

OCTOBER 2017

MADE IN CHINA 2025

GOVERNMENT PLAN IMPACT ON COPPER USE

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on behalf of Brilliance Consulting

Legal Statement

Cu

The purpose of the information in the following presentations is to guide ICA programs and provide members with information to make independent business decisions.

Antitrust Guidelines for Copper Industry Trade Association Meetings

Cu

The following guidelines with respect to compliance with antitrust laws of the United States, Japan and European Community¹ are intended to govern the conduct of participants in copper industry trade association meetings, both at the meeting itself and in informal discussions before or after the formal meeting.

Price: Competitors should not discuss future prices (including terms of sale) of their products. There is no blanket prohibition against the mention of or reference to current or past prices but limits must be observed. Such references or mentions should occur only when necessary in connection with the development of association programs. For example, reference to a particular price level in comparing the cost of a copper product to a competing product is permitted. Whenever possible, such references should be discussed in advance with legal counsel.

Competitive Information: Competitors should not discuss the market share of a particular copper producer or copper fabricator's products. Furthermore, nothing should be said at a meeting which could be interpreted as suggesting prearranged market shares for such products or producer production levels. The overall market share of copper products may be discussed with regard to competition with non-copper products and general market acceptance.

New Products: Competitors should not encourage or discourage the introduction of a new product by another competitor or reveal a particular copper company's plans to change the production rate of an existing product or to introduce a new product. No company should disclose to another company whether it is in a position to make or market a new product. New products may be discussed in a technical manner or from the standpoints of competition with non-copper products and general market acceptance.

In addition, proposed methods for and results of field and laboratory testing can be considered.

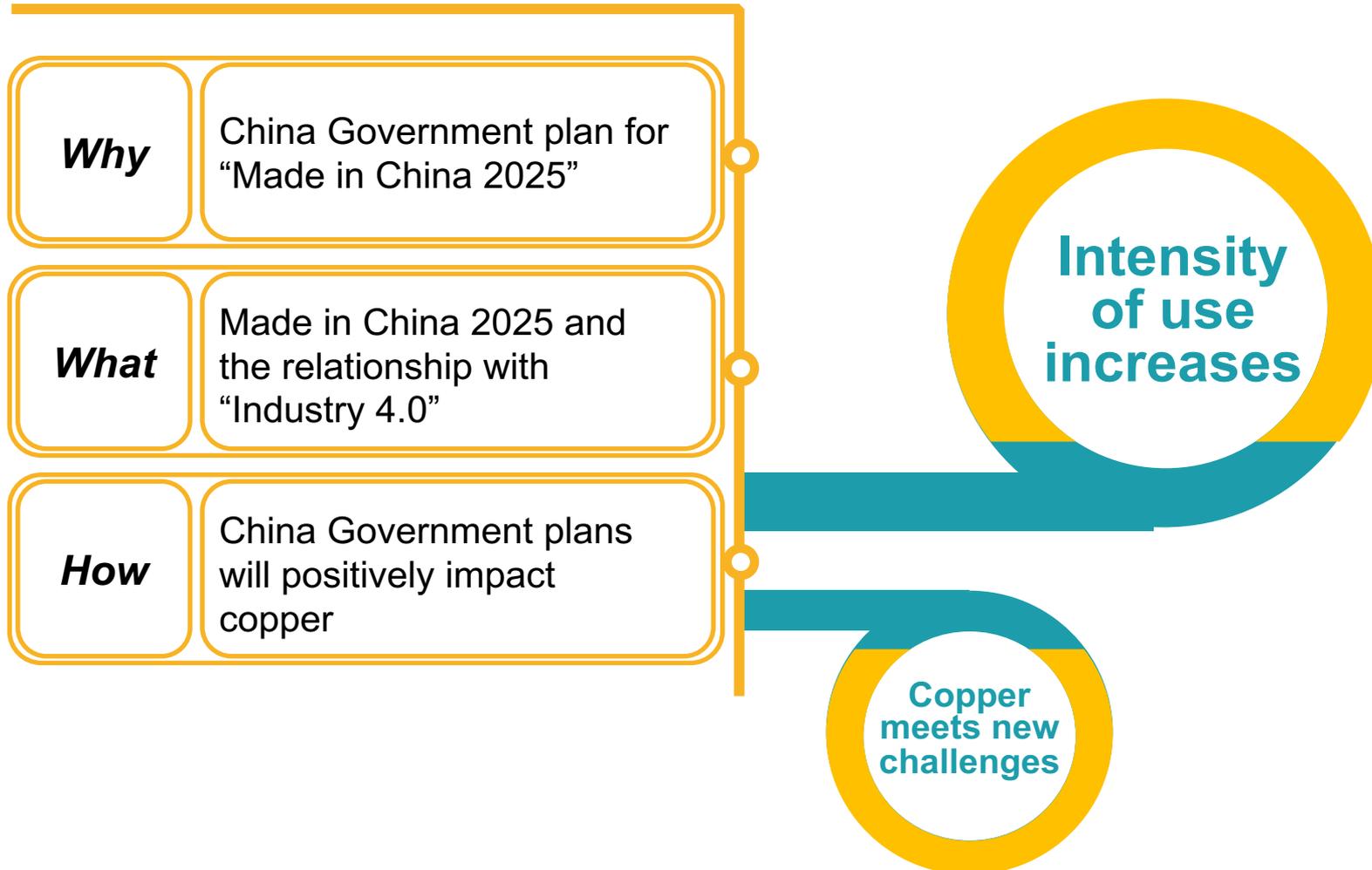
The Role of Legal Counsel: Legal counsel attends association meetings to advise association staff and other meeting attendees regarding the antitrust laws and to see that none of the matters discussed or materials distributed raise even the appearance of antitrust improprieties. During the course of a meeting, if counsel believes that the discussion is turning to a sensitive or inappropriate subject, counsel will express that belief and request that the attendees return the discussion to a less sensitive area.

