Nickel pig iron – A long term solution?

EURO NICKEL

informa

International Mining and Metals Series

Robert Cartman - Hatch

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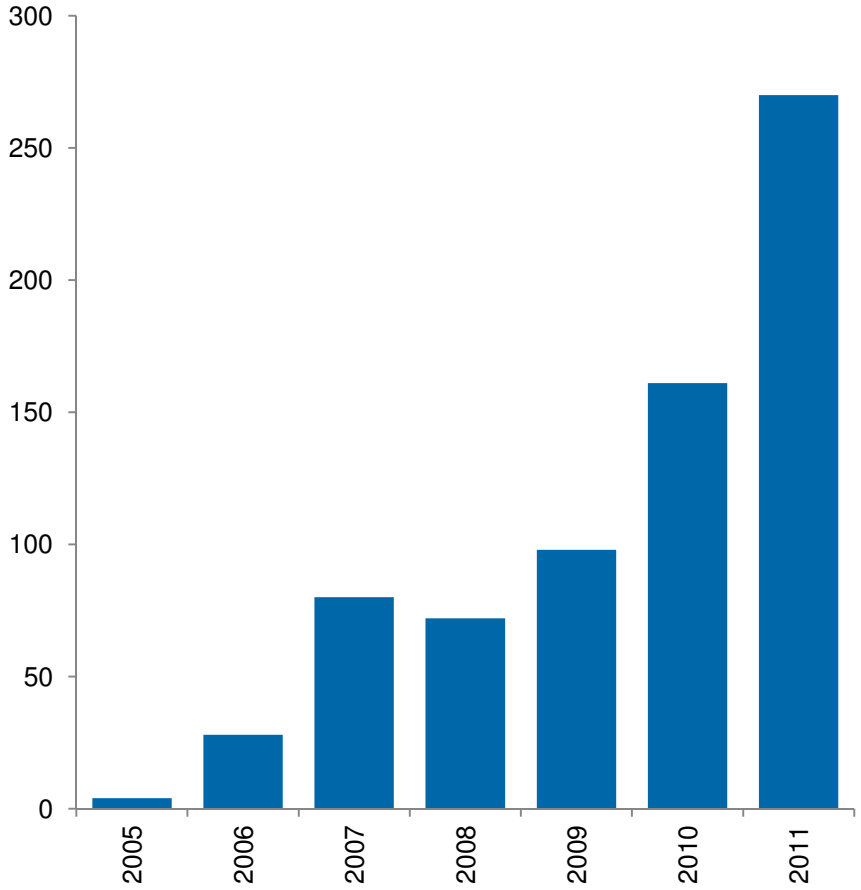
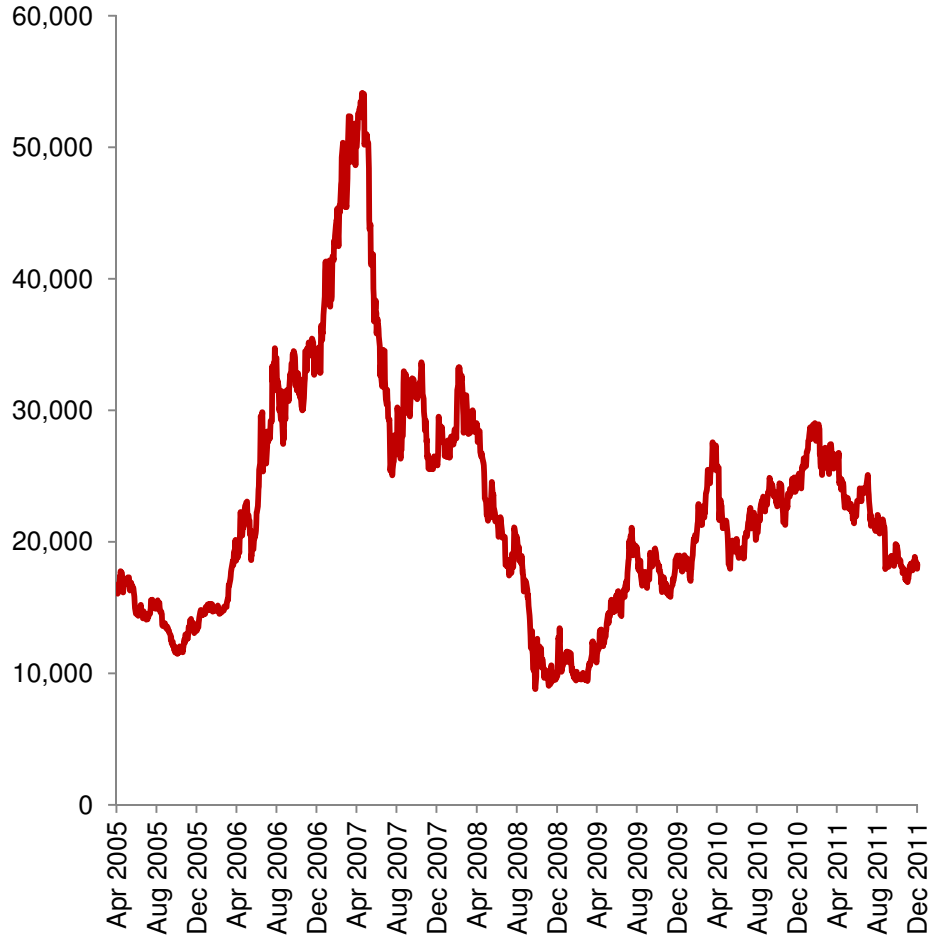
Chinese NPI production really started to take off in 2006/07 as the LME nickel price rose to record highs

