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Analysis of Energy Intensity of Basic Materials Industry in Japan

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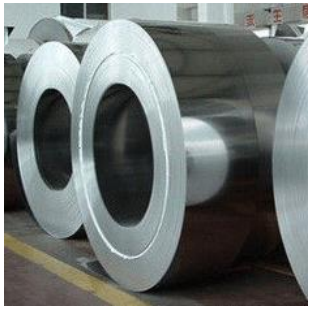
Contents

*1) http://japanese.galvanized-steelcoils.com/sale-5372291-astm-a1008-din16723-en10130-cold-rolled-steel-plate-sheet-for-oil-drum.html
*2) http://www.jcassoc.or.jp/
*3) https://www.metelec.co.uk/



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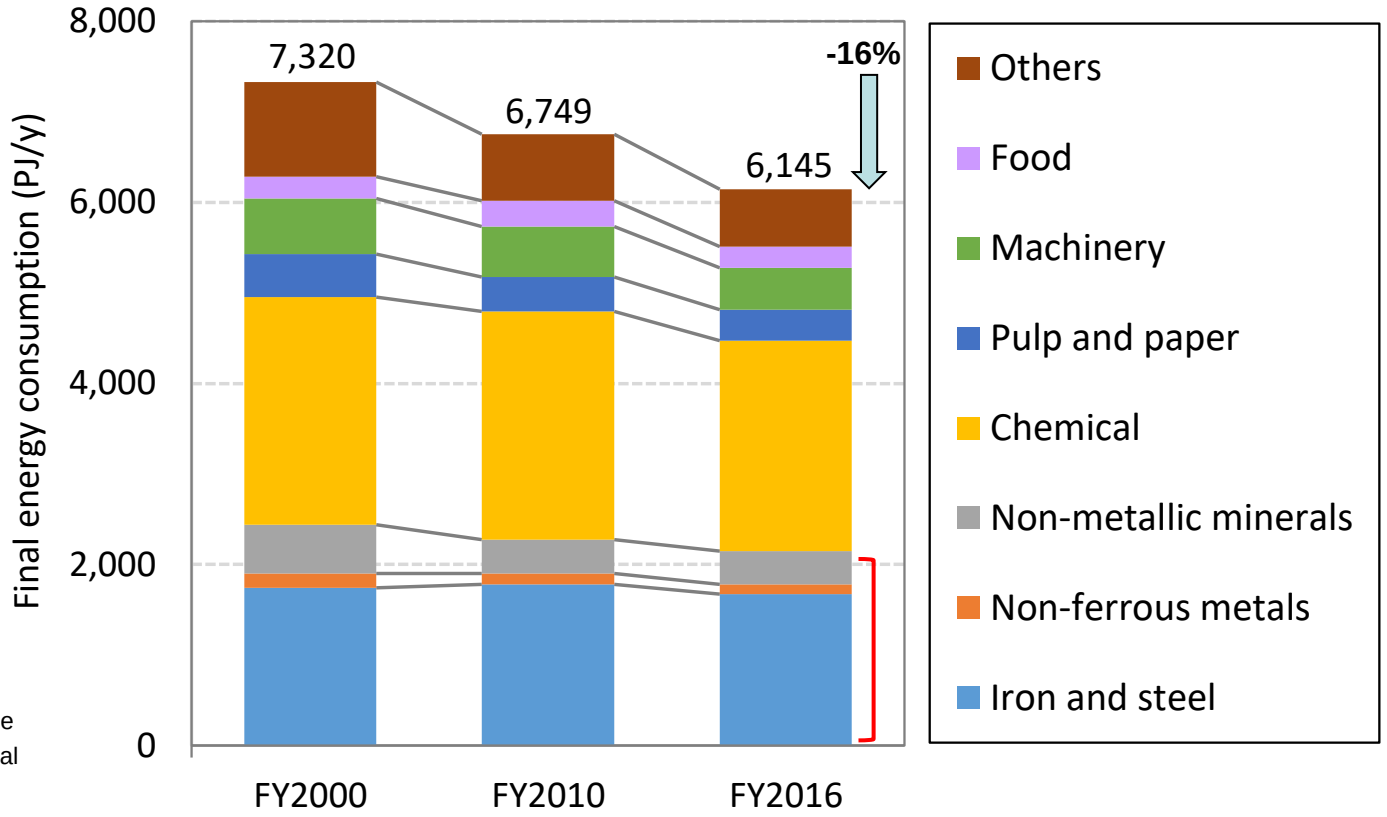
1. Introduction(1/2): background

- ✓ Energy consumption of Japanese industrial sector was decreasing
  - ➢ Factor 1 : improvement of energy intensity?
  - ➢ Factor 2 : decrease of production activity?

