

A-LCA IWG 11th session Meeting

2023.Oct.17-18

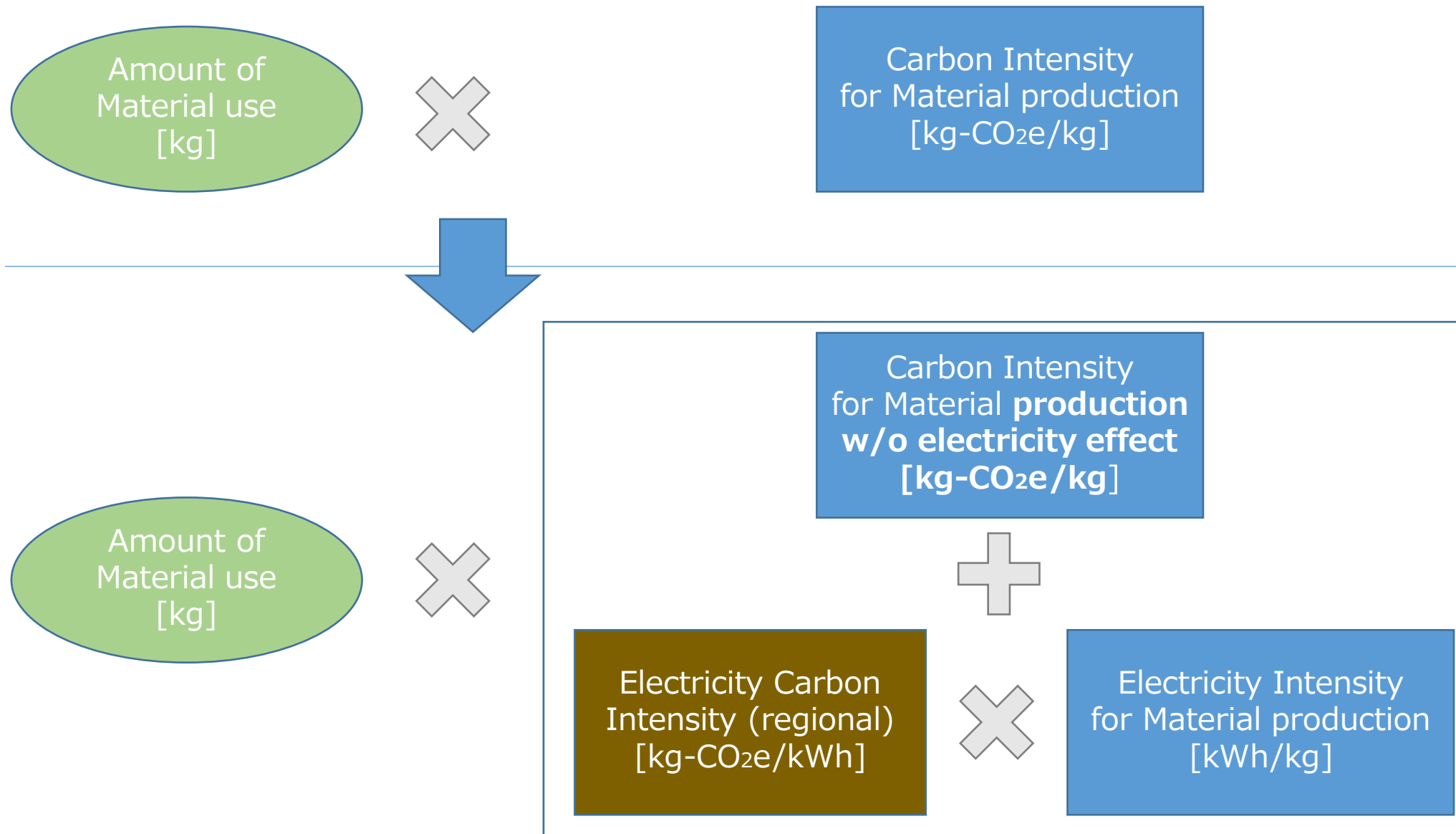
Isao Tabushi / JASIC (Japan)

Concept of SG2 method

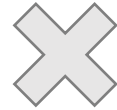
Purpose

- **Set an internationally harmonized material carbon intensity which enables a material technology to evaluate LCA toward carbon neutral**
 - : point of views
 - Usage of **recycled** material, yield rate
 - Development of global regionality (**electric power**)

Regional effect (electricity)

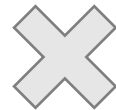


Amount of
Virgin Material
use
[kg]



Carbon Intensity
for Virgin Material
production
[kg-CO₂e/kg]

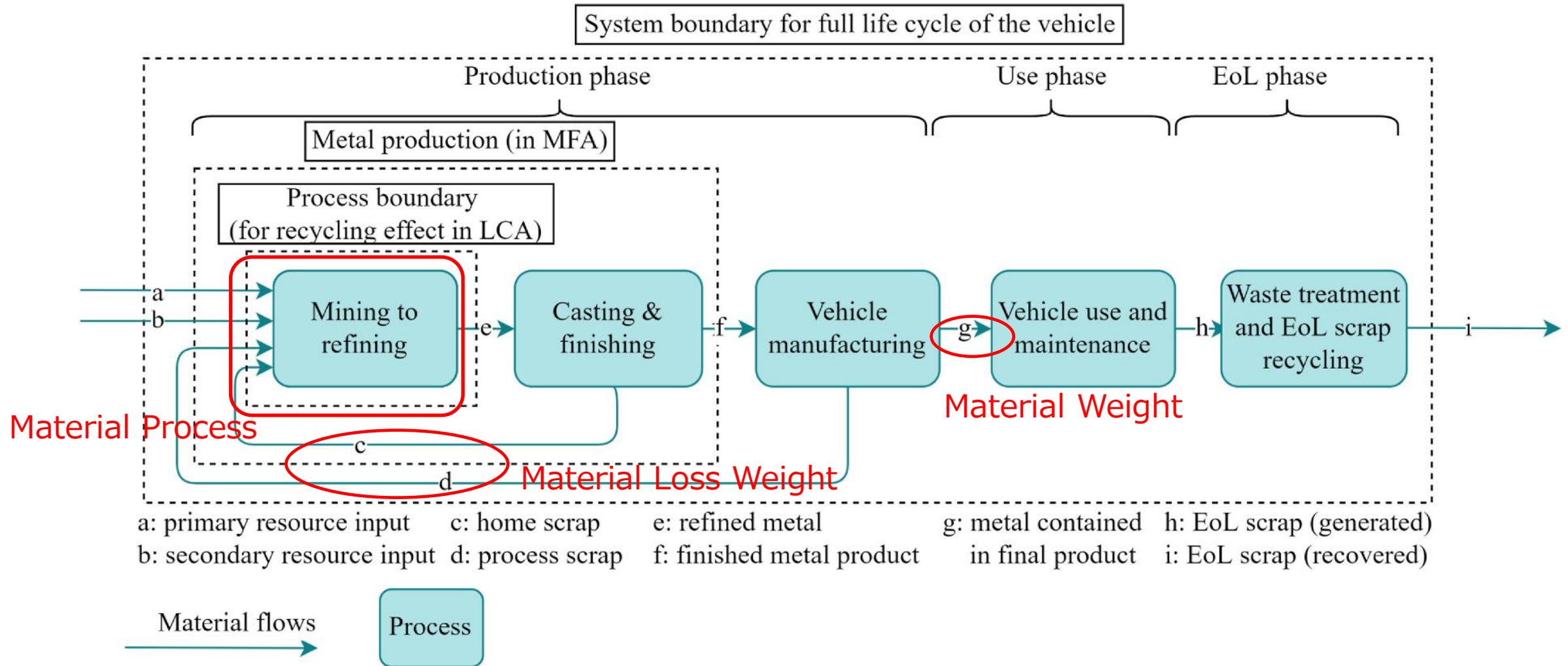
Amount of
Recycled
Material use
[kg]