A paper entitled 'Copper Industry Trade Associations and Antitrust Laws' is available upon request. 10/92, 5/93, 10/10

1. Other foreign competition laws apply to International Copper Association, Ltd. (ICA)'s activities worldwide.

Study objectives

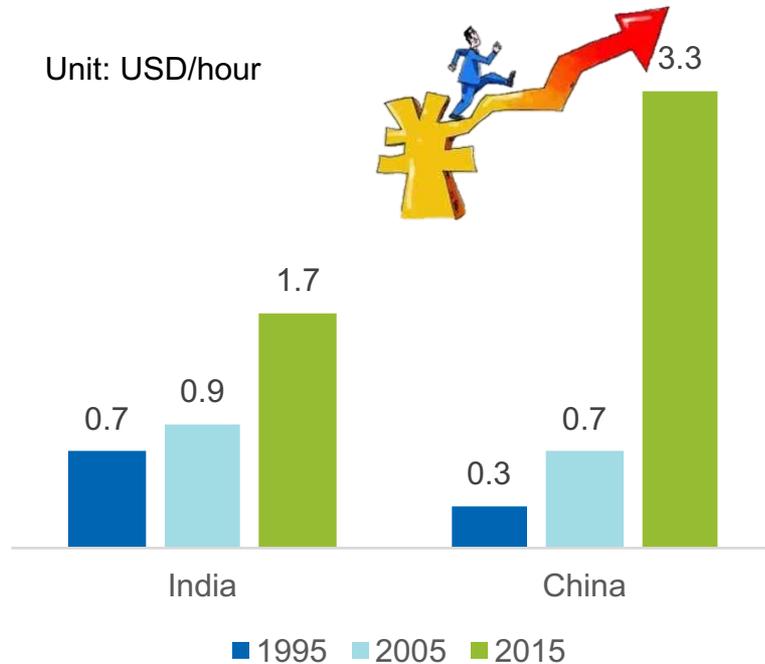
Measure the impact on copper related products and industries by the Made in China 2025 Government plan.



The Government plan

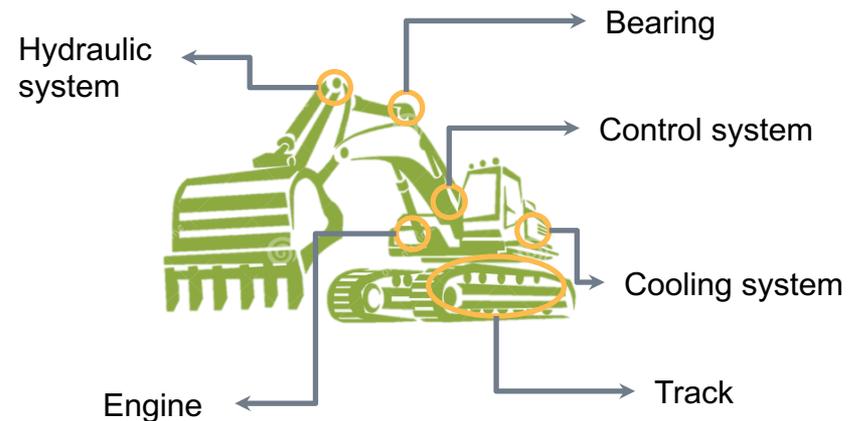
Challenges for “Made in China”

