North Easter Asian Countries and Steel Market ;

China, Japan, Korea, and Taiwan

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Ph. D. Applied Economics, 1987 - 1993, University of Minnesota, (U.S.A), Minneapolis/St. Paul, MN
Major in Environmental Economics, Minor in Forest Resource Economics
Emphases: Environmental and Resource Economics, Climate Change Economics, Enviornmental Policy

<Research Papers>

- *Transboundary Pollution Issues Among the East Asian Countries (1999),*
- *Climate Change and Business Competitiveness in Korea (2001, 2005, 2007),*
- *Economic Effect of Emission Trading and Carbon Tax(2005),*
- *Sustainable Banking and Finance (2006).*
- *Sustainable Economy and Society (2011)*
- *Green job (2011), Green Growth 1.0 (2013)*, Water and Climate Change(2014)
- Water and Human Right, Energy Efficiency (2015)

Presentation Outline

I. World Steel Market

II. Chinese Steel Industry

III. Korean Steel Industry

IV. Japanese Steel Industry

V. Taiwanese Steel Industry

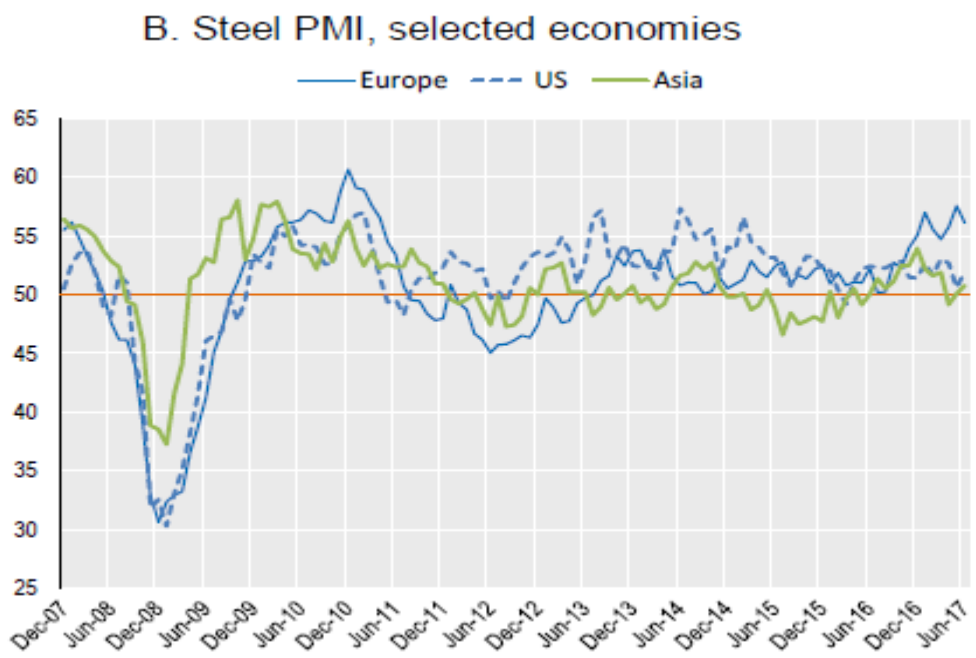
- VI. Strategies for Climate Change in Steel Industry

References

1. Developments in the World Steel Markets

- Steel market sentiment has improved since 2016, potentially pushed higher by the increase of steel prices, modest improvements in steel demand and expectations about capacity reductions.
- However, the improvement could prove temporary given the extent of the unaddressed underlying structural imbalances coupled with sluggish demand growth in the years to come.

Steel Purchasing Managers' indices(PMIs)

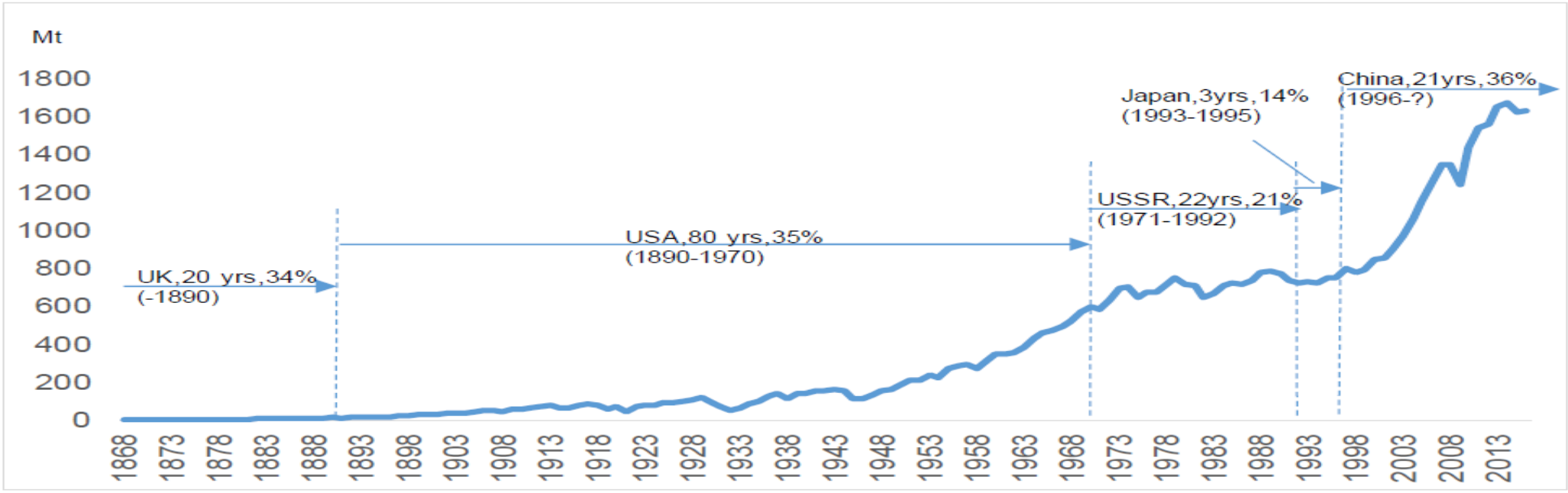


Source: Markit Economics(2017)

Global Steel Industry

- **The industry is facing the next big change:**
  strong players becoming stronger, emerging players, disruptors,
  declining of some established players, steel production to concentrate in one region

Global Crude Steel Production and No.1 Producer's Share



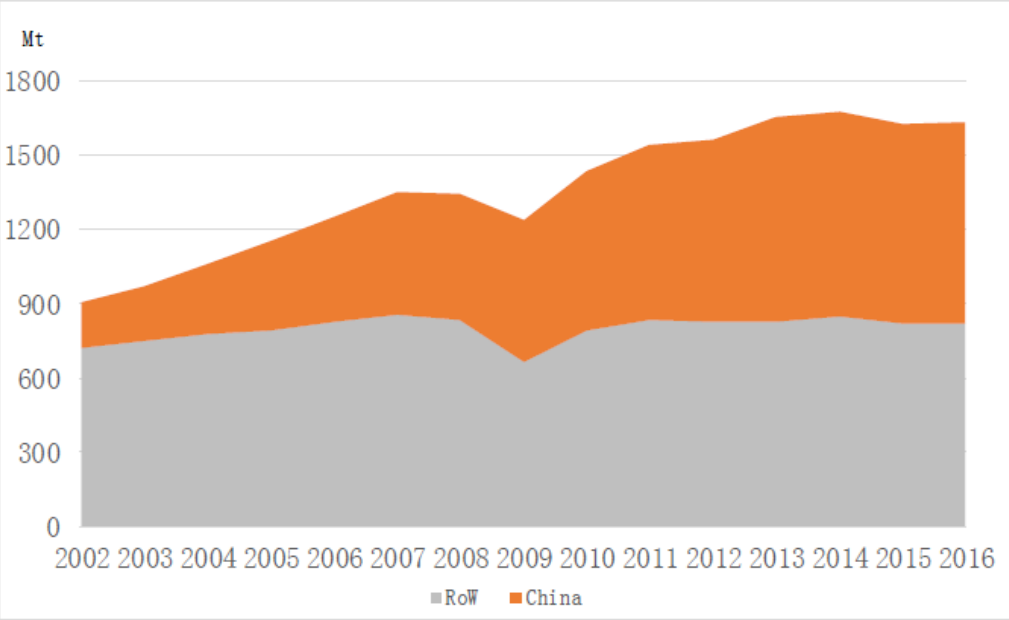
Source : worldsteel(2018)

Global steel industry

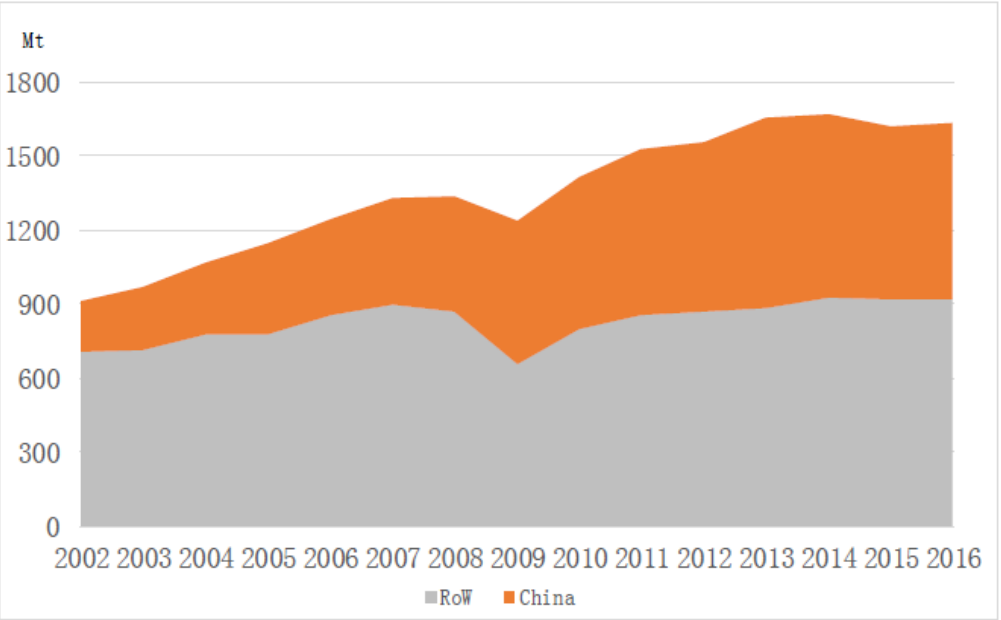
China plays a core role in global steel industry

- Steel production and consumption in RoW grew by only 14% and 30% in the past 15 years, while China's jumped by 3.4 times and 2.4 times, respectively
- China accounts for 86% of the world's increase in steel production and 70% in consumption

Crude Steel Production: China vs RoW



Apparent Steel Consumption: China vs RoW



Source : worldsteel(2018)

World Steel production

- Crude steel production increased by 4.5% in Asia during the first half of 2017 (y-o-y terms)
- Steel production growing 3.7% in South Korea, and 7.7% in Chinese Taipei.

World crude steel production developments in 2016 and 2017

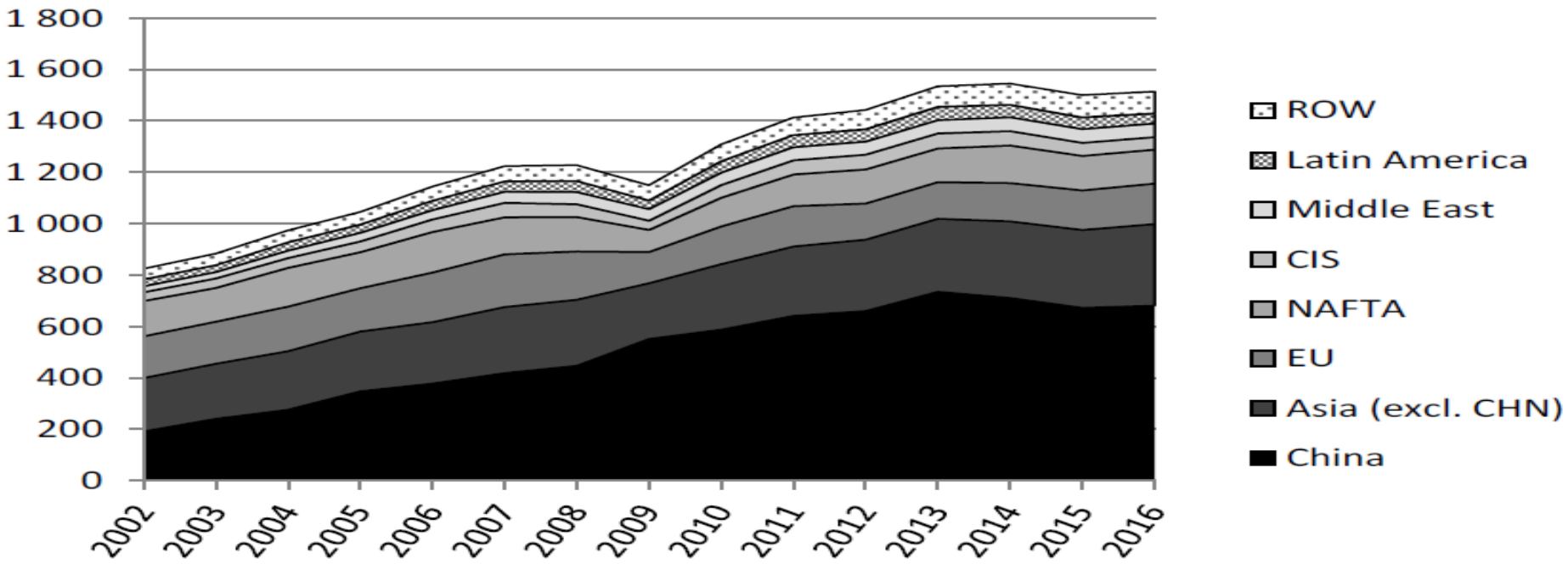
	Level, thousand mmt		% change, year-on-year		% change, year-on-year
	June 2017	**2016**	**June 2017**	**2016**	**Jan-Jun 2017 / 2016**
EU	14 237	162 145	2.8	-2.4	3.9
Other Europe	3 236	35 919	4.4	5.6	11.5
CIS	7 639	102 230	-8.0	0.8	-2.5
North America	9 662	110 624	0.2	-0.3	2.9
South America	3 412	40 220	3.4	-8.4	10.6
Africa	1 051	12 189	5.5	-4.7	11.0
Middle East	2 662	29 025	9.4	7.6	9.4
Asia, of which:	98 892	1110 865	4.7	1.9	4.5
China	73 231	807 612	5.7	1.1	4.2
Oceania	504	5 837	-13.2	2.1	5.0
World	141 294	1609 053	3.4	1.0	4.3

Source: Worldsteel(2017)

World Steel consumption

- After the decline in global steel consumption during 2015, demand for steel products around the world has recovered in 2016 to 1515 mmt.
- Increase : China (1% growth rate), India (4.1%), the European Union (2.2%), ASEAN economies (11.4%).
- Decrease : Latin America (13.6%), CIS (4.1%), NAFTA (1.6%), Middle East (1.3%), Africa (2.1%).

Apparent steel use(finished steel products)

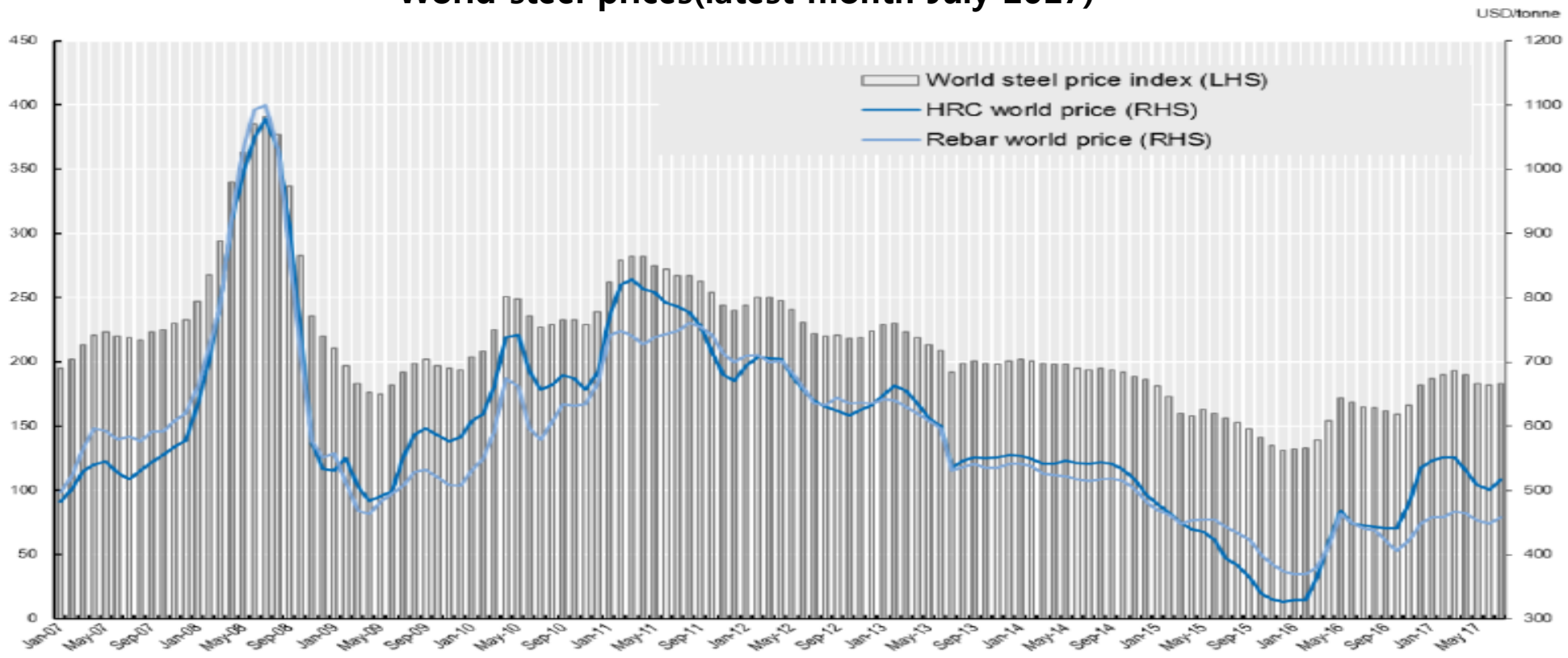


Source: Worldsteel(2017)

World Steel prices

- The modest uptake in steel demand during 2016 has seen prices respond rapidly, even in a context of ample supply.
- The world steel price index, which had been trending downwards since the second quarter of 2011, reached a floor during December 2015, and seems to be climbing back, standing now around its 2014 levels.