Final energy consumption of Japanese industrial sector



Ref) Ministry of Economy, Trade and Industry (METI). General Energy Statistics 2017.

1. Introduction(2/2): research question

✓ To fill in the tables' blanks and obtain an implication for climate mitigation policy

Profile of **primary** energy and production from 2000 to 2016

	Primary energy consumption	Primary energy intensity	Production
Iron and steel			Crude steel production: 106 ⟶105 Mt (-1.6%)
Cement			Cement production: 83 ⟶ 59 Mt (-29%)

Profile of final energy and production from 2010 to 2016

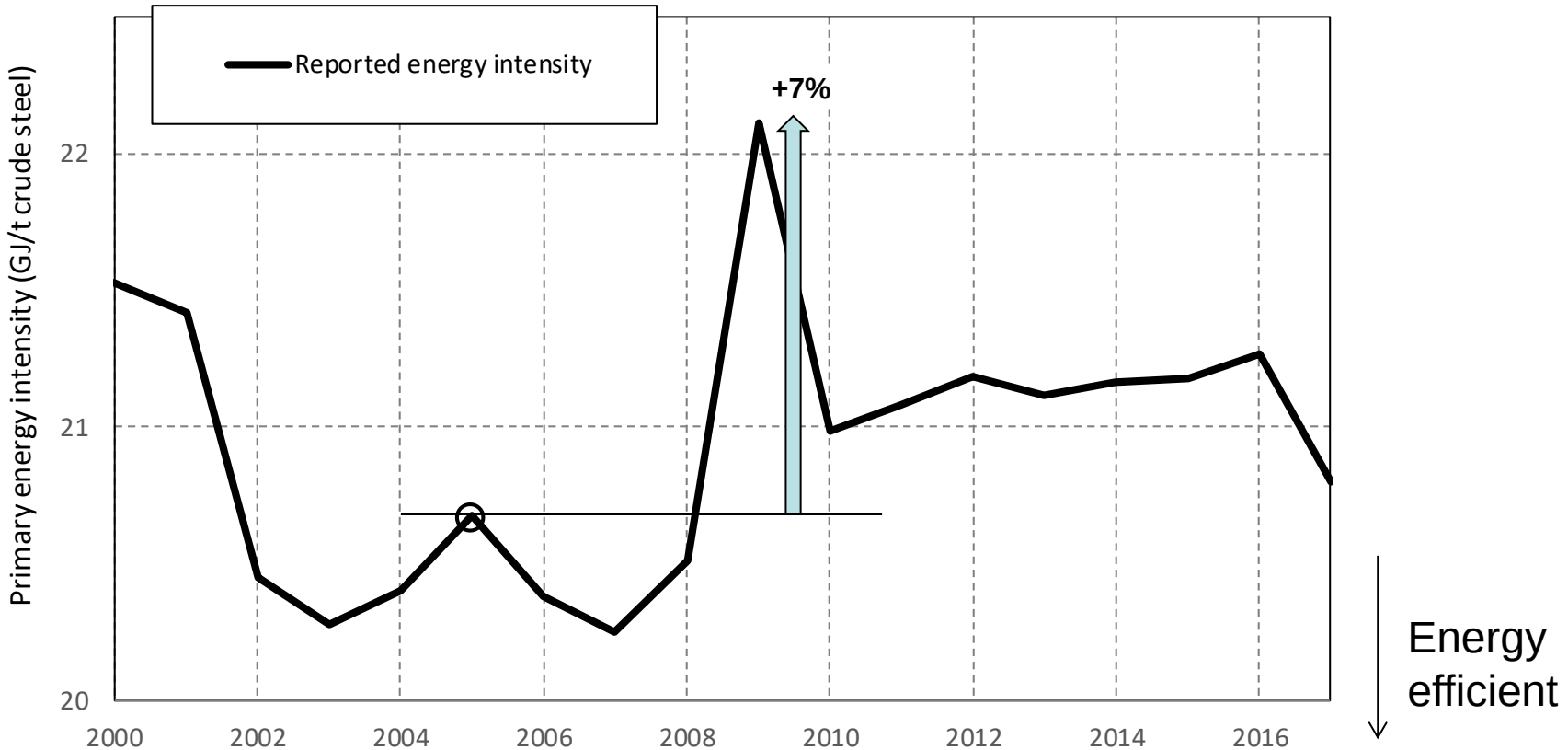
	Final energy consumption	Final energy intensity *index*	Production *index*
Non-ferrous metals	116 ⟶ 106PJ (-9%)		