Labor cost in China is higher than other developing countries



There is a shortage in core technology know-how, China has to import core components

Example: In high end excavator, imported components account for more than 50% cost of excavator



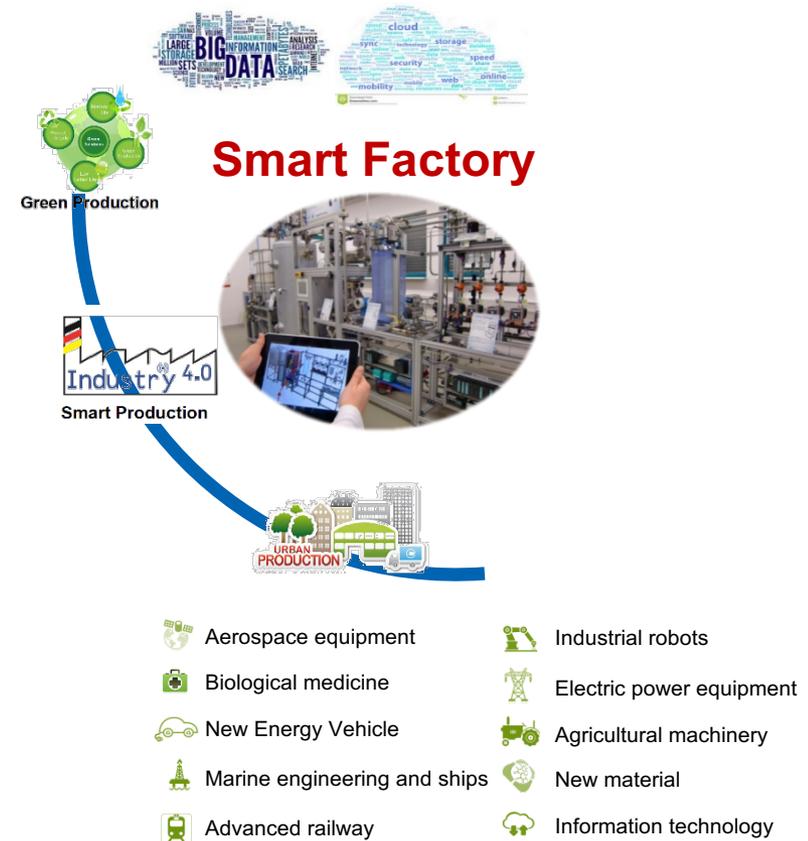
Sourcing: Deloitte global manufacture competition index report (2016)