Chinese NPI production (kt nickel content)



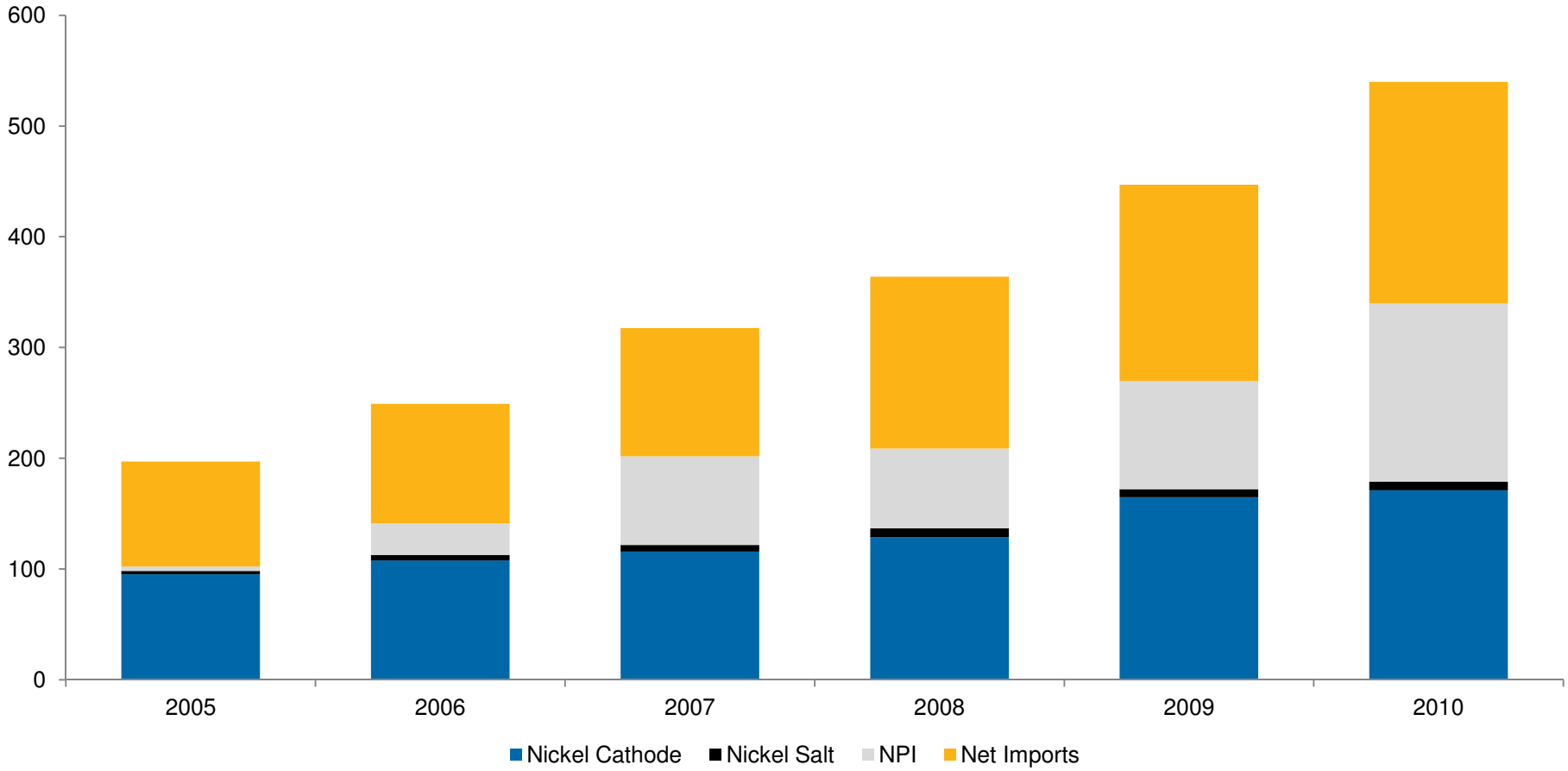
LME Ni price ($/tonne)



Source: Antaike, MB, Hatch

Nickel pig iron now accounts for more than 30% of China's primary nickel consumption, up from just 2% in 2005