World steel prices(latest month July 2017)

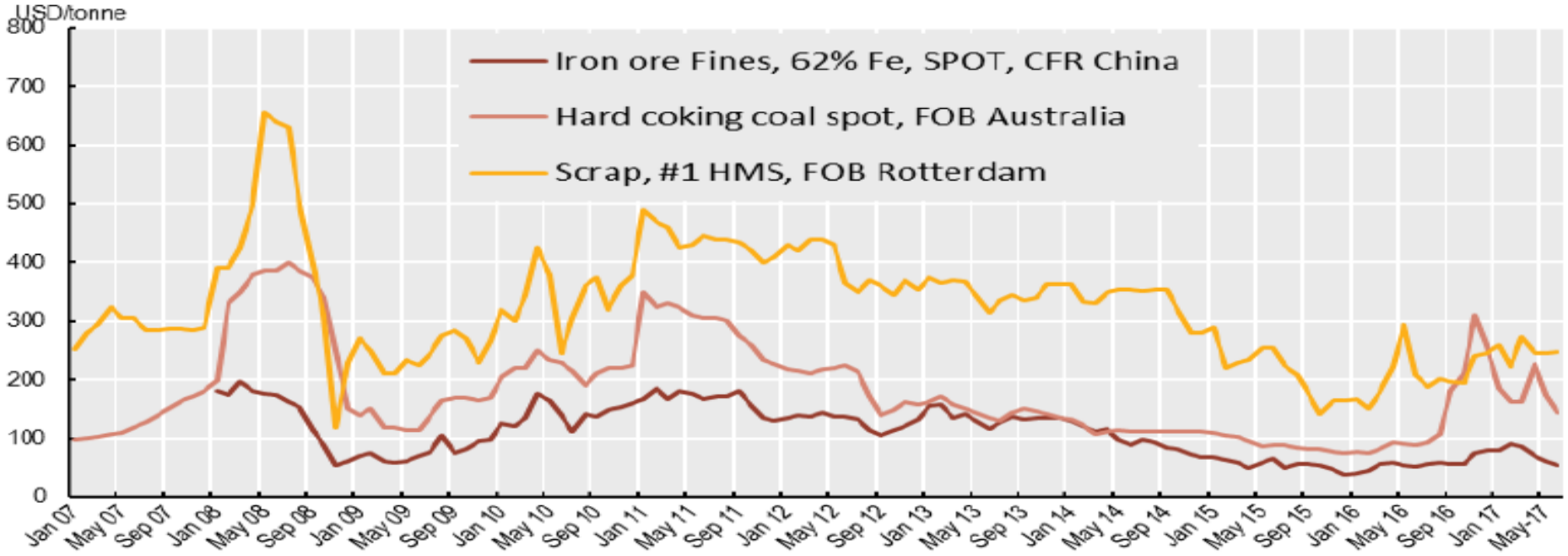


Source: Platts Steel Business Brefing

World raw material prices

- Prices of key steelmaking raw materials have declined over the past several years, helping to bring steel production costs down significantly. (Selected prices for iron ore, coking coal and scrap)
- Those prices reached record lows in the beginning of 2016, and have since recovered some ground, albeit in what seems a rather volatile and unpredictable manner.

Key raw material price indicators

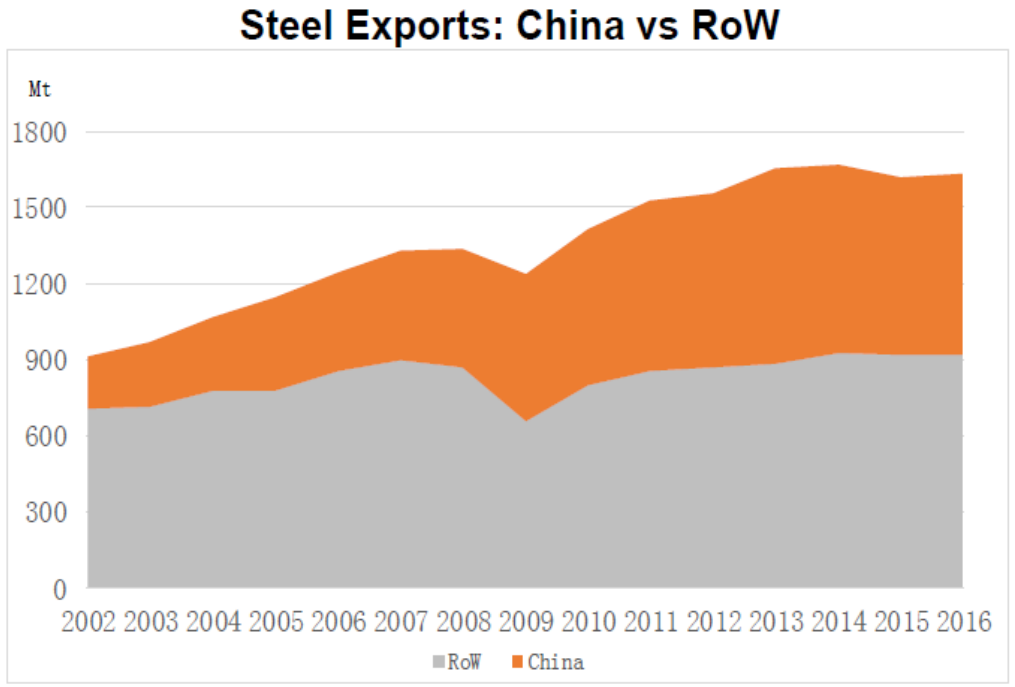


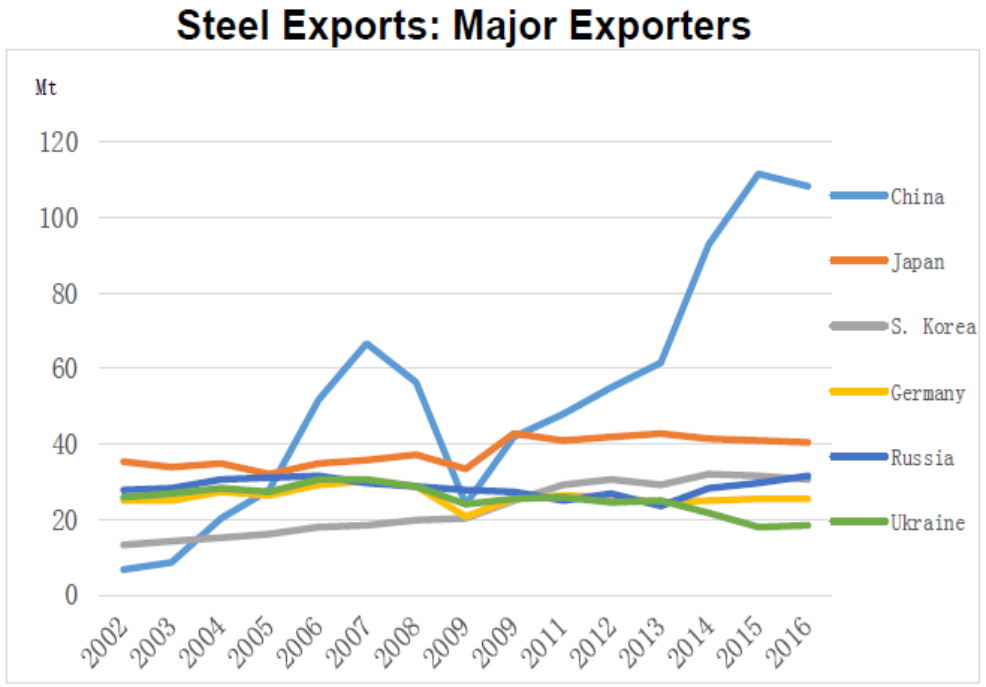
Source: Platts Steel Business Brefing

Global steel trade

China is a key player in global steel trade

- Steel exports from RoW grew by only 17% or 53.8 Mt in the past 15 years, while China's jumped by 15.3 times of 101 Mt
- China contributed 65% of the increase in the world's steel exports



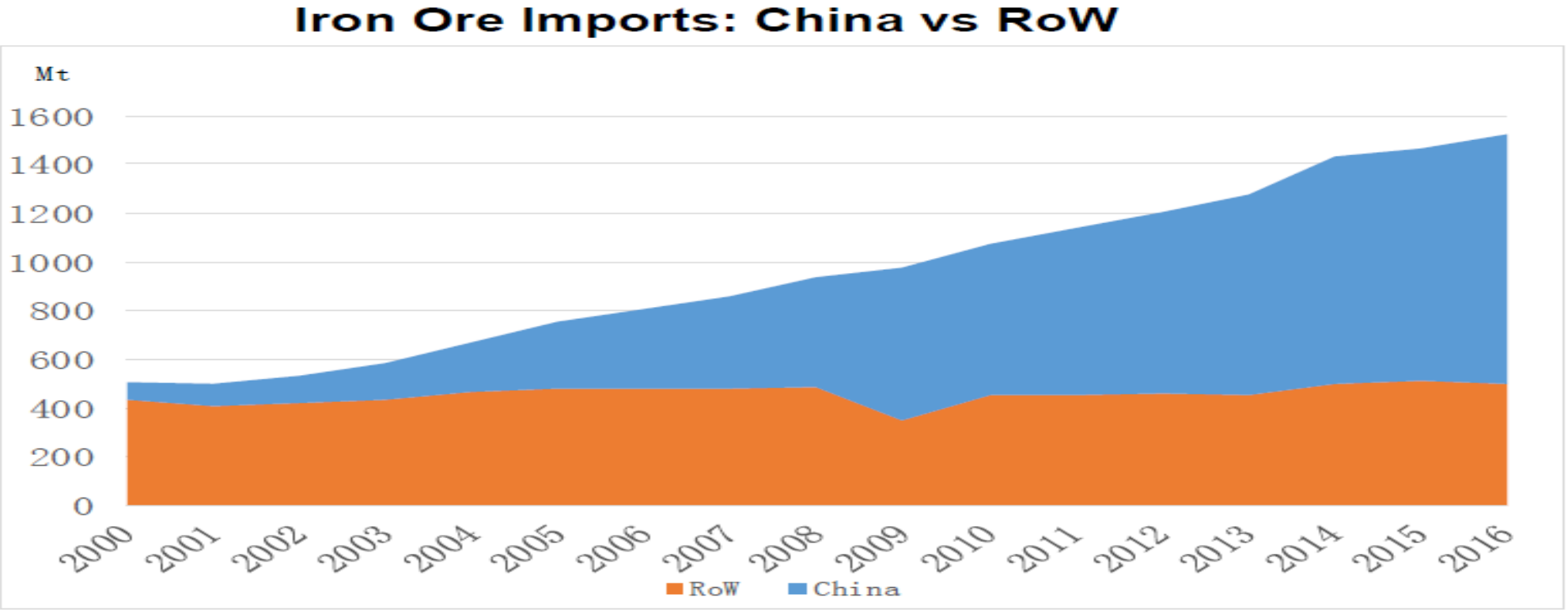


Source : worldsteel(2018)

Global steel trade

China is the only driver in global iron ore market

- Global iron ore trade increased by 1020 Mt in the past 15 years, of which 94% or 950 Mt from China, while RoW's iron ore imports grew by only 15% or 65 Mt
- More than 95% of China's new steel capacities are BF-BOF route

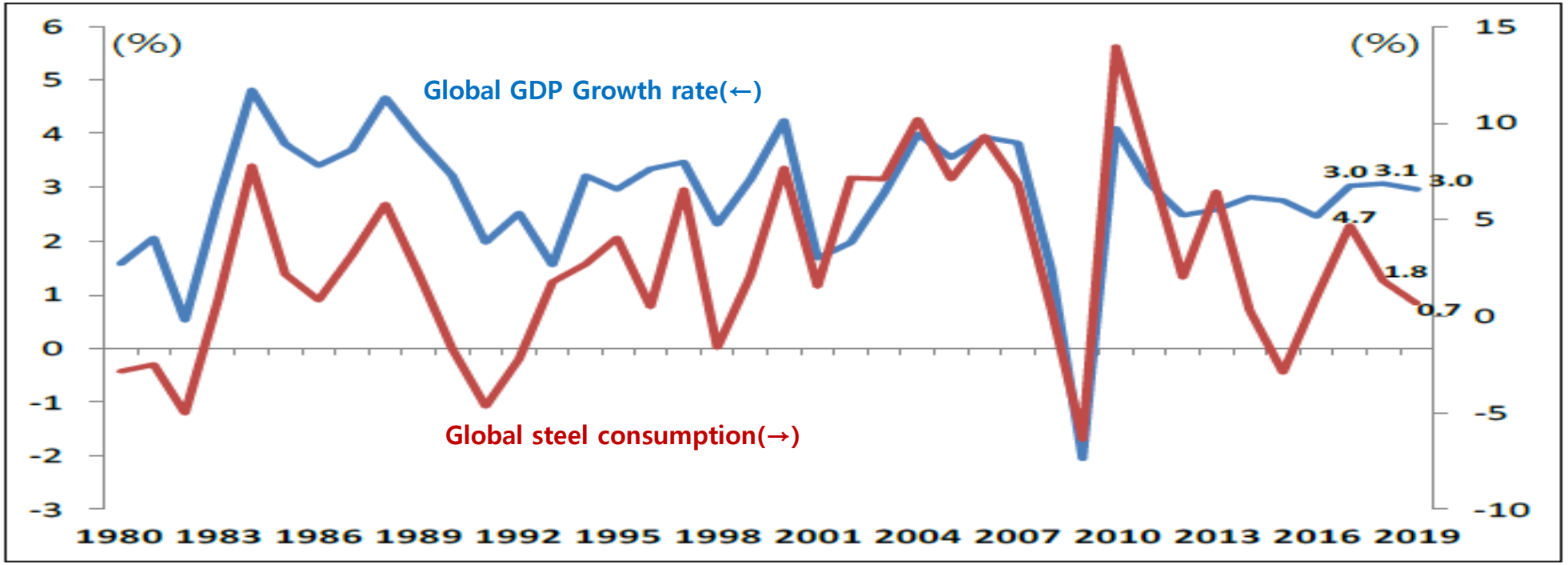


Source : worldsteel(2018)

The steel market outlook

- World steel demand recorded a high growth rate of 4.7% in 2017, but it is expected that the growth rate will decline by 1.8% and 0.7% respectively in 2018 ~ 2019.

Global GDP and steel consumption growth rate and prospect(1980~2019)



Source: IMF(2017), Worldsteel(2017)

2018~2019 Global steel demand prospect

(million tonnes, %)

	2016		2017		2018f		2019f	
North America	132.3	(△1.5)	140.7	(6.4)	145.0	(3.)	147.3	(1.6)
US	91.9	(△4.4)	97.7	(6.4)	100.3	(2.7)	102.3	(2.0)
Latin America	39.4	(△13.4)	40.9	(3.8)	43.5	(6.2)	45.6	(4.9)
Brazil	18.2	(△14.4)	19.2	(5.3)	20.4	(6.3)	21.6	(6.2)
EU28	158.4	(2.9)	162.3	(2.5)	165.6	(2.0)	166.9	(0.8)
other Europe	40.6	(1.7)	42.3	(4.1)	44.2	(4.5)	46.1	(4.4)
CIS	49.7	(△2.2)	52.8	(6.1)	54.0	(2.3)	55.0	(1.8)
Russia	38.6	(△3.0)	40.6	(5.1)	41.5	(2.1)	42.1	(1.4)
Middle east	53.1	(△1.4)	53.3	(0.4)	55.7	(4.6)	57.8	(3.7)
Africa	37.6	(△2.8)	35.1	(△6.8)	36.6	(4.5)	38.3	(4.6)
Asia	998.0	(2.2)	1,053.6	(5.6)	1,065.1	(1.1)	1,063.1	(△0.2)
China	680.3	(1.2)	736.8	(8.3)	736.8	(0.0)	722.1	(△2.0)
India	83.6	(4.3)	87.2	(4.3)	92.0	(5.5)	97.5	(6.0)
Japan	62.2	(△1.2)	64.4	(3.7)	64.5	(0.1)	64.9	(0.6)
Korea	57.1	(2.3)	56.4	(△1.2)	57.0	(1.0)	57.5	(1.0)
ASEANS	74.1	(13.9)	70.3	(△5.2)	74.9	(6.6)	79.8	(6.4)
Oceania	6.8	(△6.3)	6.4	(△5.8)	6.4	(△0.8)	6.6	(4.4)
World	1,516.0	(1.0)	1,587.4	(4.7)	1,616.1	(1.8)	1,626.7	(0.7)
except China	835.7	(0.9)	850.6	(1.8)	879.3	(3.4)	904.6	(2.9)

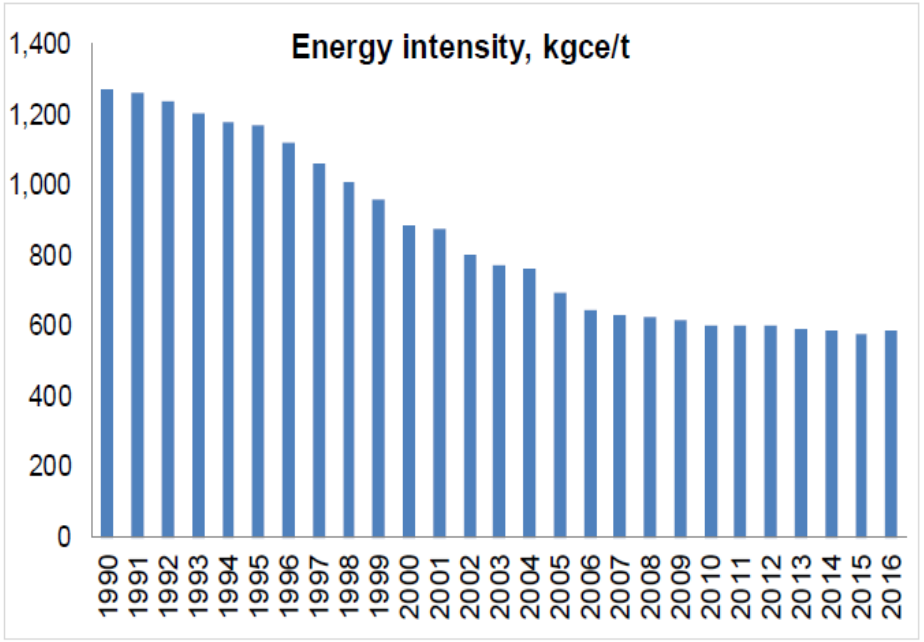
Source : worldsteel(2018)

Environmental performancein Steel Industry

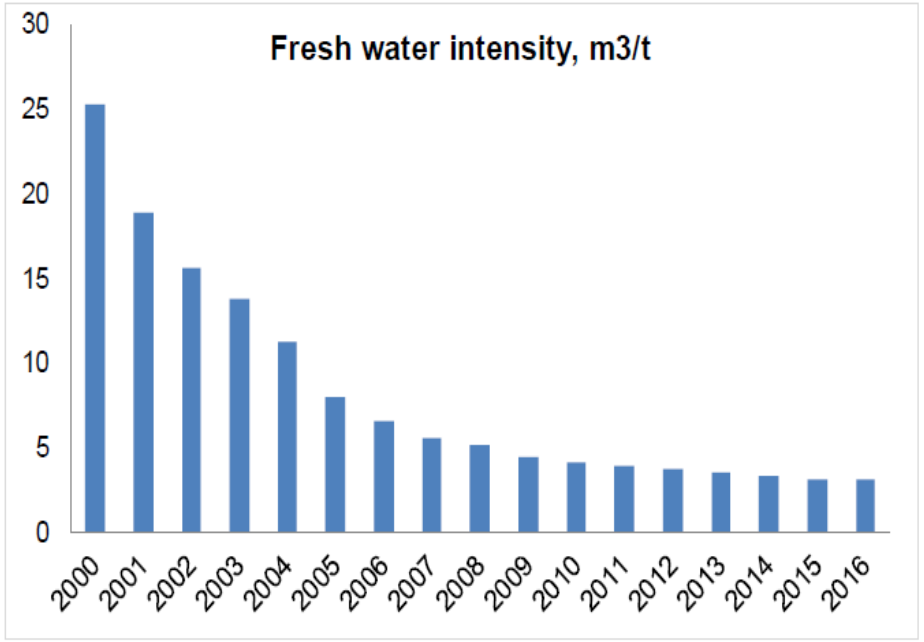
Dramatic improvement in environmental performance

- Energy intensity of mid-large steel mills declined by 27% in the past 15 years, while fresh water intensity dropped by 80%
- Not much potential for radical improvement, as it's approaching technical limits of the existing technologies

Energy Efficiency Improvement



Water Efficiency Improvement



Source: CISA(2017)

II. Chinese Steel Industry

China's steel demand is expected to decline

- Steel demand was specially driven by the government's stimulus package in 2017
- But expected to stagnate due to the economic stimulus, slowdown in the demand industry, 2018.