Industry 4.0

Made in China 2025 is the intended path to Industry 4.0



Industry 4.0 is smart production/factories



Impact on material use

Low impact

Medium impact

High impact



Biological
medicine



New
material



Electric
power
equipment



Agricultural
machinery



Aerospace
equipment



Information
technology



Marine
engineering
and ships



Advanced
railway



Industrial robots



New Energy
Vehicle

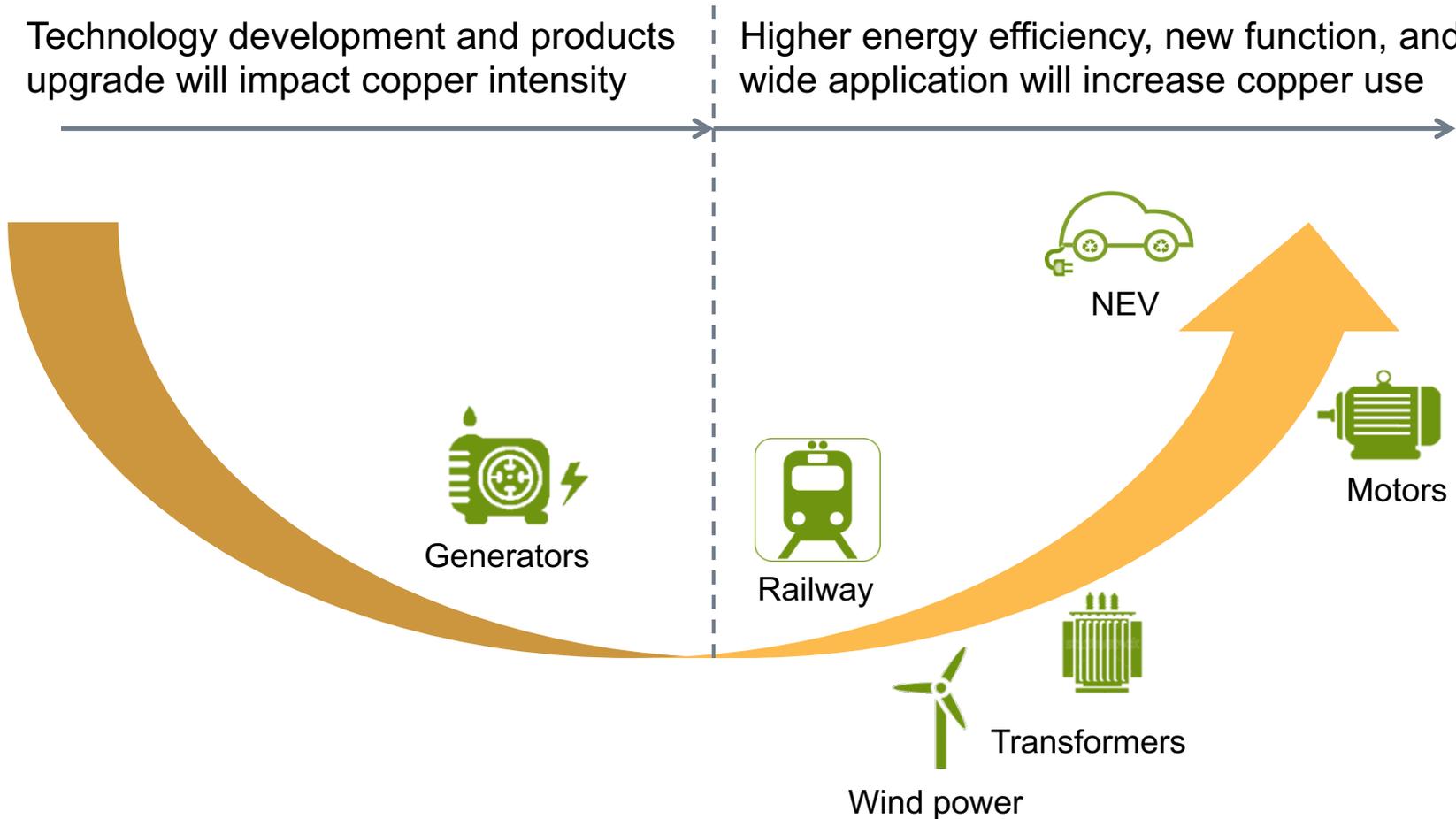
Intensity of material use

Product definition		Copper intensity in 2015
Electric power	 Motors	0.87kg/kW
	 Transformers	0.62kg/kVA
	 Generators	0.19kg/kW
	 Wind power	3.1kg/kW
Transportation	 New energy vehicles	74.9kg/vehicle
	 Railway	5.1tonnes/km

