List of abbreviations

AIST	Association for Iron & Steel Technology
BF	Blast furnace
BOF	Basic oxygen furnace
CC	Continuous casting
DRI	Direct reduced iron
EAF	Electric arc furnace

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Estimated energy intensity in 2019: Iron and steel sector (scrap-EAF route)

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Background and purpose

Background

- ✓ In order to promote early and effective GHG emission reduction, it is necessary to understand the energy intensity and the reduction potential of each region in the world.
- ✓ By using the results of EAF steel presented this time in addition to the estimation results of the energy intensity of the integrated steelworks already presented, it will be possible to calculate the GHG reduction potential of the entire steel industry.
- ✓ There is increasing mention of carbon neutrality, but before that it is important to share such information widely.

Purpose

- ✓ The purpose is to provide comparable energy intensity estimates for the steel sector in 2019 to contribute to the discussion of climate change mitigation.

Analytical framework

- ✓ The energy intensity is measured by the energy consumption (GJ) per 1t of crude steel production.
- ✓ Electricity is converted at a rate of 1MWh = 3.6GJ / 0.333 = 10.8GJ for all regions.
- ✓ Assuming the case of manufacturing ordinary steel products using scrap (the processes in [ ] below are the evaluation targets).

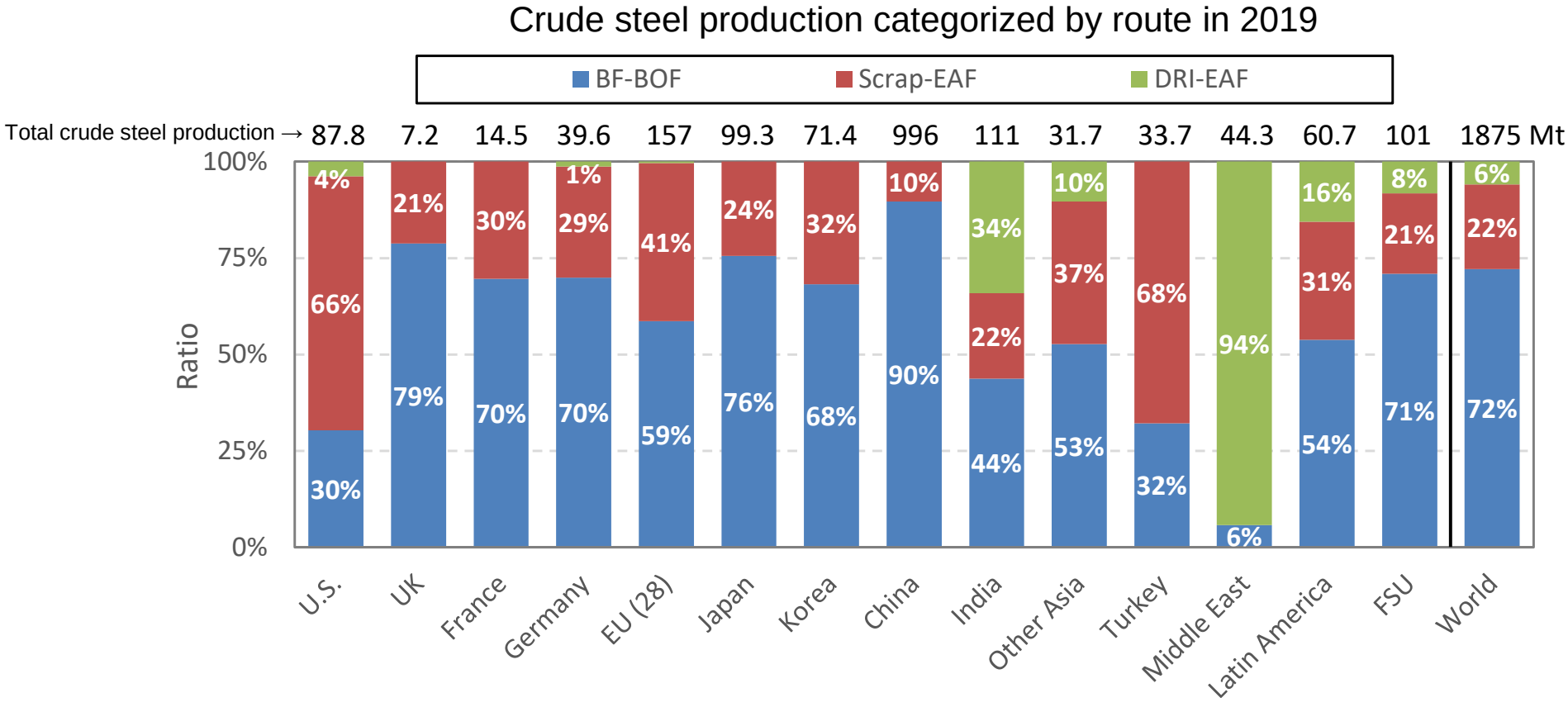
  Scrap gathering, cutting, and compression processes → Transportation of materials to steel plants → [Preheating → EAF → Secondary refining → CC → heat treatment furnace → Hot rolling] → Finishing/final processing → Steel product shipment

