



**COCHILCO**  
Ministerio de Minería

Gobierno de Chile

# COPPER CONCENTRATES: SMELTING TECHNOLOGIES UPDATE AND CUCONS MARKET

**Jorge Cantallopts**

Research and Policy Director  
Chilean Copper Commission

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01

INTRODUCTION

# INTRODUCTION

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- Sulphide copper accounts for almost **80 percent of world mine production** and more than 2/3 of Chilean production and its expected to grow its share over the time.
- Smelting arise as a strategic process for copper producer countries. Chile maintains around **9 percent of global smelting production**.
- New technology developments and higher competition for copper concentrates motivates this study.



02

BACKGROUND AND CONTEXT



# MAIN TECHNOLOGIES

Stage	Input	Output	Technology
Smelting	Concentrate	Matte, smelting slag and gases	<b>Mainly Bath and Flash</b>
Converting	Matte	Blister, converting slag and gases	Mainly Peirce-Smith
Refining	Blister	Anodic Copper, refining slag and gases	Anode Furnace
Slag treatment	Slag	Matte, discard slag and gases	Milling-flotation, Electric furnace, Slag furnace

## *Recent developments*

- Chinese reactors (BBS, SBS), bath technology.
- Chilean packed bed converting technology.
- Ausmelt C3 Converting®

# CHILEAN CHALLENGE: COMPLEX CUCON

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- Mineralogical composition affects concentrates **market performance**.
- Arsenic compounds arise in **northern Chile** and some mines in Peru.
- Mixing concentrates from various sources and penalties charges could **cost more than 200 \$US/DMT**.



03

SMELTING TECHNOLOGIES





# OPERATING SMELTERS

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- 57 operating smelter database, accounts for **88 percent of world anode capacity** in 2016.

Zone	# Smelters	Anode Capacity 2016 (000' tonne)
Chile	7	2,008
Rest of America	8	2,226
China	16	5,834
Japan	5	1,923
Rest of Asia	5	2,732
Europe	9	2,685
Rest of the World	7	1,643
<b>Total</b>	<b>57</b>	<b>19,051</b>