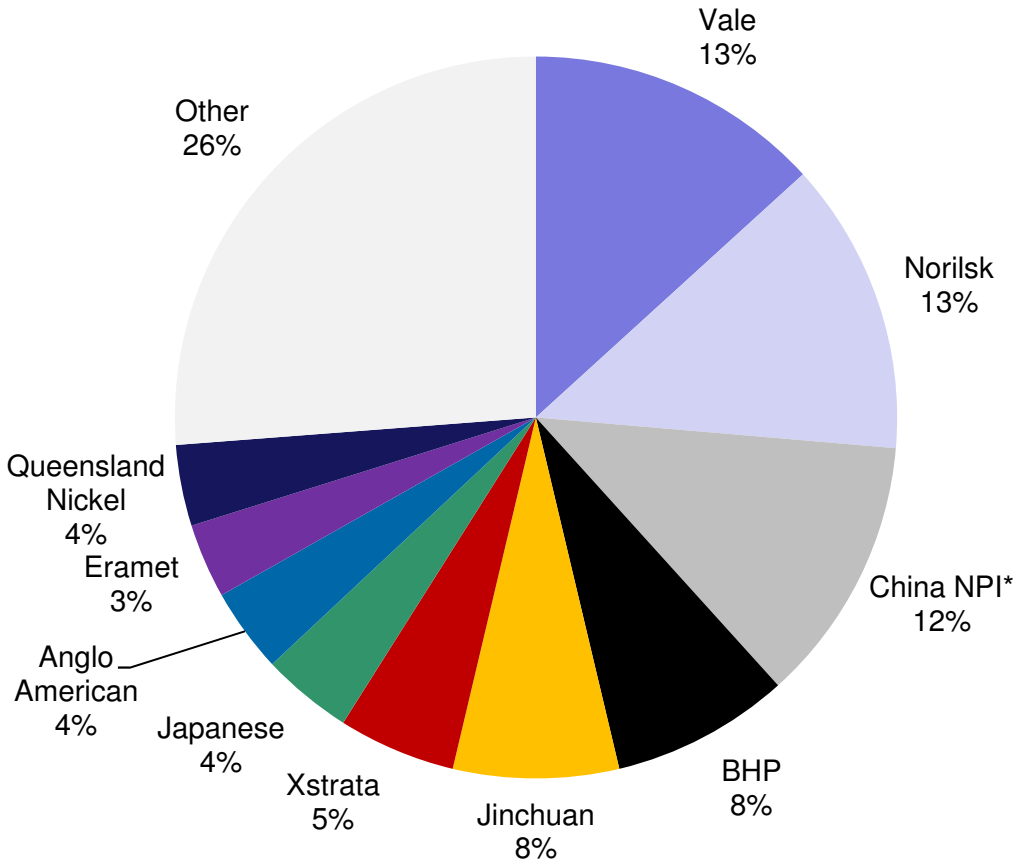
Chinese primary nickel consumption by source, kt



Source: Antaike, China Customs, Hatch

Taken as a whole, China's NPI industry rivals the major nickel players such as Norilsk and Vale

Share of nickel processing capacity, 2011



*China NPI = actual production, not capacity
Source: Company reports, Hatch

- Emergence of NPI in 2006/07 as Ni prices rose
- Quick/simple method of backward integration
- Cheaper/easier than bringing other greenfield projects on stream
- NPI now accounts for more than 30% of China's primary Ni consumption
- The industry as a whole rivals Norilsk/Vale in terms of size
- But...
  - Still very fragmented
  - In a process of change
  - Faces threats particular to NPI industry

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Currently, all NPI producers are equipped with either BF (Blast Furnace) or SAF (Submerged Arc Furnace) technology, and production capacity of most producers is below 10kt per year

Major Chinese NPI Producers (ktpy Ni contained)

Company	Location	Process	Product	Capacity (Ni Content)
Shandong Haixin	Shandong	BF, SAF	NPI (10-15% Ni)	30
Zhanhua Weiye Nickel Industry	Shandong	SAF	NPI (10-15% Ni)	20
Inner Mongolia Shangdu Industry Park	Inner Mongolia	SAF	NPI (10-15% Ni)	20
Fujian Dingxin (Tsingshan Holding Group)	Fujian	SAF	NPI (10-15% Ni)	20
Jiangxi Jiangli	Jiangxi	PAL	Nickel Metal	15
Guangxi Yinyi	Guangxi	PAL	Nickel Metal	12
Zhanhua Hugo Dragon Metal Limited (Zhanhua Qingxiang)	Shandong	BF	NPI (6-8% Ni)	10
Xuzhou Jinxiang Metallurgy	Jiangsu	SAF	NPI (10-15% Ni)	10
Chaoyang Haotian Non-ferrous Metals	Liaoning	BF + EF	Matte	10
Shanxi Dakang Group	Shanxi	BF	NPI (4-6% Ni)	9
Henan Qingpu (Tsingshan Holding Group)	Henan	BF	NPI (4-7% Ni)	8
Sichuan Jinguang Group	Sichuan	SAF	NPI (10-12% Ni)	6
Huaibei Xinyuan Ferronickel Smelter	Anhui	SAF	NPI (10-15% Ni)	6
Guangxi Xinheli	Guangxi	BF	NPI (1-2% Ni)	4
Sichuan Jinguang Group	Sichuan	BF	NPI (1-2% Ni & 4-6% Ni)	4
Fujian Xin'anjiang Nickel Alloy	Zhejiang	SAF	NPI (10-15% Ni)	4
Total				**188**