Intensity & use drivers

Technology development and products upgrade will impact copper intensity

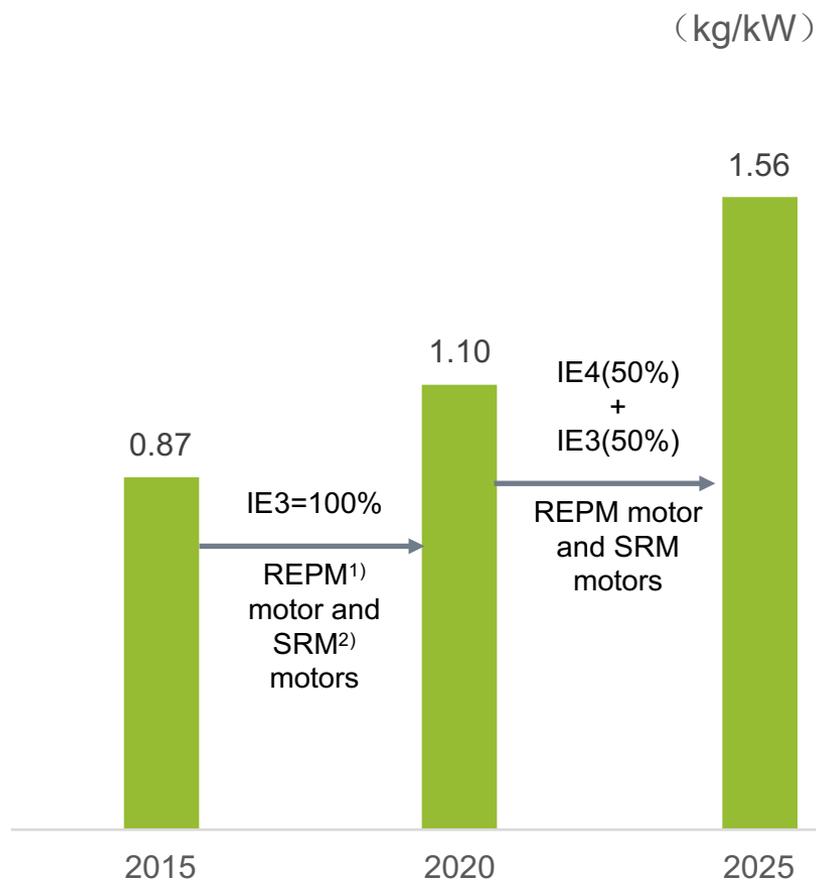
Higher energy efficiency, new function, and wide application will increase copper use



Electric power - Motors

Higher copper intensity in motors

Impacts on copper intensity of industrial motors



- **Drivers from 2015 to 2020e**
 - Higher efficient motors
 - ➔ Higher copper intensity
 - The use of REPM and SRM will be low due to technology obstacles
 - ➔ No impact
- **Drivers from 2020e to 2025e**
 - Higher efficient motors
 - ➔ More copper rotary motors
 - ➔ Higher copper intensity
 - REPM and SRM begins to be used in industrial fields
 - ➔ Little impact

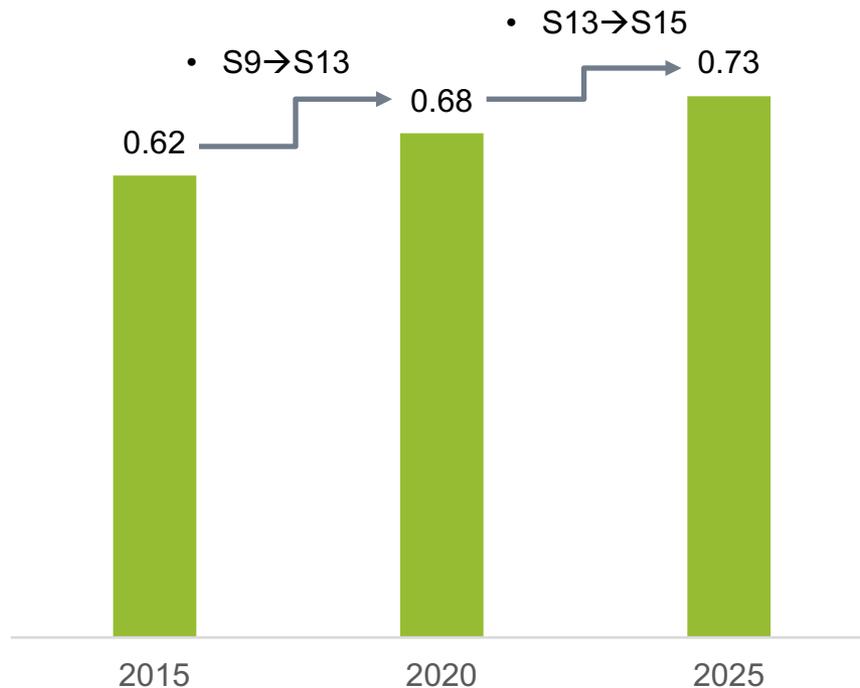
- 1) REMP: Rare earth permanent magnet motors
 2) SRM: Switched reluctance motors

Electric power - Transformers

Increased intensity use in transformers

Impacts on copper intensity of distribution transformers

(kg/kVA)



- **Drivers from 2015 to 2020e**
 - High efficient distribution transformers
 - S13 transformers will replace S9
 - Higher copper intensity
- **Drivers from 2020e to 2025e**
 - Higher efficient distribution transformers
 - S15 transformers will be widely used
 - Higher copper intensity