- ✓ Energy intensity is estimated by combining the following methods.

	A: Refer to the absolute value of energy intensity	B: Refer to relative change in energy intensity compared to 2015
1. Method based on Association for Iron and Steel Technology (AIST) "2020 EAF Roundup"	Method A1	Method B1
2. Micro-data approach based on individual statistics for each region	Method A2	Method B2
3. Macro-statistics approach based on IEA "World Energy Balances"	Method A3	Method B3
4. Assumed energy intensity given the new capacity is applied to the energy intensity for 2015		Method B4

Consolidation of steel production methods

- ✓ Not only scrap but also DRI and pig iron are widely used as iron sources for EAF.
- ✓ Steel production methods are classified into 1) BF-BOF, 2) scrap-EAF, and 3) DRI-EAF.
- ✓ Scrap-EAF is defined as a process in which 100% of the iron source is scrap, and this analysis focuses on Scrap-EAF.



Note: EU (28) figures, including the UK, are shown for easy comparison with previous results

Ref: Estimation based on worldsteel "Steel Statistical Yearbook 2021 (Extended version)"

AIST “2020 EAF Roundup”

Roundup data is based on information submitted in the third quarter of 2019.

Company and location	No. furnaces	Start-up year	Original furnace manufacturer	Furnace type	Tap-to-tap time (min.)	Avg. heat size (metric tons)	Equipped with			Charge materials (% of charge)		Power (kWh/ metric ton)	Consumptions	
							Sidewall: refractory, panel, spray	Roof: refractory, panel, spray	Oxy-fuel burners	Scrap	Alternative iron		Oxygen (Nm^3/ metric ton)	Natural gas (Nm^3/ metric ton)
Argentina														
Aceros Zapla SA Palpala, Jujuy	2	—	SMS Siemag	—	150	24	—	—	No	—	—	—	—	—

Ref: Excerpts from AIST's public version sample, etc.

