Aluminum lightens the world
アルミでかなえる、軽やかな世界

UACJ Technology for Auto Body Paneling

Dec. 18, 2023

UACJ Corporation

Product Design & Technology Department,

Fukui Works

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0. Introduction

Properties of aluminum

1. Lightweight
2. Strong
3. Excellent corrosion resistance
4. Easy to finish
5. Highly workable
6. Easy to cast
7. Conducts electricity well
8. Conducts heat well
9. Reflects light and heat
10. Strong in low temperatures
11. Aesthetically pleasing
12. Non-toxic
13. Easy to join
14. Easy to recycle
15. Non-magnetic
16. Good vacuum properties

For reference: https://www.aluminum.or.jp/basic/aluminumtoha/pdf/AboutAluminum.pdf

0. Introduction

Aluminum is a fundamental material used in many fields—it underpins our daily life

For reference: UACJ website (former)

1. Basics of aluminum products

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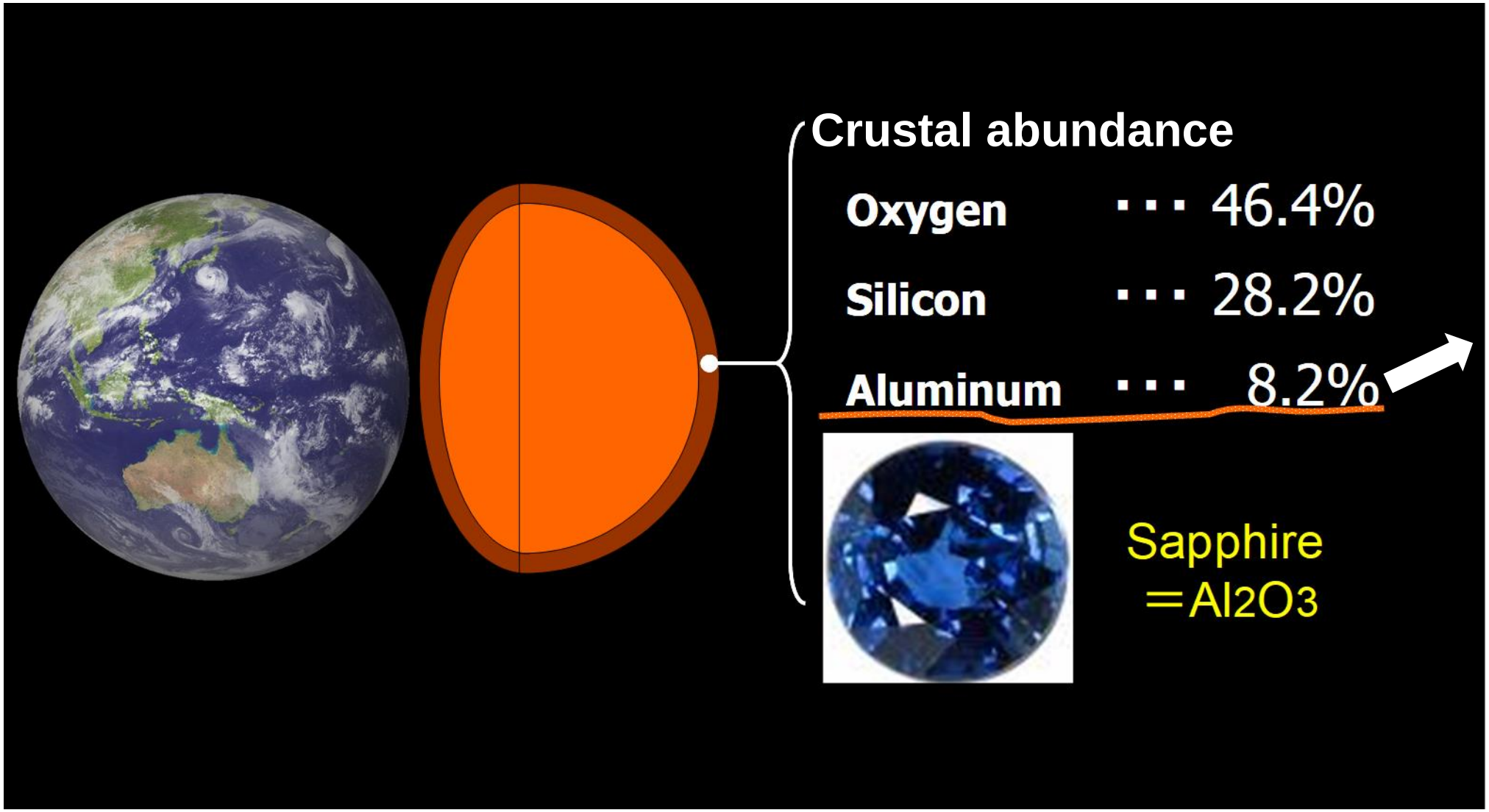


Present in the form of bauxite

Most abundant metal in the earth's crust ➡ no concern about depletion

1. Basics of aluminum products

Aluminum manufacturing method

Bauxite (Mineral: Al_2O_3-nH_2O)

Chemicals used to dissolve/separate
(Bayer process)

Alumina (Al_2O_3)

Electrolysis
(Hall-Héroult process)

Aluminum ingots

1. Basics of aluminum products

Analogy of how aluminum products are made

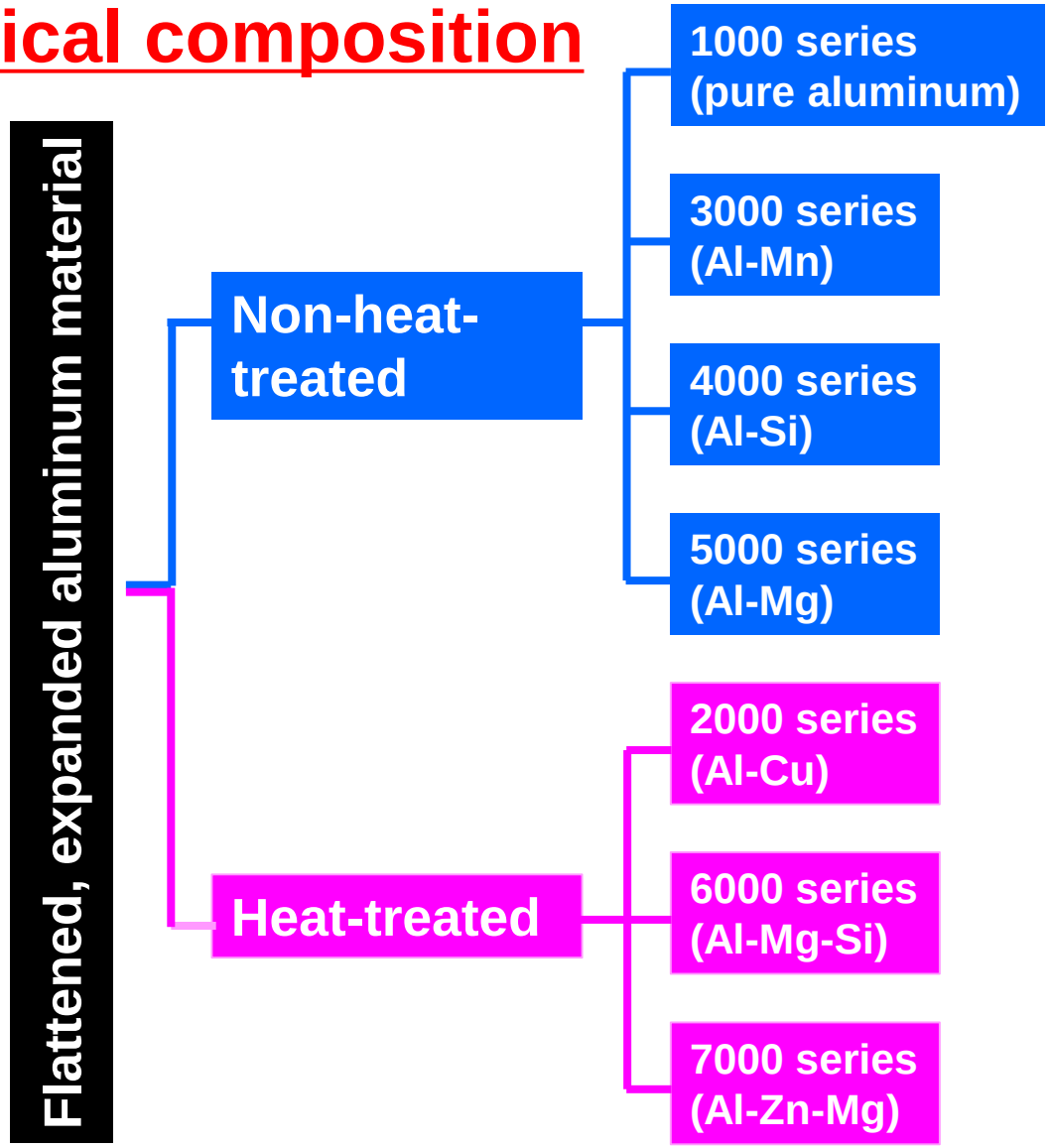
Ingredients	x	Recipe	=	Cuisine
Chemical composition	x	**Manufacturing method**	=	**Product**

Elements other than aluminum are added when necessary to increase strength or solve other problems

Processing and heat treatment conditions are devised to control strength, workability, and other material properties

