

LCA activity for Automobiles in JAPAN

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Background



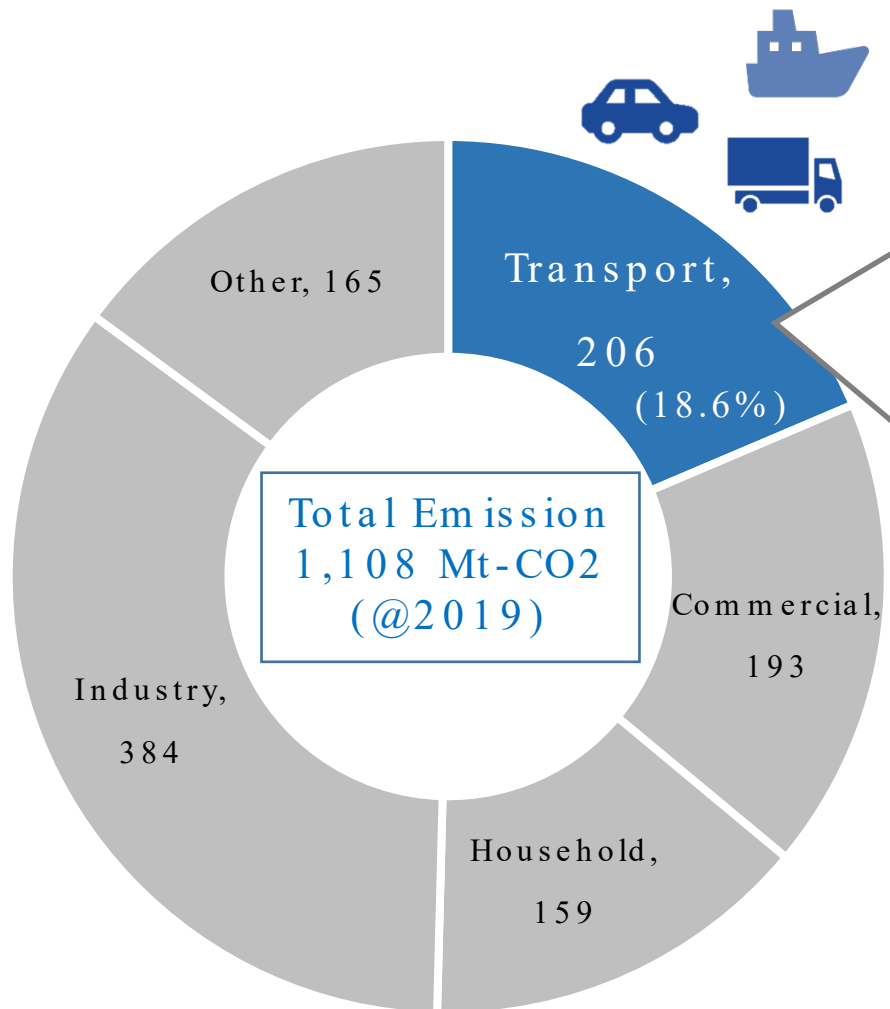
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IN PARTNERSHIP WITH ITALY

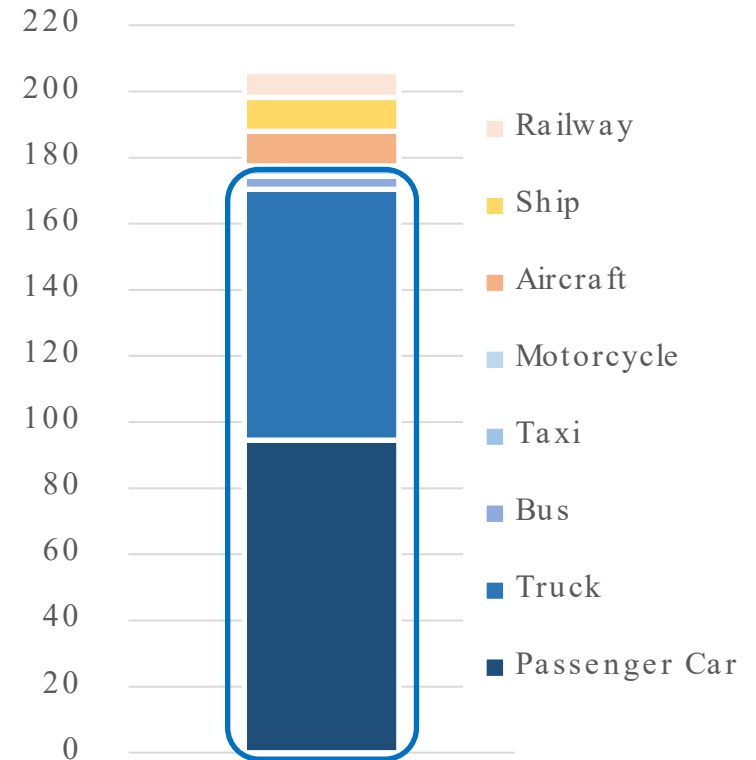


At COP 26 World Leaders Summit, Prime Minister KISHIDA Fumio made the following statements with regard to automobiles.