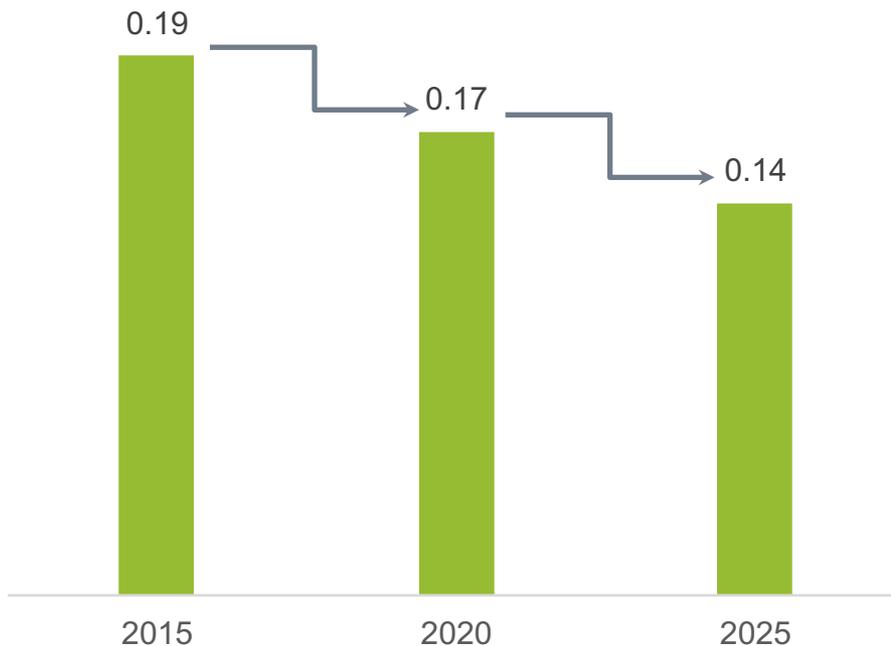
Electric power - Generators

Ultra supercritical generators lower intensity

Impacts on copper intensity of generators (conventional)

(kg/kW)

- The use of ultra supercritical generating set may lead to less copper intensity



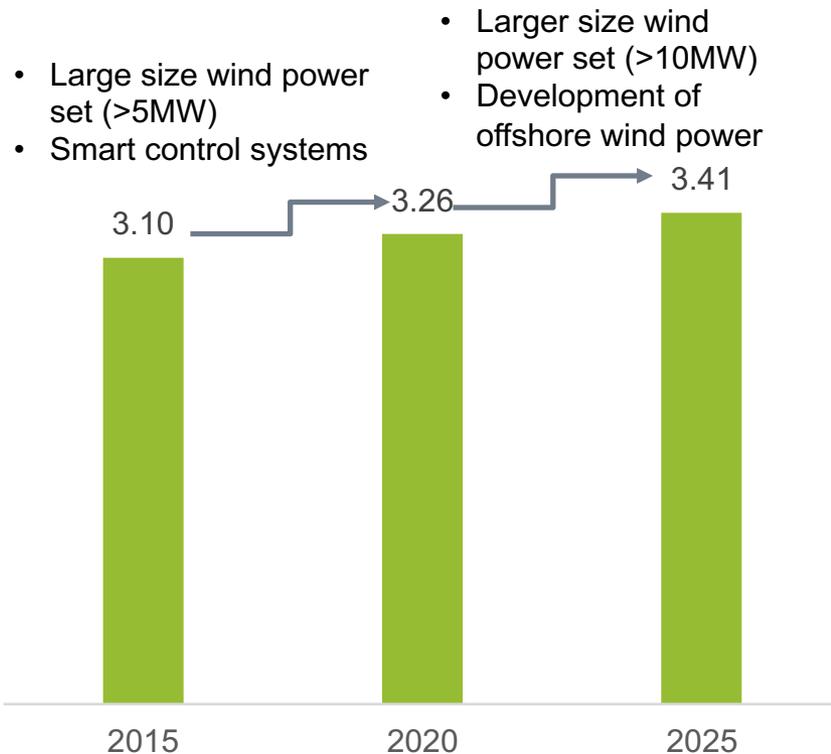
- **Drivers from 2015 to 2025e**
 - The use of ultra supercritical generating set results in a much higher capacity in generation
 - → Less in copper intensity

Electric power - Wind power

Wind power sets to increase in intensity

Impacts on copper intensity of wind power

(kg/kW)