1. Basics of aluminum products

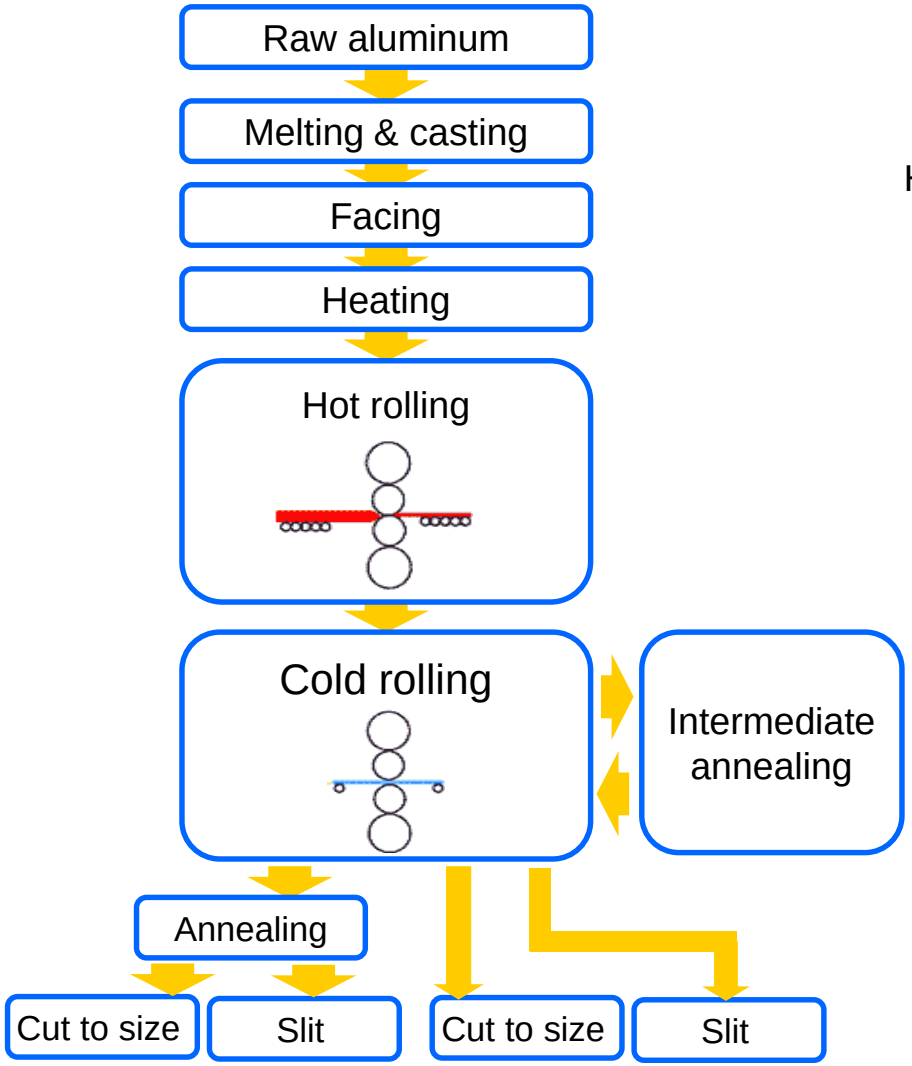
Chemical composition



- 1000 series (pure aluminum) → Reflective panels, fins, etc.
- 3000 series (Al-Mn) → Can bodies, battery cases, etc.
- 4000 series (Al-Si) → Brazing filler, etc.
- 5000 series (Al-Mg) → Can ends, structural materials, automotive parts, etc.
- 2000 series (Al-Cu) → Aircraft, machine parts, etc.
- 6000 series (Al-Mg-Si) → Window sashes, machine parts, automotive parts, etc.
- 7000 series (Al-Zn-Mg) → Aircraft, structural materials, etc.

1. Basics of aluminum products

Manufacturing method



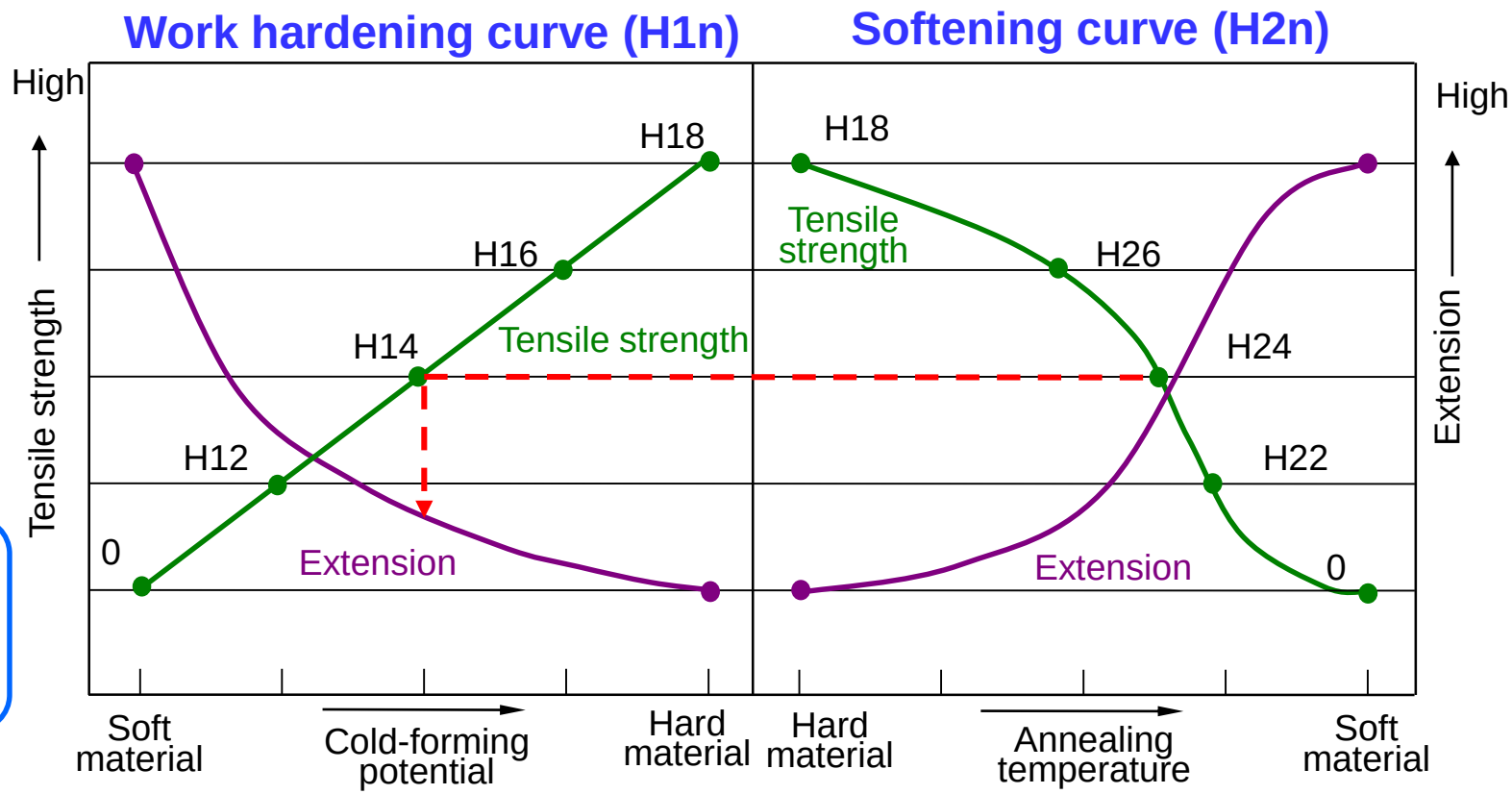


Image of processing process, tensile strength and extension

2. UACJ’s aluminum paneling for auto bodies

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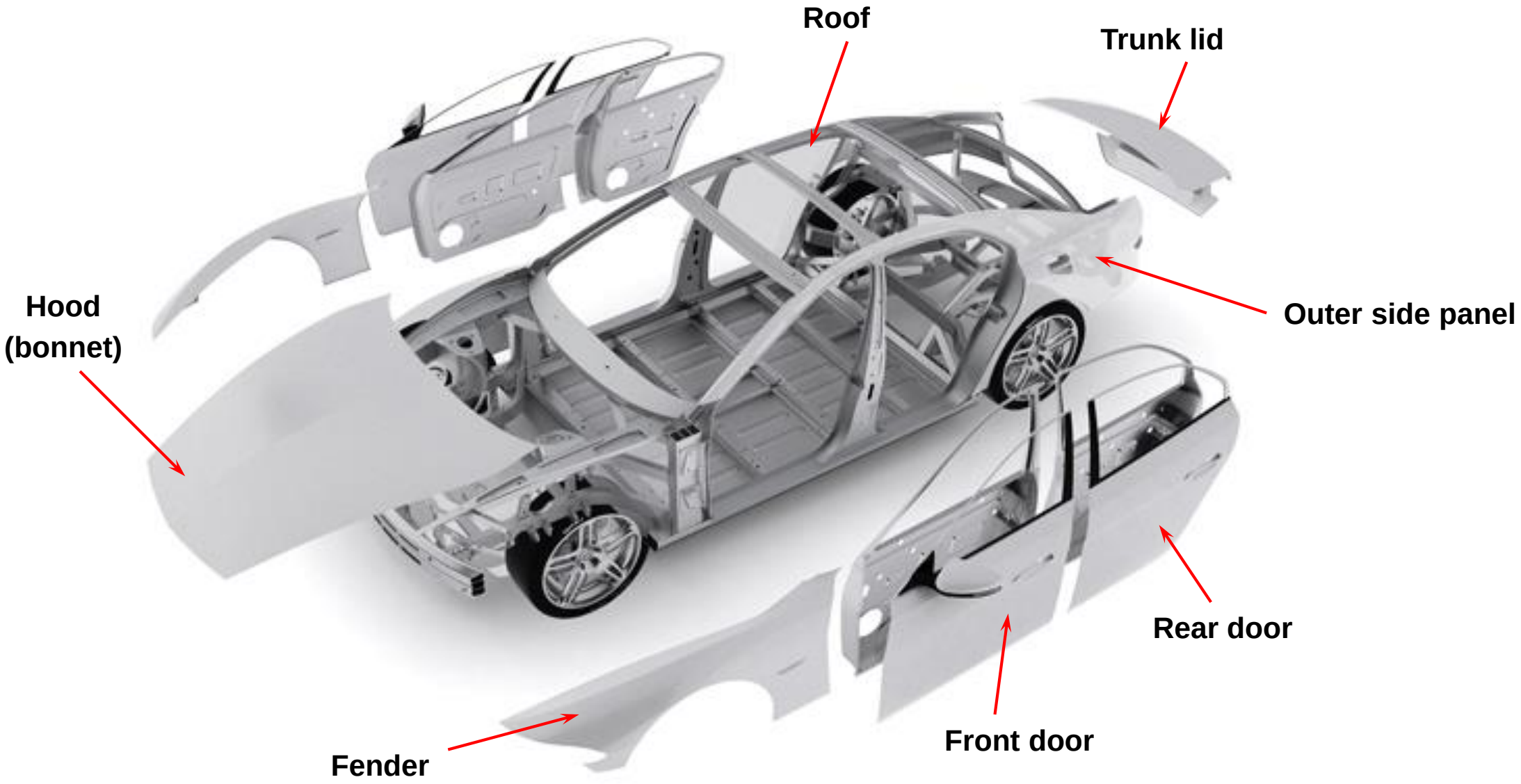