- With an aim to realizing a future where vehicles, the world's essentials, will become zero emission, Japan will take advantage of all the available options of technologies.
- By utilizing our own 2 trillion yen Green Innovation Fund, Japan will develop next-generation batteries and motors, hydrogen, and synthetic fuels, which all hold the key to the spread of electric vehicles.
- While spreading the fruits of these innovations across Asia, Japan will spearhead global efforts.

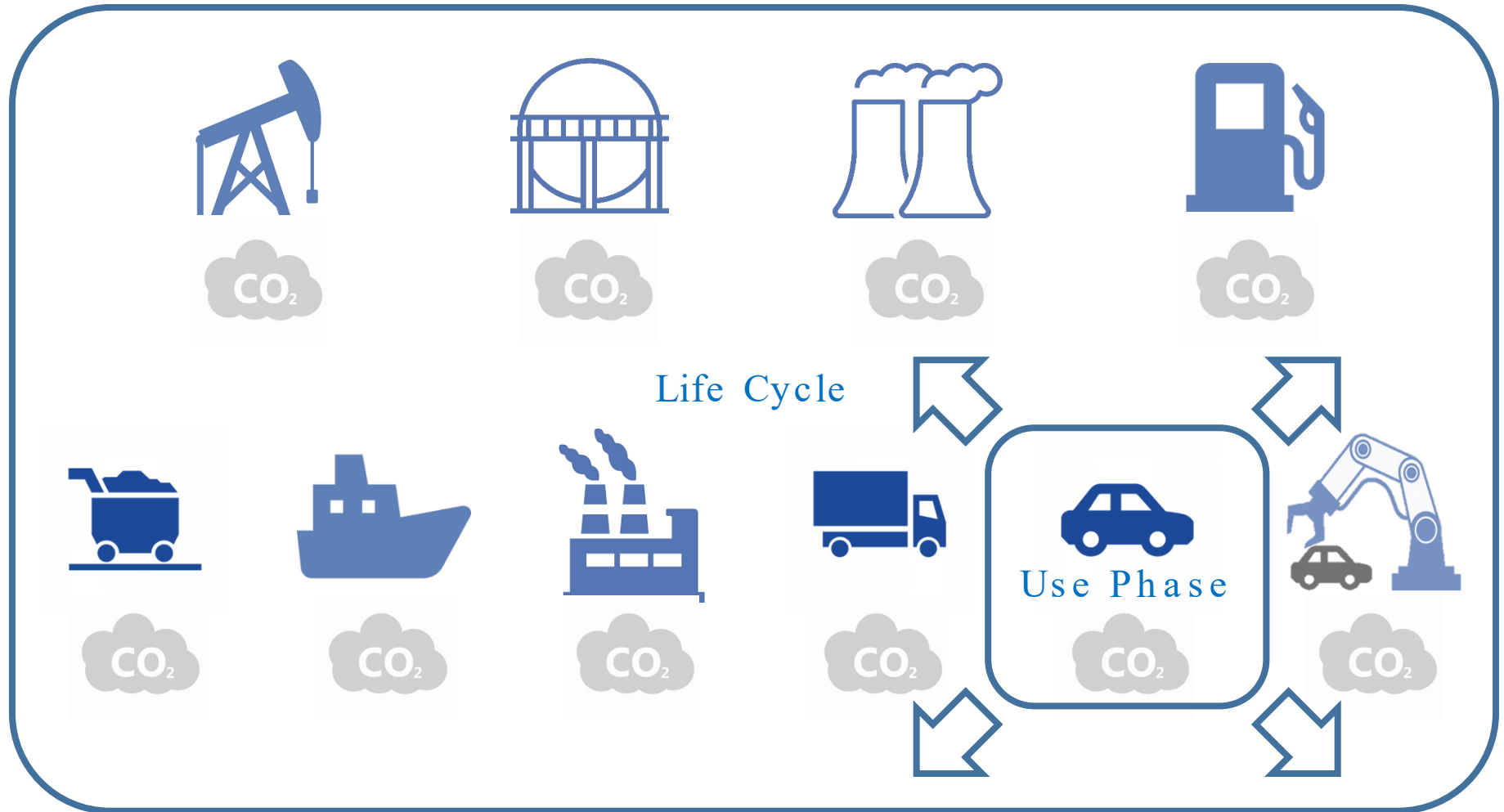


Transport Sector CO₂ Emission



Automobile has 86.1% impact in transport sector, 16.0% impact in total Japanese emission

Transport sector has large amount of CO₂ emission. Automotive industries have a responsibility to reduce it.