The proportion of steel consumption by industry(%)

construction	appliances	electrical equipment	machinery	metallic	automobile	transport	sum
55.0	1.5	3.7	18.8	8.2	8.1	4.7	100

Source: Worldsteel

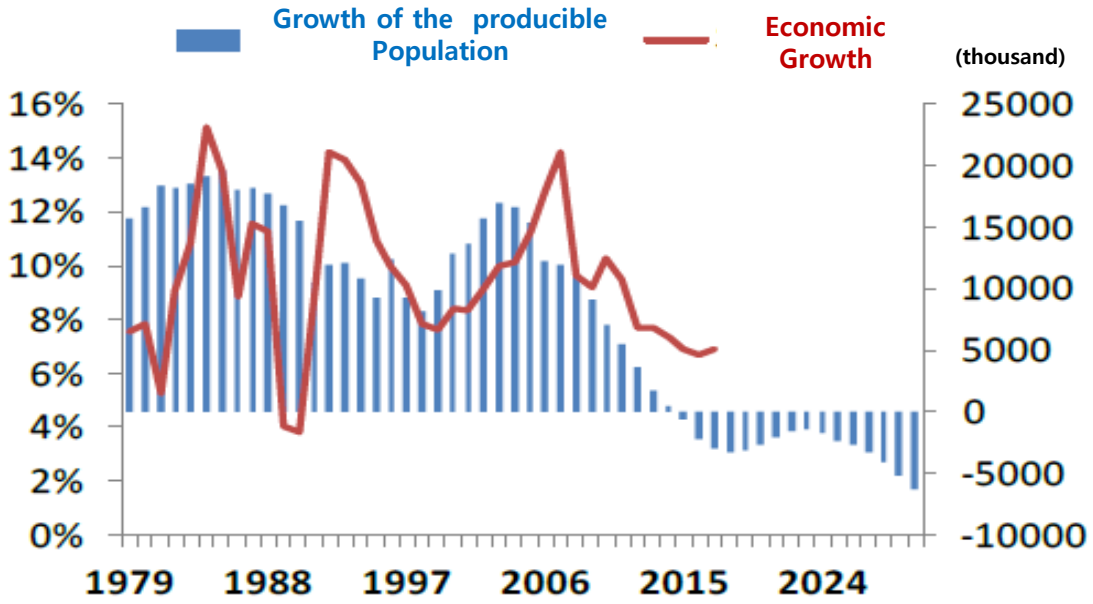
The Trend of Growth in the Steel Demand Industry(y-o-y, %)

	2014	2015	2016	2017	2018.1~2
real estate new construction area	△10.7	△14.0	8.1	7.0	2.9
automobile	7.1	2.7	13.1	3.2	△5.0
car	3.9	△8.3	3.7	△0.8	△5.8
household refrigerators	△1.0	△1.9	4.6	13.6	4.5
household washing machines	△3.3	0.7	4.9	3.2	△1.1
air-conditioning	11.5	0.0	4.5	26.4	17.0
a private vessel	5.5	△0.3	△11.9	9.5	△10.2

Source: Chinese national statistics bureau

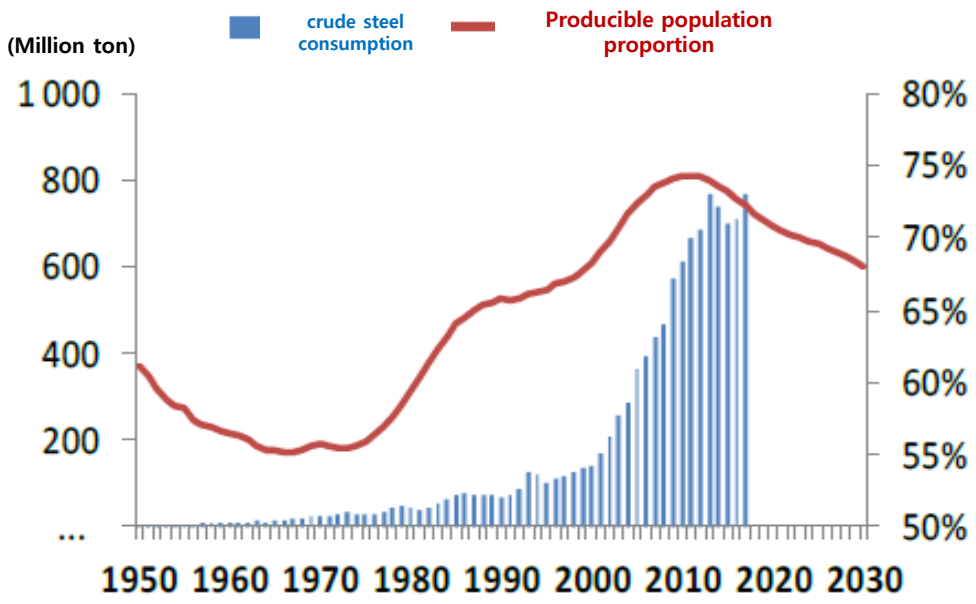
- From a mid-term perspective, there are many factors that may cause a decline in steel demand, such as a decrease in producible population, a decline in investment growth, a decline in steel concentration, and a decline in consumption of artificial steel
- The producible population is closely related to economic growth rate and steel consumption. In China, the producible population has been declining since 2015, and the proportion of the producible population has continued to decline since 2011.

Economic Growth and the Growth of the producible Population



Source: IMF, UN

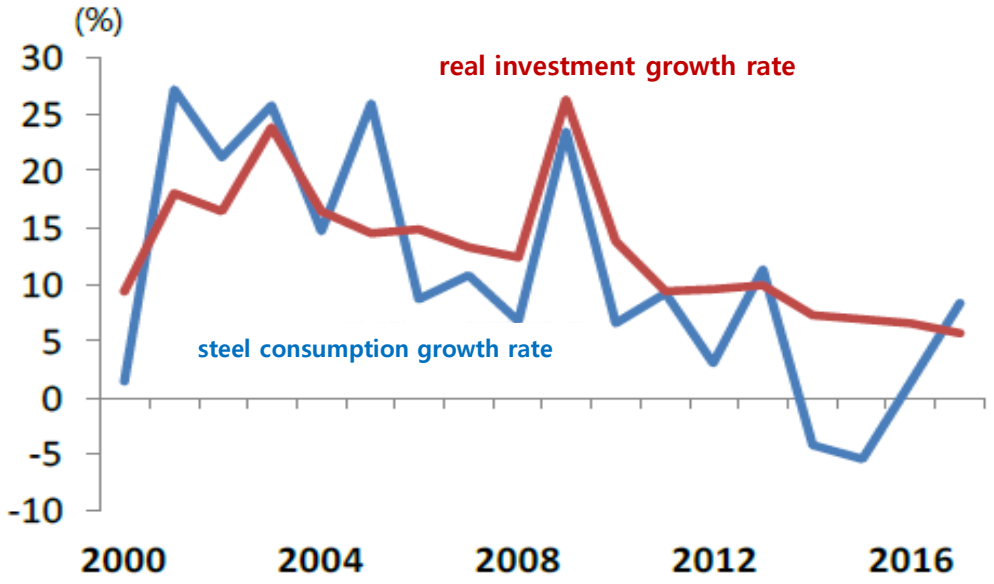
Steel consumption and producible population proportion



Source: Worldsteel, UN

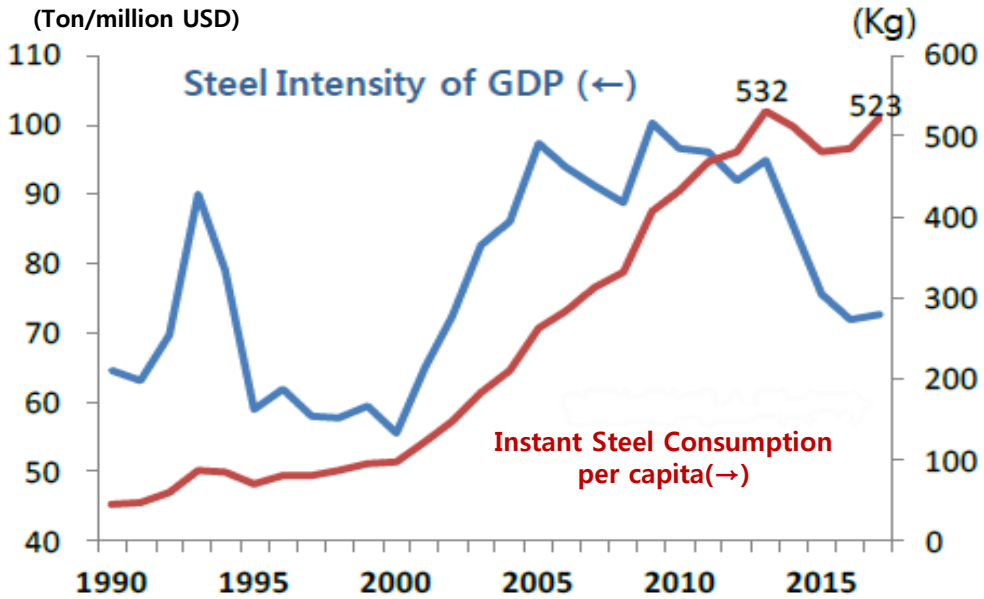
- As the Chinese government is pushing for a growth method from investment to consumption, the investment growth rate is continuously declining, which is a factor leading to a decline in steel consumption.

Real Investment and Steel Consumption Growth



Source: IHS

Iron Intensity and Instant Steel Consumption per capita



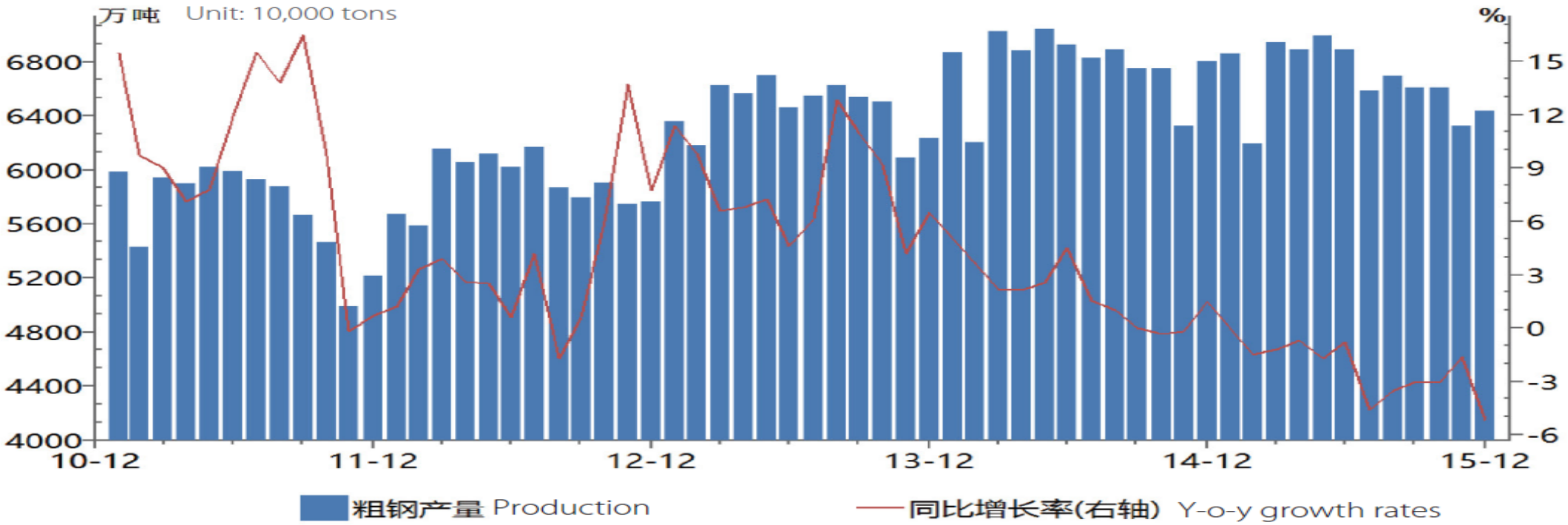
Source: HIS, worldsteel

- However, urbanization rate is rising continuously and that the Chinese government will not tolerate the plunge in the construction industry.

Steel Production

- Crude steel production in China mainland was 804 million ton in 2015, 19.18 million ton lower than the year before, down 2.33%.

Crude Steel Production and Growth in China Mainland



Source: China Steel Industry Development 2016

- The total production of crude steel in the world's 66 major steel-producing countries and regions was 1.6 billion ton in 2015, down 2.86% over the previous year.
- Crude steel production decreased in most of the major steel-producing countries and regions, and increased in very few countries.

Crude Steel Production in Major Steel-producing Countries and Regions

单位：万吨、% Unit: 10,000 tons, %

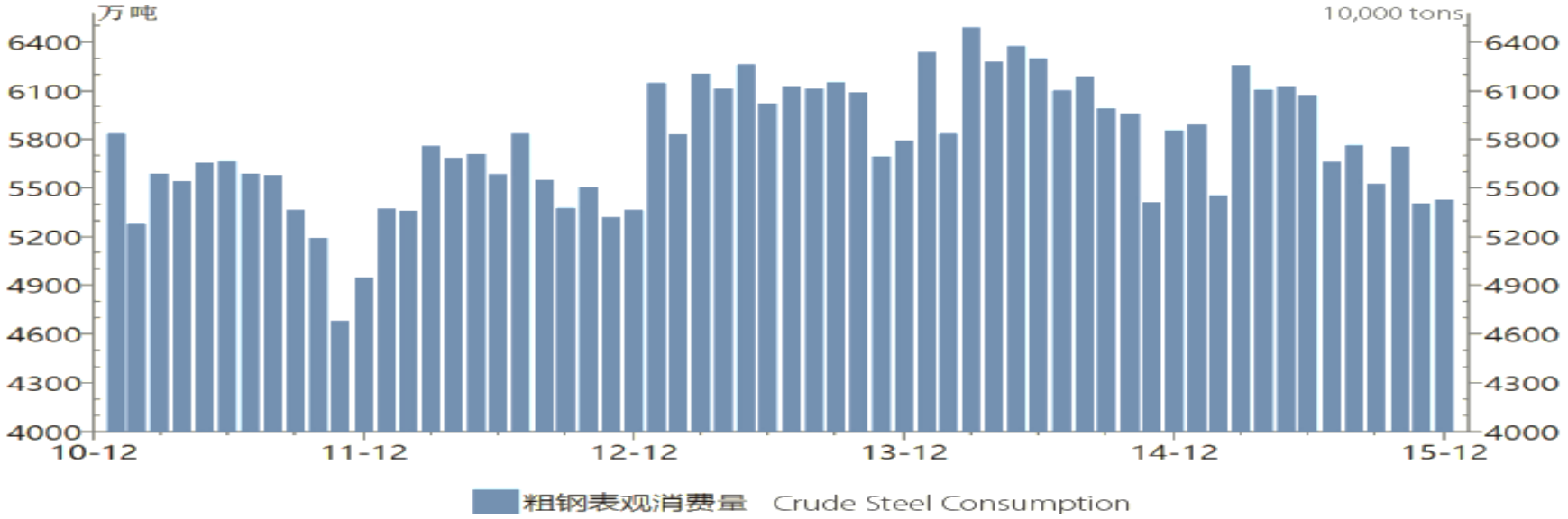
排序 No.	国家或地区 Country (region)	粗钢产量 Production of Crude Steel	同比 Y-o-y
1	中国内地 China Mainland	80382.3	-2.3
2	日本 Japan	10536.4	-4.8
3	印度 India	8978.8	2.9
4	美国 U.S.	7891.6	-10.5
5	俄罗斯 Russia	7111.4	-0.5
6	韩国 South Korea	6963.5	-2.7
7	德国 Germany	4267.8	-0.6
8	巴西 Brazil	3324.5	-1.9
9	土耳其 Turkey	3151.7	-7.4
10	乌克兰 Ukraine	2293.3	-15.6