Source: https://www.aluminum.or.jp/jidosya/japanese/index.html

2. UACJ's aluminum paneling for auto bodies

Car models with aluminum paneling (examples)

Source: https://www.aluminum.or.jp/jidosya/japanese/03/1-1.html
https://www.aluminum.or.jp/jidosya/japanese/07/

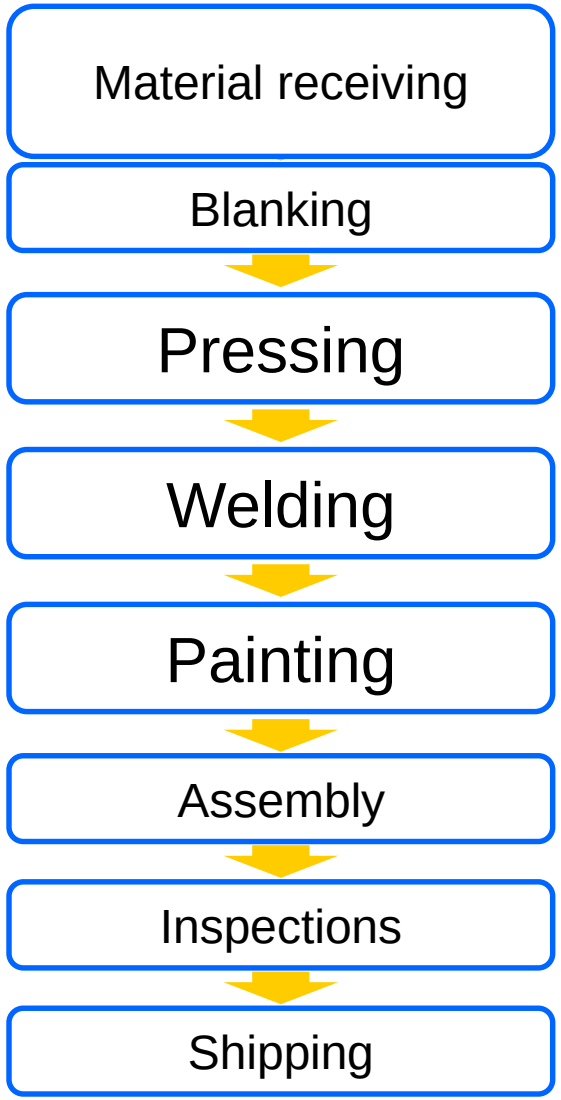
SOP	Make & model	Part(s)
1985	Sportscars	**Hood**
1989		Hood, **fenders**
1990		**All aluminum parts**
1991		Hood
1992		Hood
1993		Hood
1998		Hood, fenders
2000		Hood, **trunk lid**
2001		Hood, **roof**
2001		**Back doors**
2003	Sportscars, Large sedans, HVs	Hood, back doors
2003		Hood, **side doors**
2004		Hood, side doors
2017		Hood, fenders, **side doors**, trunk lid
2020	Sportscars, Large sedans, SUVs, HVs, EVs	**Hood**
2021		Hood, fenders, back doors, side doors, roof

First time aluminum panels were used on an auto body in Japan
(former Sumitomo Light Metal Industries)

First all-aluminum body in Japan
(former Sumitomo Light Metal Industries, former Sky Aluminum, and others)

2. UACJ’s aluminum paneling for auto bodies

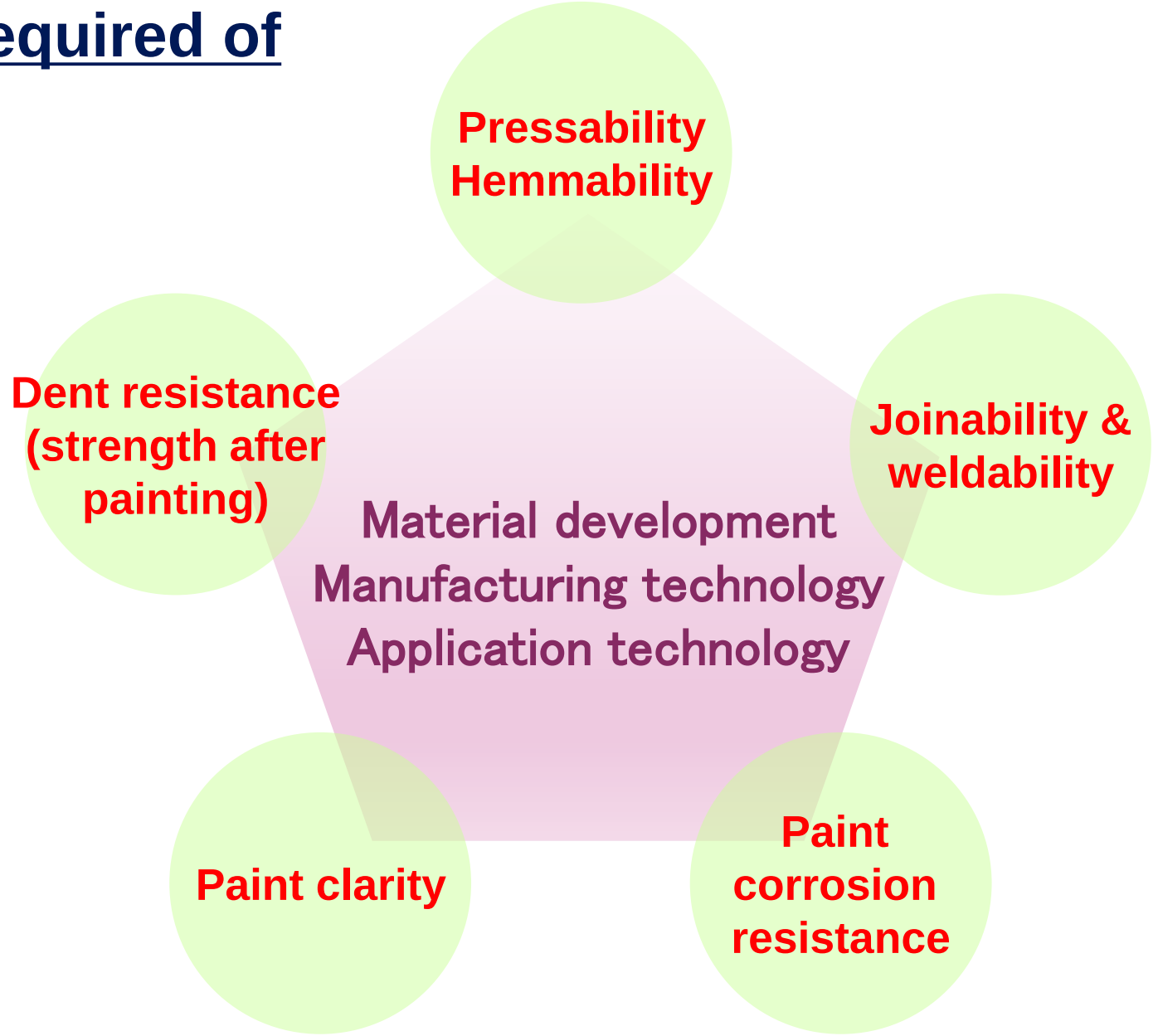
Automobile production process



For reference：https://www.jama.or.jp/library/children/encyclopedia/encyclopedia2.html
(Japan Automobile Manufacturers Association, Inc.)

