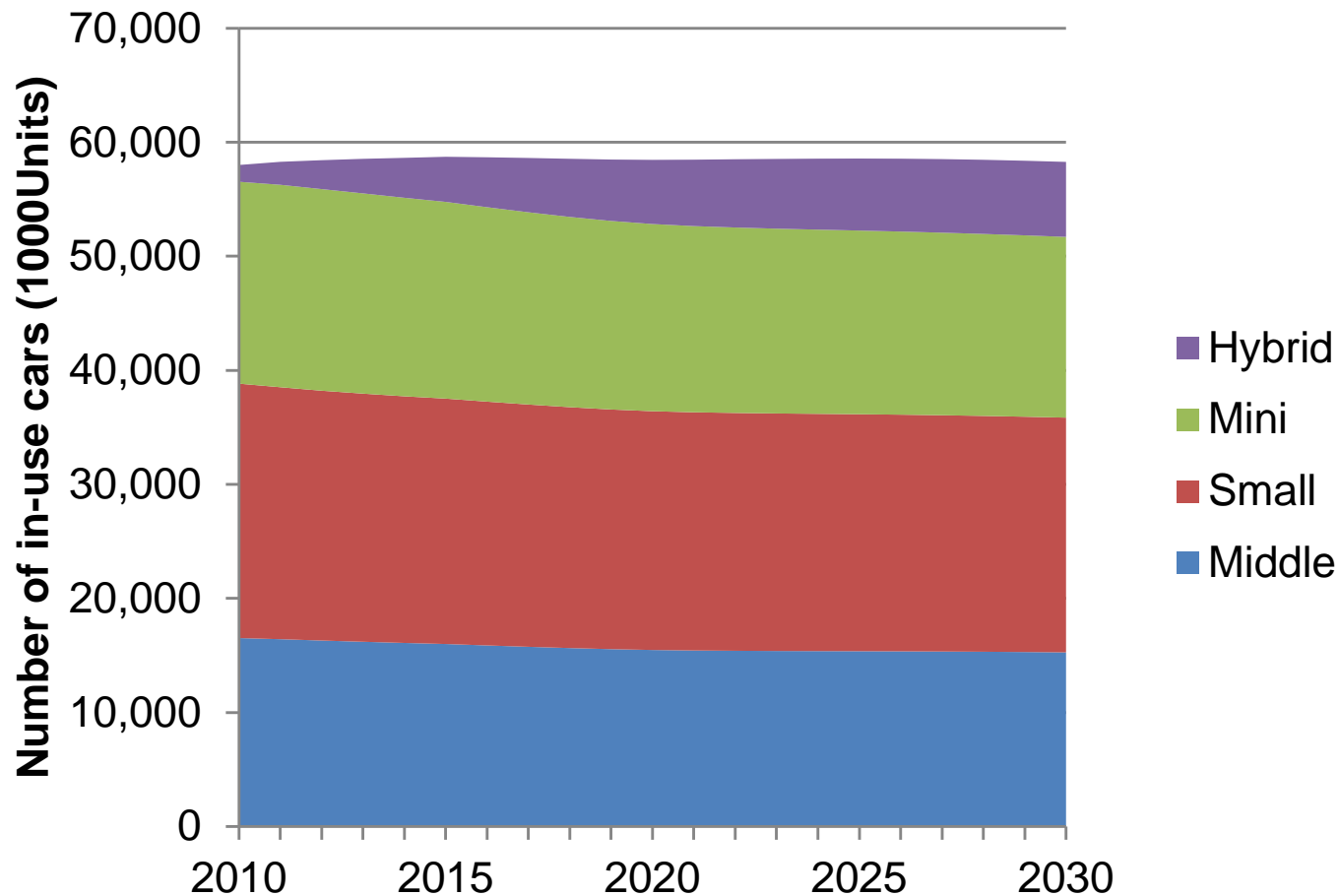


* BaU = Business as Usual

Results for the Number of

In-use Passenger Cars

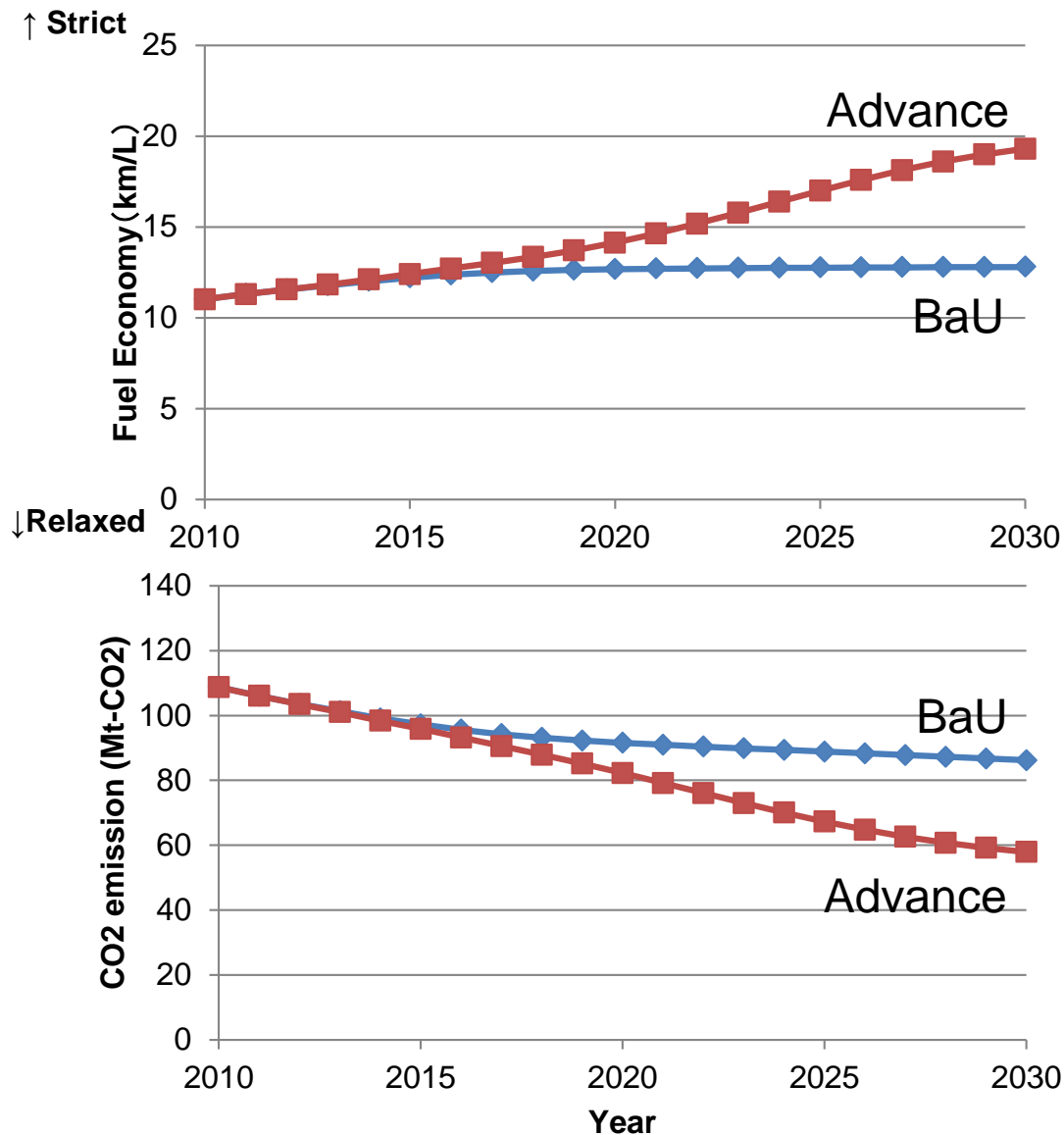
- Hybrid cars increase slightly every year and become over 10% of total cars.
- The share of each gasoline class will keep the current level in the future.



Results for Fuel Economy and CO2 Emission

➤ In the Advance Case, fuel economy of in-use cars is 75% higher in 2030 than the fuel economy of 2010.

➤ In the Advance Case, CO2 is reduced 47% by 2030 (Based on 2010).



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FER of Other Asian Countries

- **Korea: Fuel efficiency targets implemented since the 1990s and updated in 2005. New fuel efficiency targets will be adopted from 2015.**
 - ✓ Average fuel economy standards were 12.4 km/L for vehicles with 1500cc engines or less, and 9.6 km/L for engines greater than 1500cc displacement.
 - ✓ 17 km/L or 140 gCO₂e/km (equivalent to 150 gCO₂/km under the New European Drive Cycle) for model year 2015.