Source: China Steel Industry Development 2016

Steel Demand and Reduction of Excess Capacity

- Apparent crude steel consumption in China was 700 million ton in 2015, accounting for 42.9% of the world total, and China remains the world's largest steel market.
- Steel excess capacity is a global issue. According to data from World Steel Association, the utilization rate of global crude steel capacity was 69.7% in 2015.
- China's crude steel production capacity in 2014 was around 1.13 billion ton, and the capacity utilization rate was 71.2% per steel production in 2015, comparable to the global level.
- In February 2016, "Guidance for the Steel Industry to Reduce Excess Capacity and Resolve Difficulties for Further Development", planning to reduce another 100 to 150 million ton steel production capacity in the next five years

Crude Steel Consumption

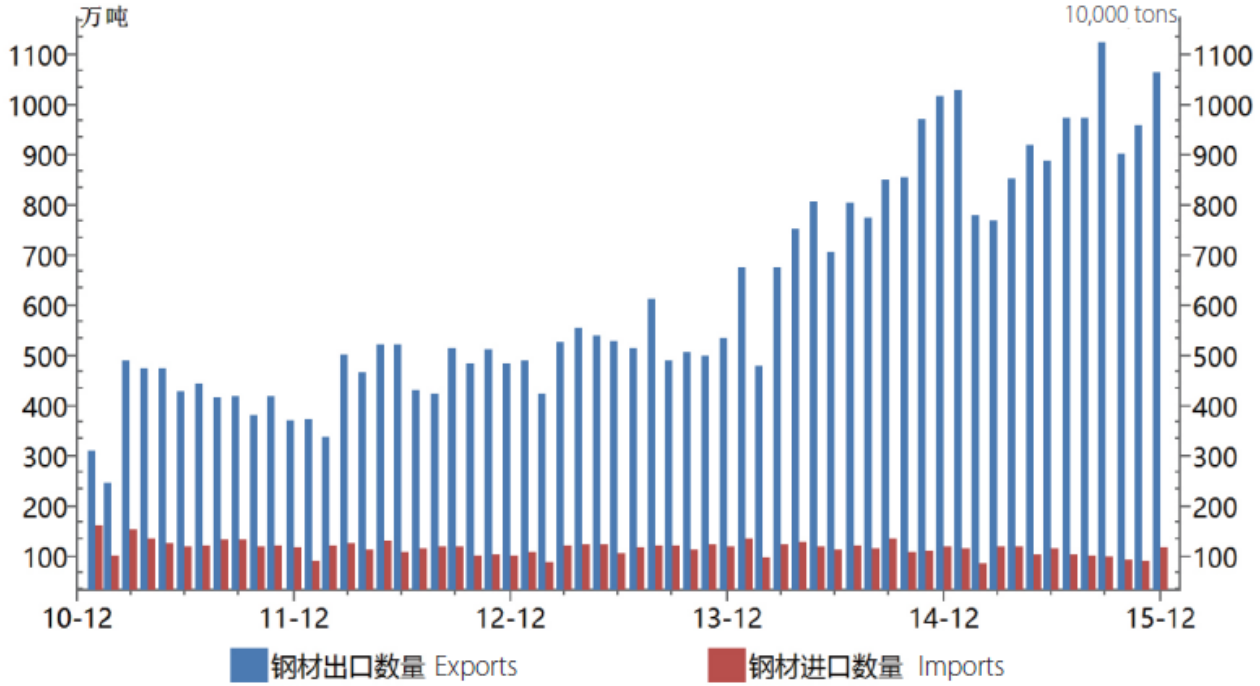


Source: China Steel Industry Development 2016

Steel Import and Export

- Steel export reached 112 million ton in 2015, up 19.9% over the previous year
- steel import stayed at 12.78 million ton, down 11.4% over the previous year
- net steel export was equivalent to 103 million ton of crude steel
- Imported 953 million ton of iron ore in 2015, up 2.2% over the previous year.
- Import Australia(607 million ton), up 10.76%, Brazil(192 million ton)- up 12.1%, South Africa(45.3783 million ton, up 4.06%.
- Iron ore import from Australia and Brazil accounted for 83.85% of the total import in 2015.

Import and Export of Steel Products



Source: China Steel Industry Development 2016

Sources of Iron Ore Imports

Source: China Steel Industry Development 2016

Energy Conservation and Environmental Protection

- In accordance with the requirement of green development, China's steel industry has increased inputs in capital, talent, technological research and development, and carried out valuable explorations in the new generation of recyclable processes for steel production, green manufacturing, and environmental management, etc.

- A number of advanced enterprises in energy conservation and environmental protection have emerged with Baosteel, TISCO and Hesteel Tangsteel becoming excellent showcases for green development.

- The implementation of the new Environmental Protection Law in 2015 has put forward higher requirements and more stringent standards on the steel industry.

- For major member enterprises of China Iron and Steel Association, the average energy consumption per ton of steel decreased from 605 kg of standard coal to 572 kg from 2010 to 2015, exceeding the target of 580 kg in energy conservation ahead of schedule

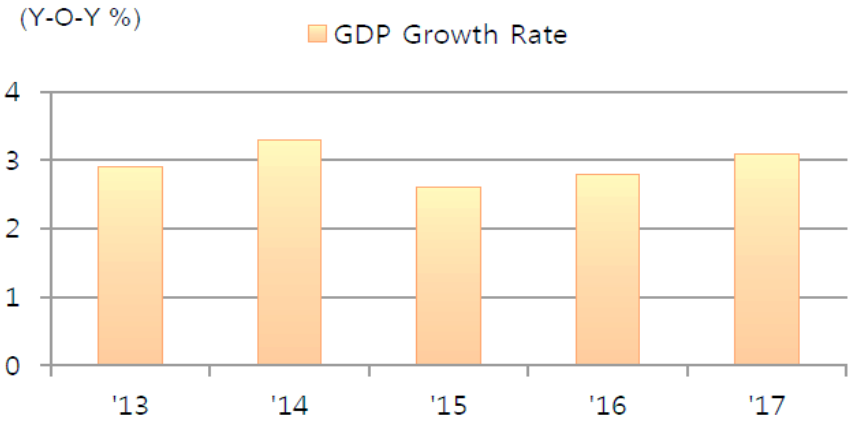
- new water consumption decreased from 4.1 cubic meters to 3.25 cubic meters, attaining the water-saving target of 4 cubic meters ahead of schedule

- sulfur dioxide emissions decreased from 1.63 kg to 0.86 kg, surpassing the target of 1.0 kg; and COD per ton of steel decreased from 70g to 22g, realizing the target ahead of schedule.

III. Korean Steel Market and General Economy

- **GDP :** In 2017 Recorded growth rate of 3.1% due to upturn in equipment investment and exports led by global economic recovery.
- **Private Consumption :** In 2017 Marked 2.5% growth rate owing to increase of wage income and consumer confidence.
- **Equipment Investment :** In 2017 Investment in IT sector such as semi-conductor and display panel led the strong growth of 14.3%.
- **Construction Investment :** In 2017 Despite government's SOC budget reduction(-6.6%), construction investment marked 7.2% growth due to active residential construction and private plant construction.
- **Exports :** In 2017 Increased by 3.6% due to global economic recovery and increased demand of semiconductors and etc.

Economic Indicators in Korea



Source: Bank of Korea(2018)

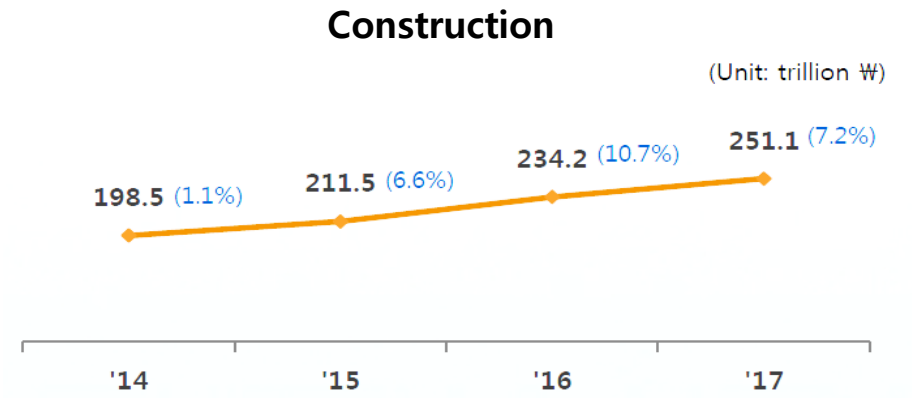
(Y-O-Y %)

	2014	2015	2016	2017
GDP	3.3	2.6	2.8	3.1
Private Consumption	1.8	2.2	2.5	2.5
Equipment Investment	5.8	5.3	-2.3	14.3
Construction Investment	1.0	3.9	10.7	7.2
Exports	2.3	0.5	2.2	3.6
Imports	1.2	2.0	3.6	7.3

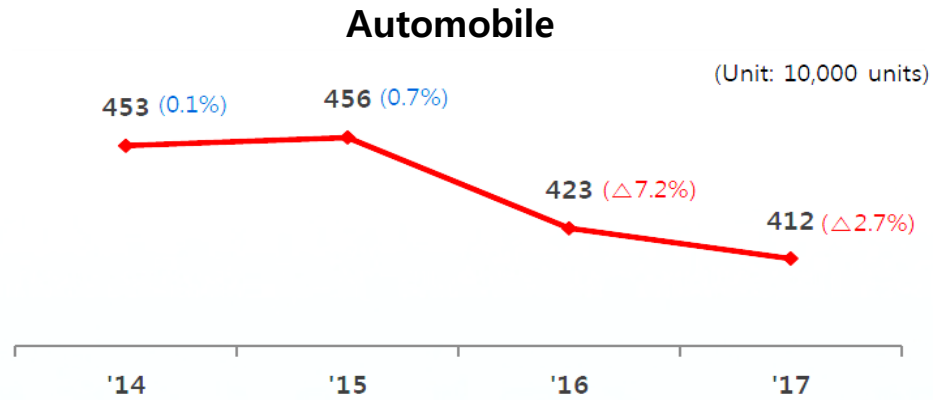
Source: Bank of Korea(2018)

Steel-using Industries in 2017

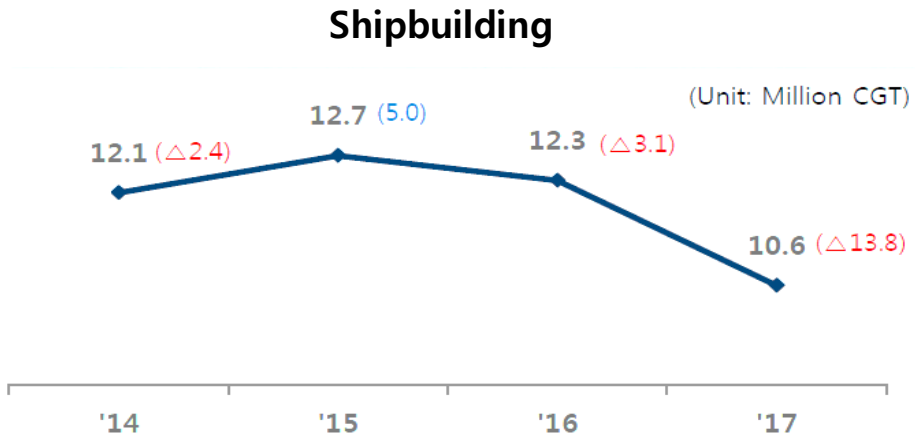
- **Construction :** Construction Investment increased by 7.2% in 2017
- **Automobile:** Auto production decreased by 2.7% in 2017
- **Shipbuilding :** ship delivery decreased by 13.8% in 2017
- **Machinery :** marchinary production increased by 6.5% in 2017



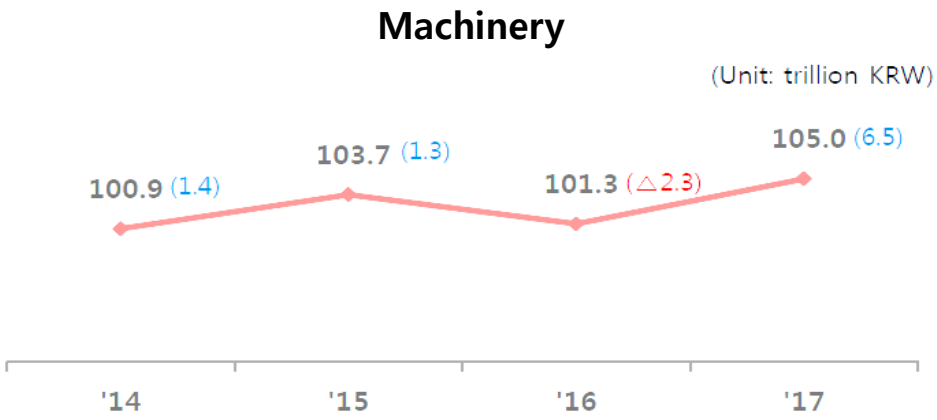
Source: Construction Association of Korea



Source: Korea Automobile Association



Source: Clarkson



Source: Korea Association of Machinery Industry

Steel-using Industries outlook 2018

- **Construction : I**nvestment is expected to grow only 0.6% due to slowing growth centered on private housing
- **Automobile :** Production is expected to remain low at around 4.1 million units due to sluggish domestic demand, exports and plant shutdowns
- **Shipbuilding :** Orders are expected to recover moderately from the order cliff, while drying volume is decline sharply
- **Machinery :** household appliances production expected to remain sluggish due to localization and export difficulties in demand for environmental appliances.

Domestic demand industry outlook

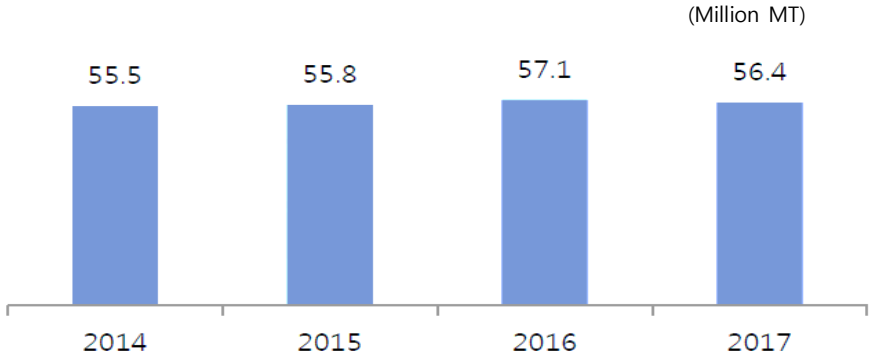
	2016	2017			2018							2019		
	annual	½ half	2/2 half	annual			½ half			2/2 half	annual			½ half
					Q1	Q2		Q3	Q4			Q1	Q2	
Automobile (thousands)	4,229 (-7.2)	2,163 (-1.5)	1,952 (-4.0)	4,115 (-2.7)	963 (-7.5)	1,089 (-2.9)	2,052 (-5.1)	1,000 (-0.2)	1,005 (5.8)	2,005 (2.7)	4,057 (-1.4)	983 (2.1)	1,125 (3.3)	2,108 (2.7)
Shipbuilding(million GT)	25.4 (7.2)	12.7 (-11.4)	9.9 (-10.8)	22.6 (-11.2)	5.2 (-26.1)	3.5 (-38.0)	8.7 (-31.4)	3.2 (-55.0)	3.0 (7.4)	6.2 (-37.4)	14.9 (-34.0)	3.2 (-38.7)	3.5 (0.0)	6.7 (-23.2)
Construction(trillion won)	233.4 (10.3)	116.5 (9.7)	134.5 (5.8)	251.1 (7.6)	50.2 (1.5)	67.6 (0.8)	117.9 (1.1)	67.1 (0.2)	67.6 (0.0)	134.7 (0.1)	252.5 (0.6)	50.0 (-0.4)	67.5 (-0.2)	117.5 (-0.3)
Machinery (2010=100)	51.9 (9.3)	48.3 (-7.9)	47.4 (-7.8)	47.9 (-7.8)	42.1 (-7.3)	58.9 (15.1)	50.5 (4.5)	54.6 (6.5)	42.1 (-3.4)	48.4 (1.9)	49.4 (3.3)	45.0 (6.9)	56.3 (-4.4)	50.7 (0.3)

Note : 1Q 2018 is estimate, after 2018 1Q the POSRI forecast, () is the rate of increase and decrease in the same period of last year

Korean Steel Market

Steel Consumption : Showed modest growth in past 3 years but decreased by 1.2% due to slump in the shipbuilding industry.

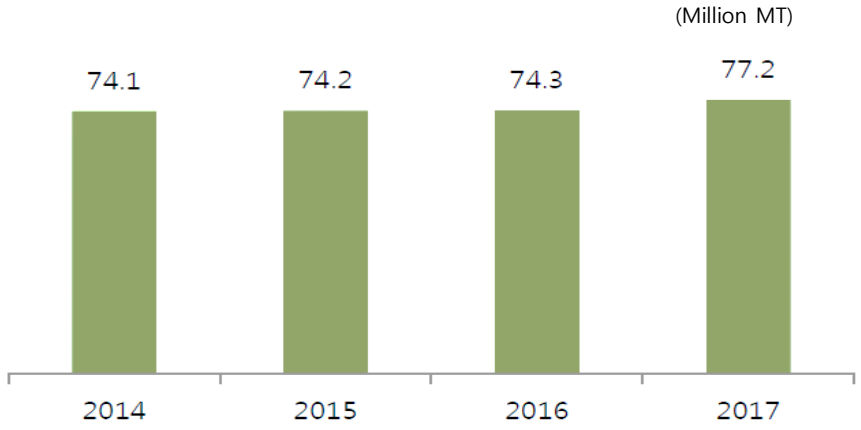
Consumption



Source: Korea Iron & Steel Association

Steel Production : Steel production has been stabilized at about 74 million tons in previous three years but increased by 3.8% in 2017.