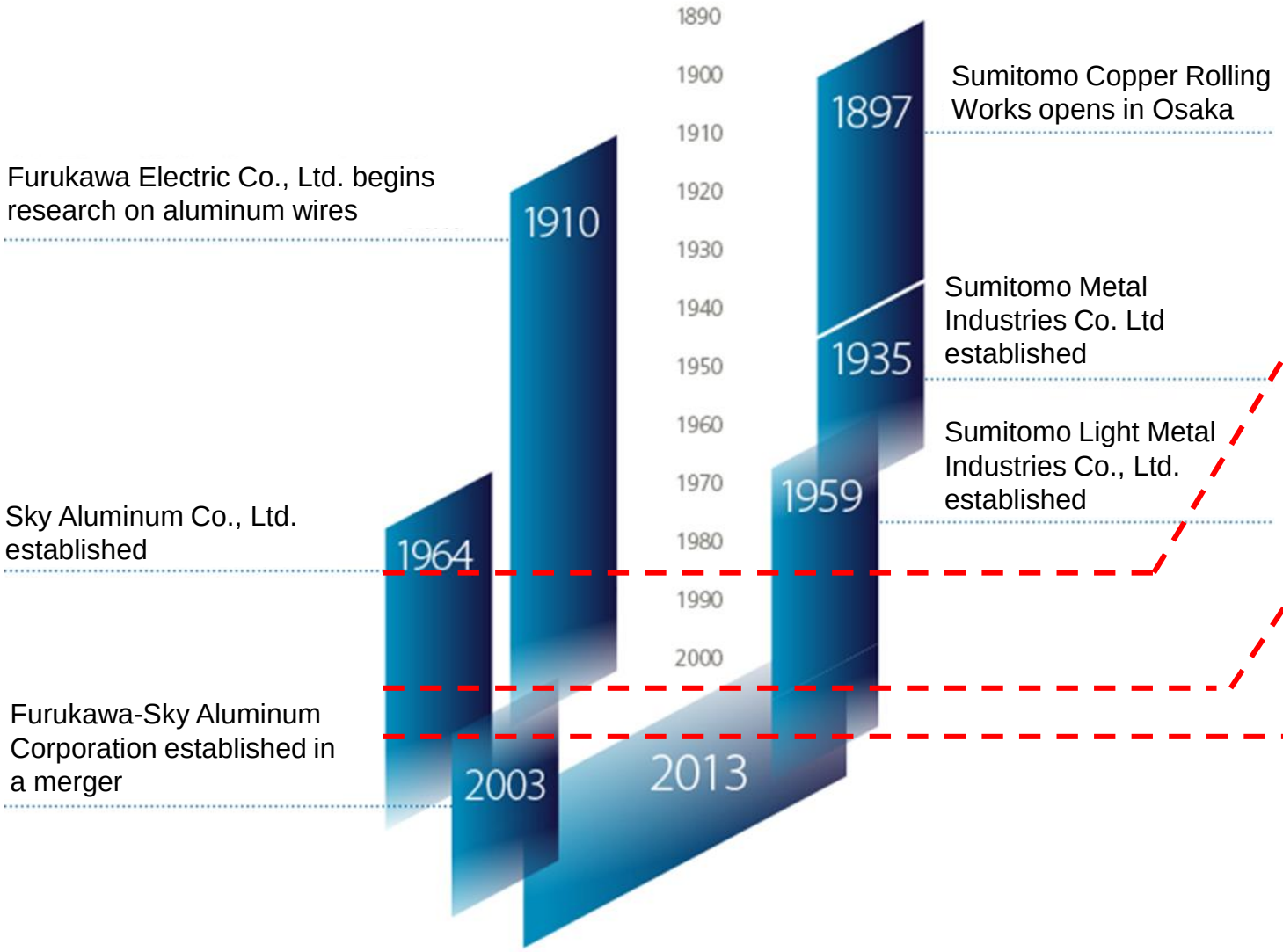
2. UACJ's aluminum paneling for auto bodies

Properties required of materials



2. UACJ's aluminum paneling for auto bodies

▼ Former Furukawa-Sky ▼ Former Sumitomo Light Metal Industries



Sumitomo Copper Rolling Works opens in Osaka

Furukawa Electric Co., Ltd. begins research on aluminum wires

Sumitomo Metal Industries Co. Ltd established

Sumitomo Light Metal Industries Co., Ltd. established

Sky Aluminum Co., Ltd. established

Furukawa-Sky Aluminum Corporation established in a merger

History of automotive material production

1985: Aluminum auto bodies first adopted

Former Sky Aluminum (Fukaya)

Former Furukawa (Fukui)

Former Sumitomo Light Metal (Nagoya)

2003: Furukawa-Sky established

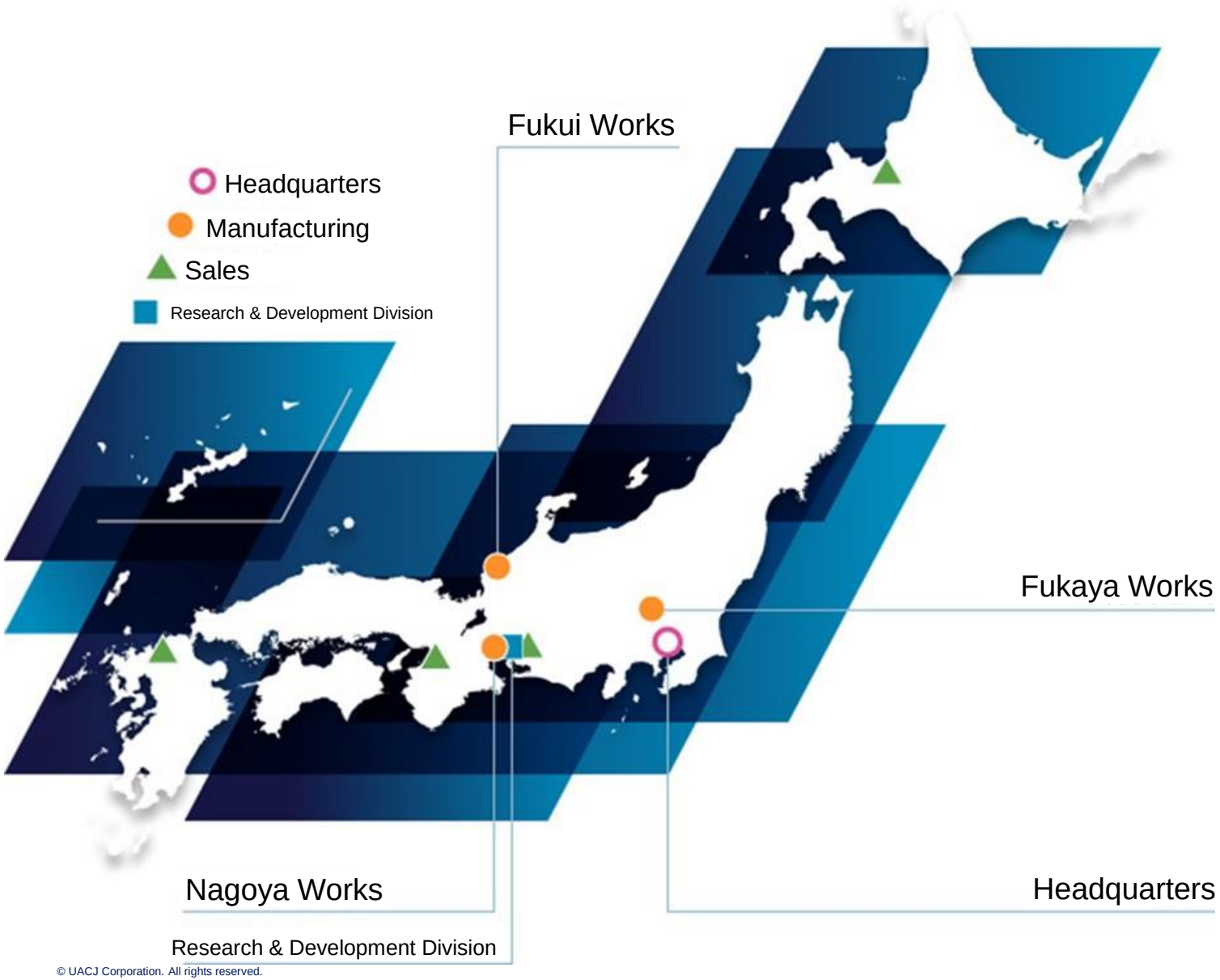
Former Furukawa-Sky (Fukaya)

2013: UACJ established

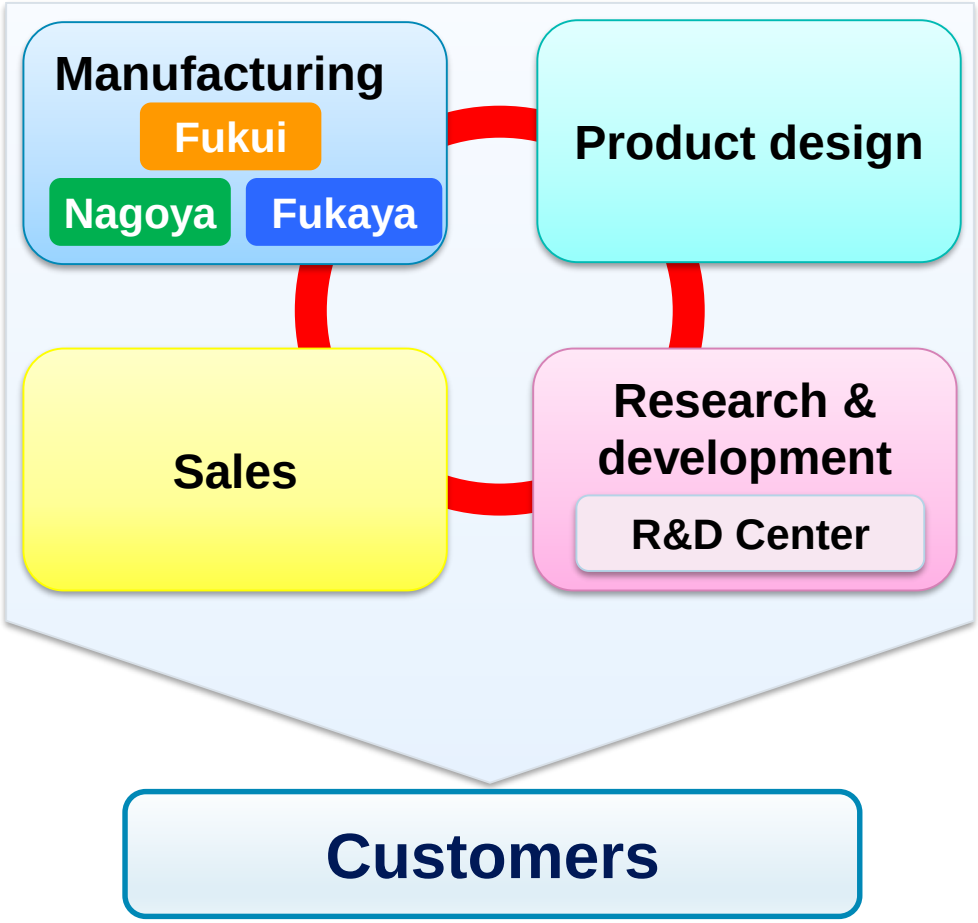
1. Integrated production in Nagoya
2. Nagoya–Fukaya collaboration

3. Integrated production in Fukui

2. UACJ's aluminum paneling for auto bodies



UACJ System for aluminum auto body paneling



2. UACJ's aluminum paneling for auto bodies

Property area: 850,000 m^2

2. UACJ's aluminum paneling for auto bodies

Ceremony for first shipment of aluminum materials for auto body panels held at Fukui Works.