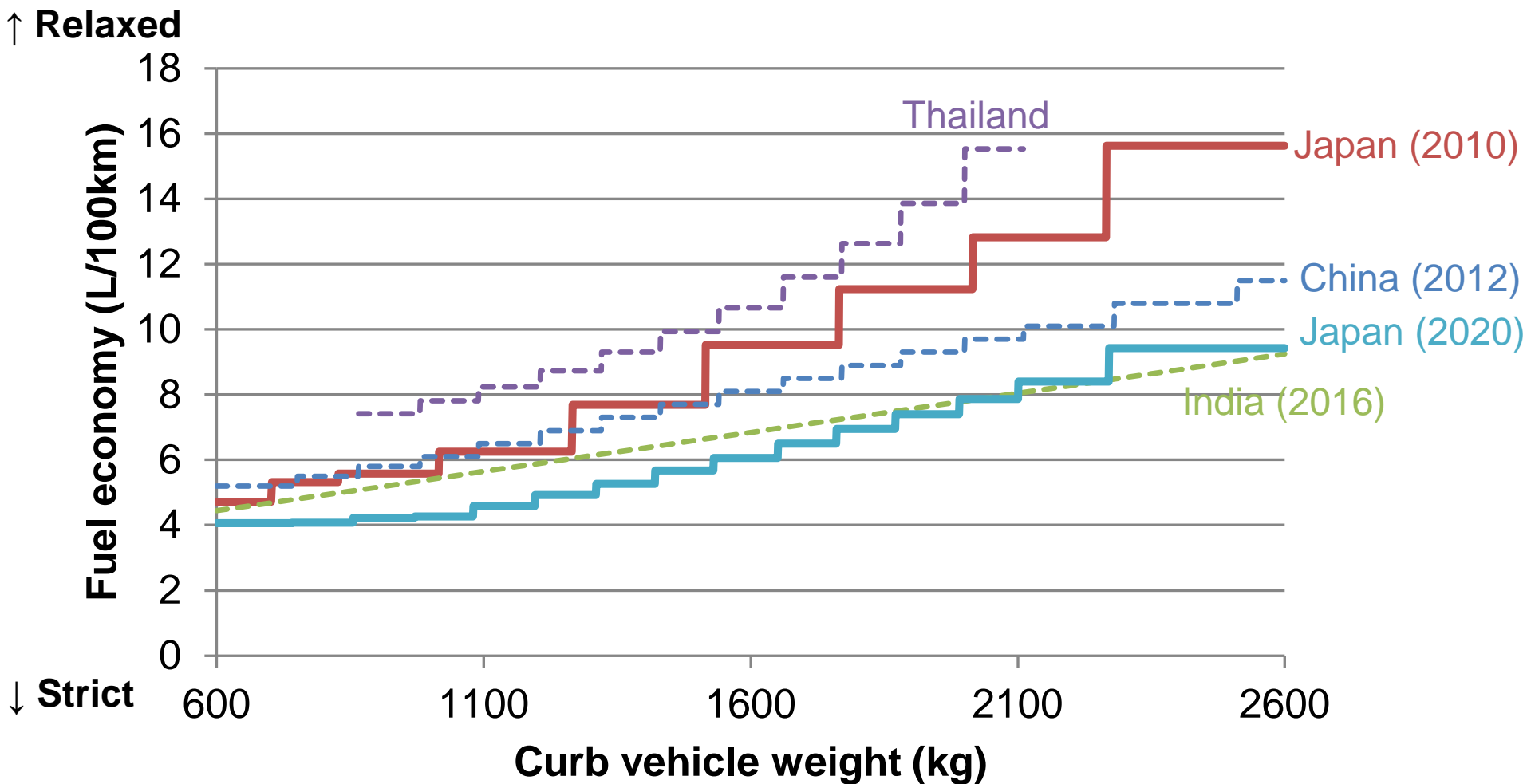
- **China: FER has been implemented since 2005 and regularly updated. In addition, the 4th regulations are being considered.**
 - ✓ FER of passenger cars is adopted under 3500kg of curb vehicle weight for gasoline and diesel vehicles. This FER sets a target of fuel economy of each class, and adopts CAFE (Corporate Average Fuel Economy).
 - ✓ Average fuel economy target of the 4th FER is 30% stricter than the 3rd FER.

- **India: FER will be adopted from 2016.**
 - ✓ Target fuel economy is calculated with a linear formula using curb vehicle weight.
 - ✓ FER adopts CAFE. FER is adopted under 3500kg of gross vehicle weight, under 9 person capacity, gasoline cars, diesel cars, LPG cars, CNG cars.

- **Thailand: FER has been considered, based on exhaust emission regulations.**

Comparison of FER of Asian Countries

This graph shows a comparison of latest FER in each country.



Four Approaches of Achieving FER in Japan

- **Implementation of a top-runner approach**
 - ✓ This approach has been to set a target based on the vehicle performance of the best current fuel economy.
 - ✓ Particular types of cars such as electric, plug-in hybrids and manual transmission cars are excluded from the top runners.

- **Fuel economy of ensuring consistency for each class**
 - ✓ Segmentalized so that competition will become fair in each category.

- **Implement CAFE approach**
 - ✓ By imposing obligation on each manufacturer, competition occurs between manufacturers to introduce advanced technologies.

- **Relatively loose penalties**
 - ✓ Purpose of the energy saving law is not to regulate manufacturers but to promote efforts by manufacturers to improve energy efficiency of each product.
 - ✓ Even if Fuel Economy Standards are not met, there is no immediate penalty.

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Conclusion

- In Japan, regulation of passenger cars and heavy duty cars is implemented and **regularly updated**, and has the effect of improving fuel economy. **FER is achieved by the efforts of automotive makers and the government.**
- The Japanese 2015 & 2020 **FER have strict targets for gasoline cars** and we need to **popularize hybrid cars more**. We also must implement **more improving fuel economy technologies**.
- In Asia, we have many environmental issues to consider, including the reduction of CO2. **Implementing FER and popularizing next-generation vehicles are important**. In addition, it is important to **analyze any effects in the long term**.
- JARI has been calculating CO2 emission for Asian countries. In the future, **we hope you will join us in projects to use our knowledge and experience to create a healthy motorized society for us all**.

Thank you for your attention.

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