Production



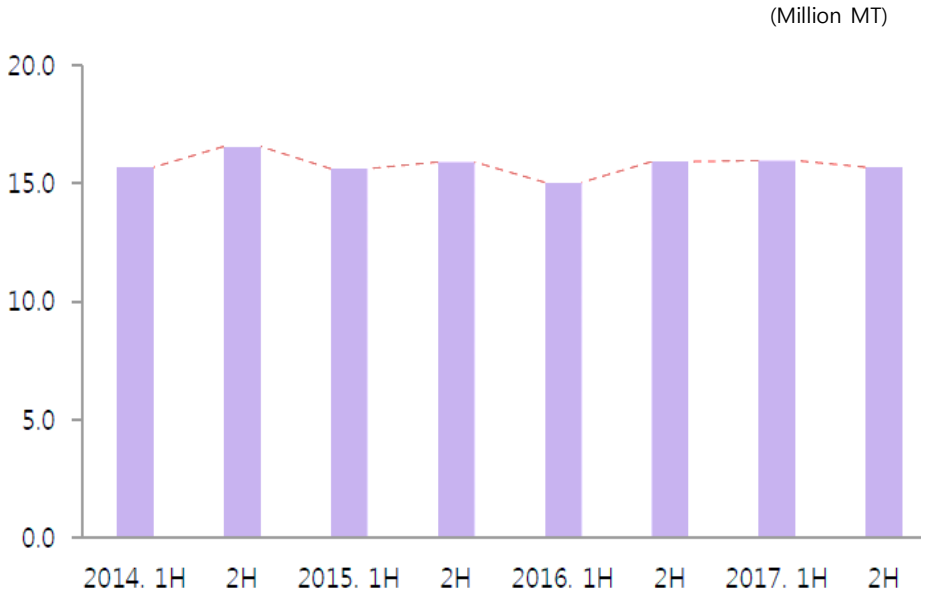
Source: Korea Iron & Steel Association

Steel Exports

2016 : Decreased by 1.8% due to slowdown of global steel demand and strong trade protectionism.

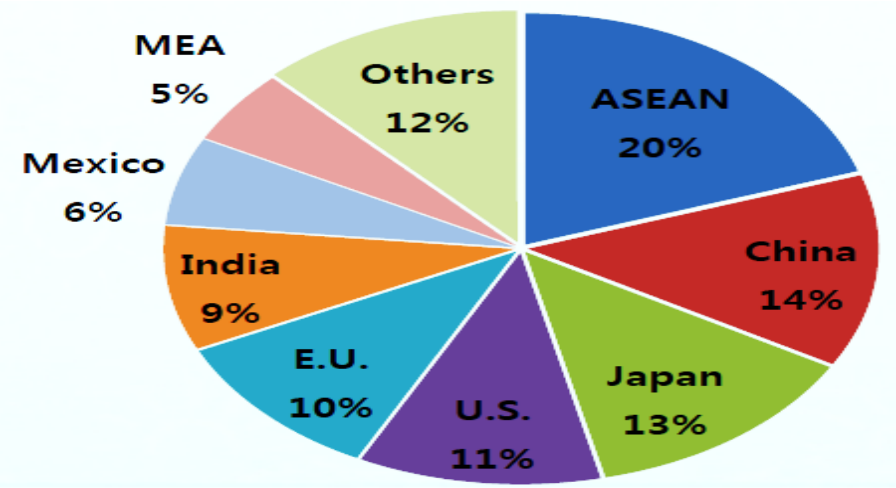
2017 : Despite decrease of exports to major markets, exports showed a similar trend to the recent years due to increase in input exports to the foreign investments by Korean steelmakers.

- Exports to China(-7.7%) and U.S.(-5.3%) decreased while exports to emerging markets like India(13.1%↑), Mexico(18.5%↑), MEA(13.5% ↑) increased.
- Korea has geographically balanced and diversified portfolio for steel exports.



Source: Korea Iron & Steel Association

Korea's Steel Exports by Country in 2017



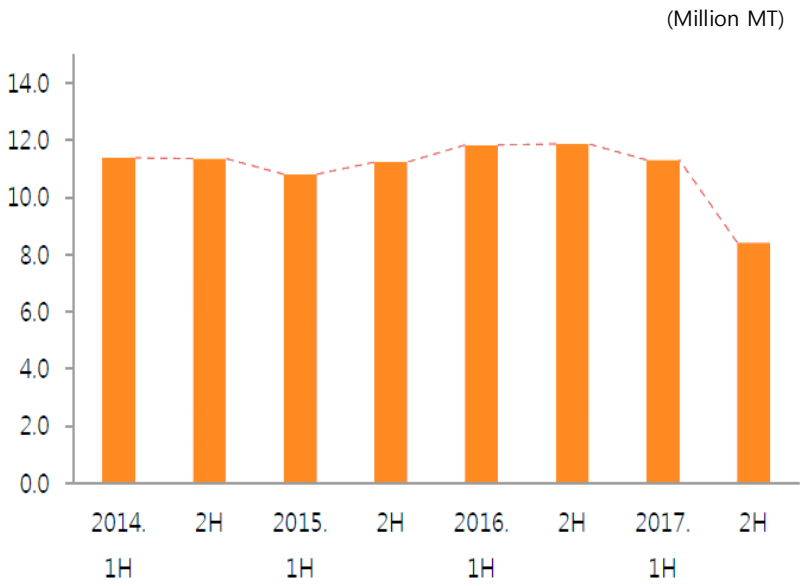
Source: Korea Iron & Steel Association

Steel Imports

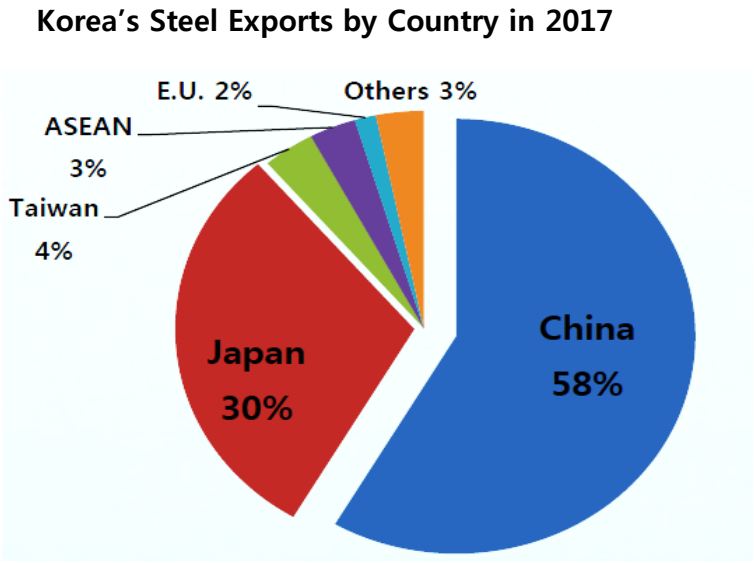
2016 : Surged by 7.5% due to maintenance work caused by unexpected troubles of blast furnace.

2017 : Decreased by 16.8% due to slump in shipbuilding industry and domestic effort to reduce imports.

- Import of plates plunged by 54.1%.
- China and Japan, which account for 88% of the total imports, decreased by 21.1% and 15.0% respectively, compared to previous year.



Source: Korea Iron & Steel Association



Source: Korea Iron & Steel Association

Steel supply and demand

- **Domestic demand :** The construction industry is expected to shrink by 1.5% in 2018 due to sluggish automobiles
- **Export :** The decline in steel pipe exports due to US import regulations will decline in 2018, but the decline is expected to be minimal
- **Production :** The increase in plate production is expected to only increase by 0.6% in 2018 due to sluggish domestic demand
- **Import :** Domestic imports continued to decline in 2018 due to sluggish domestic demand and expansion of plate materials supply, the lowest level is expected since 2004

Steel supply and demand outlook

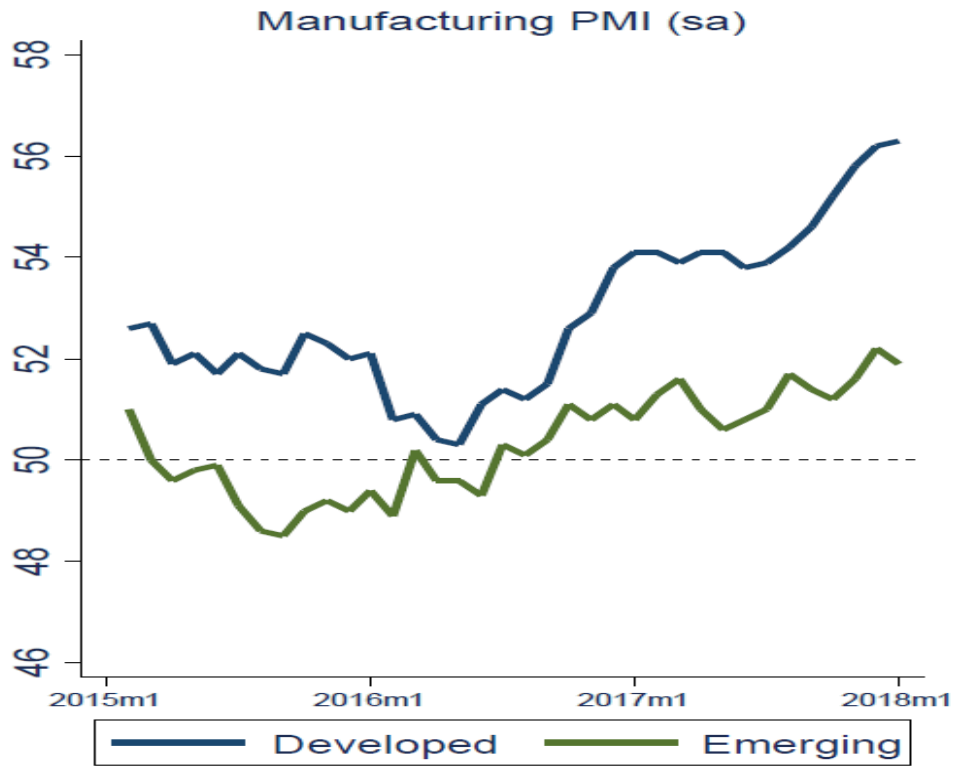
(thousand tons, %)

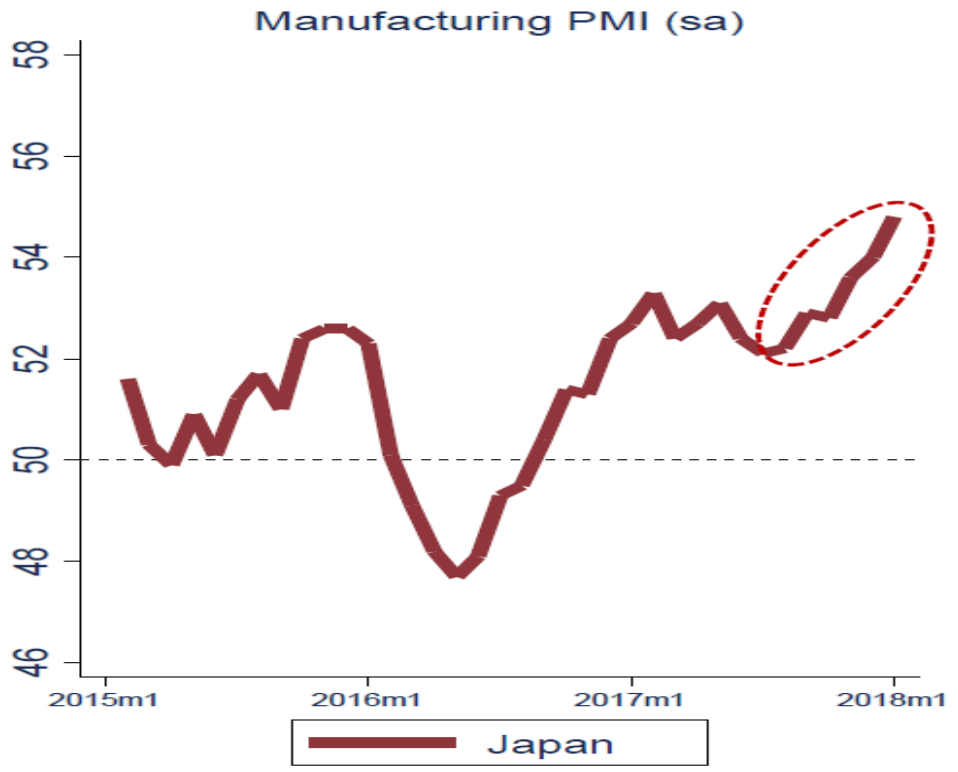
	2016	2017			2018							2019		
	annual	½ half	2/2 half	annual			½ half			2/2 half	annual			½ half
					Q1	Q2		Q3	Q4			Q1	Q2	
domestic demand	**57,076** (2.3)	**28,626** (1.2)	**27,776** (-3.5)	**56,402** (-1.2)	**13,145** (-8.3)	**14,370** (0.5)	**27,515** (-3.9)	**14,170** (1.1)	**13,855** (0.7)	**28,025** (0.9)	**55,540** (-1.5)	**13,900** (5.7)	**14,555** (1.3)	**28,455** (3.4)
export	**30,970** (-1.8)	**15,976** (6.2)	**15,693** (-1.5)	**31,668** (2.3)	**7,868** (-2.2)	**7,840** (-1.1)	**15,708** (-1.7)	**8,105** (-1.6)	**7,745** (3.8)	**15,850** (1.0)	**31,558** (-0.3)	**7,845** (-0.3)	**7,925** (1.1)	**15,770** (0.4)
production	**74,307** (0.3)	**38,498** (6.0)	**38,663** (1.8)	**77,161** (3.8)	**18,797** (-1.8)	**19,650** (1.6)	**38,447** (-0.1)	**19,830** (0.5)	**19,345** (2.2)	**39,175** (1.3)	**77,622** (0.6)	**19,250** (2.4)	**19,775** (0.6)	**39,025** (1.5)
import	**13,739** (3.8)	**6,104** (-13.0)	**4,805** (-28.5)	**10,909** (-20.6)	**2,217** (-31.3)	**2,560** (-10.9)	**4,777** (-21.7)	**2,445** (-3.1)	**2,255** (-1.1)	**4,700** (-2.2)	**9,477** (-13.1)	**2,495** (12.5)	**2,705** (5.7)	**5,200** (8.8)
semiproduct inclusion	**23,717** (7.5)	**11,320** (-4.4)	**8,418** (-29.1)	**19,738** (-16.8)	**4,054** (-29.7)	**4,955** (-10.8)	**9,009** (-20.4)	**4,335** (-5.3)	**3,850** (0.3)	**8,185** (-2.8)	**17,194** (-12.9)	**4,305** (6.2)	**4,920** (-0.7)	**9,225** (2.4)

Note : 1Q 2018 is estimate, after 2018 1Q the POSRI forecast, () is the rate of increase and decrease in the same period of last year

Manufacturing market sentiment

- Japan's manufacturing market sentiment has been stronger in line with the global upward trend

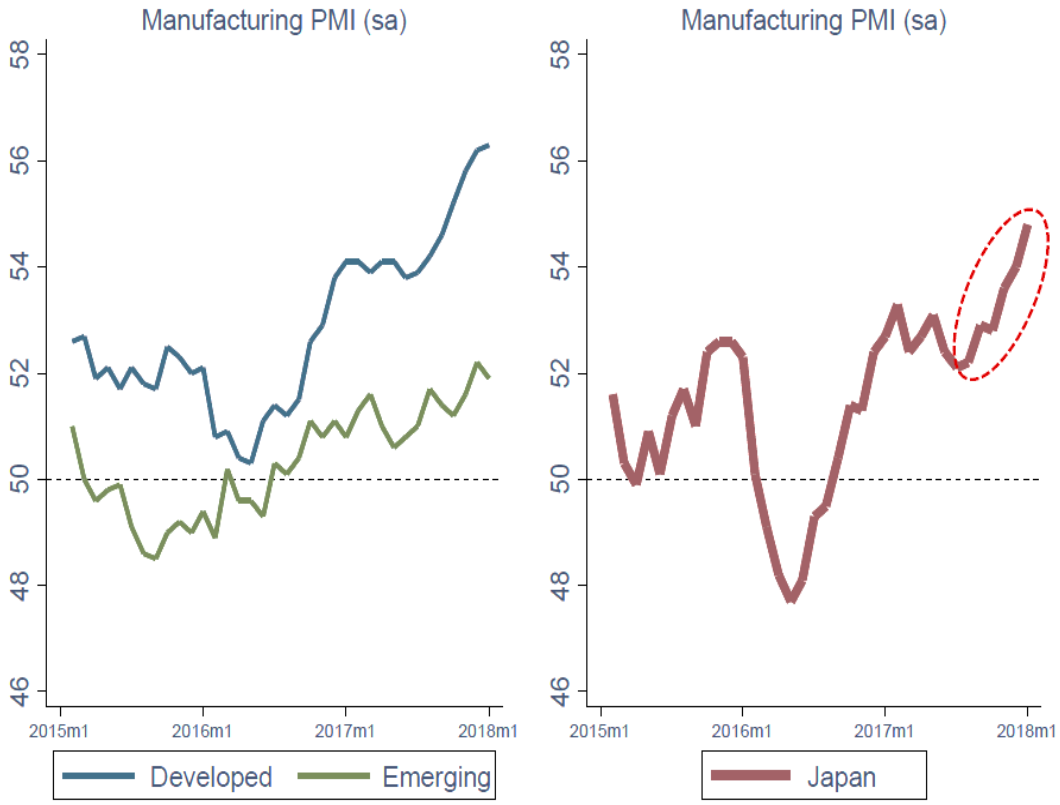




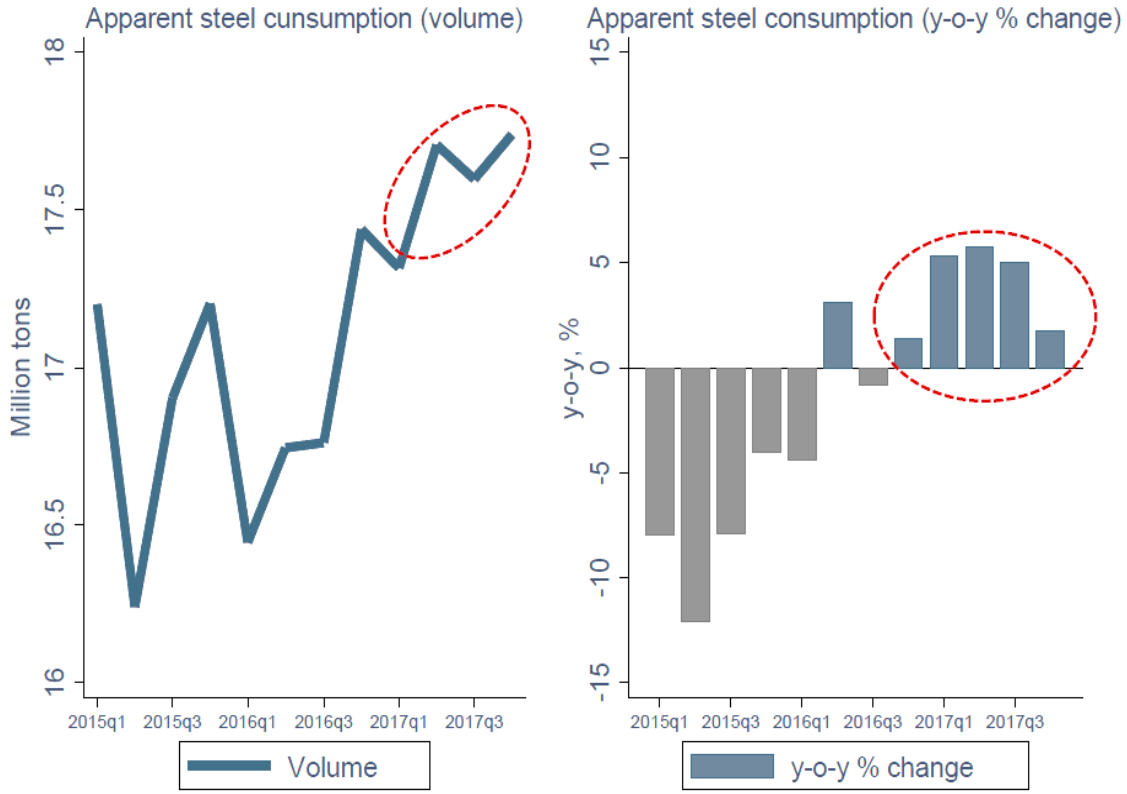
Source: Markit Economics

Steel demand

- Japan's apparent crude steel consumption has been recovering, supported by robust domestic demand