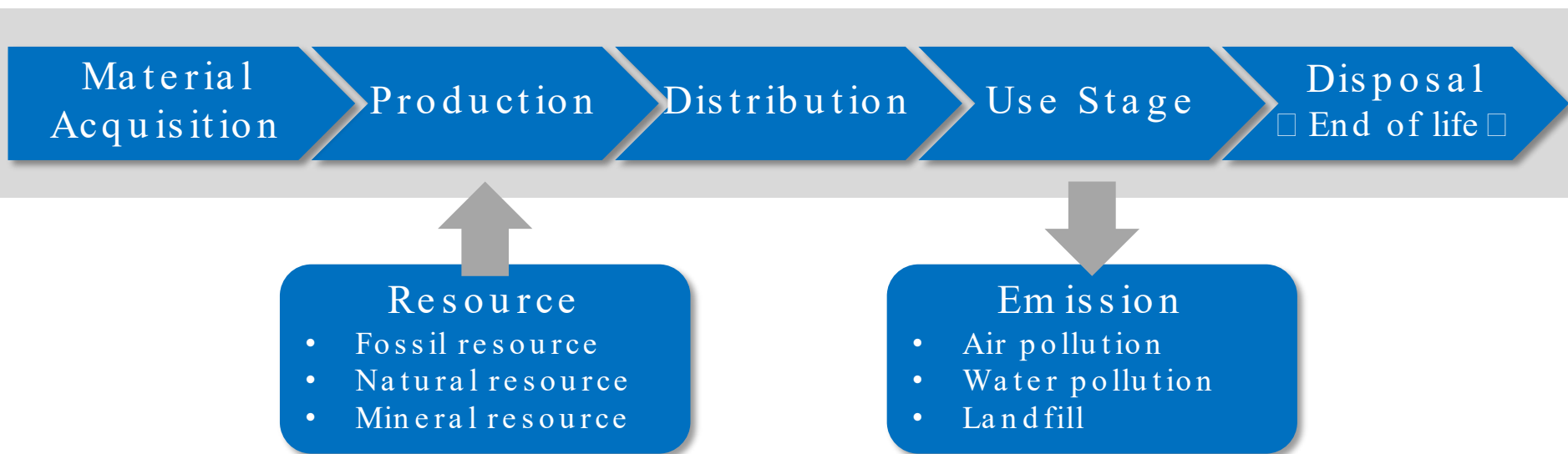


Towards carbon neutrality, it became more important to consider in life cycle perspective.

What's Product LCA

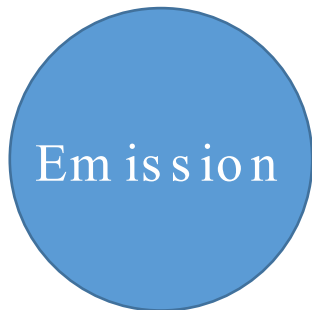
The concept of life cycle assessment (LCA) begins with the extraction of resources from the earth when it enjoys some convenience from certain products or services, and the manufacture, transportation, use, and all waste is returned to the earth. It is an appropriate and quantitative evaluation of all activities up to the point in time “the cradle to the grave”. LCA is positioned as a method for quantitatively evaluating the environmental load of products and services, and ISO 14040 describes the environmental aspects and potential environment throughout the life cycle from the collection of raw materials for products and services to manufacturing, transportation, use and disposal.

■ LCA Basic Process (5 Phase)



It is used for analyze emission effect on each life cycle stages to find out key improvement activities.

Outline of LCA method



Environmental impact

- GHG emission[kg-CO_{2e}]
- Use of Water[m^3]
- etc.



Activity at each phase

- Material[kg]
- Fuel[L]
- etc.