Ceremony for first shipment of auto body paneling

July 8, 2020

Date	Wednesday, June 30
Location	Auto body paneling factory shipping area at Fukui Works
Attendees	Works director, department heads, related personnel

Source: https://www.uacj.co.jp/release/20200708_02.htm

2. UACJ's aluminum paneling for auto bodies

UACJ's auto body paneling (examples)

		Main applications	Strength after painting	Pressability	Hemmability
6000 series	SG712-T4	Outer, inner, components	Excellent	Good	Good
	TM30-T4	Outer	Excellent	Good	Good+
	TM66-T4	Outer, inner	Excellent	Good++	Good

		Main applications	Strength after painting	Pressability	Hemmability
5000 series	GM145-O (5182-O)	Inner, components	Good	Excellent	Excellent
	GC45-O	Outer	Good+	Excellent+	Excellent
	52S-O	Inner, components	Good	Good	Excellent

2. UACJ's aluminum paneling for auto bodies

Strength after painting

Difference between 5000 and 6000 series

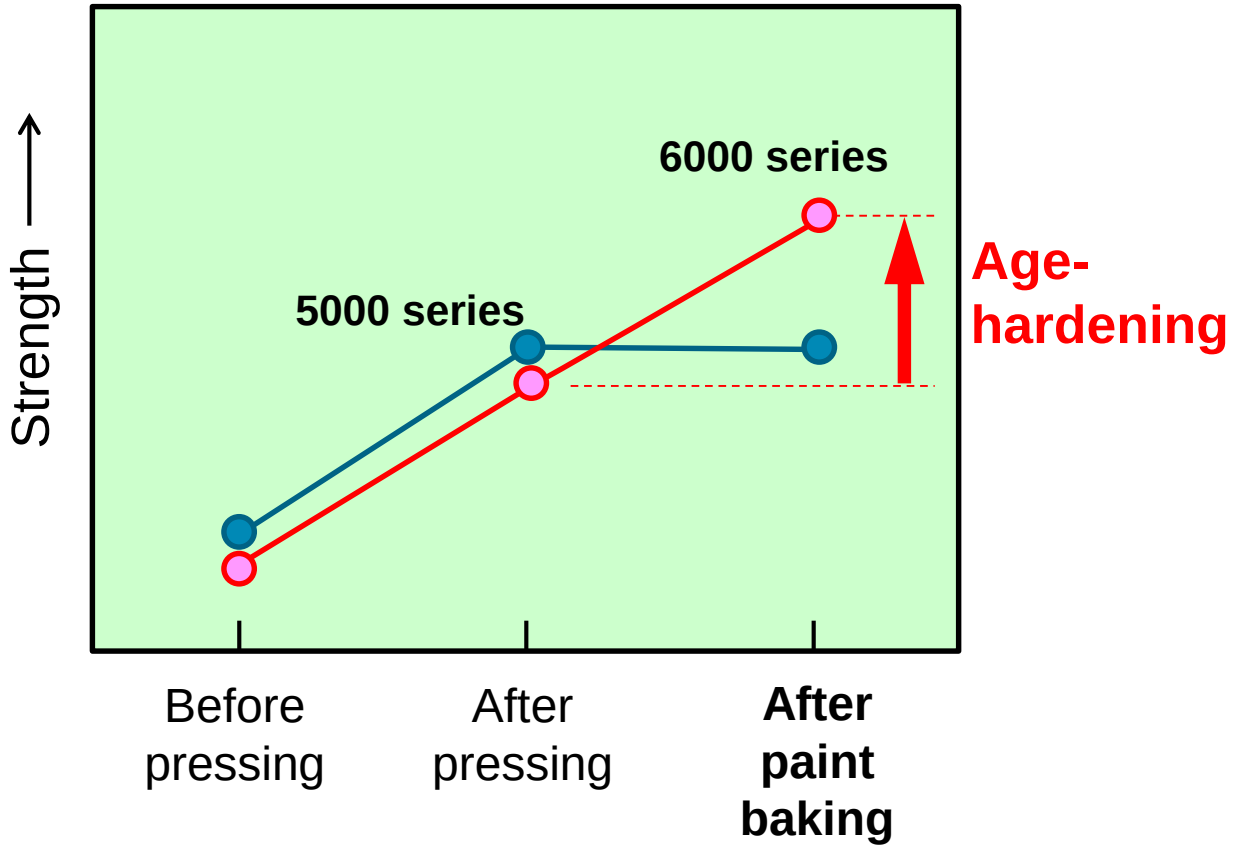


Figure 1: Image of manufacturing process and strength

6000 series: Improved strength after paint baking

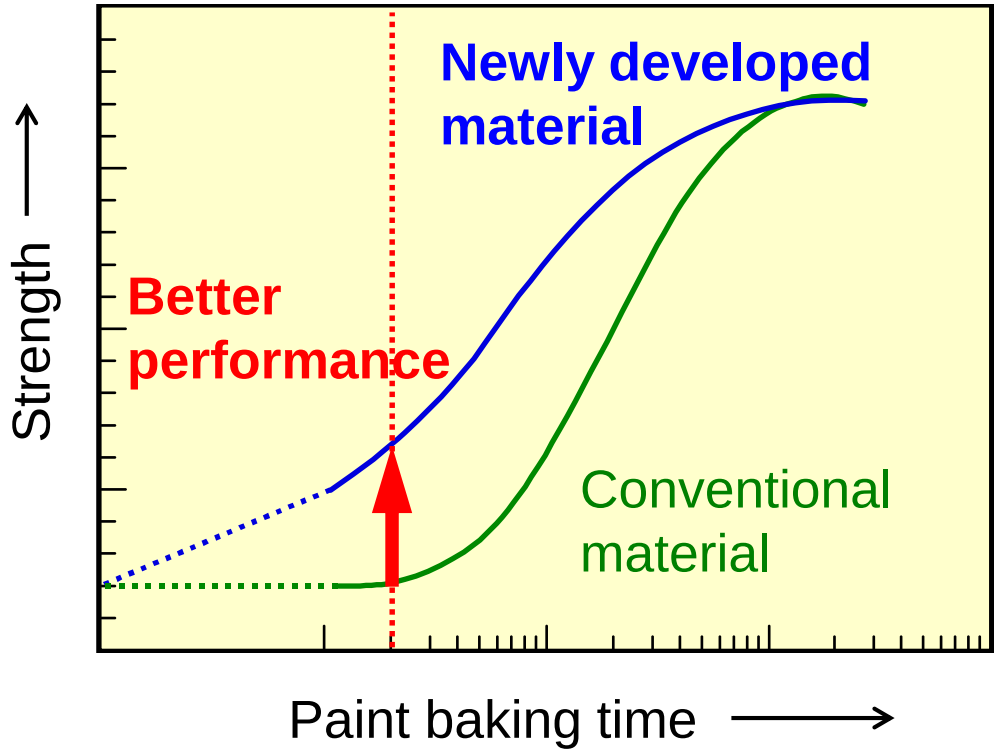
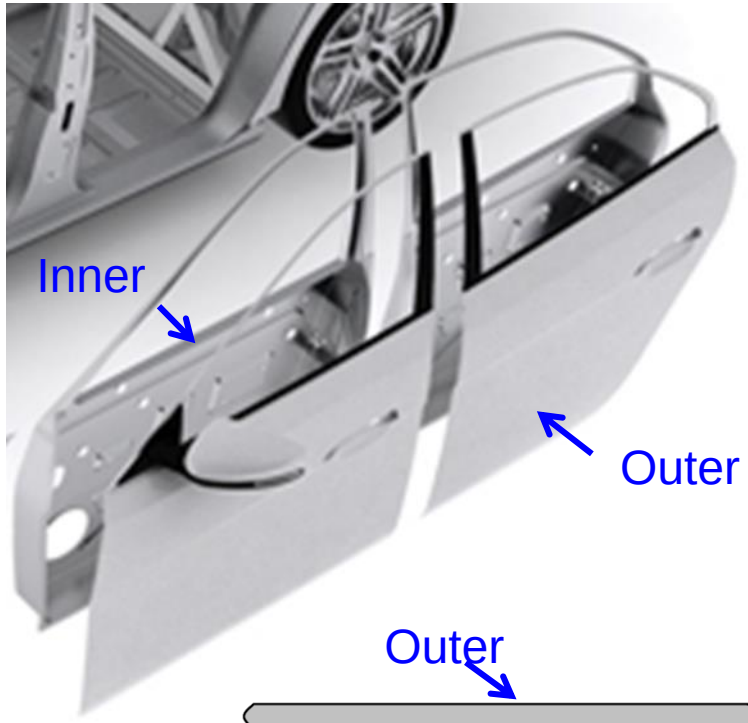
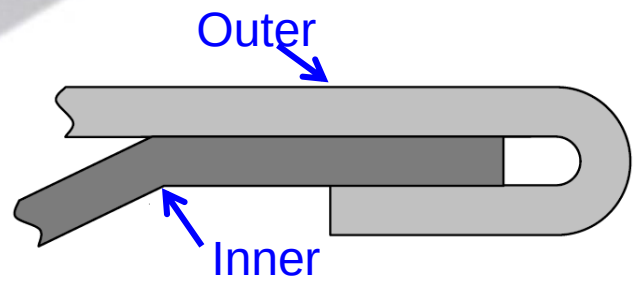