Carbon Intensity
for Recycled Material
production
[kg-CO₂e/kg]

Level	Activity Data			Intensity Data
	Vehicle Weight [kg]	Material Distribution [%]	Scrap Rate of Material [%]	Carbon Intensity of Material Acquisition [kg-CO ₂ e/kg]
Level1	Primary data	All Secondary data	All Secondary data	All Secondary data
	Amount of Material Use at the Vehicle [kg]		Scrap Rate of Material [%]	Carbon Intensity of Material Acquisition [kg-CO ₂ e/kg]
Level2	All Primary data		All Secondary data	All Secondary data
Level2.5	↑		Partially Primary data	↑
Level3	↑		All Primary data	↑
Level3.5	↑		↑	Partially Primary data
Level4	↑		↑	All Primary data

Discussion of Activity data & Intensity data



reference: (2)Impact of recycling effect in comparative life cycle assessment for materialsselection - A case study of light-weighting vehicles
<https://www.sciencedirect.com/science/article/pii/S0959652622009465?via%3Dihub>

$$\text{CFPm} = \Sigma(\mathbf{M} \times \mathbf{I})$$

$$\mathbf{M} = \mathbf{M0} \div (\mathbf{L1} \times \mathbf{L2} \times \mathbf{L3} \times \cdots \times \mathbf{Ln})$$

$$\mathbf{I} = \mathbf{Re} \times (\mathbf{Ir} + \mathbf{Ier} \times \mathbf{Ie}) + (1 - \mathbf{Re}) \times (\mathbf{Iv} + \mathbf{Iev} \times \mathbf{Ie})$$

<Primary data>
Lv1: none
Lv2: **M0**
Lv3: **Ln, Re, Ie**
Lv4: **Ir, Ier, Iv, Iev**

CFPm : Carbon FootPrint for Material Acquisition Phases [kg-CO2e]

M : Material Mass [kg]

I : Material Acquisition Carbon Intensity [kg-CO2e/kg]

M0 : Final product Material amount [kg]

Ln : Loss Rate of Production Phases [%]

Re : Recycle Rate [%]

Ie : Electricity Carbon Intensity [kg-CO2e/kWh]

Ir : Recycled Material Acquisition Phases Carbon Intensity wo Electricity effect [kg-CO2e/kg]

Iv : Virgin Material Acquisition Phases Carbon Intensity wo Electricity effect [kg-CO2e/kg]

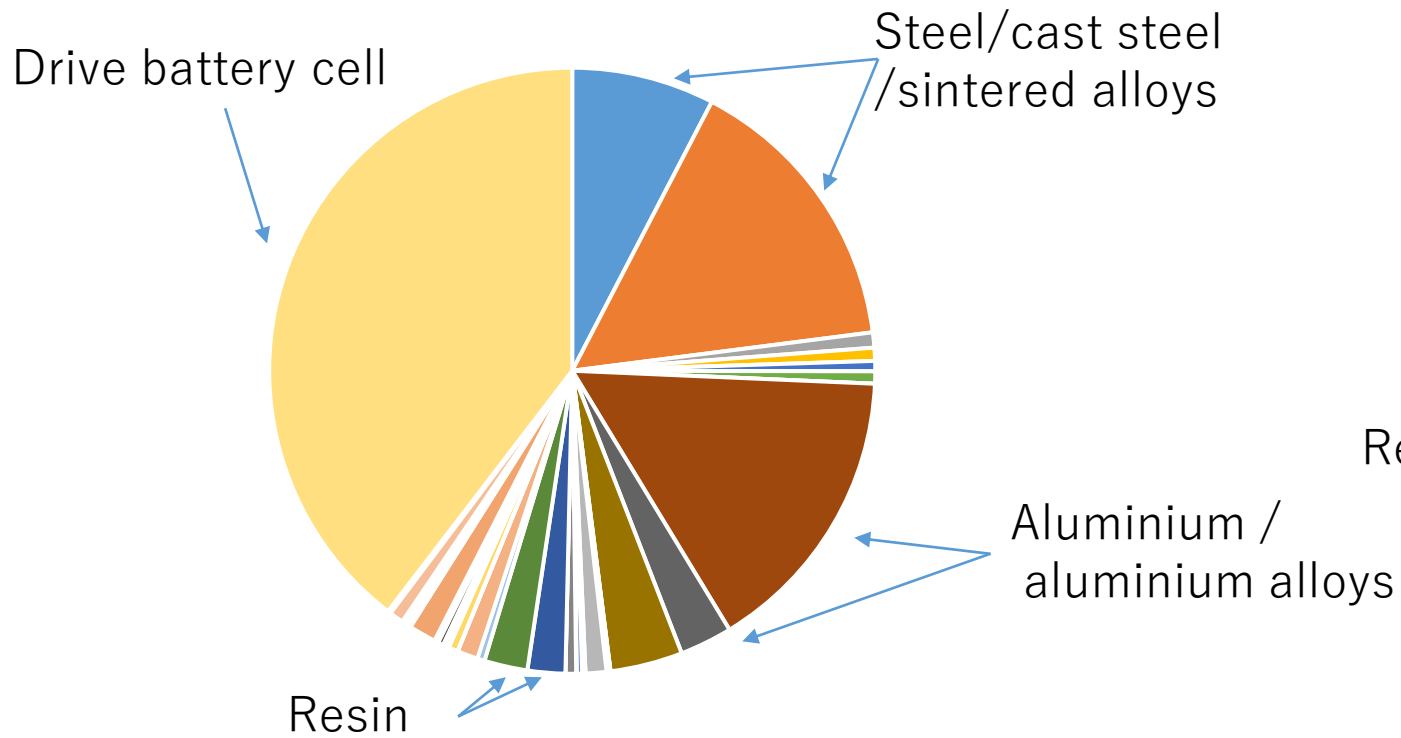
Ier : Recycled Material Acquisition Phases Electricity Intensity [kWh/kg]