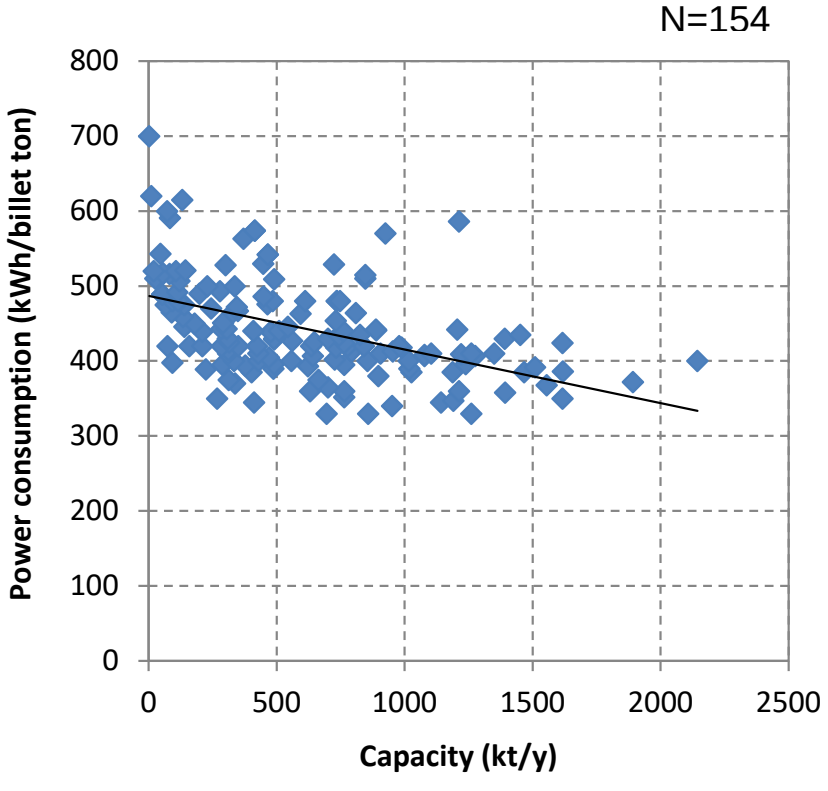
- ✓ This AIST table is based on EAF data reported by AIST participating companies.
- ✓ Production capacity, iron source ratio, power intensity (kWh/t), natural gas intensity (Nm^3/t), etc. are listed for each EAF.
- ✓ However, there are some N/A terms marked with "-" in the table.

Coverage of AIST “2020 EAF Roundup”

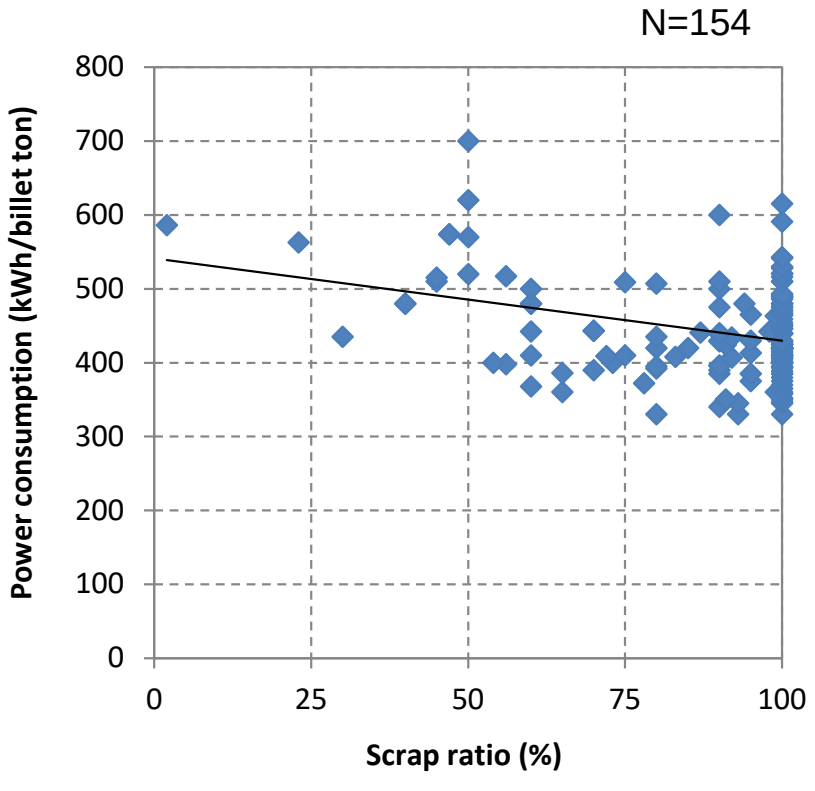
	Number of EAFs listed in AIST	Coverage of AIST “2020 EAF Roundup”	N/A term ratio
Canada	19	100%	10%
U.S.	131	100%	20%
Mexico	17	75%	25%
Brazil	12	44%	5%
Colombia	7	100%	15%
Ecuador	3	100%	75%
Peru	2	46%	30%
Chile	3	100%	0%
Argentina	8	100%	31%
Uruguay	1	100%	0%
Germany	1	10%	0%
Italy	11	57%	5%
Australia	3	100%	0%
AIST total	218	78%	18%