2.1 Iron and steel sector

- ✓ We estimated (net) primary energy intensity (GJ/t crude steel) in the Japanese steel sector based on METI (2017a,b,c)

Ministry of Economy, Trade and Industry (METI), 2017a. General Energy Statistics 2017.
METI, 2017b. Monthly Report of the Current Survey of Energy Consumption: Total-C.Y.2017.
METI, 2017c. Yearbook of current production statistics 2017.

Primary energy intensity (GJ/t crude steel)



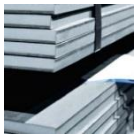
2.2 Decomposition of energy intensity: iron and steel sector

✓ Investigated factor:

x1_Hot metal ratio

≈ Pig iron ratio, Non-scrap ratio
Primary steel ratio,
Blast furnace ratio, Non-EAF ratio

x2_Product mix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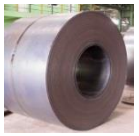
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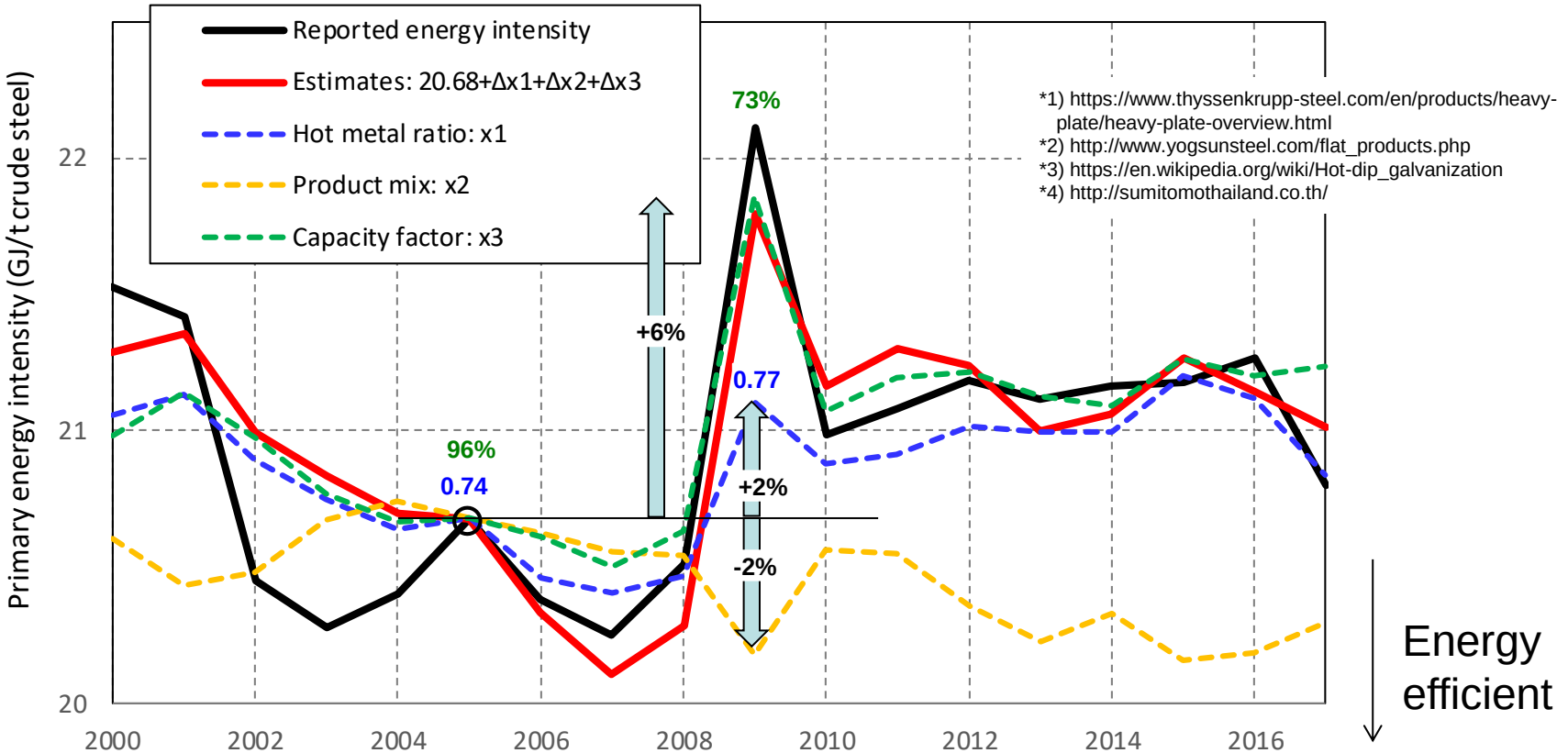
x3_Capacity factor