Iev : Virgin Material Acquisition Phases Electricity Intensity [kWh/kg]

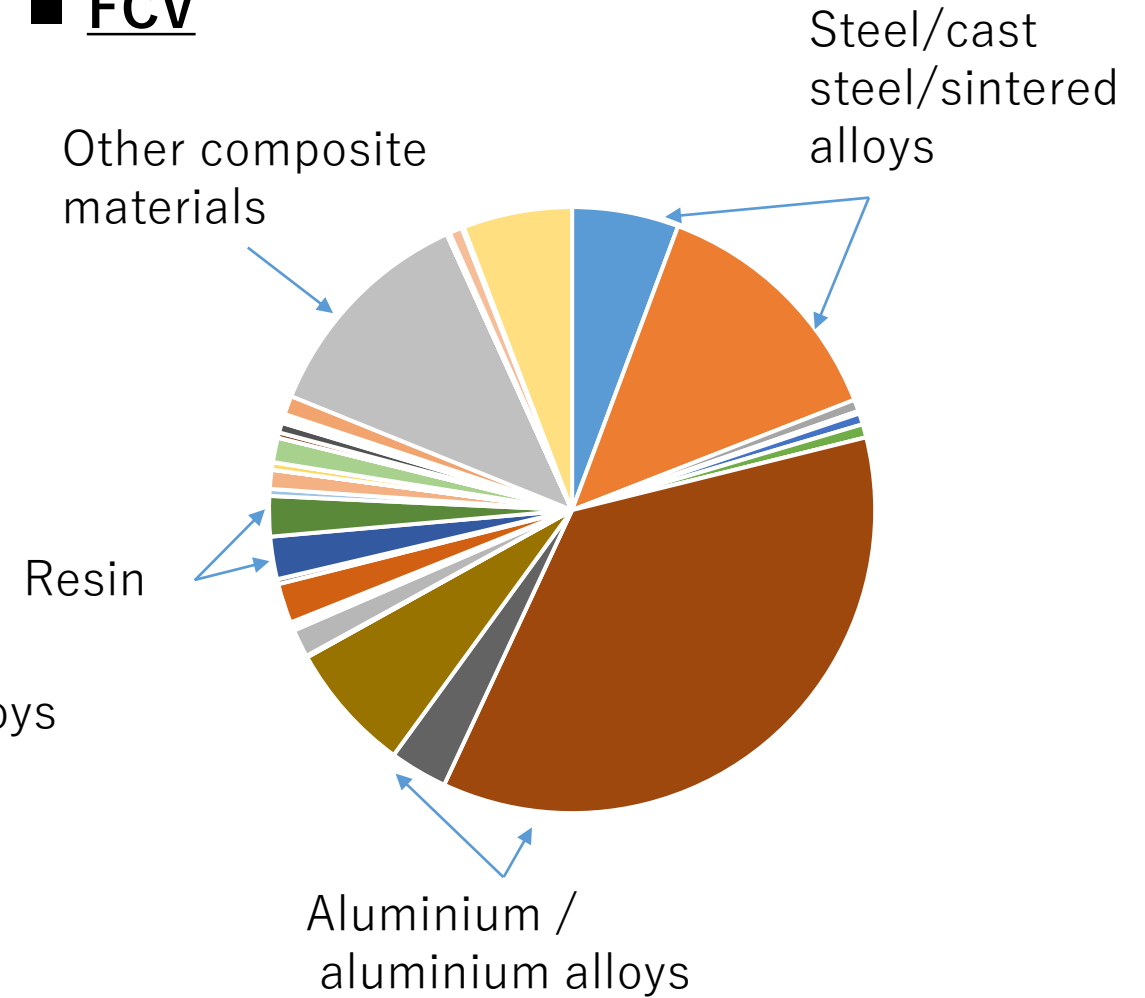
Material Classification & System Boundary