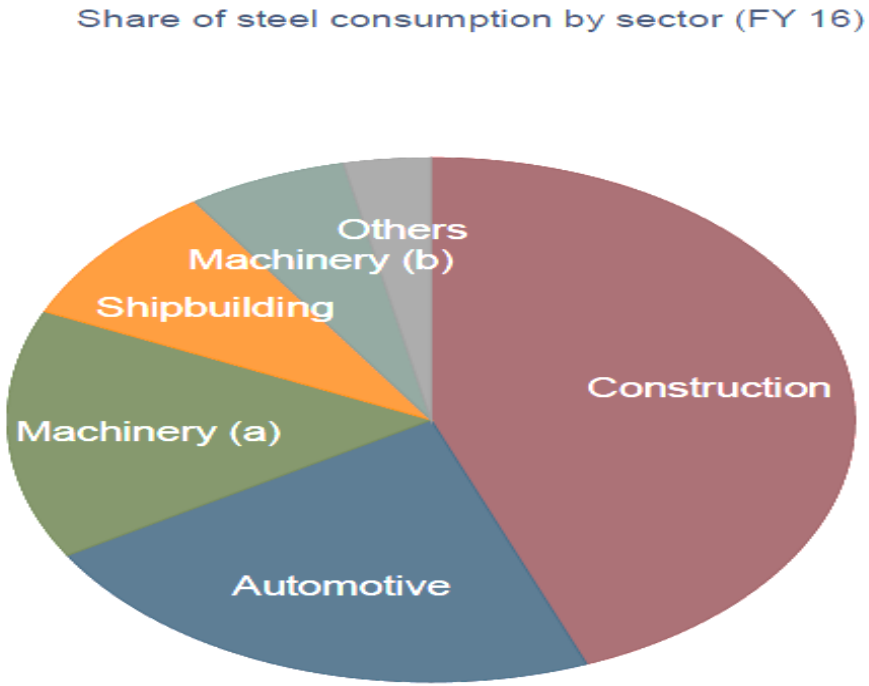
Source:
JISF

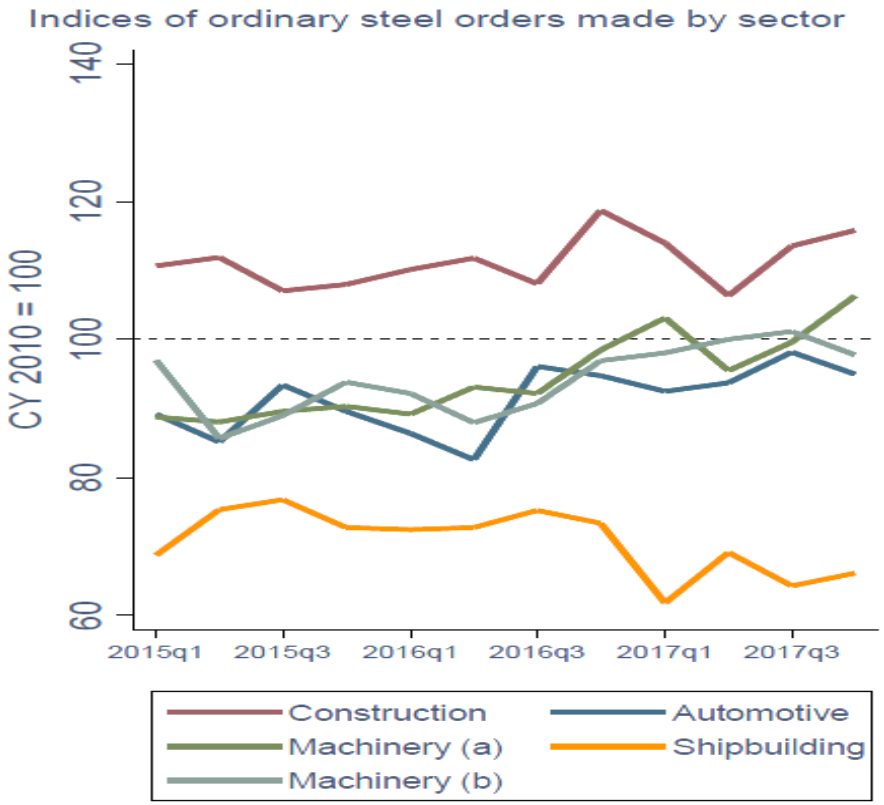


Source: JISF

Role of steel-using sectors

- Construction and some manufacturing sectors have been the major drivers of Japan's steel demand

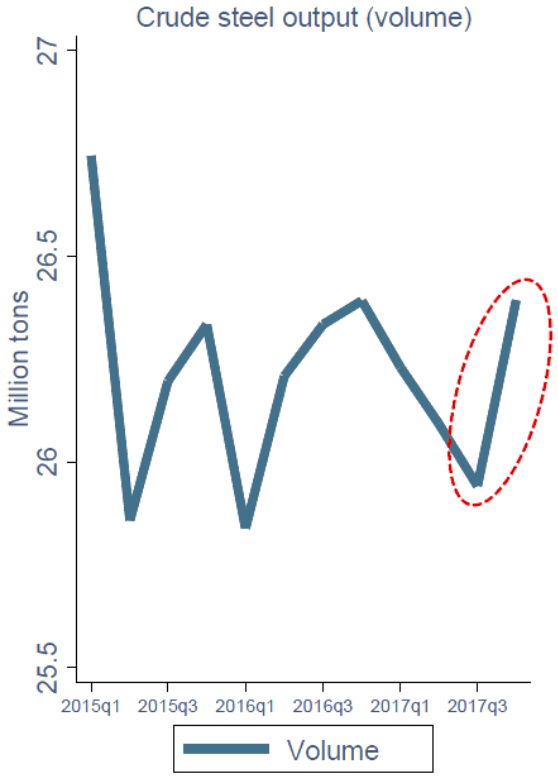


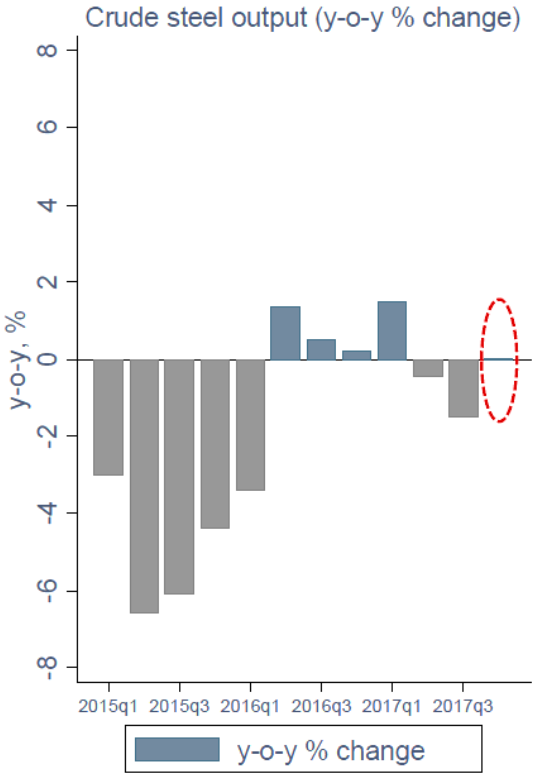


Notes: Data are on an ordinary steel basis. Machinery (a) denotes industrial machinery.
Machinery (b) denotes electrical machinery.
Source: JISF

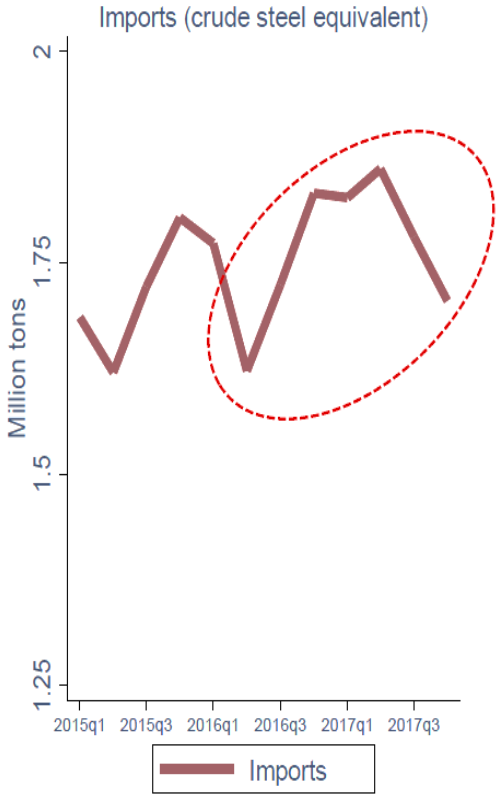
Steel supply

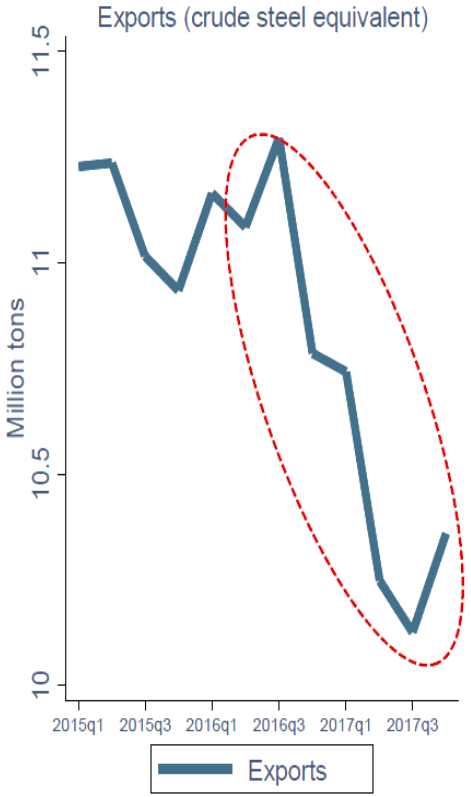
- Japan's crude steel output has been recovering gradually
- Japan's steel imports have grown faster than its steel export





Source: JISF





Source:
JISF

Outlook

- Projects associated with the Tokyo 2020 Olympic and Paralympic Games should have a positive effect on Japan's steel demand

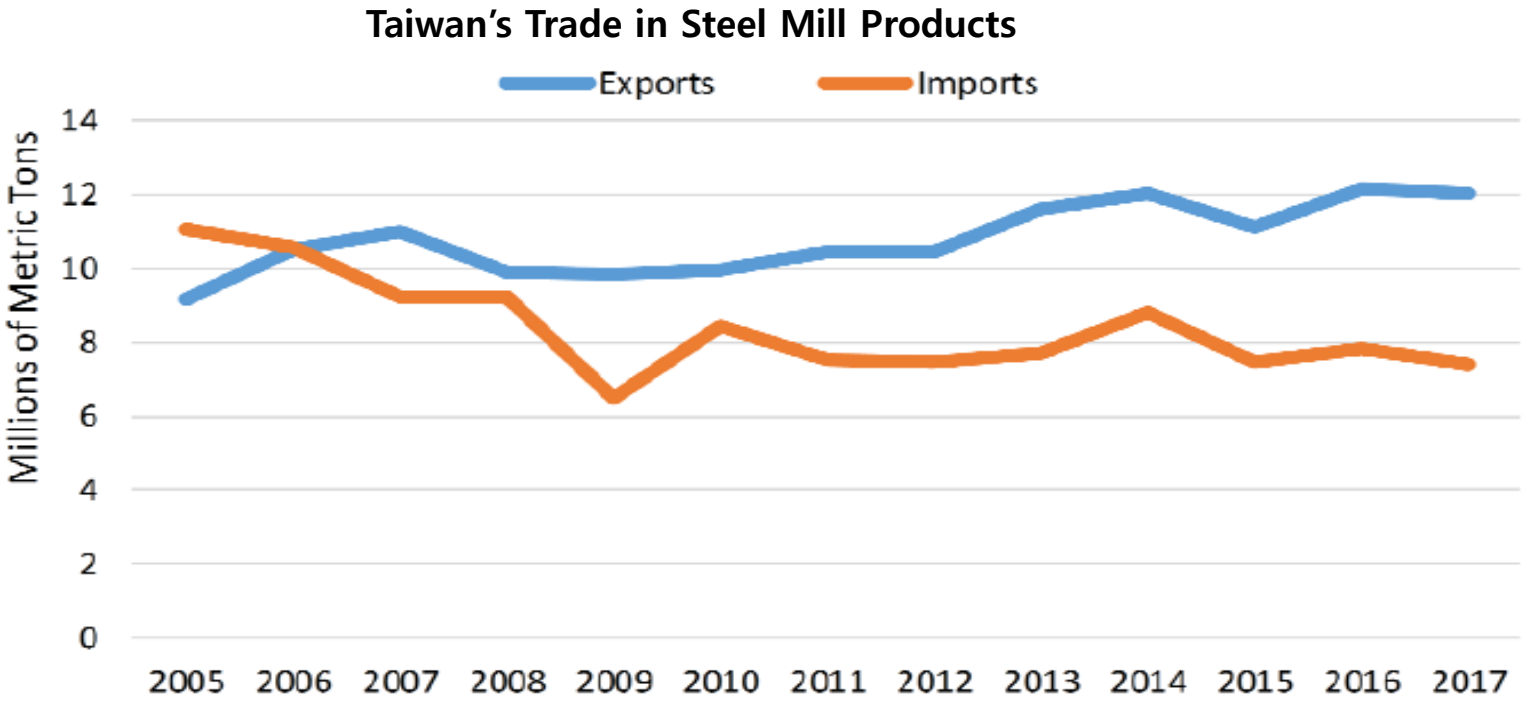
		FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
		Million tons			y-o-y growth rates, %		
Ordinary steel		49.0	49.5	**49.6**	1.2	1.0	**0.2**
	Construction	21.6	21.6	**21.7**	2.0	0.2	**0.5**
	Manufacturing	27.4	27.9	**27.9**	0.5	1.7	**0.0**
Special steel		12.7	13.1	**13.2**	1.8	3.6	**0.2**

Source: JISF

V. Taiwanes Steel Industry

Steel Trade Balance

- Rising exports and falling imports caused Taiwan's steel trade deficit to become a steel trade surplus between 2006 and 2007.
- In 2017, Taiwan's steel trade surplus amounted to 4.6 million metric tons, up from 4.3 million metric tons in 2016.



Source: HIS Markit Global Trade Atlas

Imports

- Taiwan is the world's nineteen-largest steel importer. In 2017, Taiwan imported 7.4 million metric tons of steel, a 6 percent decrease from 7.8 million metric tons in 2016.

- The four countries highlighted in the map below represent the top import sources for Taiwan's imports of steel, with each sending more than 500 thousand metric tons to Taiwan and together accounting for 83 percent of Taiwan's steel imports in 2017.

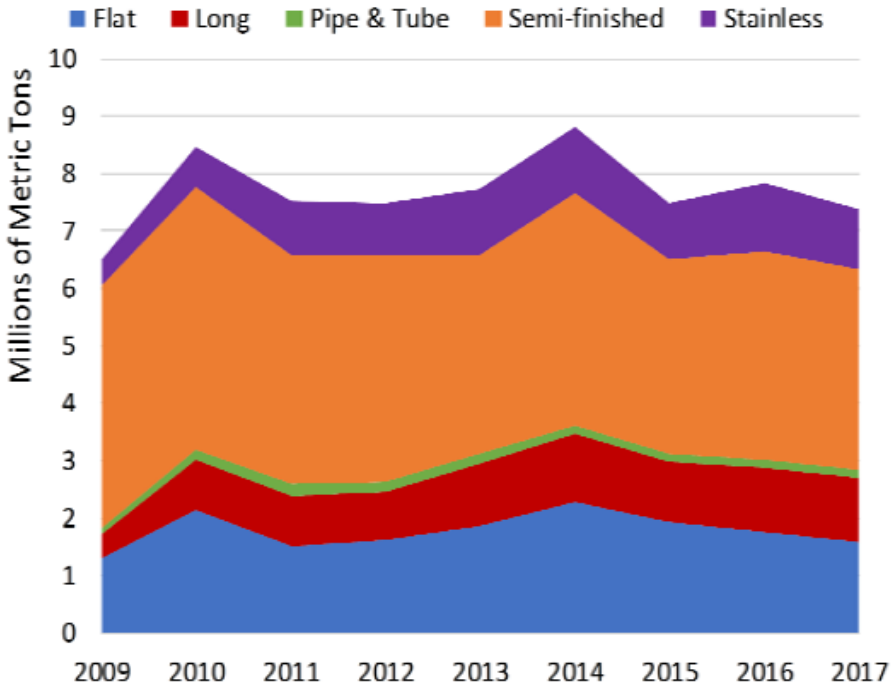
Taiwan's Imports of Steel Mill Products 2017

Source: Global Trade Atlas(2018)

Import Volume, Value, and Product

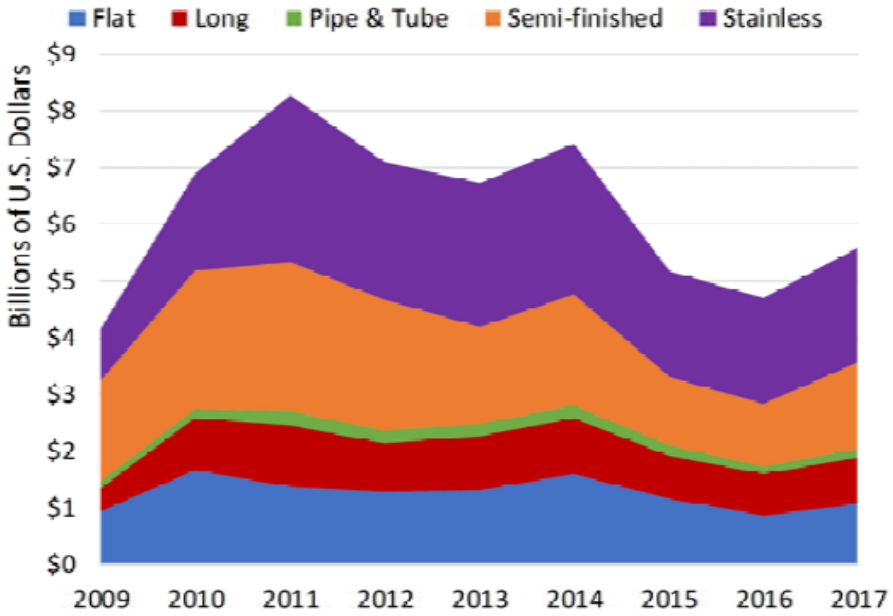
- Taiwan has averaged 7.9 million metric tons of annual steel imports in recent years.
- In 2016, the volume of Taiwan's steel imports increased by 5 percent to 7.8 million metric tons from 7.5 million metric tons in 2015 before decreasing by 6 percent to 7.4 million metric tons between 2016 and 2017.