= Utilization rate,
Production/capacity

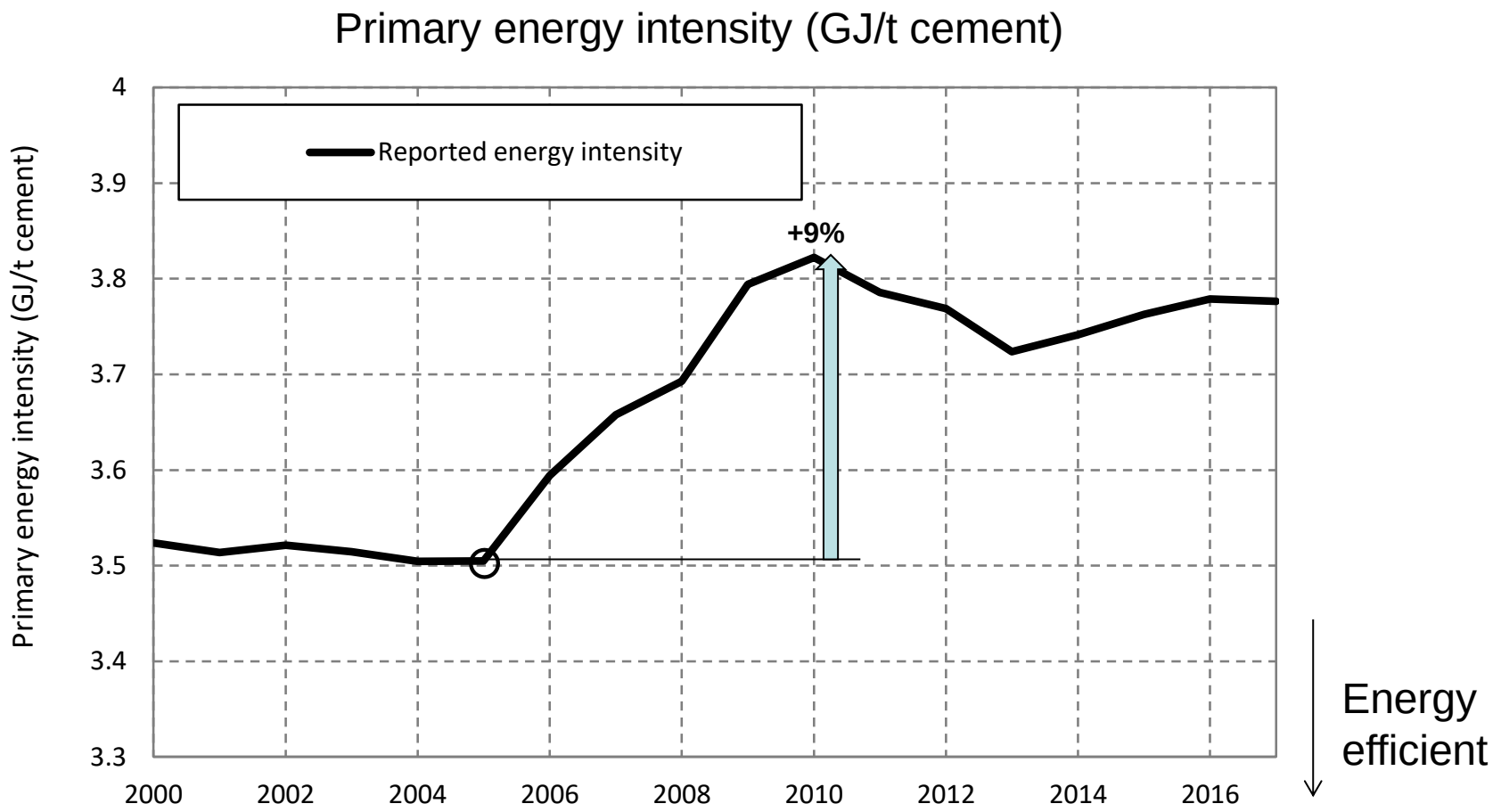
Primary energy intensity and its determinants