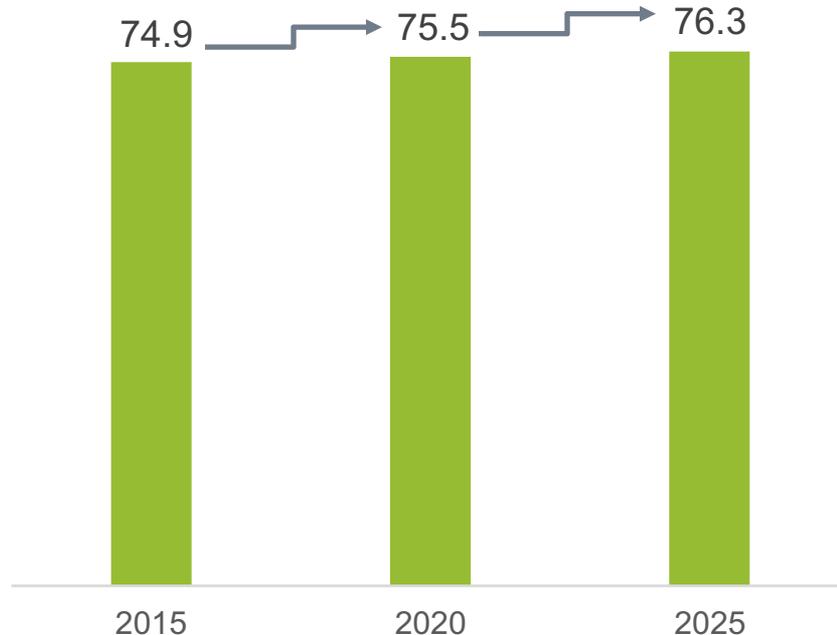
- **Drivers from 2015 to 2025e**
 - The use of larger generators in wind power development
 - → Increase in copper intensity
 - More installation of offshore wind power generation in the near future
 - → Increase in copper intensity

Transportation - New energy vehicles

Increased intensity of use

Impacts on copper intensity of new energy vehicles¹ (kg/Vehicle)

- Longer cruising range and faster speed need high efficient motors
- More battery capacity needs high energy intensity



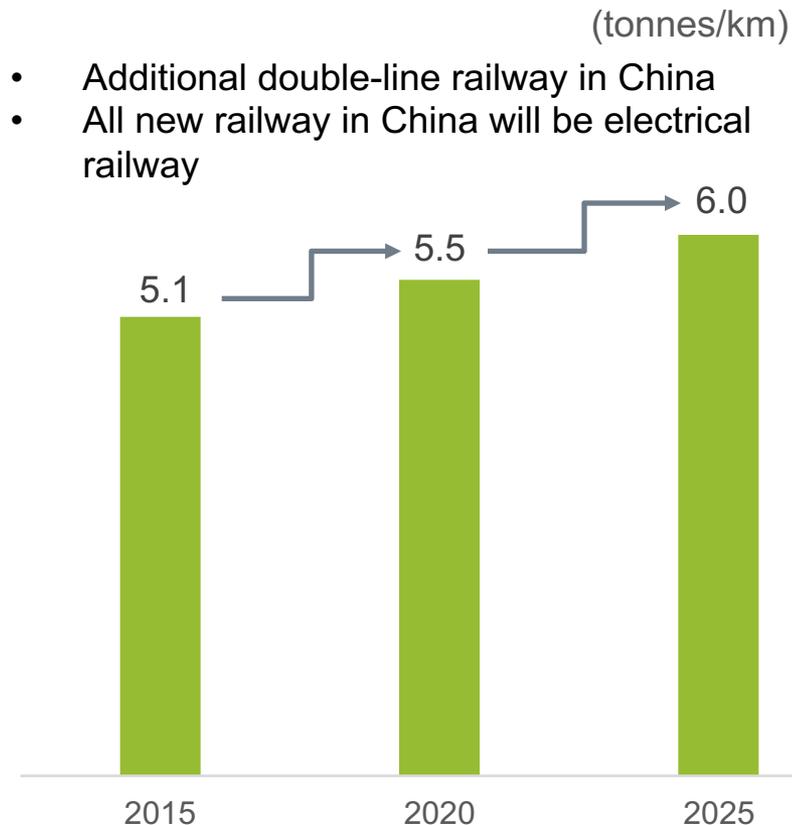
- **Drivers from 2015 to 2025e**
 - Motors: high efficient motors
 - ➔ Higher copper intensity
 - Batteries: High energy intensity
 - Harnesses:
 - ➔ Copper is dominant now
 - ➔ Alternatives in R&D phase