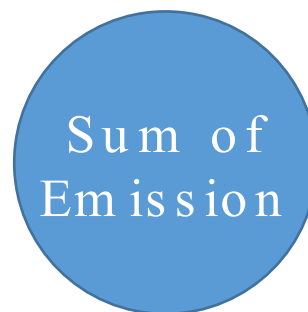
Intensity at each activity

- Material intensity[$\text{kg-CO}_{2e}/\text{kg}$]
- Fuel intensity[$\text{kg-CO}_{2e}/\text{L}$]
- etc.



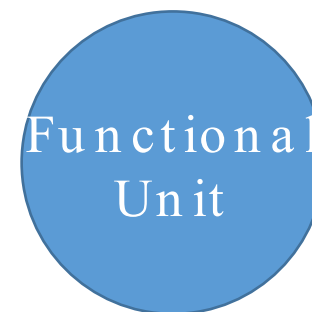
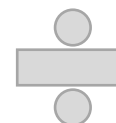
Environmental assessment

- Vehicle LCA[$\text{kg-CO}_{2e}/\text{km}$]
- BATT LCA[$\text{kg-CO}_{2e}/\text{kWh}$]
- etc.



Environmental footprint

- GHG emission[kg-CO_{2e}]
- Use of Water[m^3]
- etc.



Performance of product

- Lifetime mileage[km]
- Provided energy[kWh]
- etc.

In LCA, it is difficult to collect all activity data, intensity, and functional unit as primary data, so it is common to combine with secondary data.

■ Primary Data □

refers to **data from specific processes within the supply-chain** of the company. Primary data may be obtained through meter readings, purchase records, utility bills, direct monitoring, material/product balances, or other methods for obtaining data from specific processes in the value chain of the company

■ Secondary Data □

refers to **data not from specific process within the supply-chain** of the company. This refers to data that is not directly collected, measured, or estimated by the company, but **sourced from a third-party** life-cycle-inventory database or other sources. Secondary data includes **industry-average data, literature studies**, engineering studies and can also be based on financial data, and other generic data.

Only the primary data can be taken the responsibility by the reporting company.

ISO 14040:2006



Environmental management — Life cycle assessment — Principles and framework

Principle framework for LCA

- Definition of purpose and scope of LCA
- LCI stage
- LCIA stage
- Life cycle interpretation stage
- LCA reporting and critical review



There are no guidelines
defining detailed LCA
methodology for automobiles

ISO 14040 series are written for all products and services.
Product category rules for Automobiles need to be developed. 10

LCA activity for Automobiles in JAPAN

Background / Aim

- Increasing demand for information disclosure (visualization) of comparable LC-CO₂ emissions such as carbon footprint (CFP).
- Increasing the number of organizations / companies that publish LCA results in the automobile industry.



LC-CO₂ emissions suitable for automobiles, which guarantees "fairness of evaluation", "transparency of results" and "easiness of calculation", which enables comparison between products considering the characteristics and actual conditions of the automobile industry. Consider how to calculate the quantity.

In JAPAN we already developed transparency Automobile LCA method in 2011.