Source: Antaike, company reports, Hatch

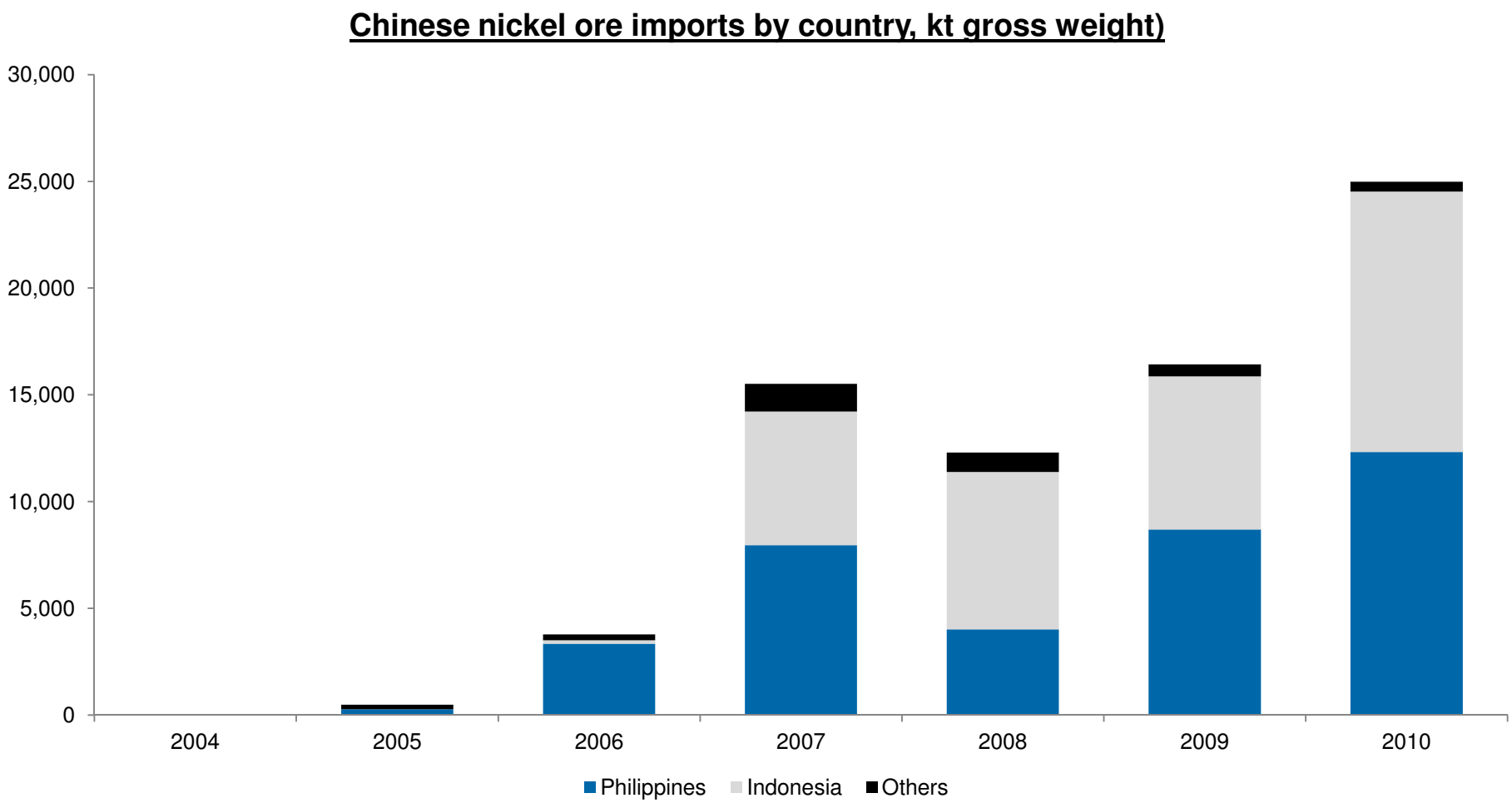
Chinese NPI producers are mainly located in Shandong, Shanxi, Inner Mongolia and Jiangsu. Linyi in Shandong province is the largest NPI producing region

Distribution of NPI producers in China

- Many NPI producers in Inner Mongolia previously smelted other alloys (e.g. FeSi, FeMn) and use SAF technology
- Some NPI producers in Shandong, Jiangsu and Fujian relatively new with SAF facilities built in recent years and have larger production capacity
- BF NPI producers are mainly located in Shandong, Shanxi and Jiangsu, and these BFs were previously used to produce pig iron. These operations under threat from government closures