Vehicle CO2 ratio by material type

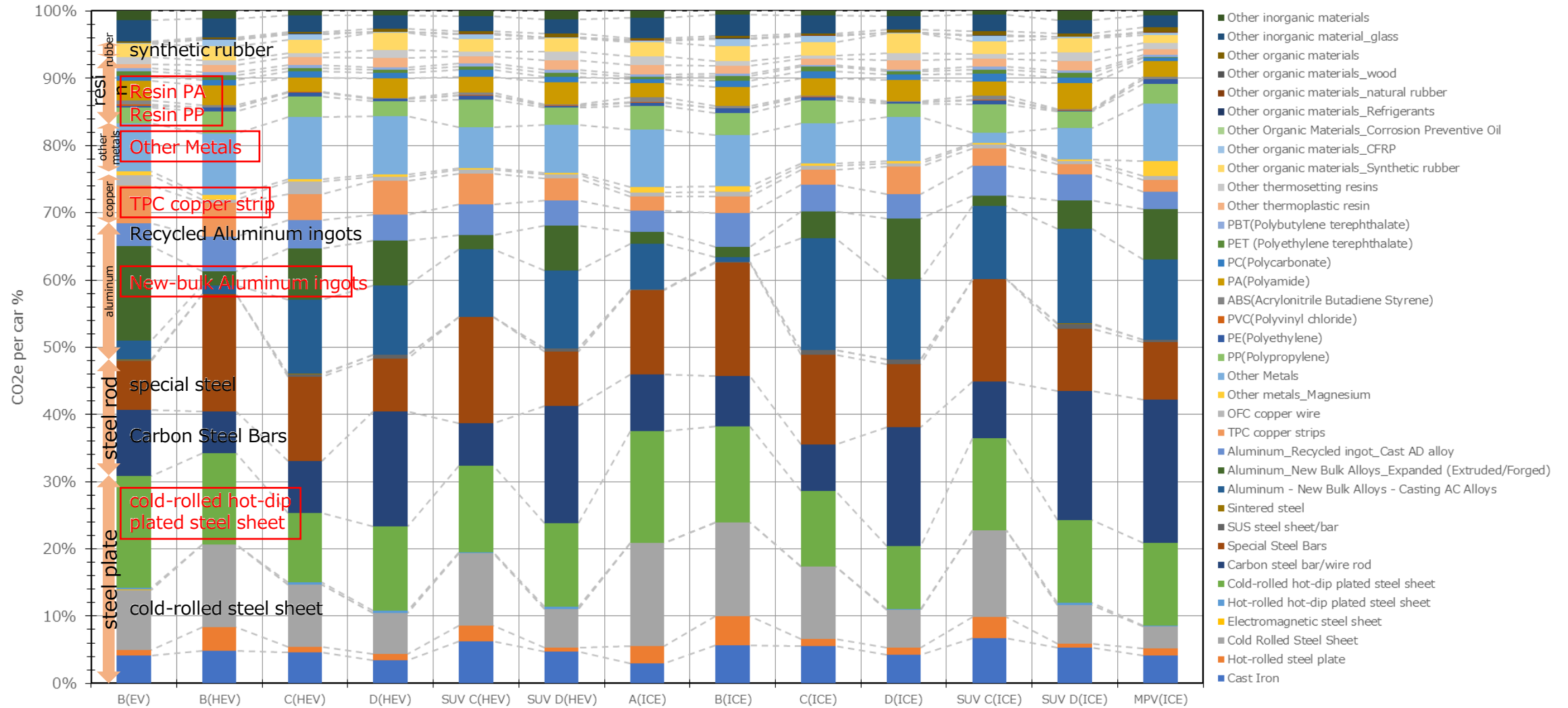
■ Small EV



■ FCV



Applicable products

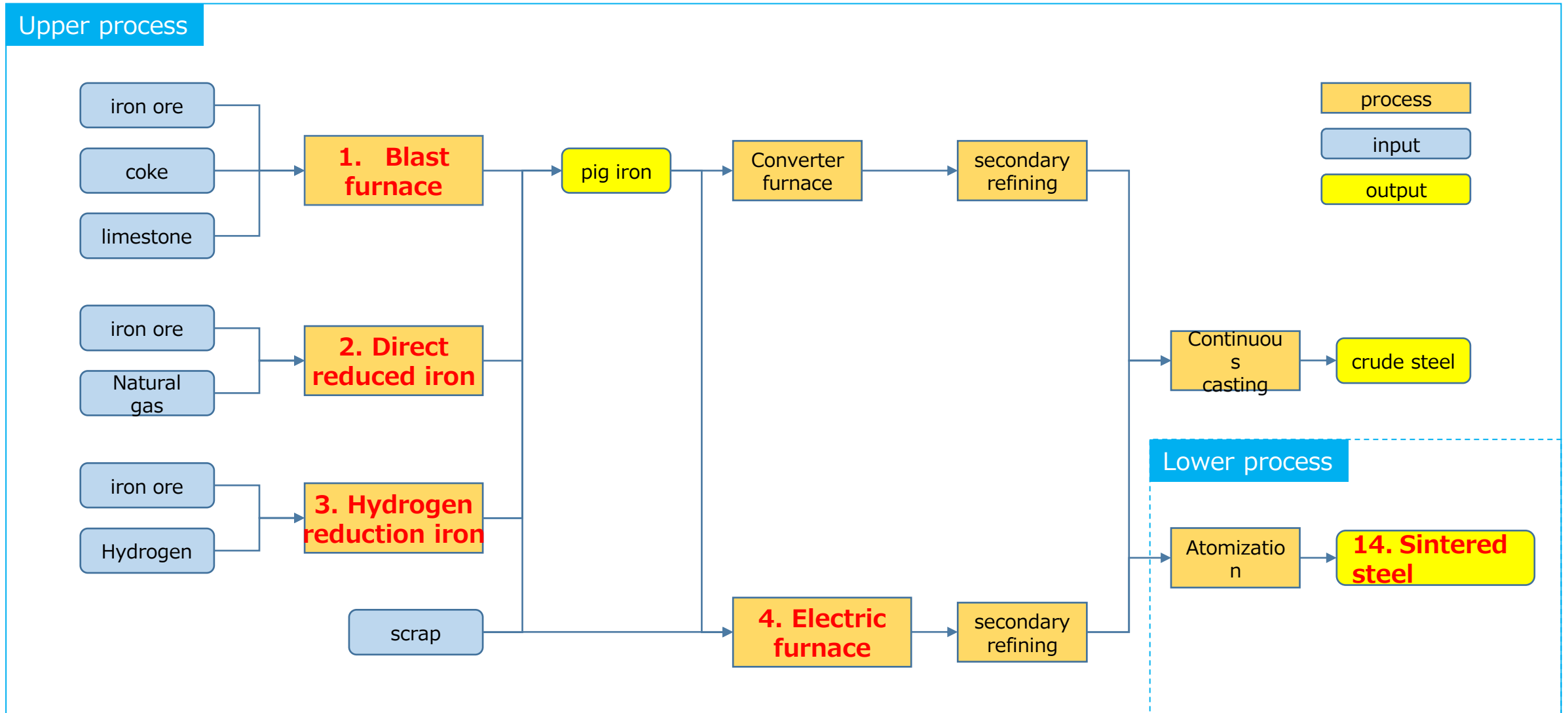


Marked items account for a large percentage of CO2 emissions in the material classification