Definition of Lifecycle

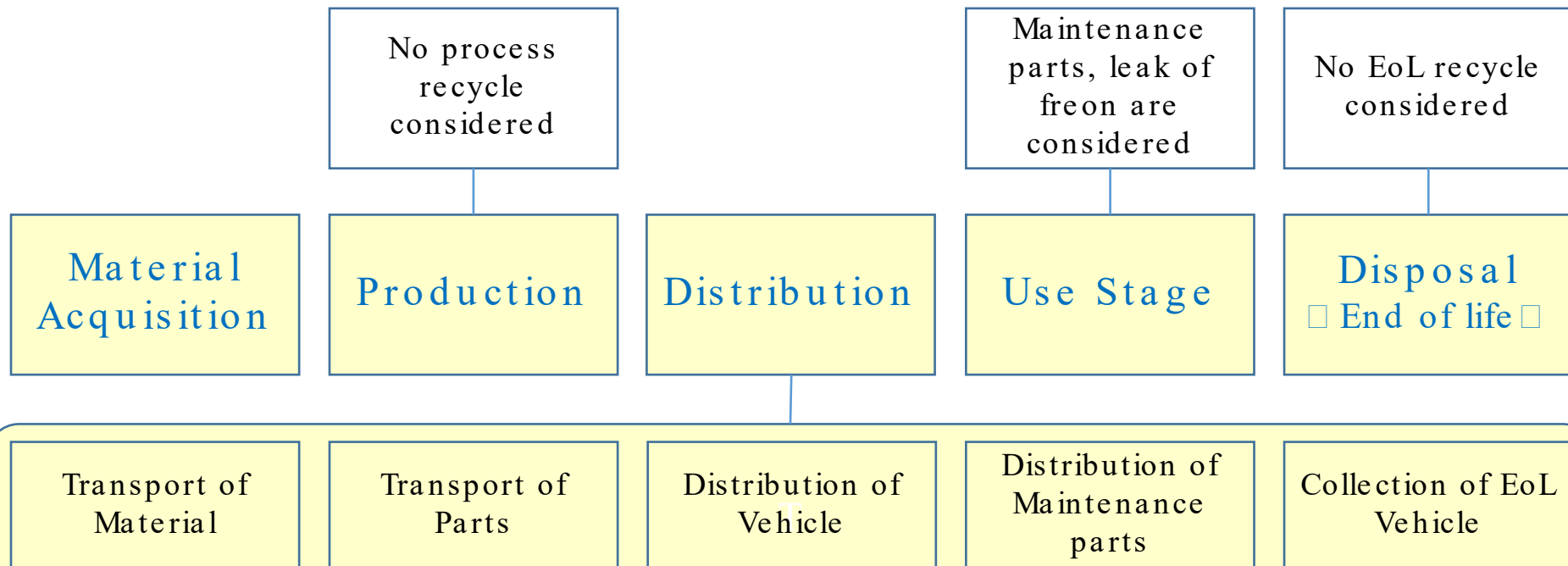
□ Scope of Product □

Passenger Car (Petrol/Diesel/Hybrid/Electric)

□ Functional Units □

Lifetime mileage 110,000 km □ 13 years

□ System boundary □



※each scenario has been defined

Now being revised

※Blue □ Primary Data
 ※Red □ Secondary Data

■ Material Acquisition & Pre-Processing Phase

Item List		Activity Data			Carbon Intensity		
		Amount		Yield			
Materials	1	Cast Iron	xxx	kg	47.1%	1.18	kg-CO _{2e} /kg
	2	Non-Alloy, Low Alloy Steel	xxx	kg	60.2%	1.76	kg-CO _{2e} /kg
	3	High Alloy Steel	xxx	kg	57.2%	1.51	kg-CO _{2e} /kg
	4	Cast Aluminum	xxx	kg	65.8%	2.54	kg-CO _{2e} /kg
	5	Aluminum Alloy	xxx	kg	60.2%	11.00	kg-CO _{2e} /kg
	6	Copper	xxx	kg	100.0%	2.72	kg-CO _{2e} /kg
	7	Zinc Alloy	xxx	kg	100.0%	5.13	kg-CO _{2e} /kg
	8	Lead	xxx	kg	100.0%	2.10	kg-CO _{2e} /kg
	9	Platinum, Rhodium	xxx	kg	100.0%	2,838.00	kg-CO _{2e} /kg
	10	Thermoplastic Resin	xxx	kg	93.3%	2.43	kg-CO _{2e} /kg
	11	Polyurethane	xxx	kg	93.3%	3.77	kg-CO _{2e} /kg
	12	Unsaturated Polyester	xxx	kg	93.3%	4.13	kg-CO _{2e} /kg
	13	Polymer Material	xxx	kg	93.3%	4.21	kg-CO _{2e} /kg
	14	Paint	xxx	kg	75.0%	3.73	kg-CO _{2e} /kg
	15	Ceramic, Glass	xxx	kg	70.0%	1.73	kg-CO _{2e} /kg
	16	Electronic Parts Materials	xxx	kg	100.0%		kg-CO _{2e} /kg
	17	Lubricant	xxx	kg	100.0%	0.64	kg-CO _{2e} /kg
	18	Coolant, Glycol	xxx	kg	100.0%	1.59	kg-CO _{2e} /kg
	19	Refrigerant	xxx	kg	100.0%	3.01	kg-CO _{2e} /kg
Specific Parts Materials		Tire	xxx	kg	100.0%	1.86	kg-CO _{2e} /kg
		Lead Acid Battery	xxx	kg	100.0%	1.26	kg-CO _{2e} /kg
		Nickel Metal Hydride Battery	xxx	kWh	100.0%	170.00	kg-CO _{2e} /kWh
		Li-Ion Battery (HEV)	xxx	kWh	100.0%	189.00	kg-CO _{2e} /kWh
		Li-Ion Batter (EV)	xxx	kWh	100.0%	101.00	kg-CO _{2e} /kWh