3.1 Cement sector

- ✓ We estimated (net) primary energy intensity (GJ/t cement) in the Japanese cement sector based on METI (2017a,b,c)

Ministry of Economy, Trade and Industry (METI), 2017a. General Energy Statistics 2017.
METI, 2017b. Monthly Report of the Current Survey of Energy Consumption: Total-C.Y.2017.
METI, 2017c. Yearbook of current production statistics 2017.



3.2 Decomposition of energy intensity: cement sector

*2

✓ Investigated factor:

y1_Clinker to cement ratio

=  / 

*1

y2_Waste and by-products

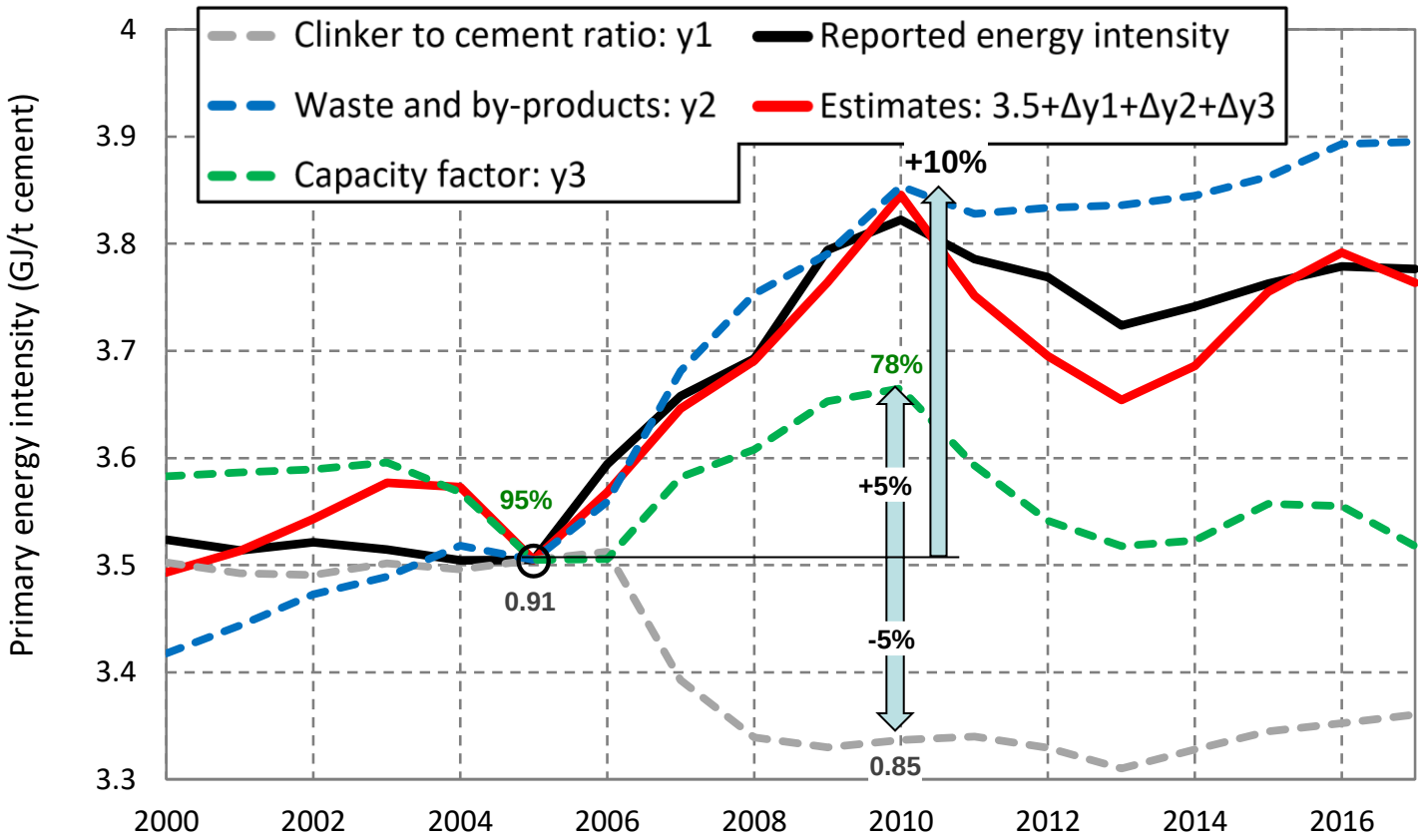
$$= \frac{\text{Input of sewage sludge and industrial sludge}}{\text{Cement production}}$$