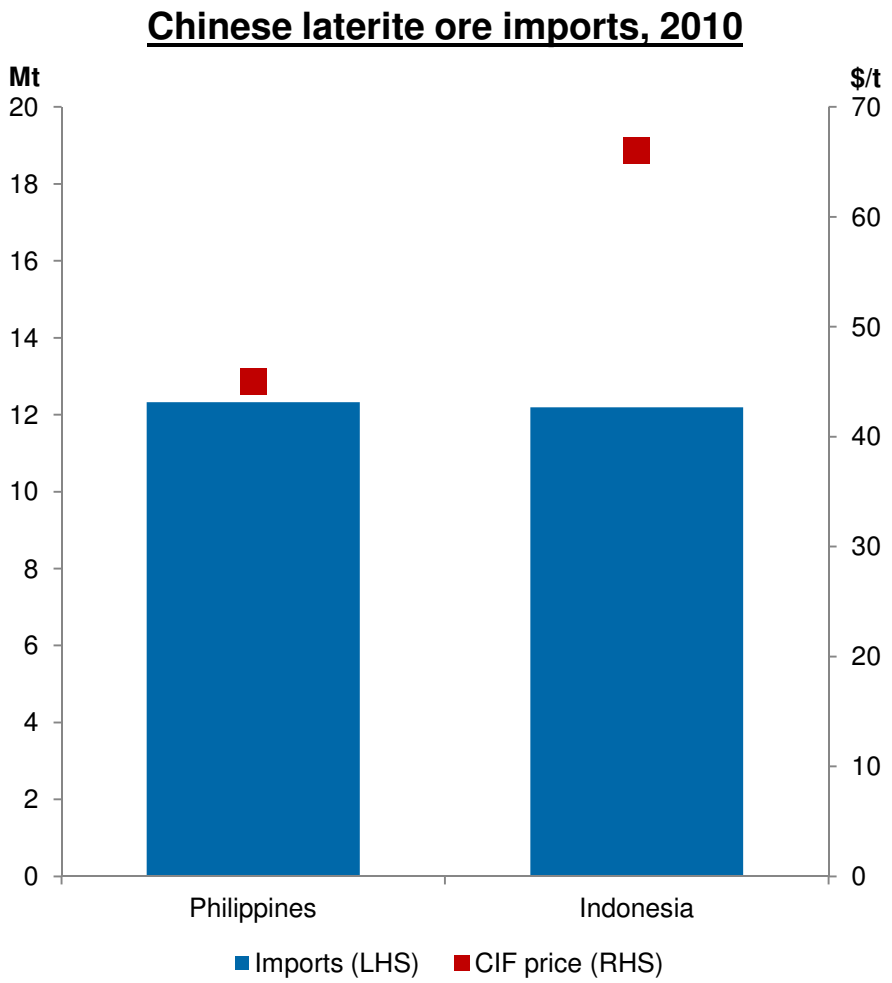
Source: Hatch field research

The Chinese NPI industry is almost completely reliant on importing nickel ore from Indonesia and the Philippines at present



Source: China Custom, Hatch

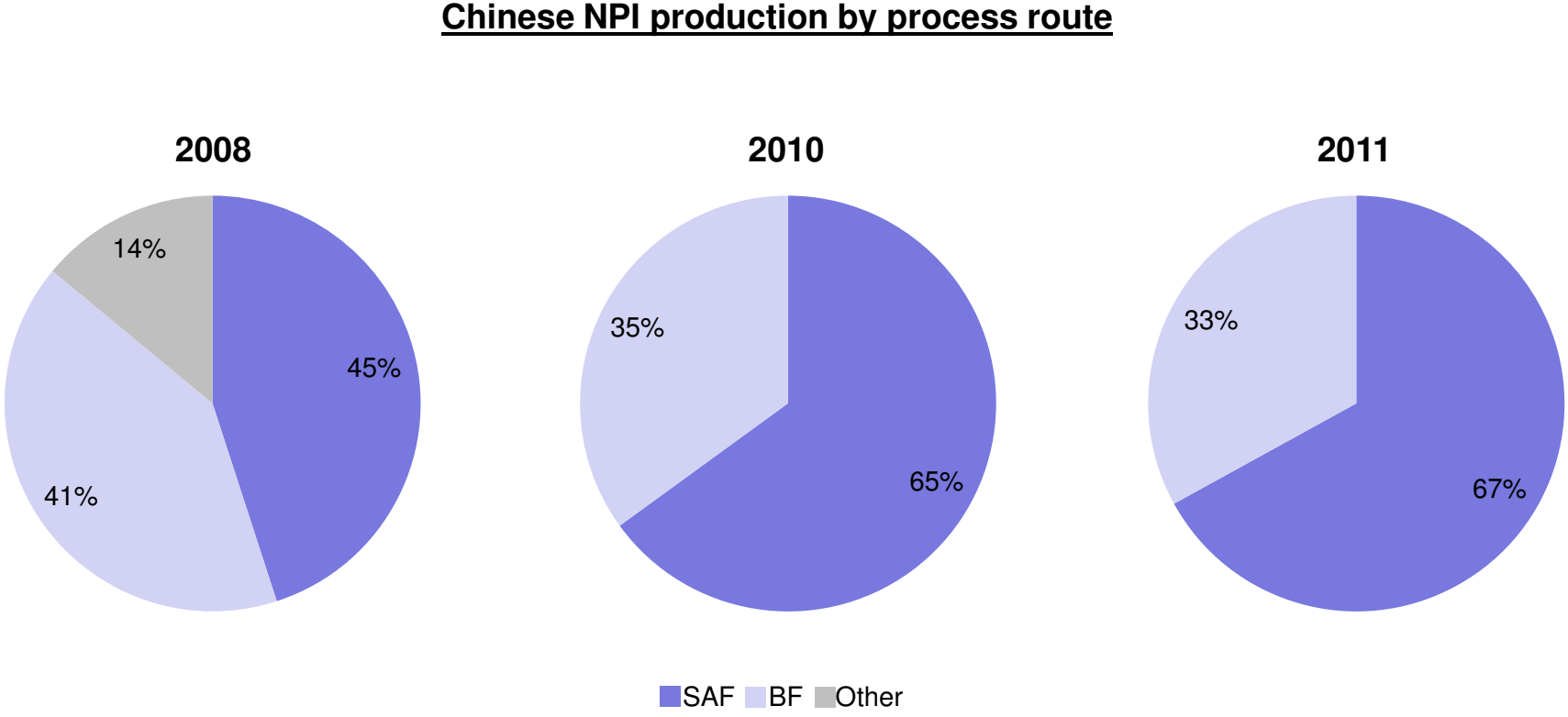
The nickel ores imported from Indonesia and the Philippines generally supply different customers given the variance in grade