Complementing data in AIST “2020 EAF Roundup”

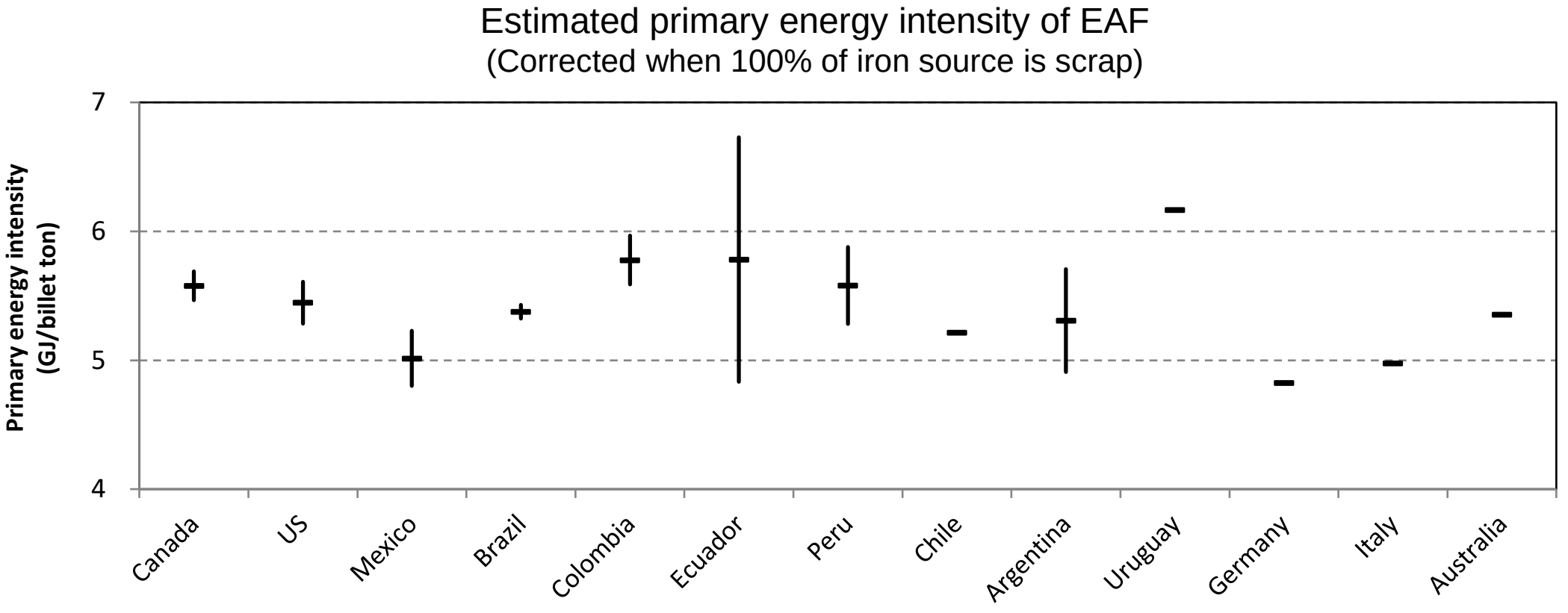
Relationship between capacity and power consumption intensity



Relationship between scrap ratio and power consumption intensity



Results based on AIST “2020 EAF Roundup”