Figure 2: Image of paint baking time and strength

2. UACJ's aluminum paneling for auto bodies

Hemmability

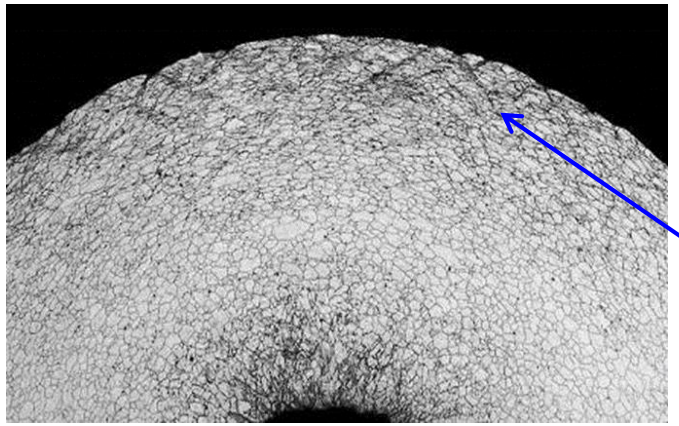




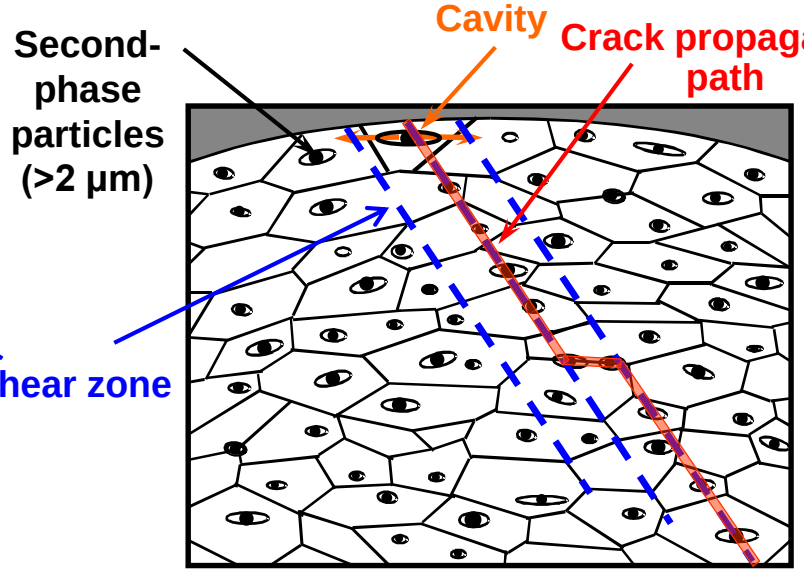
Schematic illustration of hemmed flange

Himuro et al. : *Furukawa-Sky Review, 1 (2005), 9-14*

Mechanism analysis



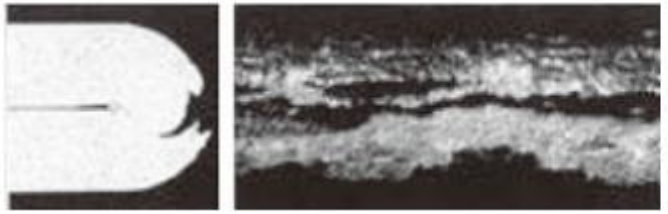
Hibino et al: Light Metals, 53 (2003), 534



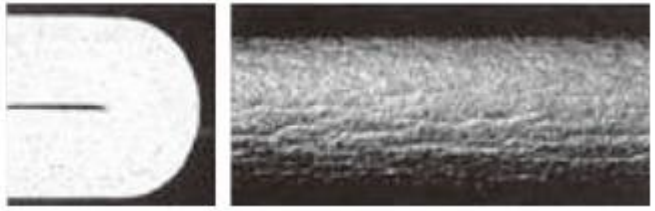
Asano et al.: Light Metals, 52 (2002), 448

Hemmability can be improved by suppressing the number of second-phase particles larger than 2 μm and shear zone formation