Source: China Customs, Hatch

- Indonesia and Philippines the key sources of laterite ore for NPI producers
- Ore imported from Indonesia generally higher-grade i.e. >1.5% and favoured by SAF producers
- Ore imported from Philippines generally lower-grade i.e. <1.7% and used largely by BF producers

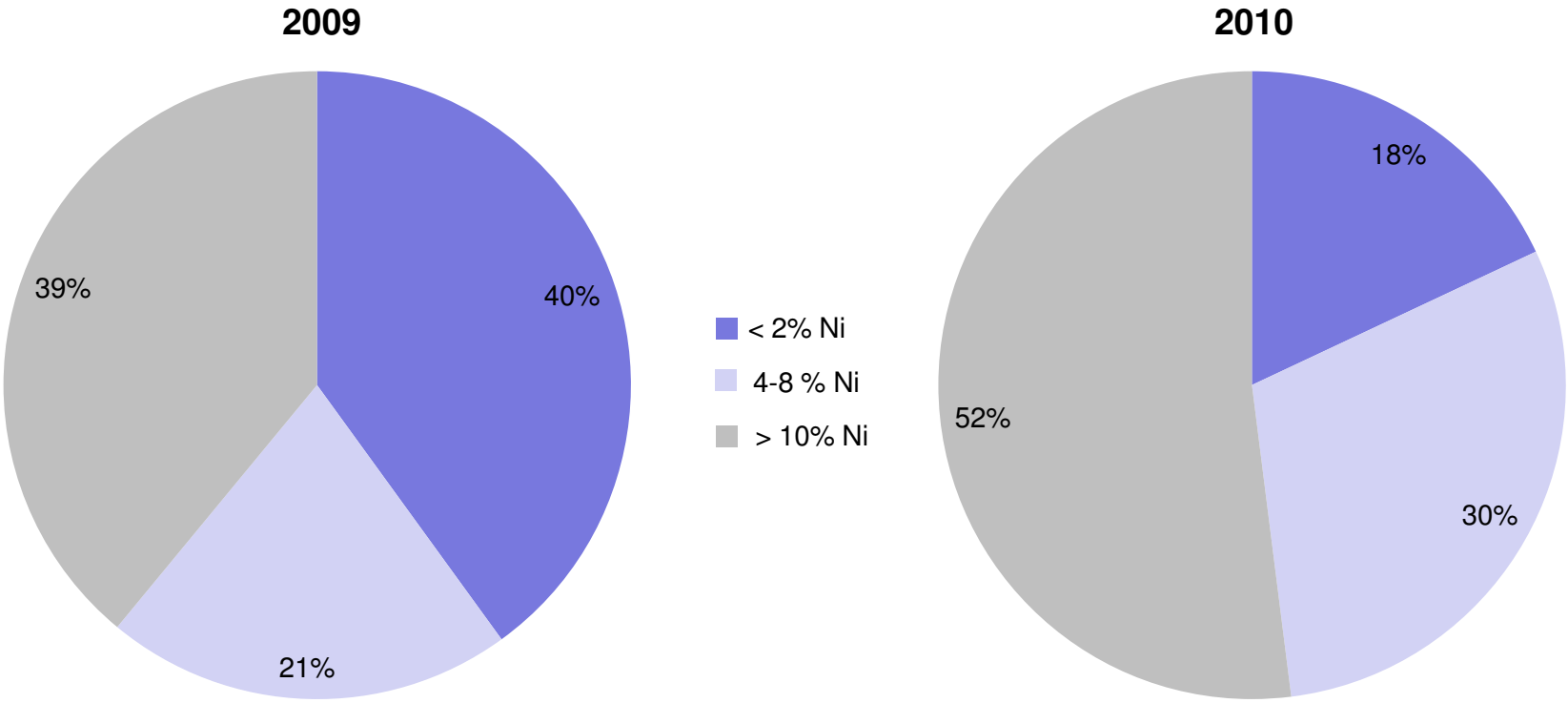
Producing NPI via electric furnaces has become more popular as the government has targeted small blast furnaces for closure



Source: CBIChina, Hatch

NPI production has shifted toward higher-grade material as the industry has matured and the use of electric furnaces has become more widespread

Chinese NPI production by grade (based on nickel content)