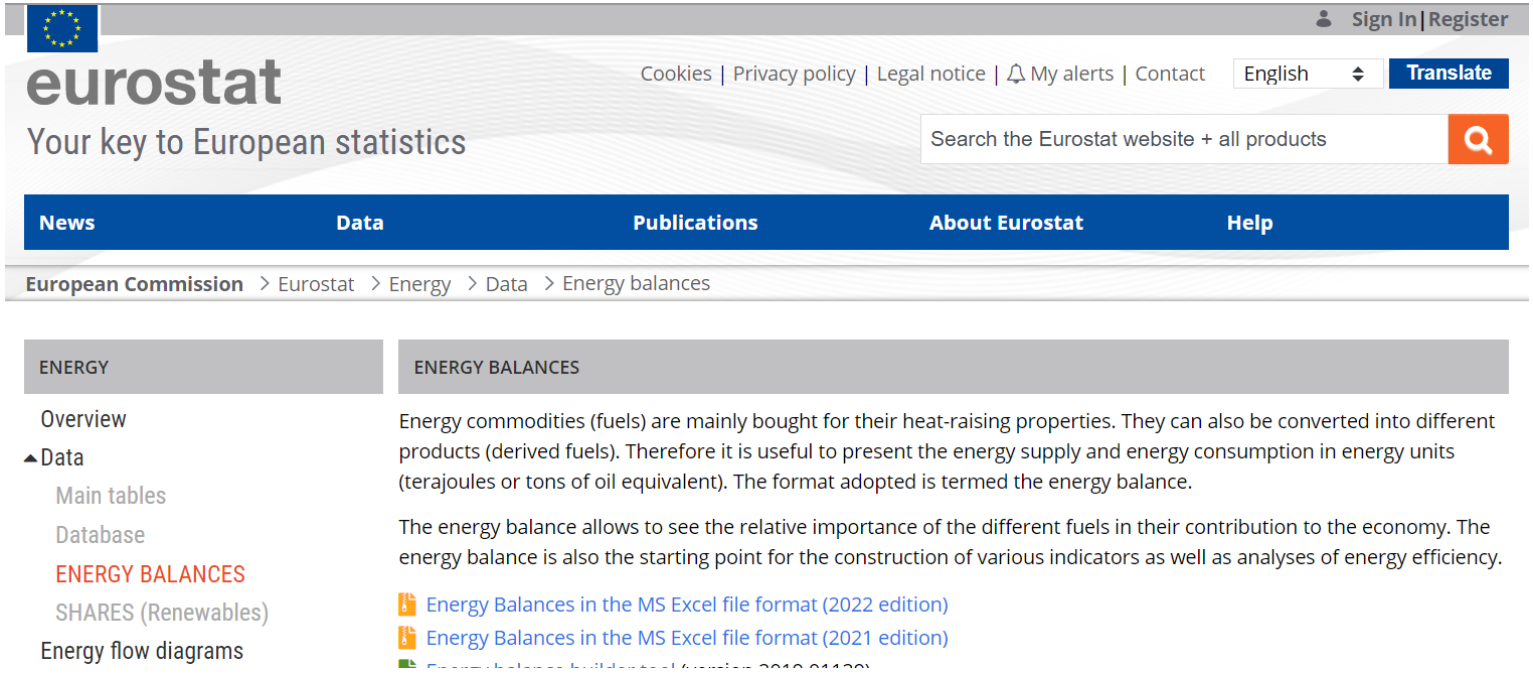
- ✓ The energy consumption in the above figure covers only EAF.
- ✓ By adding 2.96 GJ/t to the upper end of the above figure, the boundary becomes consistent and can be compared with other estimated values.
- ✓ 2.96 GJ/t is an estimated value of energy consumption for secondary refining, continuous casting, heat treatment furnace, hot rolling equipment, etc.