Material Classification	Manufacturing Process			Examples of components used in automobiles					
	upper processes	mid-process	lower processes	Body & Chassis	Batteries and Motors	Engine	Transmission	Standard Components	
Steel	Blast Furnace / Electric Furnace	-	Cast iron	Brake caliper, brake disc, knuckle		Bearing caps, crank pulleys, damper pulleys Drive Plate, Camshaft, Turbo Housing			
			Cast steel						
			Hot-rolled steel sheet	Upper arm, lower arm, steel wheel, pedal, seat frame					
			Cold-rolled steel sheet	Side panel, Roof panel, Bumper beam, Roof frame, Door sash, Inside panel, Airbag module, Seat frame, Radiator				CVT belt	
			Electromagnetic steel sheet						
			Hot-rolled hot-dip galvanized steel sheet						
			Hot-rolled electro galvanized steel sheet						
			Cold-rolled hot-dip galvanized steel sheet	Side frames, floor panels, door panels, fender panels, hood panels, tailgate panels, trunk lid panels, side sills, rear frames, steering hanger beams, inside panels, dash panels	IPU Bracket				
			Cold-rolled electro galvanized steel sheet	Brake tube, wiper arm					
			Carbon steel bar/wire rod	Tire cords, door beams, steering hanger beams, seat frames			piston ring	DIFF Case	
			Special steel bar	Suspension Spring			Piston pin, connecting rod, crankshaft, valve	CVT pulleys, transmission gears, bearings, drive shafts, e-Axle	Gears, Bearings
			Special steel wire rod/spring steel	Sway bar, Torsion bar					Bolts, nuts, springs
			Stainless steel sheet/bar	Fuel Pipe, Exhaust Manifold, Exhaust Pipe, Converter, Muffler			Fuel pipe, fuel rail, EGR pipe, EGR cooler		gasket
Sinterd steel				Motor Rotor	Pulley, sprocket, connecting rod, bearing cap, oil pump rotor, valve guide	Synchro Hubs, Prenteral Gear Carriers	magnet		