Now being revised

※Blue □ Primary Data
 ※Red □ Secondary Data

■ Production Phase

Item List		Activity Data		Carbon Intensity	
Processing	1	Cast Iron	xxx	kg	3.05 kg-CO _{2e} /kg
	2	Non-Alloy, Low Alloy Steel	xxx	kg	0.53 kg-CO _{2e} /kg
	□	Aluminum Alloy	xxx	kg	2.00 kg-CO _{2e} /kg
	3	High Alloy Steel	xxx	kg	2.82 kg-CO _{2e} /kg
	4	Cast Aluminum	xxx	kg	1.56 kg-CO _{2e} /kg
	7	Zinc Alloy	xxx	kg	1.56 kg-CO _{2e} /kg
	9	Platinum, Rhodium	xxx	kg	1.56 kg-CO _{2e} /kg
	10	Thermoplastic Resin	xxx	kg	1.56 kg-CO _{2e} /kg
Specific Parts Production	11	Polyurethane	xxx	kg	1.56 kg-CO _{2e} /kg
	12	Unsaturated Polyester	xxx	kg	1.56 kg-CO _{2e} /kg
		Tire	xxx	kg	0.58 kg-CO _{2e} /kg
		Lead Acid Battery	xxx	kg	0.46 kg-CO _{2e} /kg
		Nickel Metal Hydride Battery	xxx	kWh	77.60 kg-CO _{2e} /kWh
Assemble		Li-Ion Battery (HEV)	xxx	kWh	54.00 kg-CO _{2e} /kWh
		Li-Ion Batter (EV)	xxx	kWh	80.70 kg-CO _{2e} /kWh
	Vehicle Weight	xxx	kg	0.02 kg-CO _{2e} /kg	

■ Transport & Distribution Phase

Item List		Activity Data		Carbon Intensity	
Material	Vehicle Weight	xxx	kg	0.018	kg-CO _{2e} /kg
Parts				0.010	kg-CO _{2e} /kg
Vehicle				0.045	kg-CO _{2e} /kg
Maintenance				0.006	kg-CO _{2e} /kg
EoL				0.015	kg-CO _{2e} /kg

Detail of the method (3 / 3)

Now being revised

※Blue □ Primary Data
※Red □ Secondary Data

■ Use Phase

Item List		Activity Data				Carbon Intensity	
		Fuel/ Electric Efficiency		Lifetime mileage			
Well to Tank	JC08 Mode for Gasoline	xxx	km / L	110,000	km	0.34	kg-CO _{2e} /L
Tank to Wheel						2.32	kg-CO _{2e} /L
Well to Tank	JC08 Mode for Diesel	xxx	km / L			0.14	kg-CO _{2e} /L
Tank to Wheel						2.59	kg-CO _{2e} /L
Well to Tank	JC08 Mode for EV	xxx	km / kWh	0.48	kg-CO _{2e} / kWh		

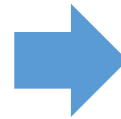
Item List		Activity Data		Carbon Intensity	
Freon Emission	(For Single FAN)	13	Years	12.3	kg-CO _{2e} /Y
	(For Dual FAN)			19.0	kg-CO _{2e} /Y
Maintenance	Vehicle Weight	xxx	kg	0.33	kg-CO _{2e} /kg

■ End of Life Phase

Item List		Activity Data		Carbon Intensity	
EoL	Vehicle Weight	xxx	kg	0.38	kg-CO _{2e} /kg

■ Review

- ✓ Fairness of evaluation
- ✓ Result transparency
- ✓ Easy calculation



Achieved the target
at 2011

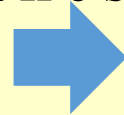


■ Concern

- Not able to assess activities towards carbon neutral. (new technology/no recycle consider)

※Neither activity data or intensity cannot be ZERO

- Only of Japanese production & market



New methodology are required

It's able to assess CO₂ emissions, but now, we would like to assess activities which towards carbon neutrality.

Direction of new methodology

※blue : Primary data

		Material Acquisition	Production	Distribution	Use	End of Life
JAMA 2011	Activity data	Weight of material[kg]	Weight of processed material[kg]	Weight of distributed material[kg]	Fuel economy [km / L] Electricity economy [Wh / km] Lifetime mileage[km]	Weight of Vehicle[kg]
	Intensity	Material intensity [kg-CO2e/kg]	Processed intensity [kg-CO2e/kg]	Distribution intensity [kg-CO2e/kg]	Fuel intensity [kg-CO2e/L] Electricity intensity [kg-CO2e/kWh]	Disposal intensity [kg-CO2e/kg]