Micro-data approach based on individual statistics

Europe

- ✓ Energy intensity of European countries was estimated with reference to Eurostat Energy Balances (2022 edition) in the figure below.
- ✓ For example, the following estimates for Germany were obtained: A2: 8.4 GJ/t, B2: 8.6 GJ/t.

https://ec.europa.eu/eurostat/web/energy/data/energy-balances

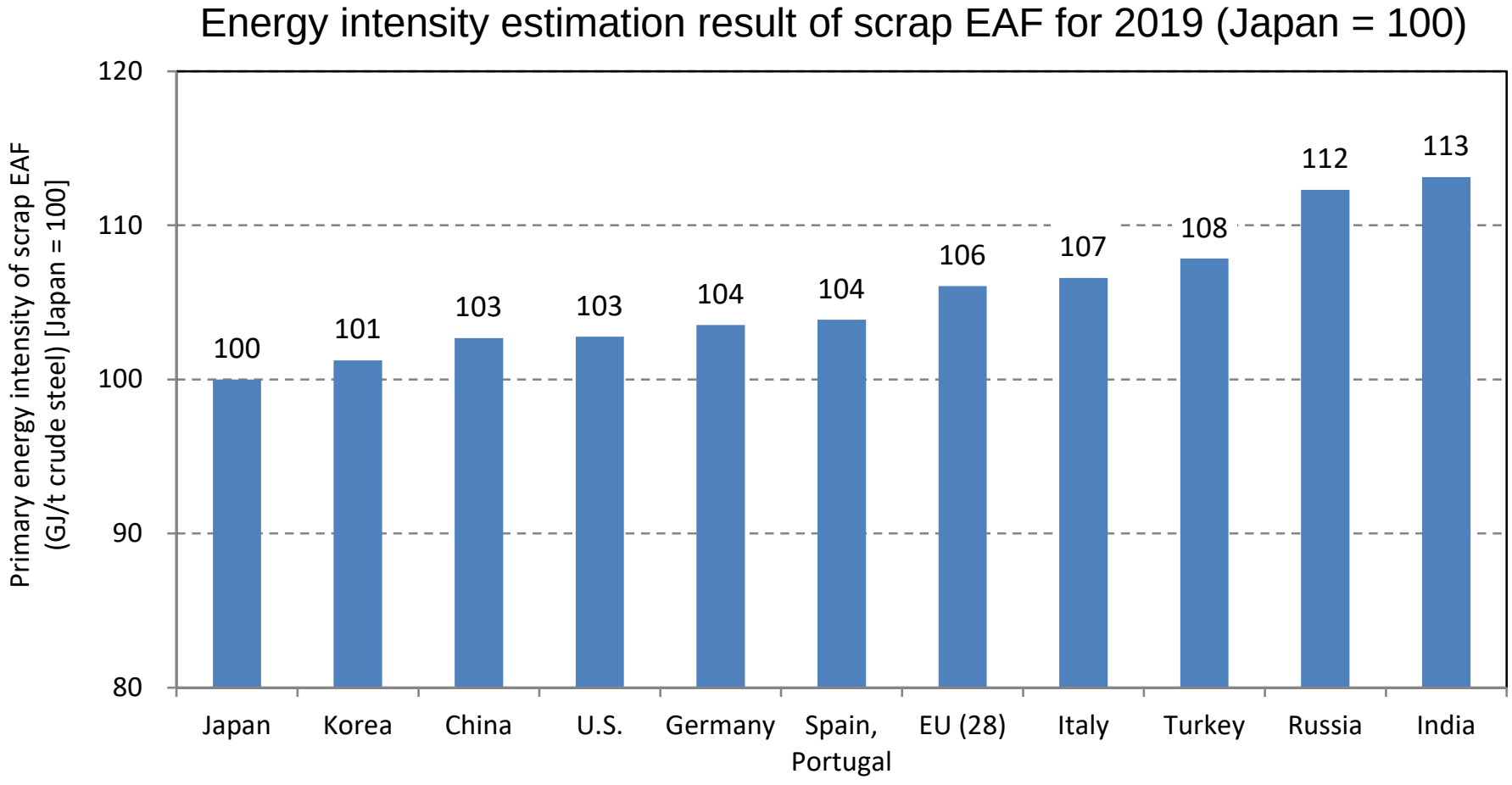


Japan

- ✓ Japanese energy intensity was estimated based on “General Energy Statistics.”