x3_Capacity factor

= Utilization rate, Production/capacity

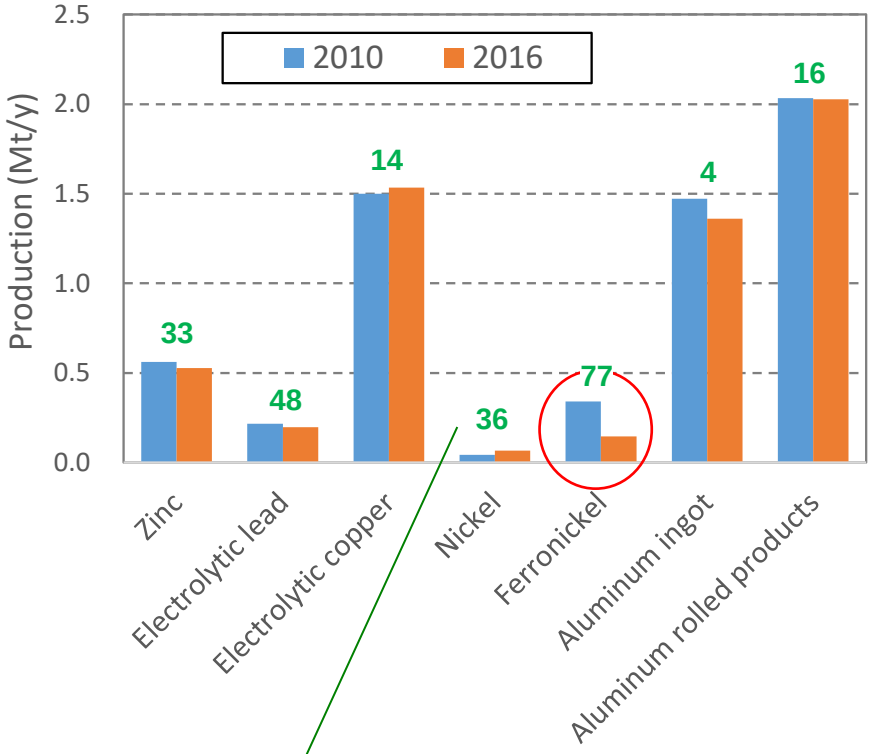
*1) http://www.jcassoc.or.jp/
*2) https://www.nikkei.com/article/DGXNASDD290PI_R00C12A3M10900/