The reduction of low grade (<2%) nickel NPI is because:
a) the government has been shutting down some mini BFs; and b) low grade nickel NPI has a relatively small market
Source: TISCO, Hatch

More than 600kt of new NPI production capacity has been announced and this will have a big impact on the nickel ore markets

Planned NPI projects in China (ktpy nickel contained)

Company	Location	Process	State	Capacity (Ni Content)
Sinosteel	Hebei	PFK*	Phase I, commissioned in 2011	15
Sinosteel	Hebei	PFK*	Phase II, planning	45
JNMC	Guangxi	RKEF	Planning	100
Jien Nickel	Inner Mongolia	RKEF	Phase I, commission in 2013	20
Jien Nickel	Inner Mongolia	RKEF	Phase II, planning	80
Macrolink Group	Guangxi	RKEF	Planning	50
Sichuan Jinguang Group	Guangxi	RKEF	Commission in 2013	50
Guangdong Guangxin Holding Group	Guangdong	RKEF	Commission in 2012	50
Anhui Tenglong Alloy	Anhui	RKEF	Commission in 2013	20
Hanking Group	Liaoning	RKEF	Phase I, commission in 2013	30
Hanking Group	Liaoning	RKEF	Phase II, planning	30
Delong Nickel Industry	Jiangsu	RKEF	Commission in 2012	20
Taiwan E-United Group	Fujian	RKEF	Planning	30
Fujian Fufeng	Fujian	RKEF	Planning	50
Ruitian Steel	Fujian	RKEF	Planning	30
Total				**620**

*Pobuzhsky ferronickel plant process: old ferronickel process developed in the Ukraine