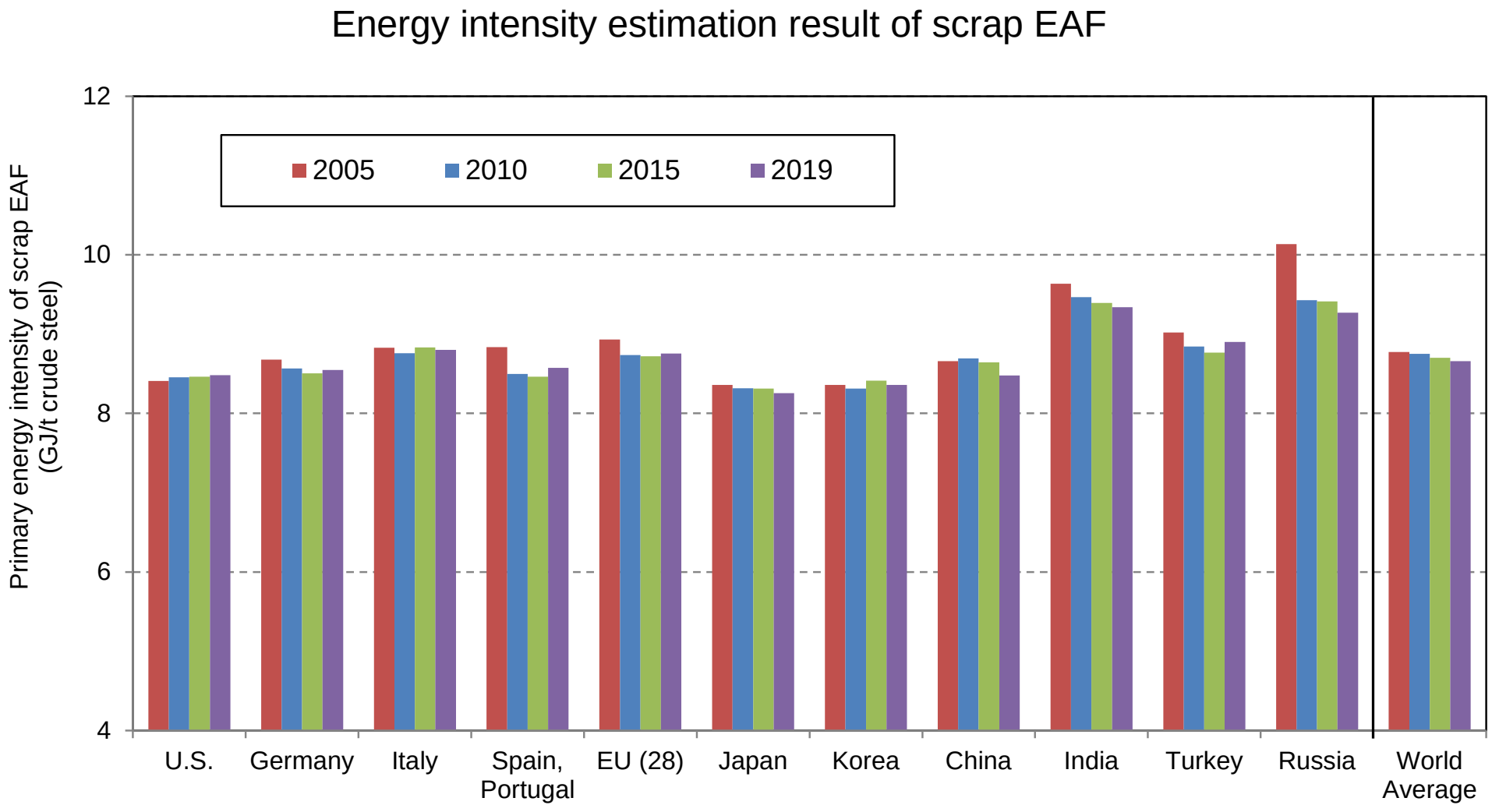
Estimated results for 2019 (Japan = 100)

- ✓ The following final estimation results were calculated by weighted averaging the estimated values obtained by methods A1 to B4.



Note: EU (28) figures including the UK are shown for comparison with existing results.

Estimated results for 2005-2019



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