Before improvement



After improvement



Source : https://www.uacj.co.jp/products/sheeting/aas-panel.htm

2. UACJ’s aluminum paneling for auto bodies

Pressability

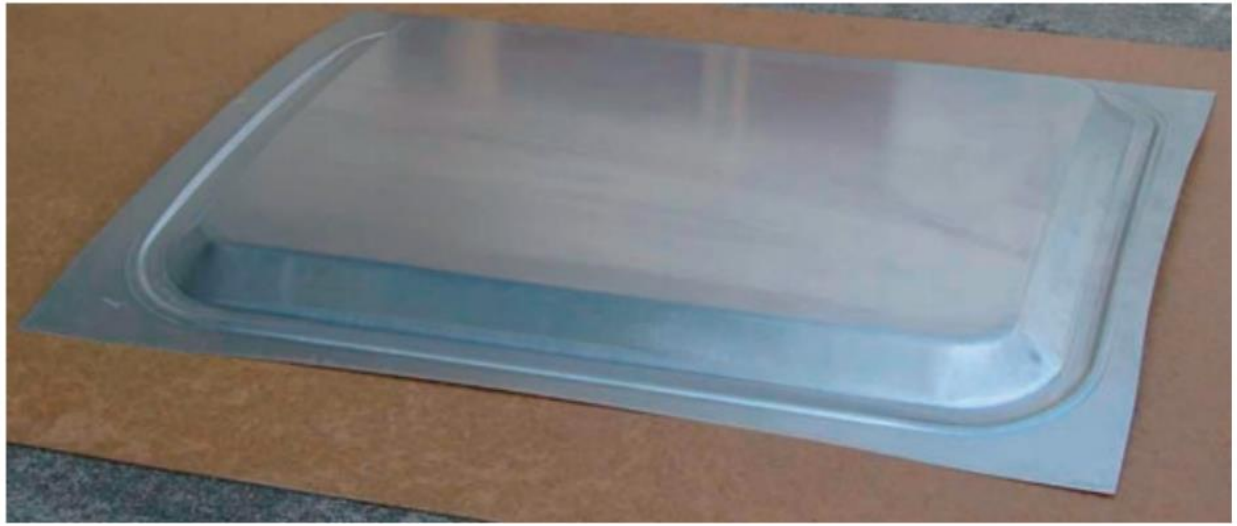


Figure 1: Experimental press mold for 6000 series development alloy sheet

Noguchi: Furukawa-Sky Review, 3 (2007), 1–6

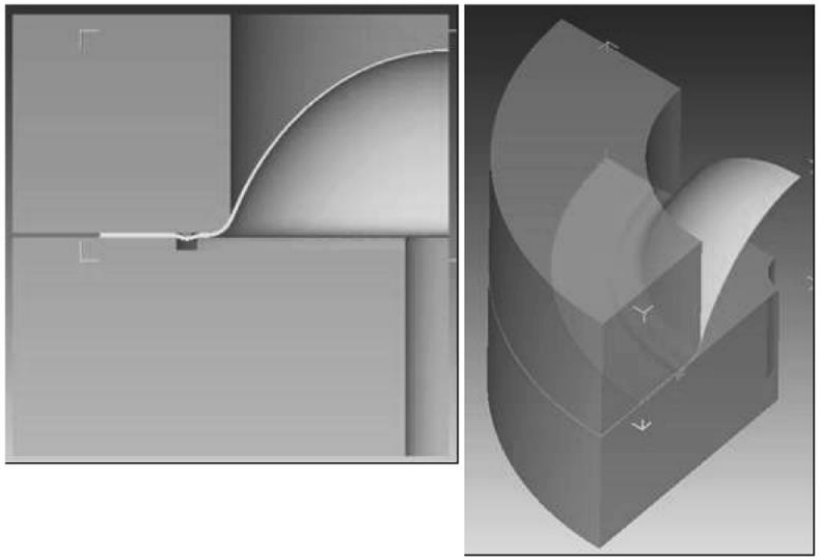


Figure 2: Example of hydraulic bulge analysis

Uema et al.: Light Metals, 213 (2013), 961–970

3. UACJ’s environmental response in the context of auto body paneling

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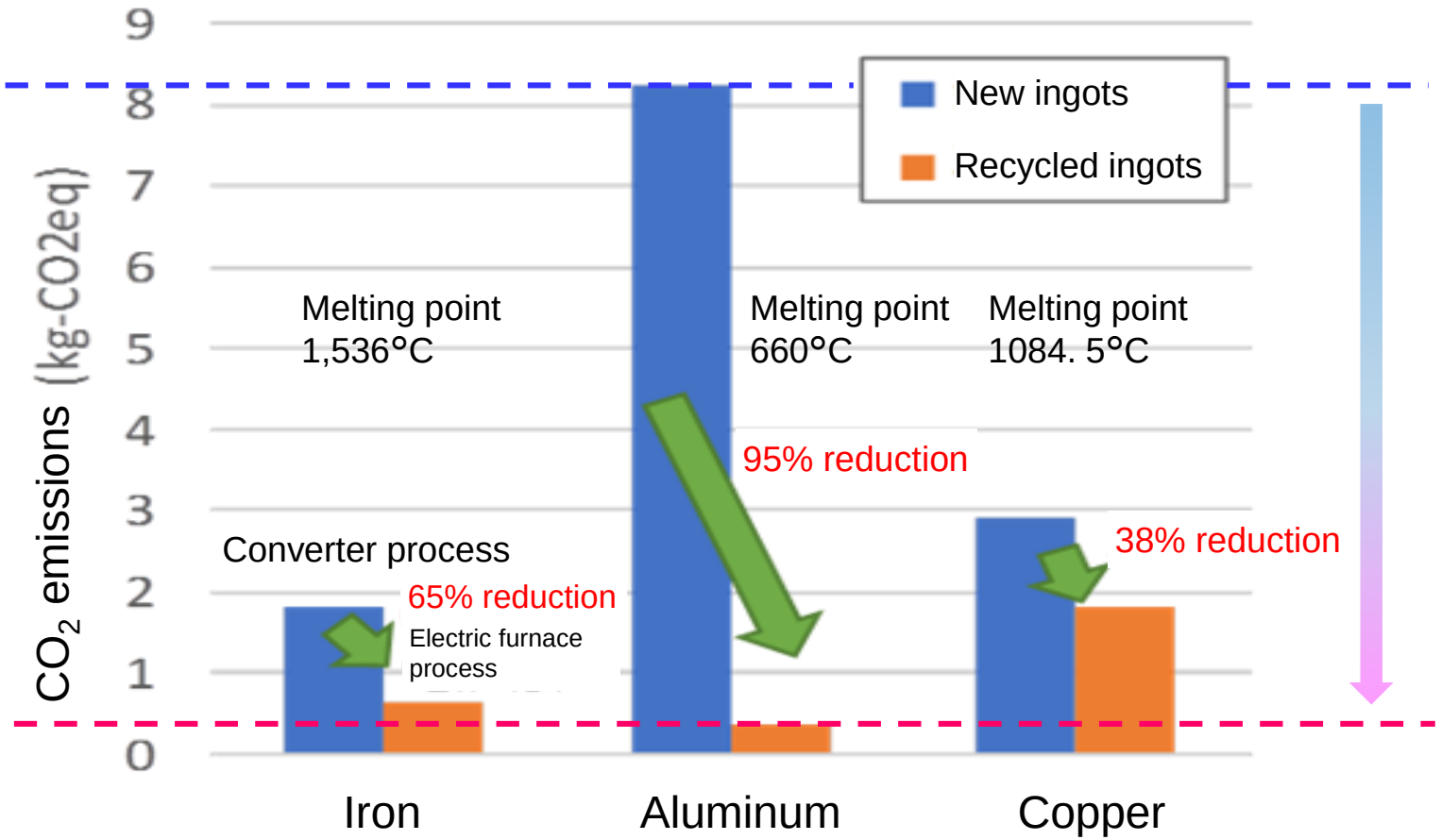
3. UACJ's environmental response in the context of auto body paneling

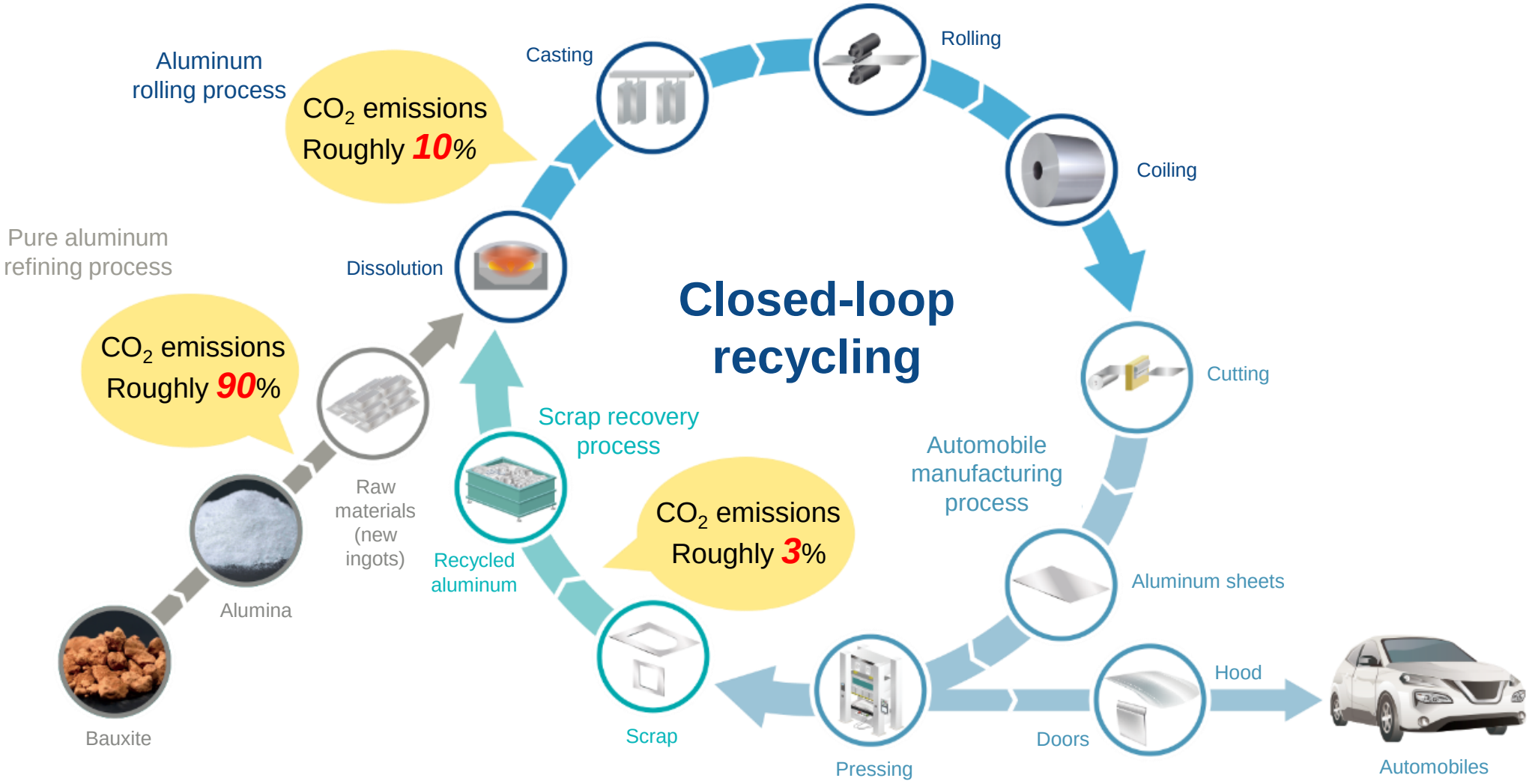


Using recycled materials reduces CO_2 emissions

Source：IDEAv2

Recycling aluminum delivers greater CO_2 emissions reductions than other metals

3. UACJ's environmental response in the context of auto body paneling



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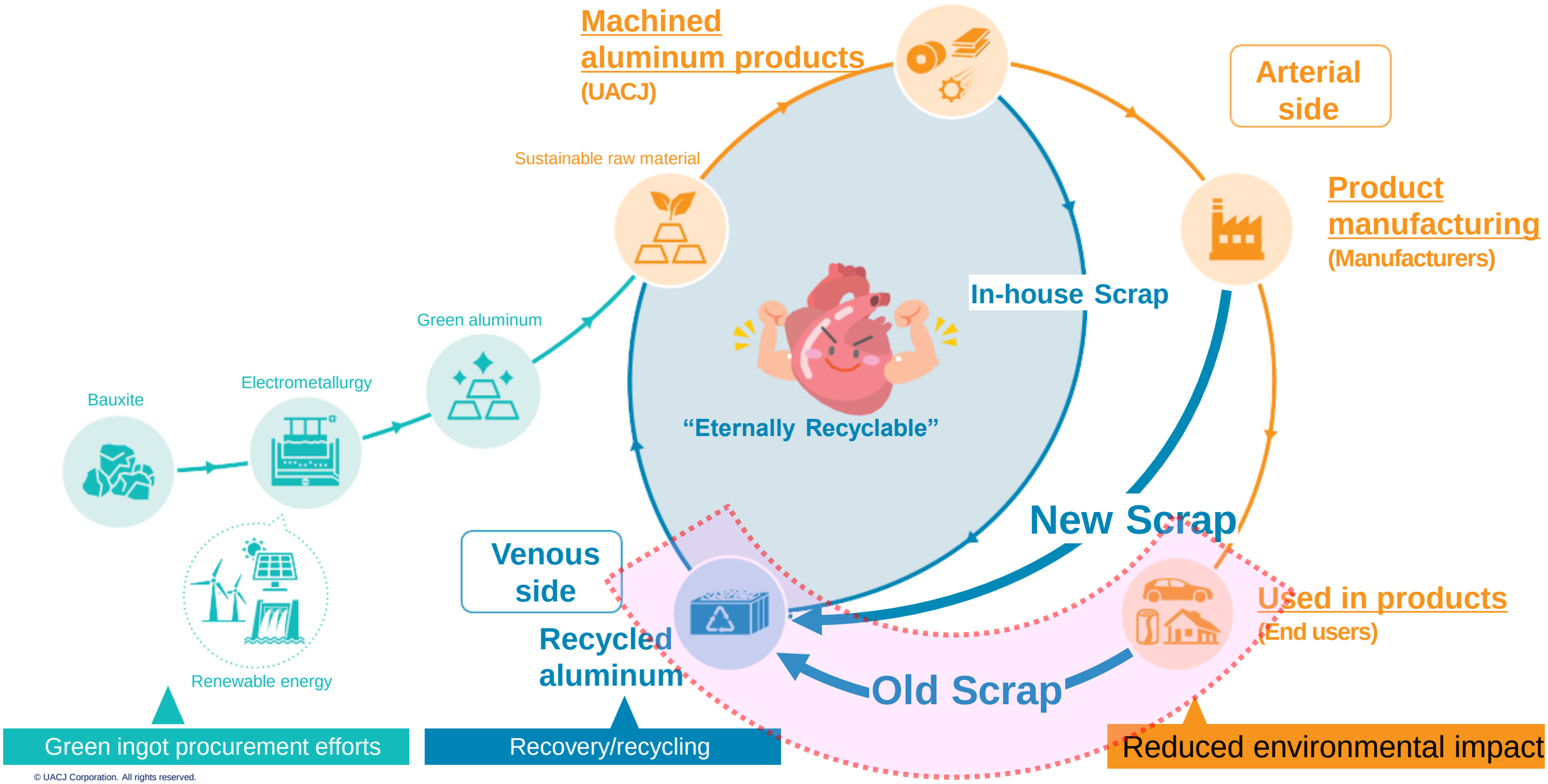