Material flow Concept - Steel

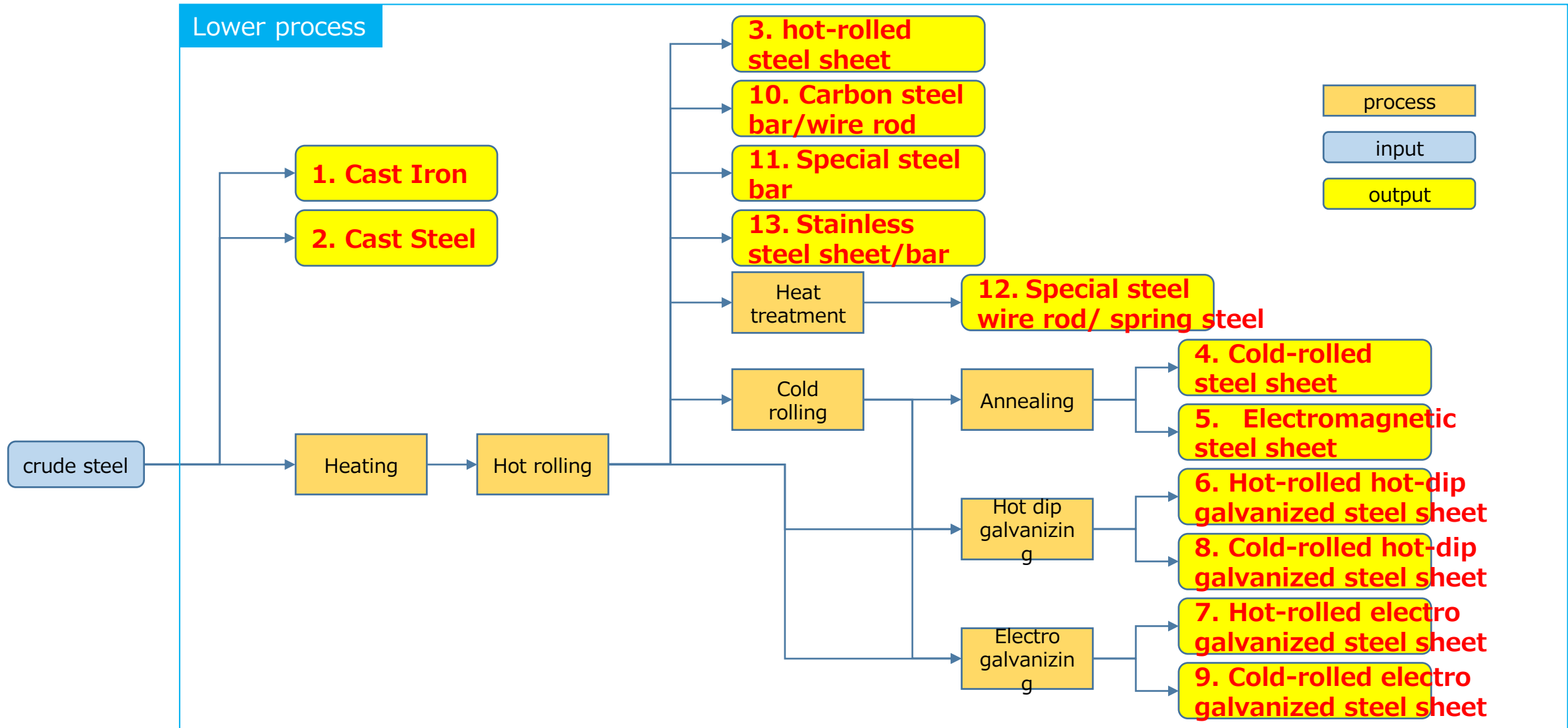
Under Discussion in SG2



4 Classes for Upper Process

Material flow Concept - Steel

Under Discussion in SG2

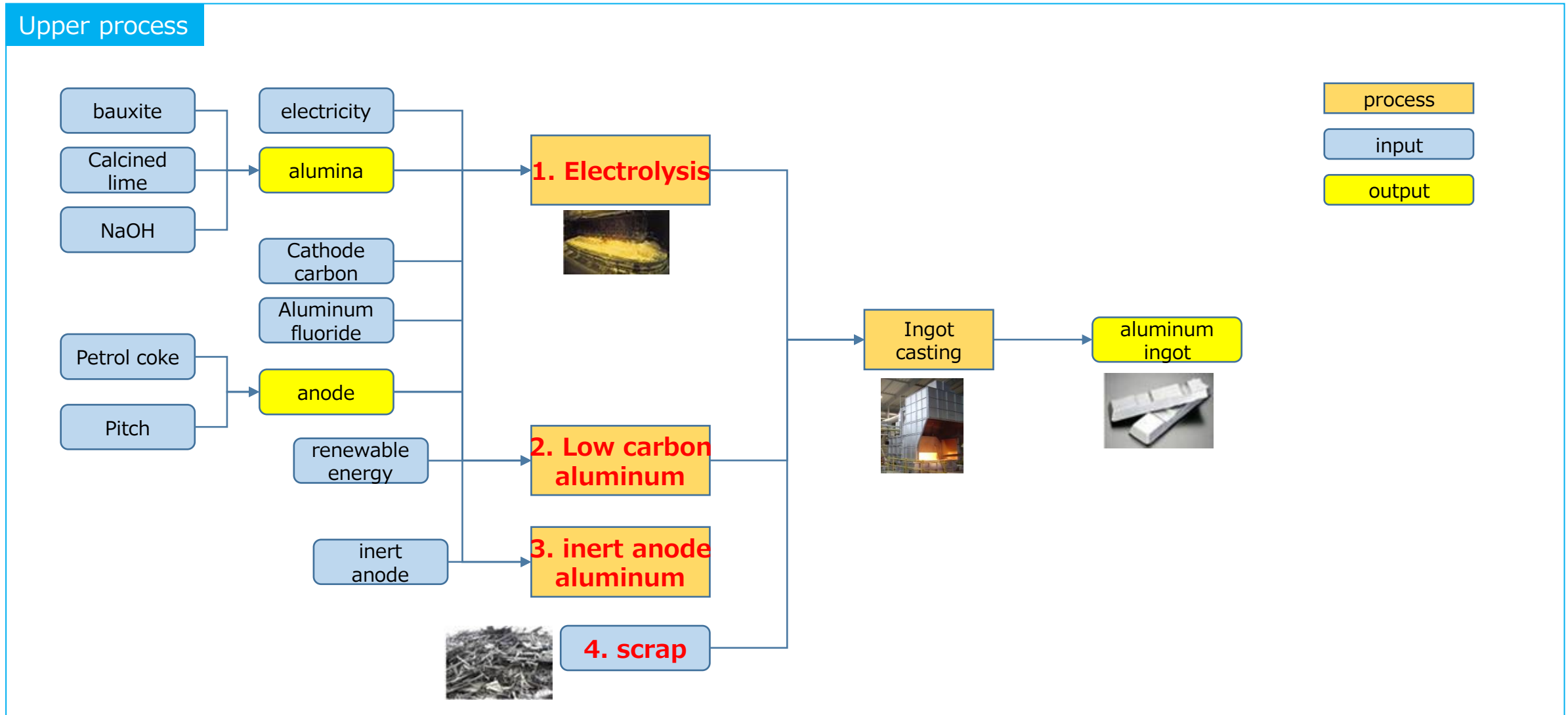


14 Classes for Upper Process (one process is on previous slide)

Material Classification	Manufacturing Process			Examples of components used in automobiles				
	upper processes	mid-process	lower processes	Body & Chassis	Batteries and Motors	Engine	Transmission	Standard Components
Aluminum Alloy	New Ingot Aluminum Alloy	-	Aluminum Casting	aluminum wheel		Cylinder head, oil pump housing		
			Aluminum Die casting		Battery Module, IPU Case	Cylinder block, piston, W/P housing	T/M Case, DIFF Case	
			Wrought Aluminum(Plate)					
			Wrought Aluminum(Extruded)	Hood panel, bumper beam	IPU frame	W/J Cover	e-Axle	