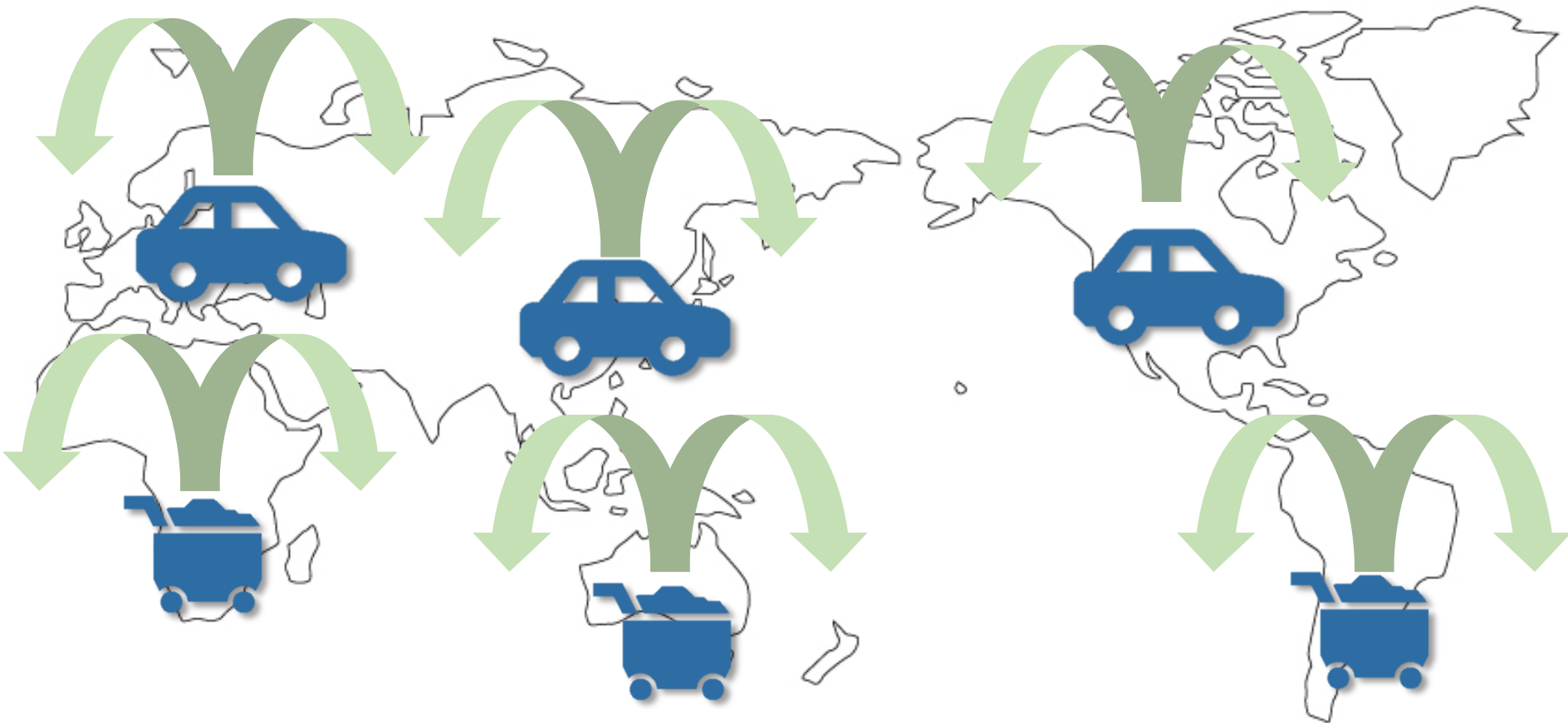
Activity data (= weight of vehicle) cannot be ZERO.
Need to develop methodology which intensity could be ZERO.

New Concept	Activity data	Weight of material[kg]	Energy of processed material[kWh]	Weight of distributed material[kg]	Fuel economy [km / L] Electricity economy [Wh / km] Lifetime mileage[km]	Weight of recycled material[kg] Weight of disposed material[kg]
	Intensity	Material intensity [kg-CO2e/kg]	Energy intensity [kg-CO2e/kWh]	Distribution intensity [kg-CO2e/kg]	Fuel intensity [kg-CO2e/L] Electricity intensity [kg-CO2e/kWh]	Recycling intensity [kg-CO2e/kg] Disposal intensity [kg-CO2e/kg]

Current automobile LCA methodology is being reviewed and updated in Japan towards make it able to assess carbon neutrality activity