3. UACJ's environmental response in the context of auto body paneling

Developing low-CO_2 recycled aluminum materials

(Received the Japan Aluminum Association Award for Development in 2020)

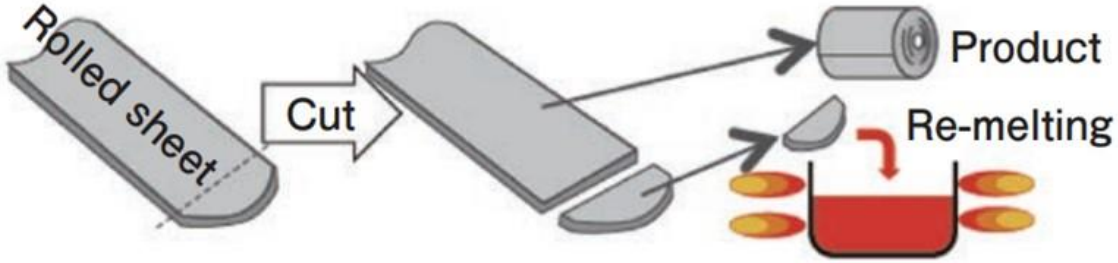


Fig.1 Generation of aluminum scrap.

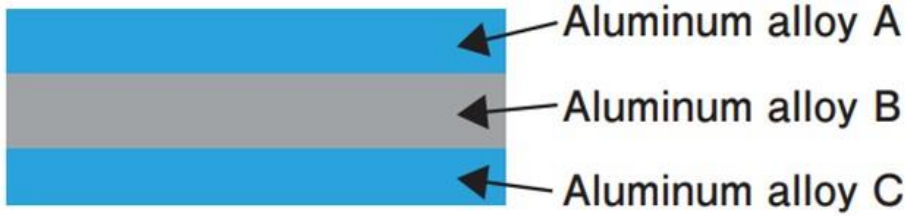
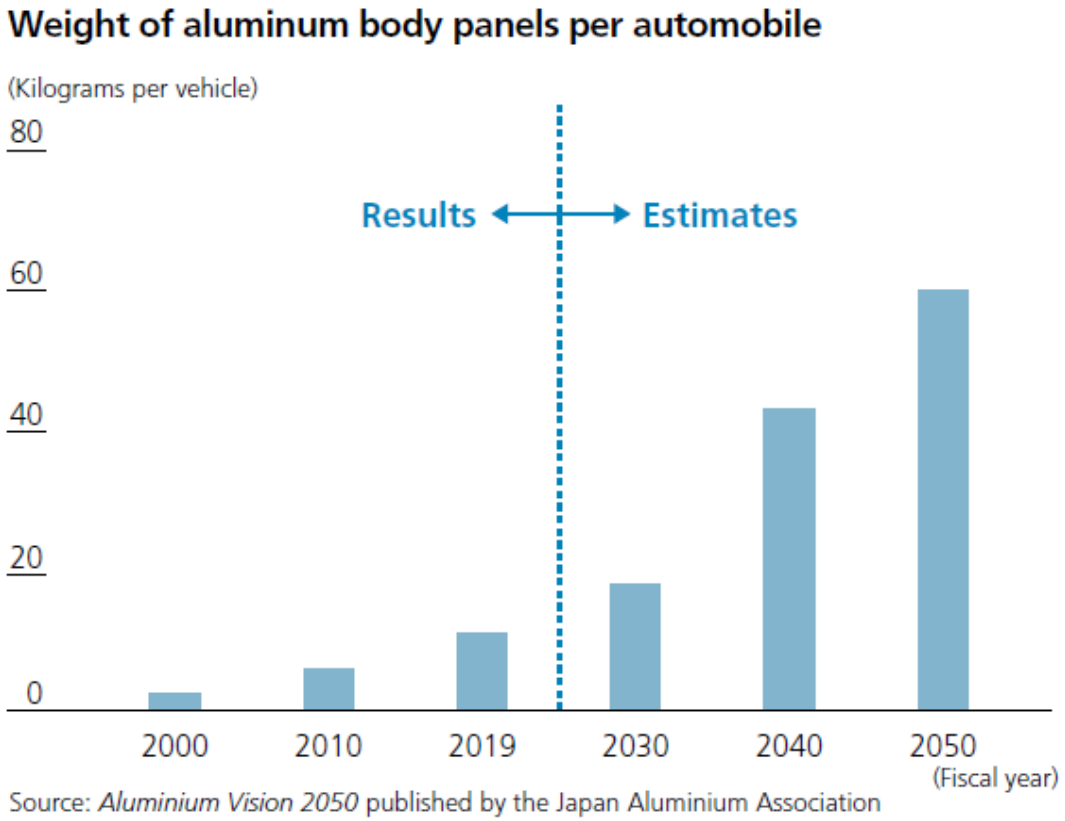


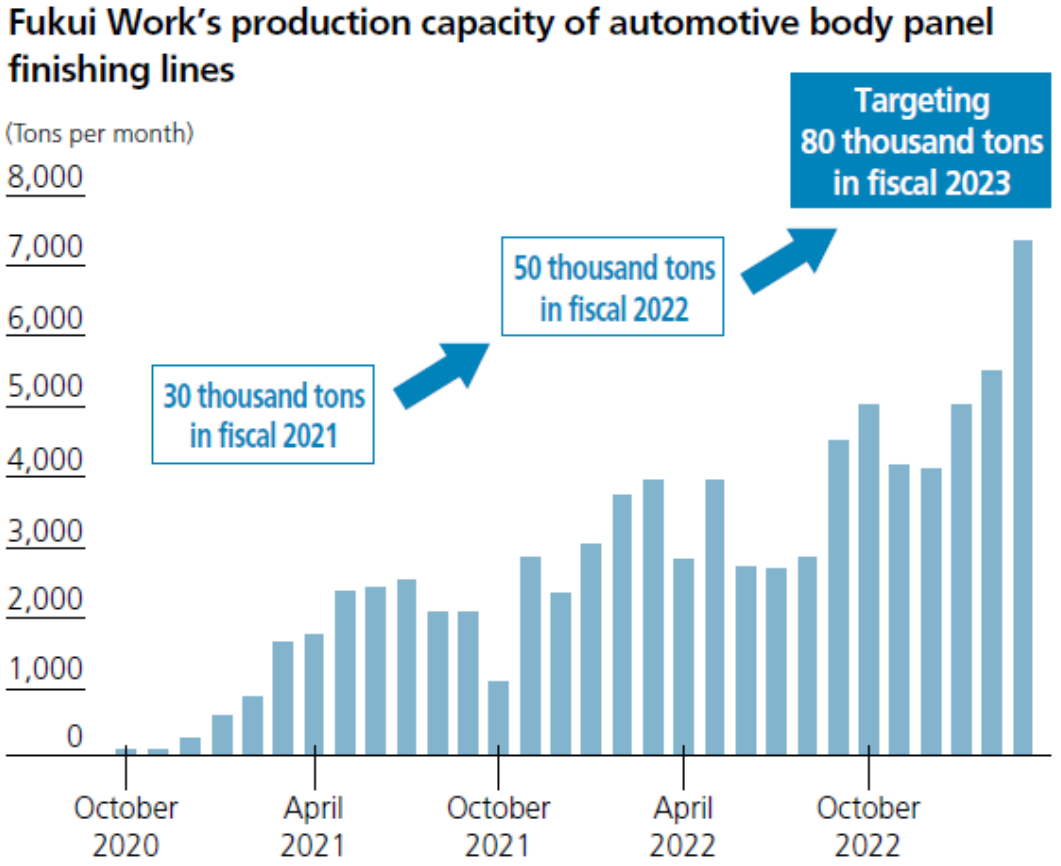
Fig.2 Illustration of clad sheet.

Source: Nishikawa et al., UACJ Technical Reports, Vol. 8(1), 2021, 62–65

UACJ developed alloys for auto body panels using in-house scrap generated during production of aluminum sheets for heat exchangers.

3. UACJ's environmental response in the context of auto body paneling





Source: UACJ Report 2023

4. Conclusion

We will use technology that promotes a circular economy to increase the added value of aluminum in an effort to enhance our corporate value!

Thank you for your attention.

Aluminum lightens the world

アルミでかなえる、軽やかな世界