Taiwan's Imports of Steel Mill Products
Millions of Metric Tons



Source: HIS Markit Global Trade Atlas

Taiwan's Imports of Steel Mill Products
Billions of USD

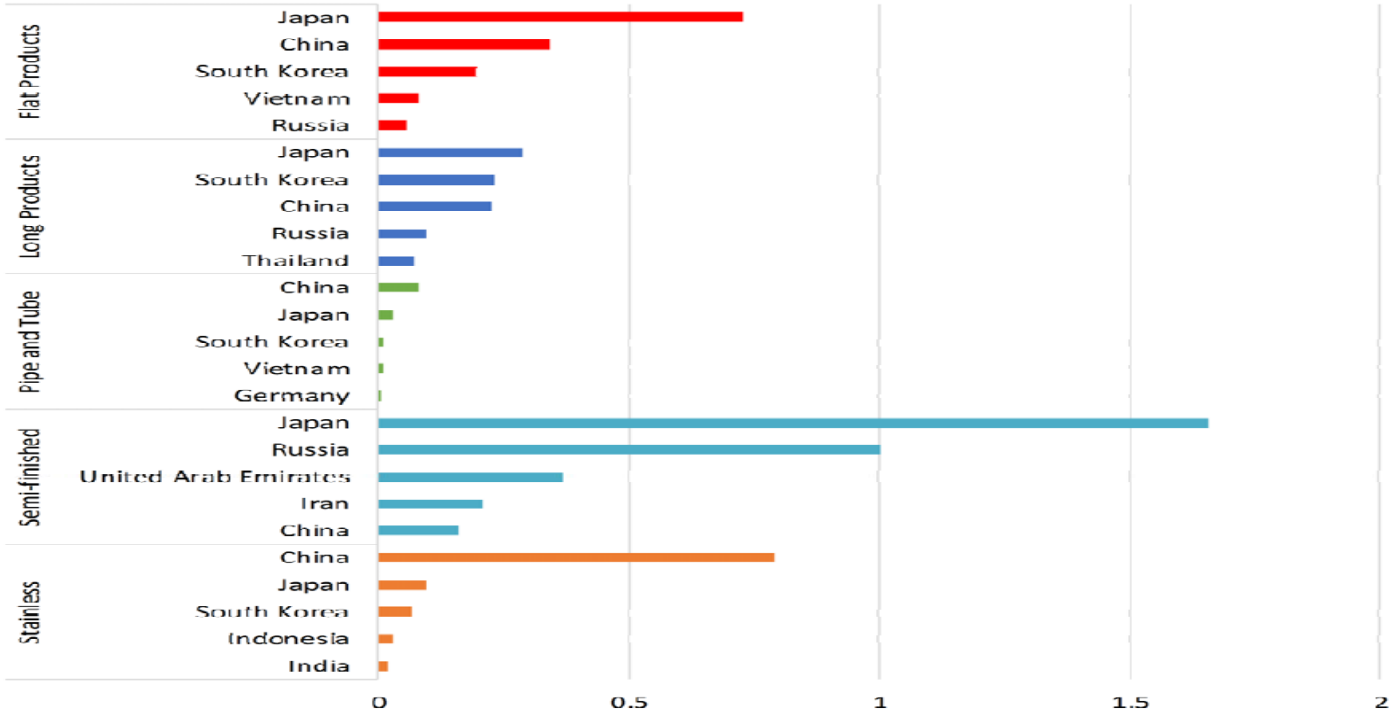


Source: HIS Markit Global Trade Atlas

Top Sources by Steel Product Category

- The top source countries for Taiwan's imports by volume vary across types of steel products, though Japan and China held the top two spots for nearly every product category.
- Taiwan imported the largest share of flat products from Japan in 2017 at 46 percent (727 thousand metric tons), followed by China at 21 percent (340 thousand metric tons).
- Japan also accounted for the largest shares of Taiwan's imports of long products at 26 percent (286 thousand metric tons) and semi-finished steel at 47 percent (789 thousand metric tons).

Taiwan's Top 5 Import Sources by Product 2017



Source: HIS Markit Global Trade Atlas

Millions of Metric Tons

Taiwan's Import Market Share in Top Destinations

- In 2017, the import market share for Taiwan's steel products increased in five of Taiwan's top export destinations for which data are available.
- The share of steel imports from Taiwan increased the most in Belgium and South Korea, each up 1.6 percentage points from 2016.

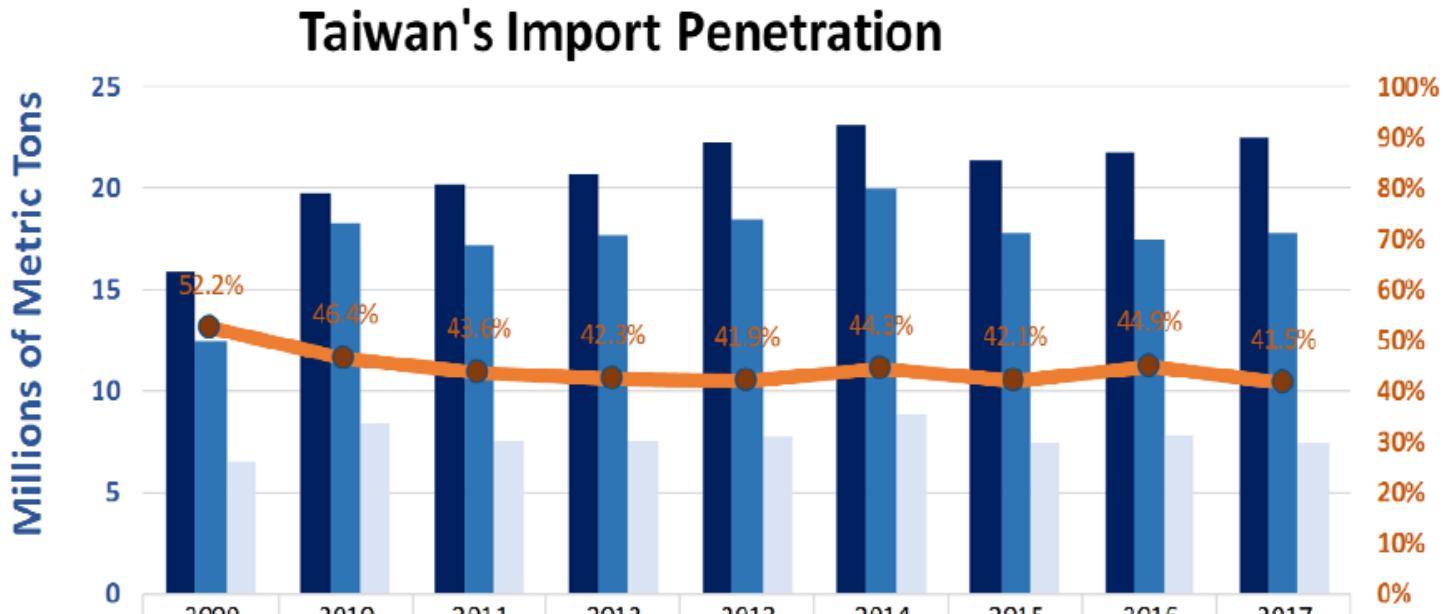
Taiwan's Steel Import Market Share

Top 10 Export Destinations	Share of Imports from Taiwan 2016	Taiwan's Rank in 2016	Share of Imports from Taiwan 2017	Taiwan's Rank in 2017
Vietnam	0.0%	N/A	N/A	N/A
China	11.7%	3	11.1%	3
United States	3.3%	9	3.3%	9
Japan	17.3%	3	16.9%	2
Malaysia	10.8%	4	12.1%	3
South Korea	2.0%	4	3.6%	3
Thailand	5.4%	4	4.1%	5
Belgium	0.9%	15	2.5%	9
Australlia	6.2%	4	7.2%	3
Indonesia	2.7%	7	3.5%	7

Source: IHS Global Trade Atlas

Overall Production and Import Penetration

- Taiwan's crude steel production decreased 7 percent in 2015 to 21.4 million metric, production has since increased 5 percent to reach 22.4 million metric tons in 2017.
- In 2017, the gap between production and demand stood at 4.6 million metric tons.



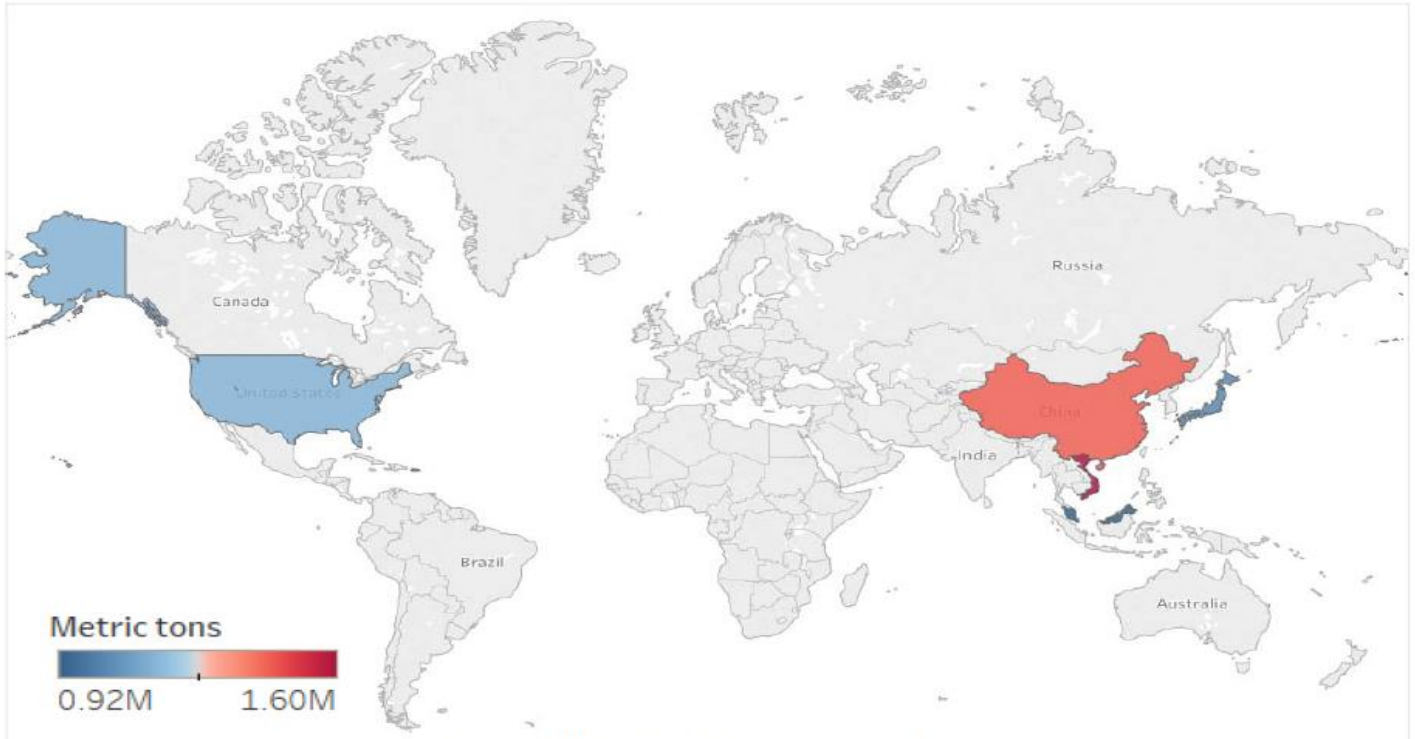
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	15.8	19.8	20.2	20.7	22.3	23.1	21.4	21.8	22.4
Apparent Consumption	12.5	18.2	17.2	17.7	18.4	19.9	17.8	17.4	17.8
Imports	6.5	8.5	7.5	7.5	7.7	8.8	7.5	7.8	7.4
Import Penetration	52.2%	46.4%	43.6%	42.3%	41.9%	44.3%	42.1%	44.9%	41.5%

Sources: World Steel Association; IHS Markit Global Trade Atlas

Exports

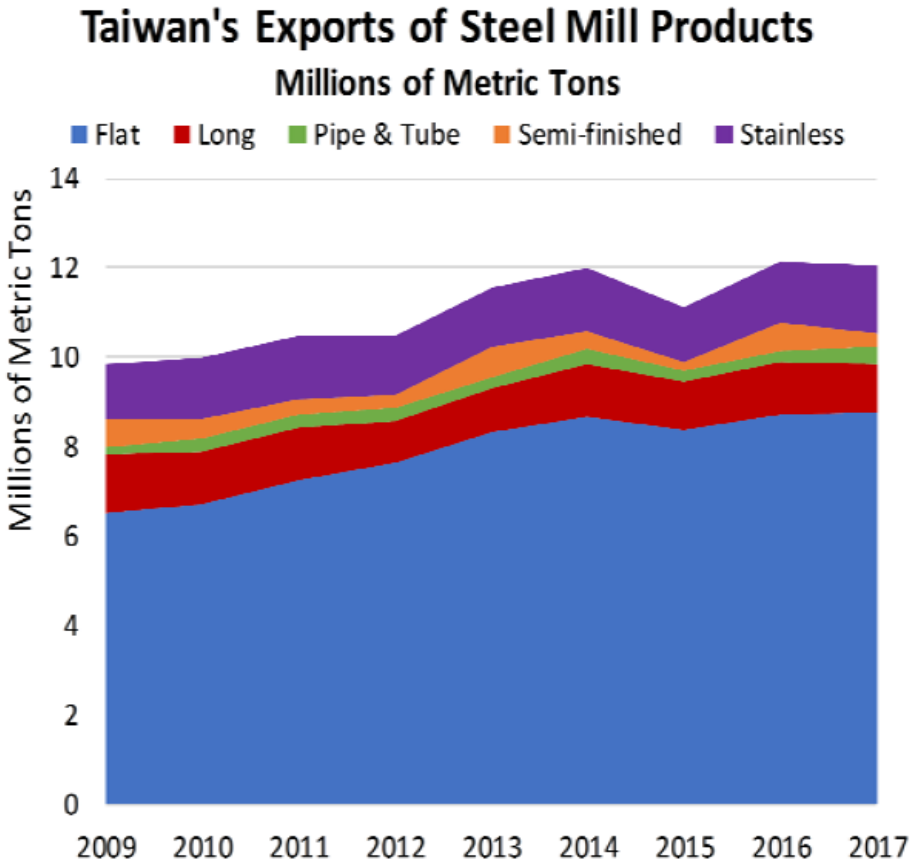
- Taiwan is the world's thirteenth-largest steel exporter. In 2017, Taiwan exported 12.0 million metric tons of steel, a one percent decrease from 12.2 million metric tons in 2016.
- Taiwan's exports represented about 3 percent of all steel exported globally in 2016.
- The five countries highlighted in the map below represent the top markets for Taiwan's exports of steel, receiving more than 900 thousand metric tons each and accounting for 51 percent of Taiwan's steel exports in 2017.

Taiwan's Exports of Steel Mill Products - 2017

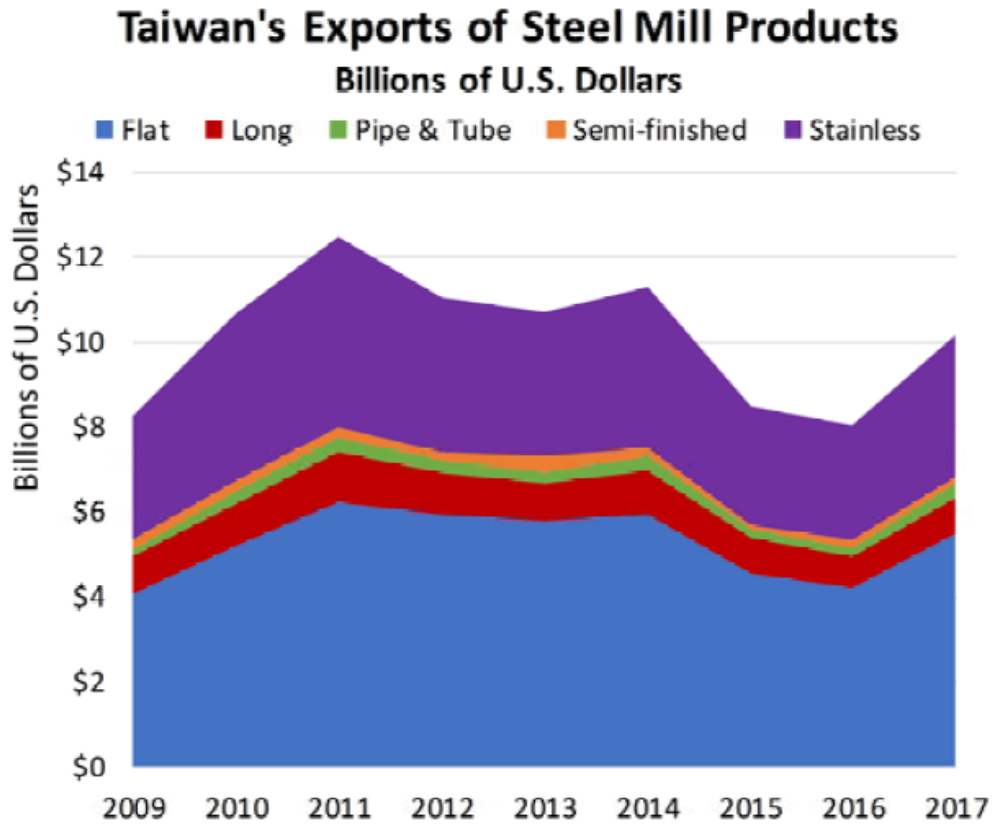


Export Volume, Value, and Product

- In 2017, Taiwan's steel exports decreased by 1 percent to 12.0 million metric tons. The value of Taiwan's 2017 steel exports increased by 27 percent to $10.2 billion from $8.0 billion in 2016, which can be attributed to an increase in global steel prices.