Material flow Concept - Aluminum alloy

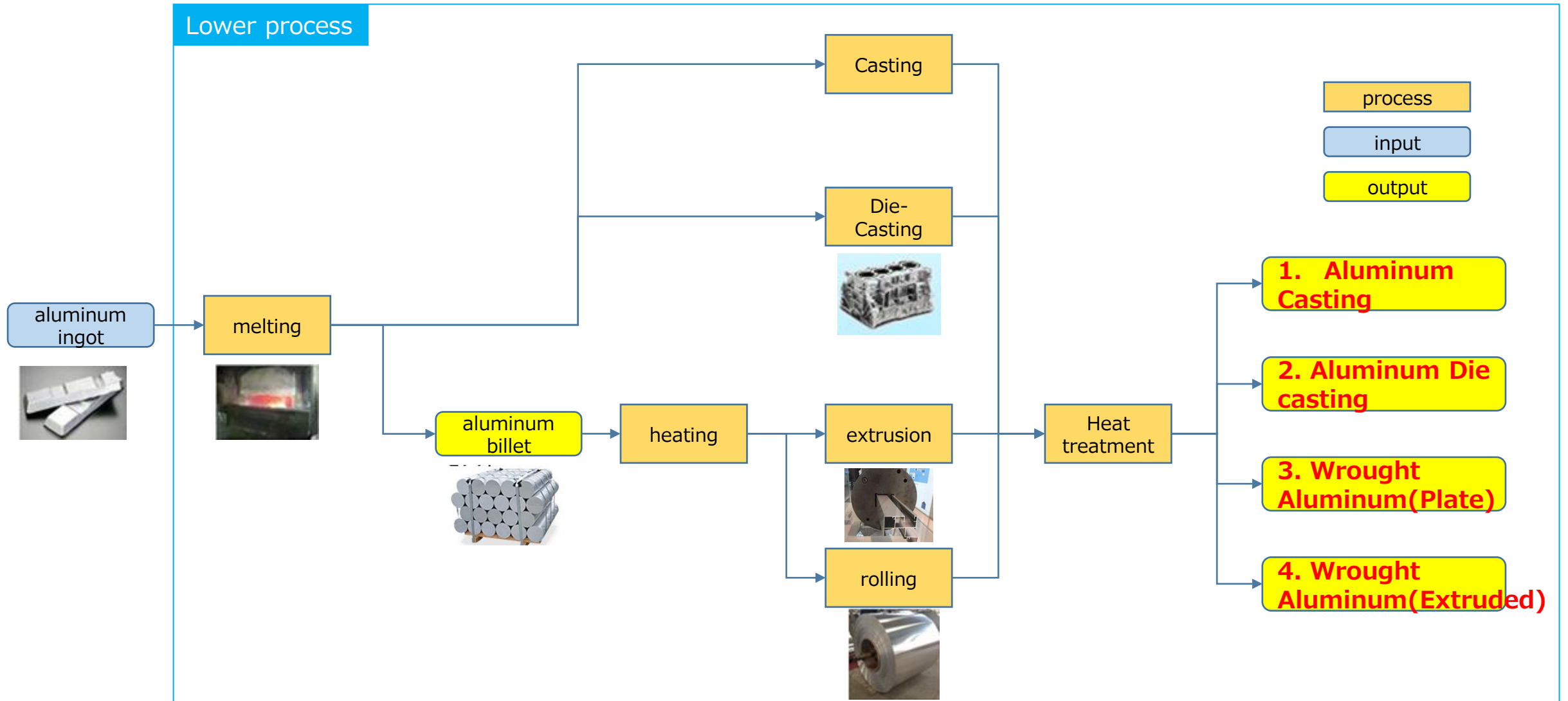
Under Discussion in SG2



4 Classes for Upper Process

Material flow Concept - Aluminum alloy

Under Discussion in SG2



4 Classes for Lower Process

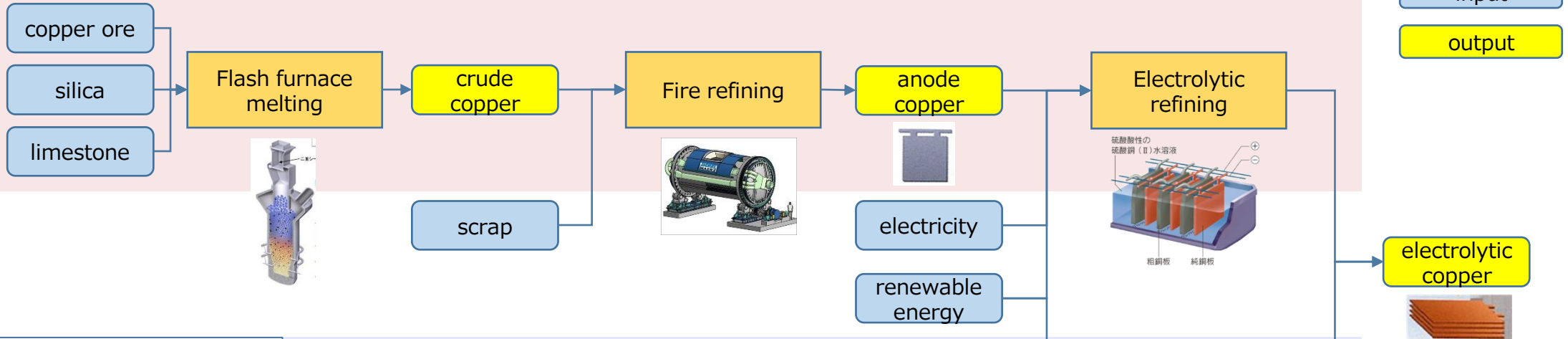
Copper Alloy

Material Classification	Manufacturing Process			Examples of components used in automobiles				
	upper processes	mid-process	lower processes	Body & Chassis	Batteries and Motors	Engine	Transmission	Standard Components
Copper Alloy	Flash Smelting	Shaft Furnace	TPC strip		Battery Module, Busbar, Compressor			Harnesses, Cables
			TCP wire					
		Oxygen Free	OFC strip					
			OFC wire					

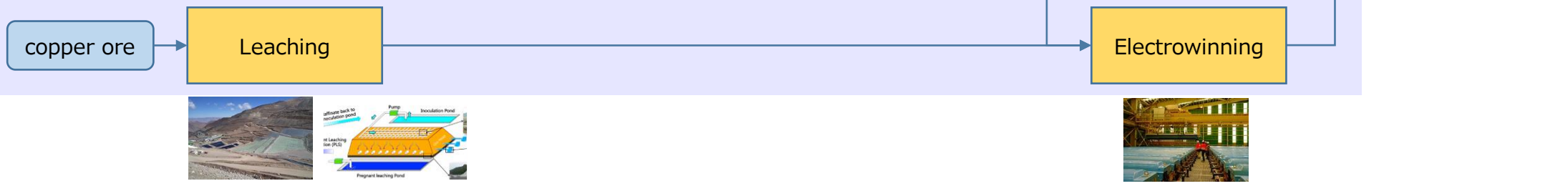
Upper process

https://www.mesco.co.jp/eng_tech/copper/
https://www.meti.go.jp/policy/tech_evaluation/c00/C0000000H29/171225_Copper_1st/Copper_1st_05.pdf
<https://sekatsu-kagaku.sub.jp/transition-elements2.htm>
<https://response.jp/article/2010/01/20/135064.html>
<https://www.jx-nmm.com/company/industry/resource/process01.html>
<https://www.mdpi.com/2075-163X/8/2/32>