Source: Antaike, company reports, Hatch

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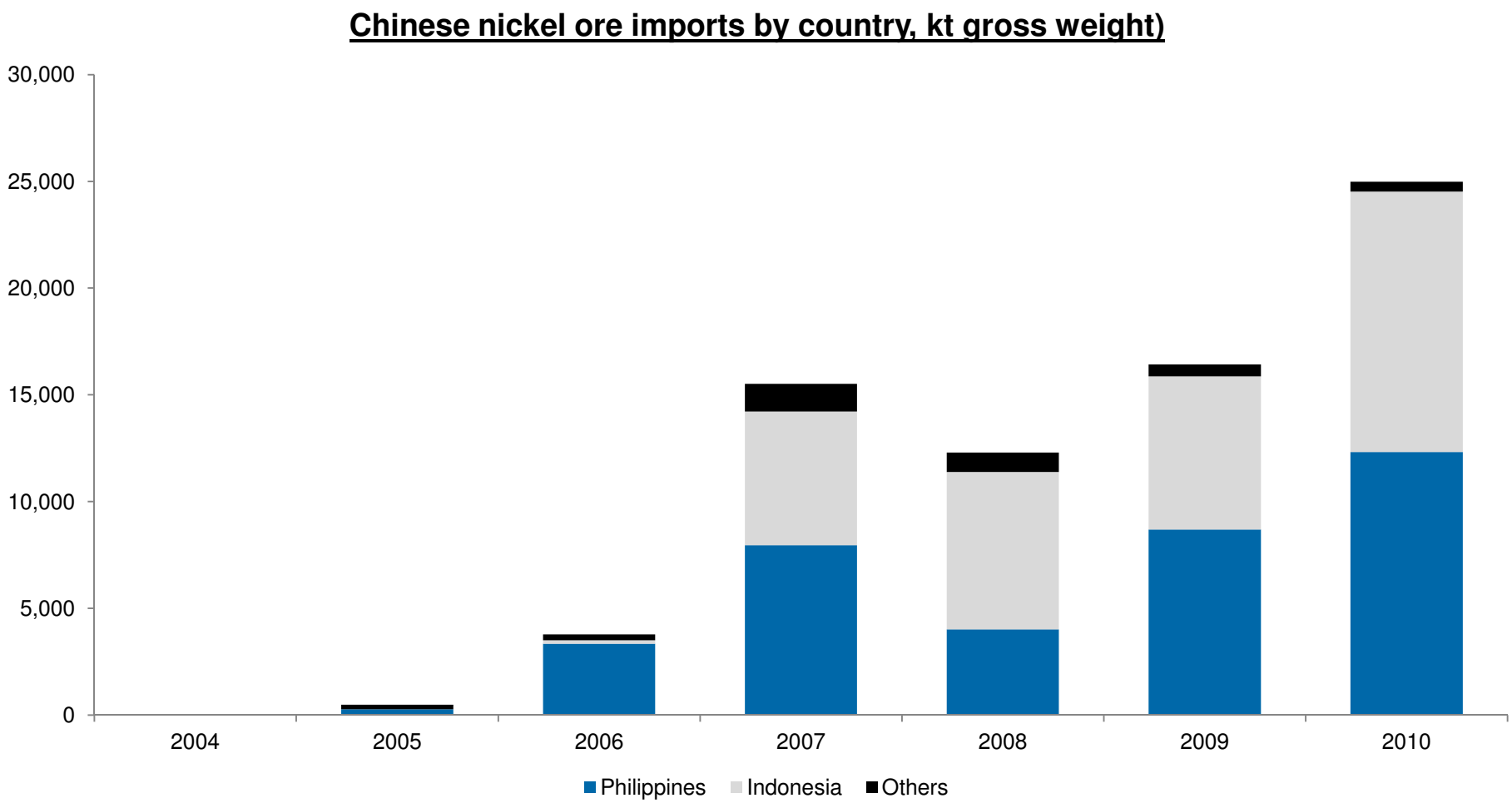
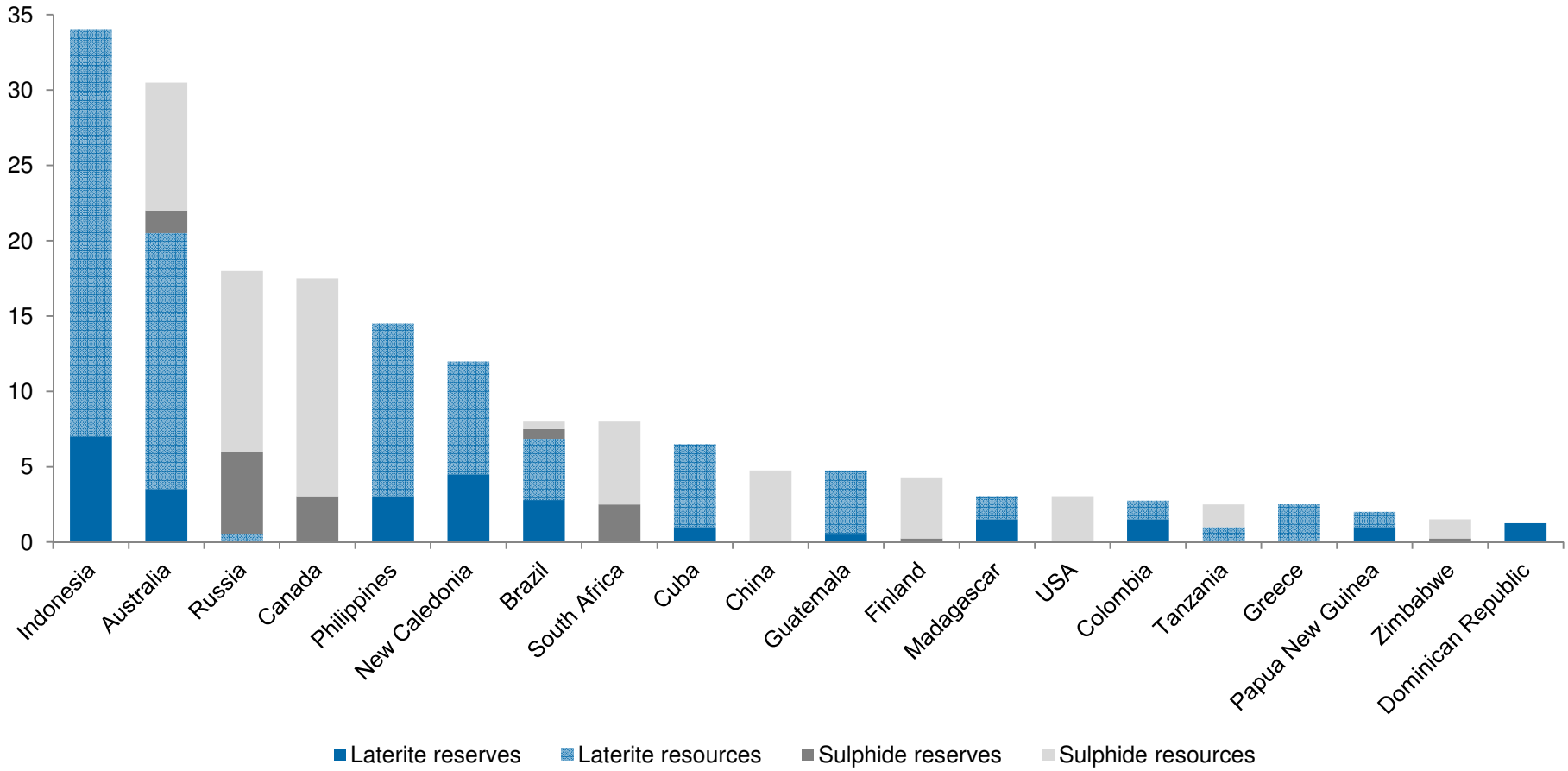


Source: China Custom, Hatch

Should Indonesia ban the export of nickel ores, the Chinese NPI industry may become even more reliant on the Philippines for ore supply

Nickel reserves and resources, Mt nickel content



Source: Metalytics, USGS, Hatch

Thoughts and conclusions…

- **NPI has grown to become a major source of primary nickel**
- **Will remain but is constantly evolving and maturing as an industry**
  - Likely to eventually consolidate into larger producers, producing material similar to a FeNi
- **Another 400-500kt of primary nickel will be needed over the next ≈ 15yrs to satisfy China's likely increase in demand**
  - unless there is a sharp increase in the scrap ratio
- **NPI industry faces threats, most notably at the moment the Indonesian ban on nickel ore exports**
  - will have to find alternative supplies, perhaps from further mining expansion in Philippines
  - smelters to backward-integrate, purchase mining rights in countries with laterite resources?

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