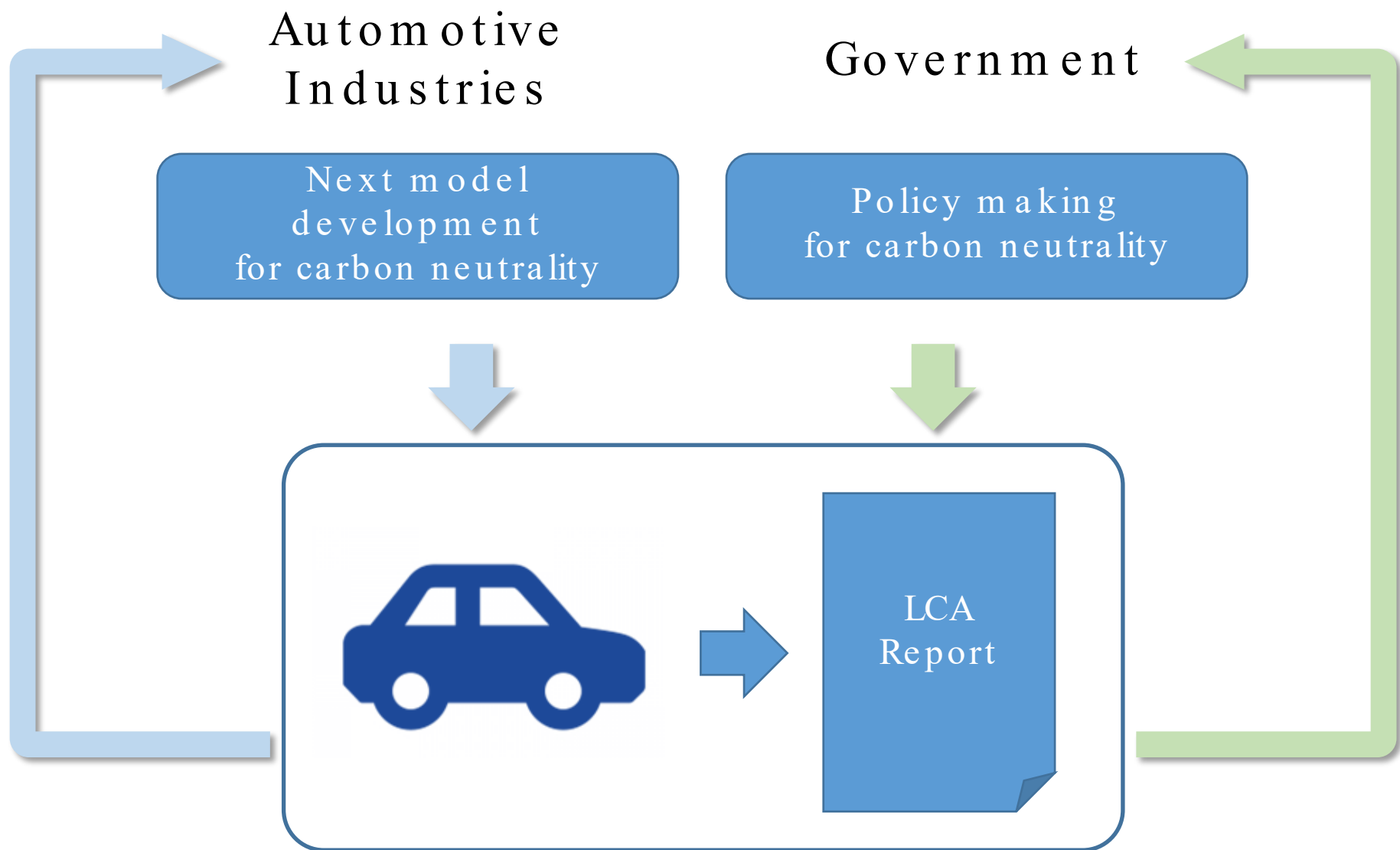
Needs of LCA for Automobiles

Vehicles come from & go to all over the world



Materials come from & go to all over the world

Automotive industries affect to all over the world.
It cannot deal at particular country discussion.



Develop worldwide harmonized LCA method for assistance in policy making or product development.

Conclusion

➤ Urgent

- It is urgent that the fight against climate change.

➤ Life cycle perspective

- Towards carbon neutrality, it became more important to consider in life cycle perspective.

➤ Automobiles LCA method in JAPAN

- In JAPAN we already developed transparency Automobile LCA method.
- It's able to assess CO₂ emissions, but now, we would like to **assess activities which towards carbon neutrality.**

➤ Worldwide harmonize

- Carbon neutrality cannot be achieved without worldwide government and private enterprise cooperation.
- **Let's discuss LCA methodology for Automobiles !!**

Thank you