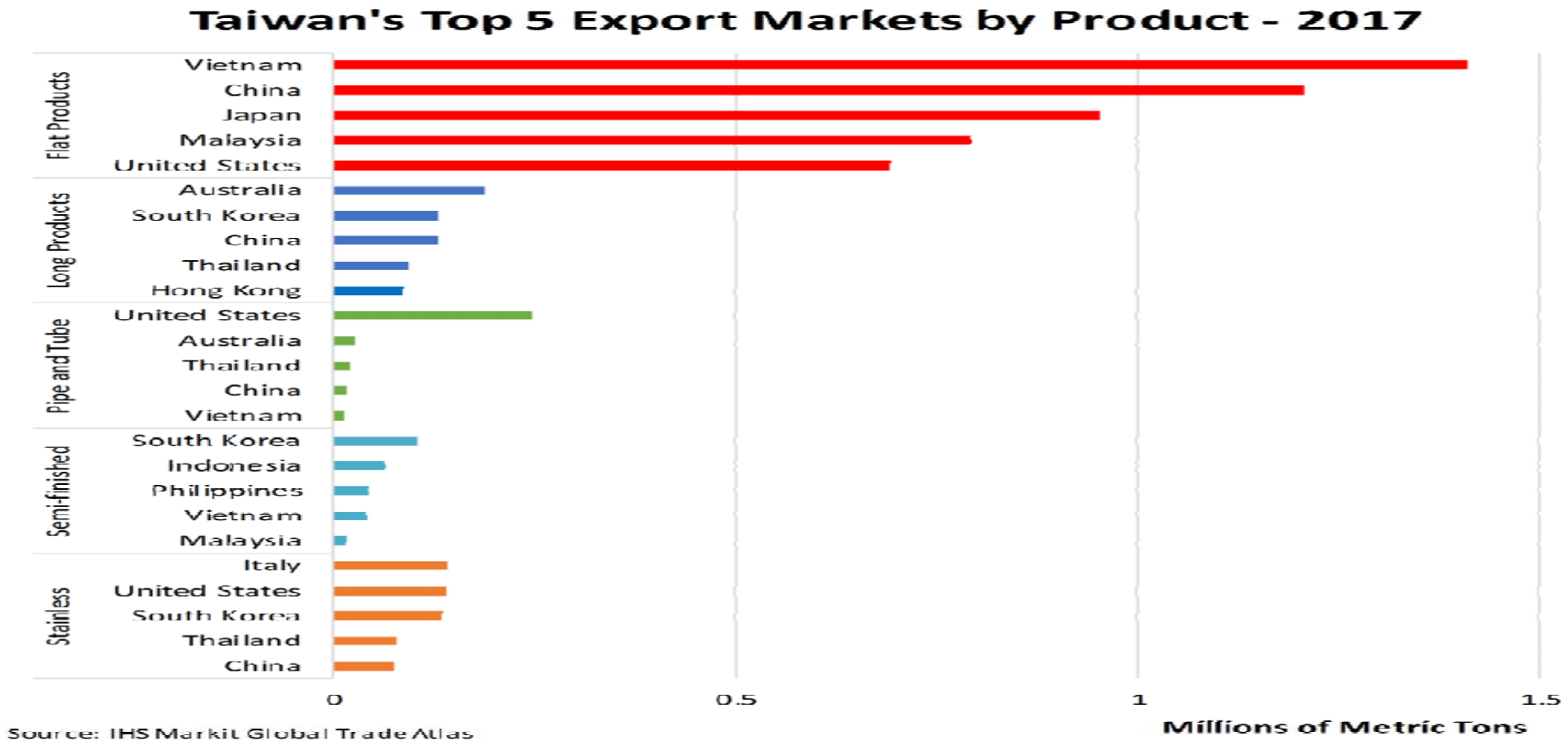
Source: IHS Markit Global Trade Atlas



Source: IHS Markit Global Trade Atlas

Top Markets by Steel Product Category

- Taiwan's top export markets by volume vary across types of steel products. Vietnam accounted for the largest share of Taiwan's exports of flat products in 2017 at 16 percent (1.4 million metric tons), followed by China at 14 percent (1.2 million metric tons).
- South Korea was the largest market for semi-finished exports at 37 percent (104 thousand metric tons), while Italy accounted the largest share of stainless exports at 10 percent (143 thousand metric tons).



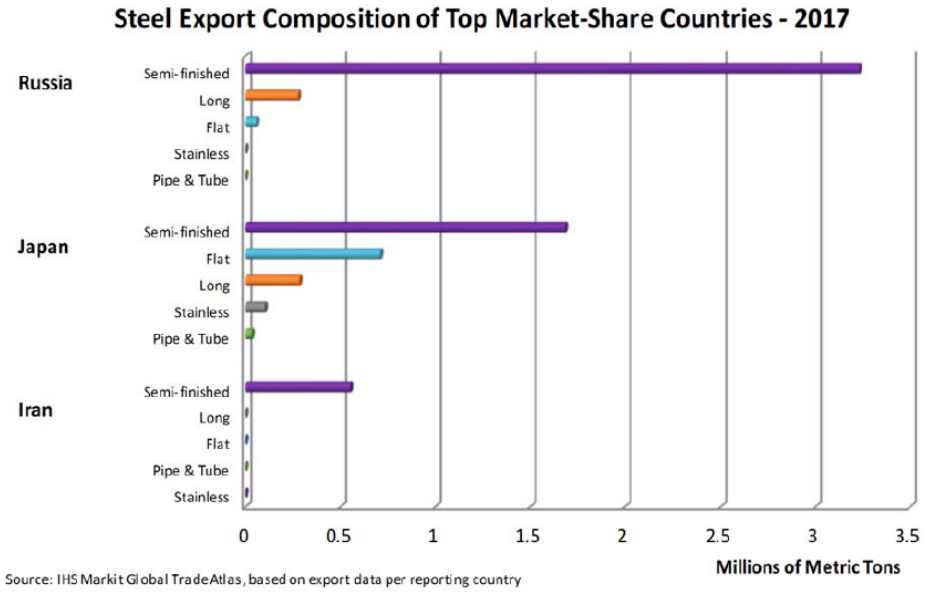
Taiwan's Export Market Share from Top Source Countries

- In 2017, the share of steel exports sent to Taiwan from its top import sources increased half of the top sources for which data are available.
- The share of Japan's steel exports to Taiwan showed the largest increase — up 1.5 percentage points from 2016, followed by Russia (up 1 percentage point).

Taiwan's Steel Export Market Share

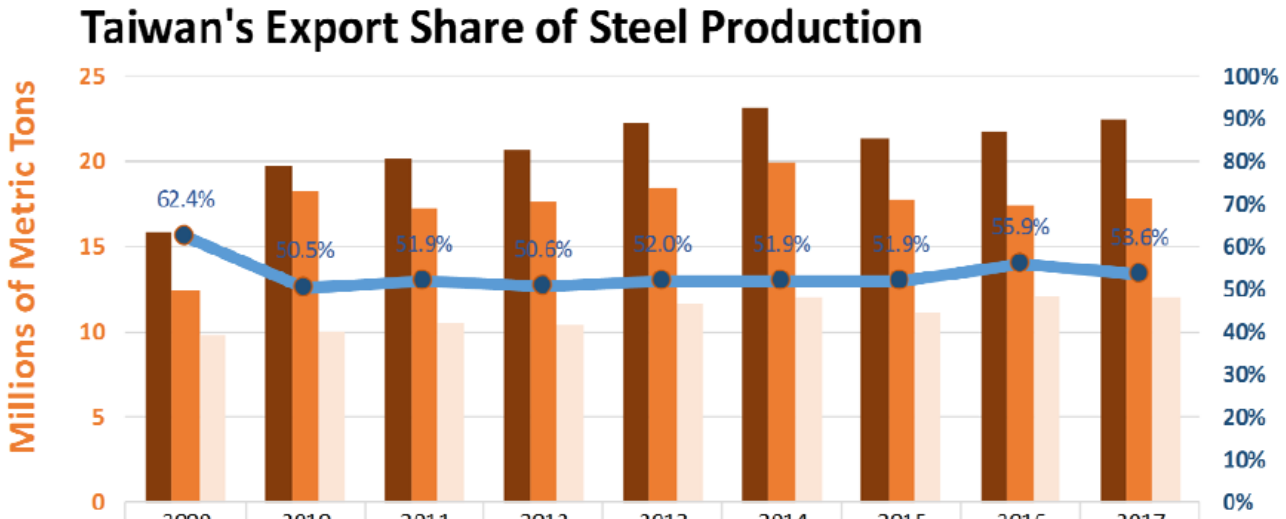
Top 10 Import Sources	Share of Exports to Taiwan 2016	Taiwan's Rank in 2016	Share of Exports to Taiwan 2017	Taiwan's Rank in 2017
Japan	6.1%	5	7.5%	4
China	2.3%	11	2.1%	11
Russia	10.4%	2	11.5%	2
South Korea	2.3%	12	1.8%	13
United Arab Emirtes	N/A	0	N/A	N/A
Iran	10.3%	4	7.4%	5
India	0.5%	33	0.9%	26
Vietnam	N/A	0	N/A	N/A
Thailand	6.5%	5	5.0%	8
United Kingdom	0.6%	21	1.0%	16

Source: IHS Global Trade Atlas



Overall Production and Export Share of Production

- Taiwan's crude steel production increased 3 percent to 22.4 million metric tons from 2016 to 2017.
- In 2017, the gap between production and demand widened to a peak of 4.6 million metric tons.
- Taiwan's steel exports as a share of production fell by nearly 12 percentage points as production increased while exports held steady. Since then, the export share has remained above 50 percent and reached 53.6 percent in 2017.



	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	15.8	19.8	20.2	20.7	22.3	23.1	21.4	21.8	22.4
Apparent Consumption	12.5	18.2	17.2	17.7	18.4	19.9	17.8	17.4	17.8
Exports	9.9	10.0	10.5	10.5	11.6	12.0	11.1	12.2	12.0
Export Share of Production	62.4%	50.5%	51.9%	50.6%	52.0%	51.9%	51.9%	55.9%	53.6%

Sources: World Steel Association; IHS Markit Global Trade Atlas

VI. Strategies for Climate Change in Steel Industry

- The reduction of CO2 from steel production is an established priority, as is the reduction of GHG emissions during the life cycle of products that use steel.

Possible directions for climate change mitigation

1. Carbon

- Used as a reducing agent
- But the CO_2 produced will need to be captured and stored.
  → including maximum use of scrap, best practice operations and CO_2 capture for storage.
- The ironmaking solutions include the blast furnace with integrated CCS as in the HIsarna program, a re-designed smelting reduction process
  → reduction of 20% of CO_2 per ton of steel produced

2. Hydrogen

- Used as a reducing agent replacing carbon(the reaction produces only water vapor)
- Hydrogen, either pure or as a synthesis gas (syngas), can be used in conventional direct-reduction reactors or in more futuristic flash reactors.

※ The hydrogen will need to be produced using carbon-free energy
→ the energy requirement would be higher than using it directly in the steelmaking process

Source: World Steel Association, Fact Sheet – Climate change mitigation by technology, innovation and best practice transfer (2018.02)

Strategies for Climate Change in Steel Industry

- The reduction of CO2 from steel production is an established priority, as is the reduction of GHG emissions during the life cycle of products that use steel.

Possible directions for climate change mitigation

3. Biomass

- Biomass – can be used to generate the reducing agent (carbon), either from charcoal, for example, or syngas
- Biomass can be added as charcoal in blast furnaces, to the coke oven charge, burned as fuel in steelmaking reactors or used in direct reduction as syngas etc.

※ A balance needs to be considered in the amount of land area used to grow the biomass and the volume of steel required in the region

4. CCS

- Storage - in deep saline aquifers, depleted oil or gas fields, compensate for existing gasfield extraction or enhanced oil/gas recovery and used in coal mines as geological storage, or turned back into carbonates (mineralogical storage)
- Developed such as gaseous cement used as reef replacement or building water barrier

(ex) Emirates steel – capture and use the CO_2 for enhanced oil recovery(EOR)
→ store 800,000 tCO_2 annually

Source: World Steel Association, Fact Sheet – Climate change mitigation by technology, innovation and best practice transfer (2018.02)

Strategies for Climate Change in Steel Industry

Steel in the circular economy

- Continuing to fulfill a positive role in sustainable future comes with some major challenges

1. Recycling

- The use of steel scrap – reduces carbon emissions from the steel life cycle
  ※ Limited by the availability of scrap due to the long life of steel products

2. Use of by-product

- Byproducts – reduces CO_2 emissions by substituting resources in other industries
  (ex) blast furnace slag – the cement industry , steelmaking slags – civil works aggregates

3. Energy efficiency

- Reduced energy consumption per ton of steel produced by 60%(for 50 years)
- But there is limited room for further improvement on the basis of existing technology

4. Use of finished steel

- Avoid CO_2 emissions from the use of high grade applications
  (ex) high strength steels – reduce the weight → carry more steel for the same amount of CO_2

5. Life cycle approach

- Considers the emissions associated with the manufacture of steel products
  + the reduction in energy consumption from the use of lighter and stronger steels

Source: World Steel Association, Steel's contribution to a low carbon future and climate resilient societies – worldsteel position paper (2017)

Strategies for Climate Change in Steel Industry

Global steel industry activities – dedicated initiatives

1. Breakthrough technology development

- The development and introduction of radical new steelmaking technologies with a lower carbon footprint including reuse of CO_2

(ex) Hisarna(Europe), COURSE50(Japan), State of the Art Clean Technologies (SOACT, Pacific rim), POSCO(Korea&China), Steel Corporation(Taiwan)

2. LCI database

- Establish the database of life cycle inventory data of a wide range of steel products

3. Technology sharing

- Sharing the technical reports in cooperation with steel companies of WSA
  → Improve the environmental performance

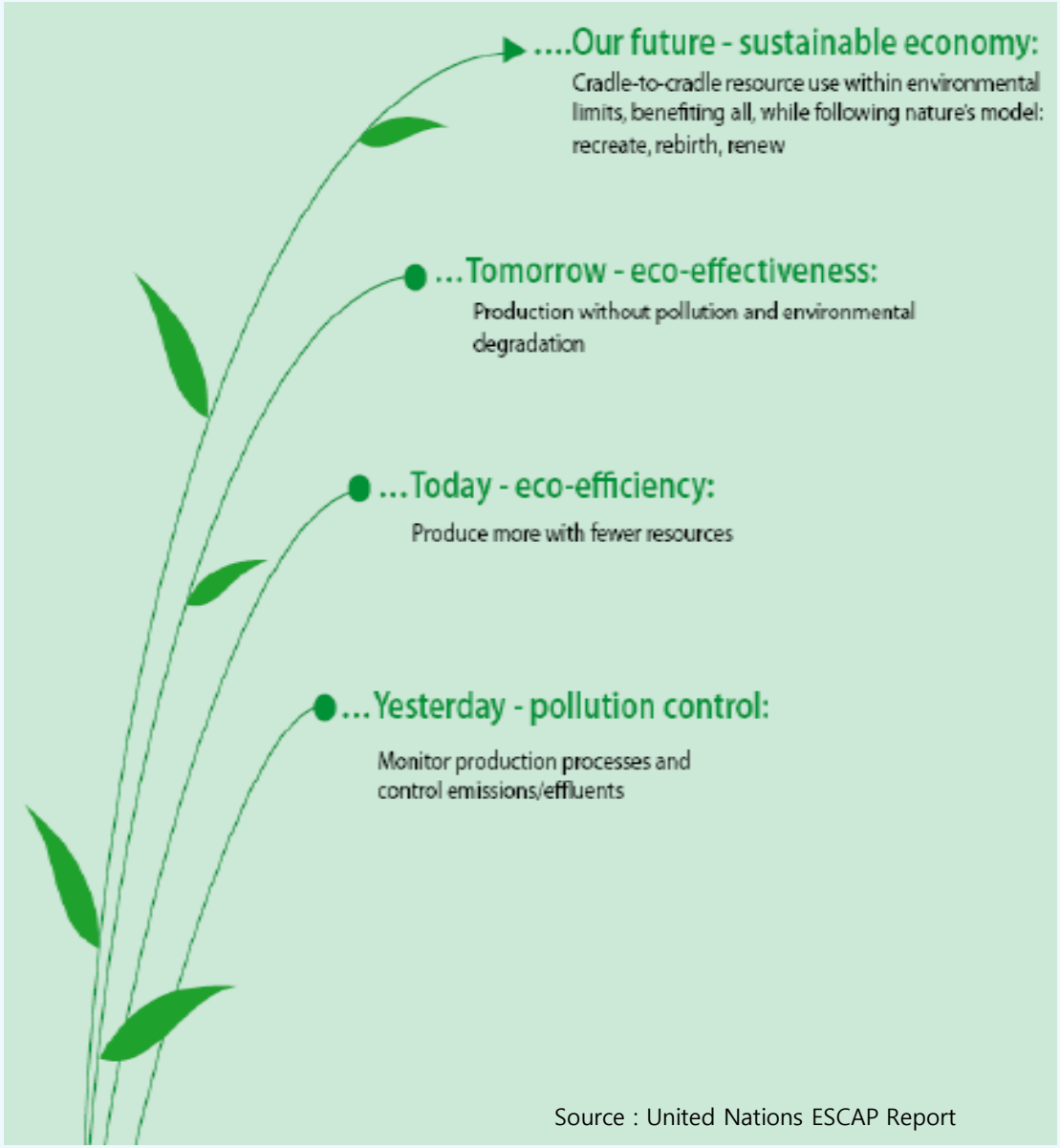
4. Market development programs

- Development programs for improving the energy efficiency in steel-using sectors

5. Climate action recognition program

- Development and agreement of a common calculation methodology for the CO_2 footprint of steel plants

Source: World Steel Association, Fact Sheet – Climate change mitigation by technology, innovation and best practice transfer (2018.02)



Source : United Nations ESCAP Report

Thank you

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