Primary energy intensity and its determinants

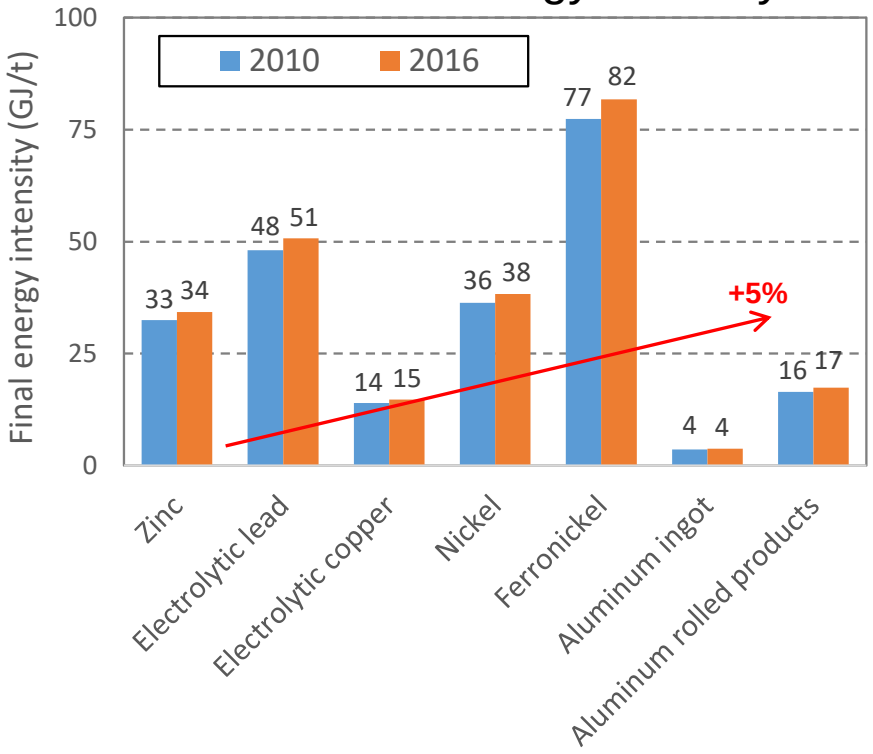


4. Non-ferrous metals sector

1. Production



Results of energy intensity



2. Assumption of relative energy intensity

3. Total energy consumption
116PJ ⟶ 106PJ

- ✓ Energy intensity *index*: 100 ⟶ 105
  - ➢ Capacity factor: 100 ⟶ 86
  - ➢ Grade of copper concentrate: 28.1% ⟶ 27.2%
- ✓ Production *index*: 100 ⟶ 86

5. Summary(1/2)

- ✓ We empirically investigated energy intensity and its determinants of steel, cement, and non-ferrous metals sectors in Japan

2000 ⟶ 2016	Primary energy consumption	Primary energy intensity	Production
Iron and steel			Crude steel production: 106 ⟶105 Mt (-1.6%)
Cement			Cement production: 83 ⟶ 59 Mt (-29%)

2010 ⟶ 2016	Final energy consumption	Final energy intensity *index*	Production *index*
Non-ferrous metals	116 ⟶ 106PJ (-9%)		

5. Summary(1/2)

- ✓ We empirically investigated energy intensity and its determinants of steel, cement, and non-ferrous metals sectors in Japan
- ✓ Only in the steel sector energy intensity has been improved, all three sectors' production activity levels were decreasing

2000 → 2016	Primary energy consumption	Primary energy intensity	Production
Iron and steel	2290 → 2230PJ (-2.8%)	21.5 → 21.3GJ/tcs (-1.2%)	Crude steel production: 106 → 105 Mt (-1.6%)
Cement	294 → 223PJ (-24%)	3.52 → 3.78GJ/t cement (+7%)	Cement production: 83 → 59 Mt (-29%)

2010 → 2016	Final energy consumption	Final energy intensity *index*	Production *index*
Non-ferrous metals	116 → 106PJ (-9%)	100 → 105 (+5%)	100 → 86 (-14%)

5. Summary(1/2)

- ✓ We empirically investigated energy intensity and its determinants of steel, cement, and non-ferrous metals sectors in Japan
- ✓ Only in the steel sector energy intensity has been improved, all three sectors' production activity levels were decreasing
- ✓ Dominant factor of energy consumption decline was production decline *not energy intensity improvement*

Rate of change

	Energy consumption	Energy intensity	Production
Iron and steel (from 2000 to 2016)	-2.8%	-1.2%	-1.6%
Cement (from 2000 to 2016)	-24%	+7%	-29%
Non-ferrous metals (from 2010 to 2016)	-9%	+5%	-14%

5. Summary(2/2)

Decomposition analysis of energy intensity suggests:

- ✓ Key factor of energy intensity transition:
  - ➢ Iron and steel ← capacity factor(CF), hot metal ratio, and product mix
  - ➢ Cement ← waste (sludge) input, CF, and clinker to cement ratio
  - ➢ Non-ferrous metals ← CF, grade of raw material input
- ✓ Not only internal efforts, e.g., investment on energy saving tech., but also external factors affected the consequence of energy intensity transition

Rate of change

	Energy consumption	Energy intensity	Production
Iron and steel (from 2000 to 2016)	-2.8%	-1.2%	-1.6%
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Non-ferrous metals (from 2010 to 2016)	-9%	+5%	-14%

Final energy v.s. electricity

Japanese industrial sector