1) exclude copper components in infrastructure

Transportation - Railway

Advanced systems support growth in material use

Impacts on copper intensity of railway

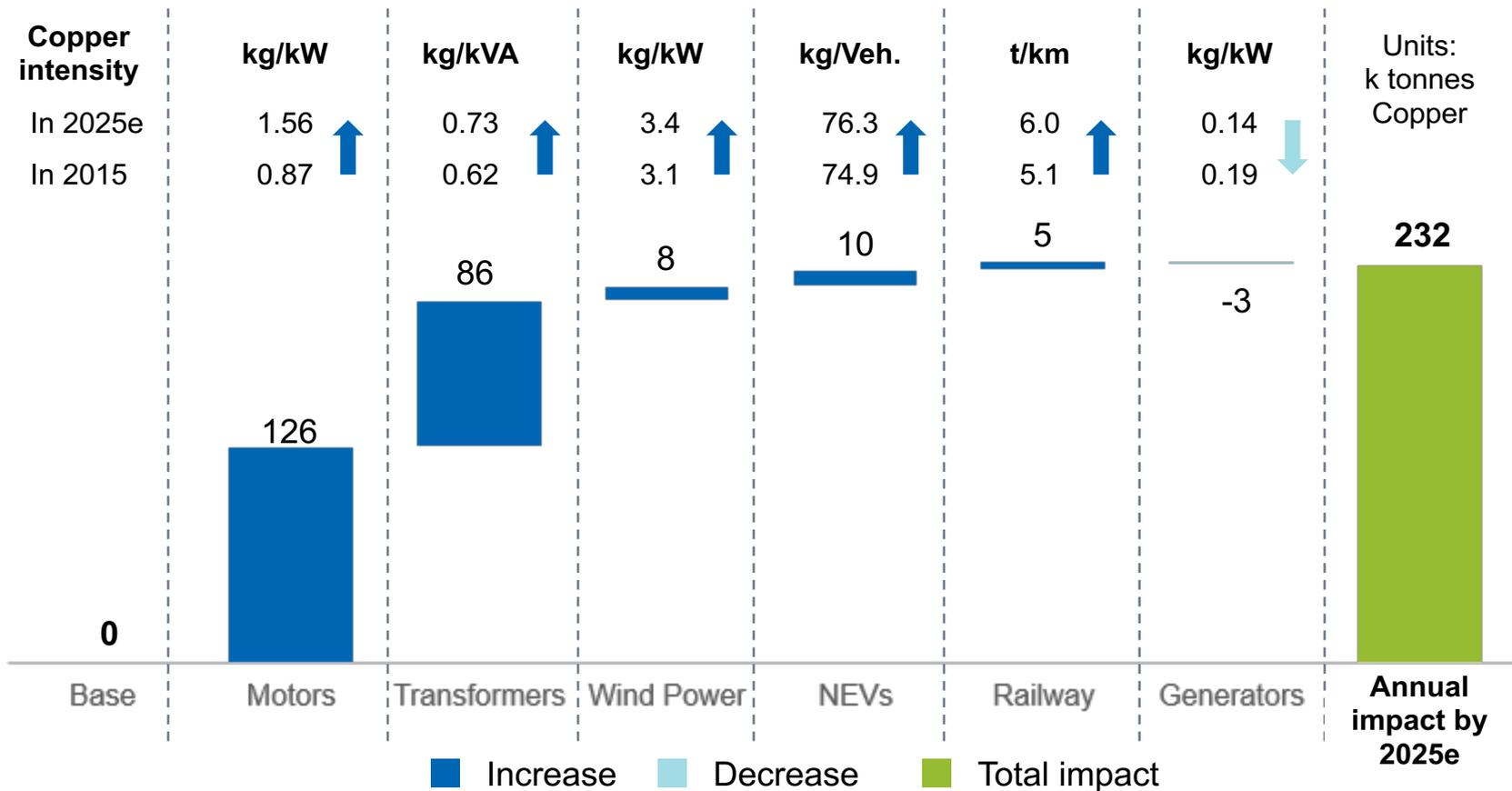


• Drivers from 2015 to 2025e

- Additional double-line railway will be constructed
 - ➔ Increased copper density
- More electrical railway system in the near future
 - ➔ Increased copper density

Forecast

Total copper impact from “Made in China 2025”



Made in China 2025 will lead to an additional 232k tonnes copper usage annually, by 2025.