1. Pyrometallurgy

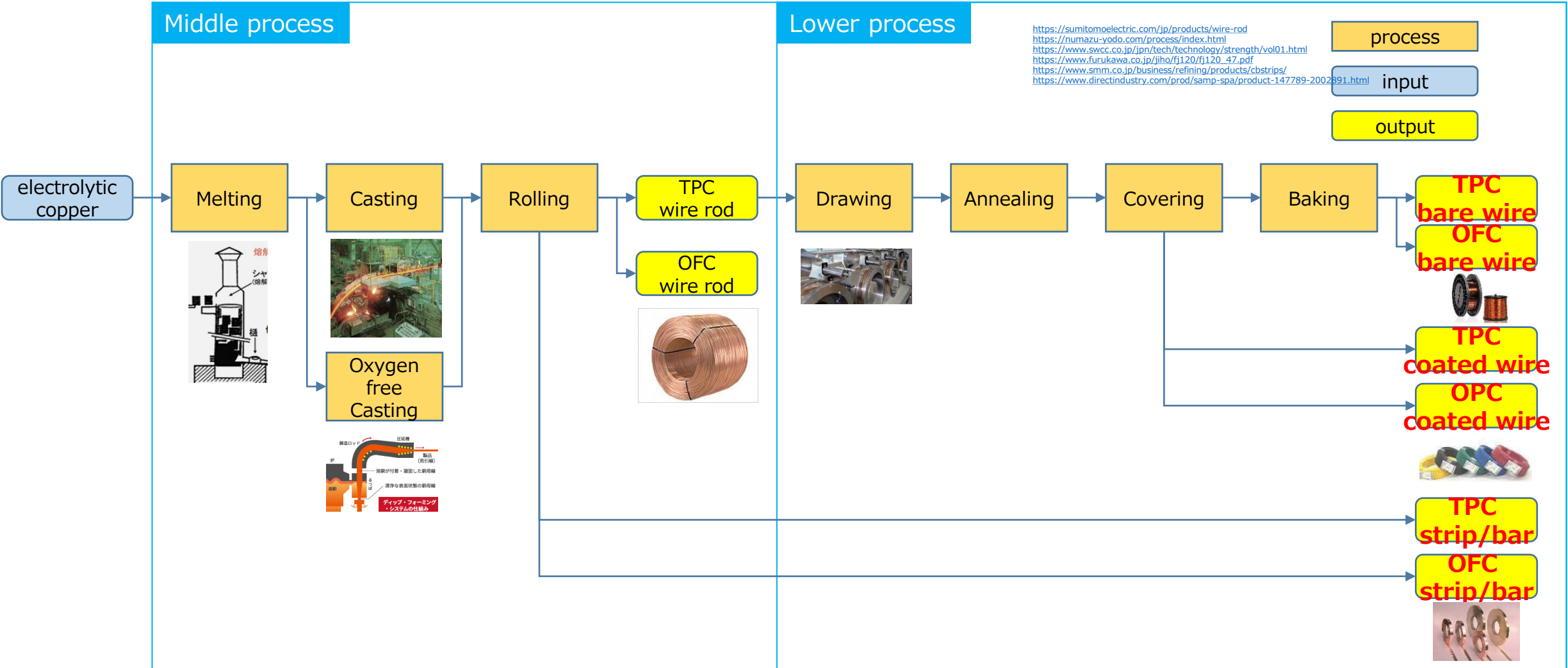


2. Hydrometallurgy



Material flow Concept - Copper

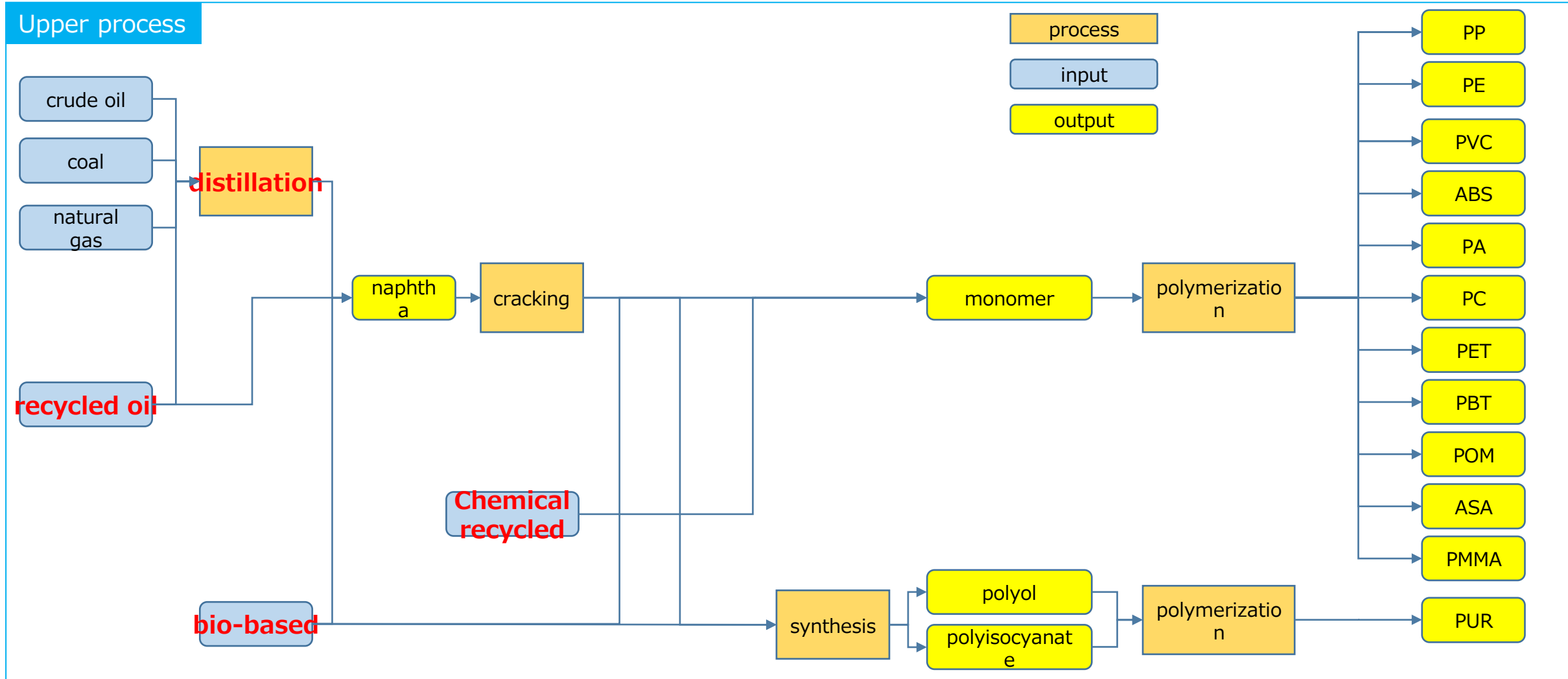
Under Discussion in SG2



4 (or 6) Classes for Lower Process

material classification	Manufacturing Process			Representative parts				
	Upper processes	mid-process	lower processes	Body & Chassis	Batteries and motors	engine	transmission	General-purpose parts
Resin	fossil resources		PP	Front end module carrier, radiator fan shroud, radiator reservoir tank, undercover, bumper, side garnish, emblem, spoiler, headlight cover, taillight cover, instrument panel, center console, door lining Trunk side lining, airbag module cover, steering wheel, HVAC	Battery Module, IPU Cover, Radiator			
			PE	Tire code, fuel tank, washer tank, air duct, instrument panel, glove box, floor carpet, insulator	Battery Module			
			PVC					Wire Coating
			ABS	Front grille, spoiler, wheel cap cover, lower garnish, air conditioner outlet, heat pump module				
			PA	Tire Cord, Radiator Fan, Pillar Garnish, Side Garnish, Airbag Fabric, Cooling Tube		Intake manifold, cylinder head cover, air cleaner case		
			PC	Displays, headlight lenses, speakers	Battery Module			
			PET	Tires, Dash insulators, Carpets, Roof linings, Fender inners	Battery Module			
			PBT	Light				harness connector
			PUR					
			POM					
			ASA					
PMMA								

Under Discussion in SG2



4 Classes for Upper Process

Under Discussion in SG2