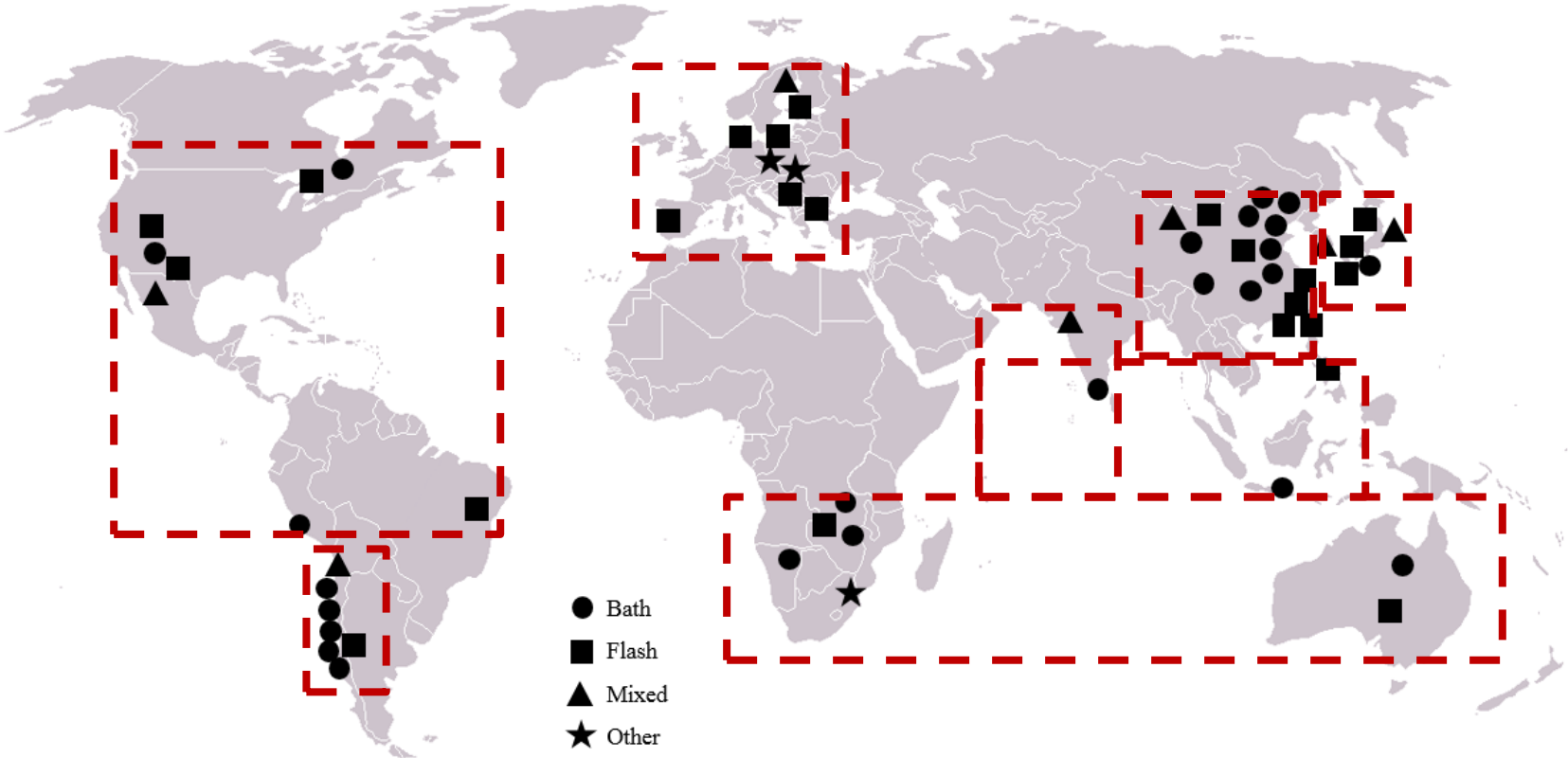
# SMELTING TECHNOLOGIES

24 Bath  
smelters

23 Flash  
smelters

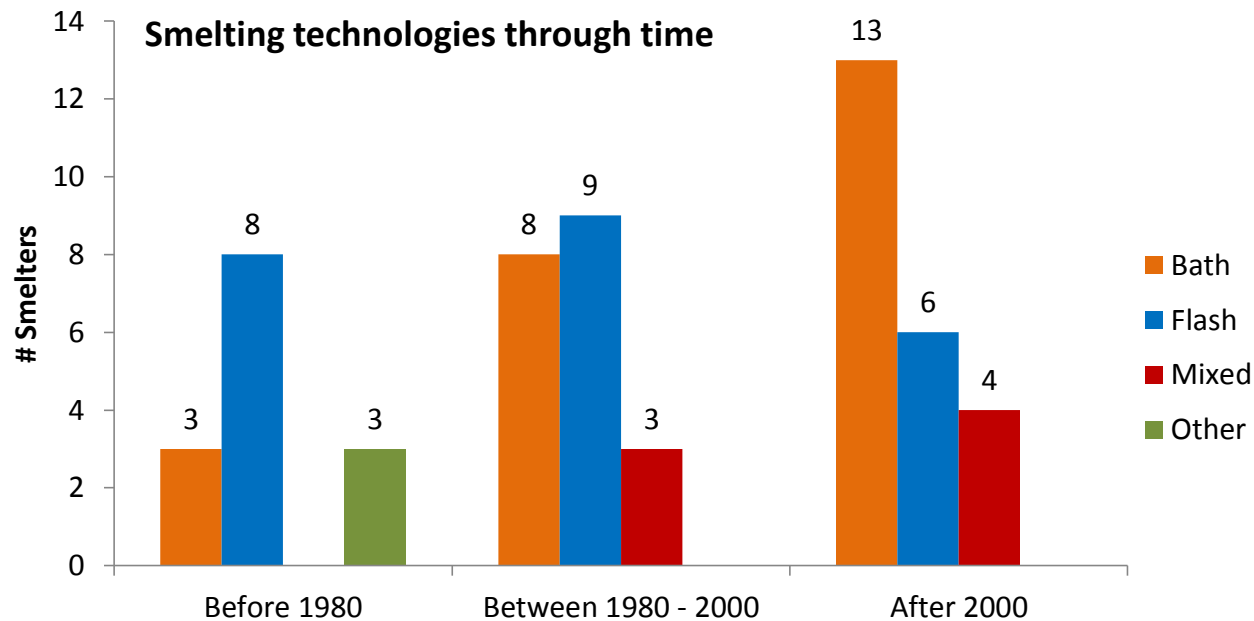
7 mixed  
smelters

3 other  
smelters



# CHANGING PREFERENCES

- Until 2000's **flash smelting technology** represent most of the smelting preferences in new operations.
- Since, most of the new smelter prefer **bath smelter**, mostly Ausmelt/Isasmelt<sup>®</sup> furnaces and Chinese reactors.



# COST COMPARISON BY TECHNOLOGY

## Smelting capacity and direct cash costs\*

Average cost: 26.6 c/lb  
Range: 19-36 c/lb

FLASH capacity (44%)  
Average cost: 15.2 c/lb  
Range: 9 to 31 c/lb

BATH capacity (36%)  
Average cost: 18.8 c/lb  
Range: 9 to 45 c/lb

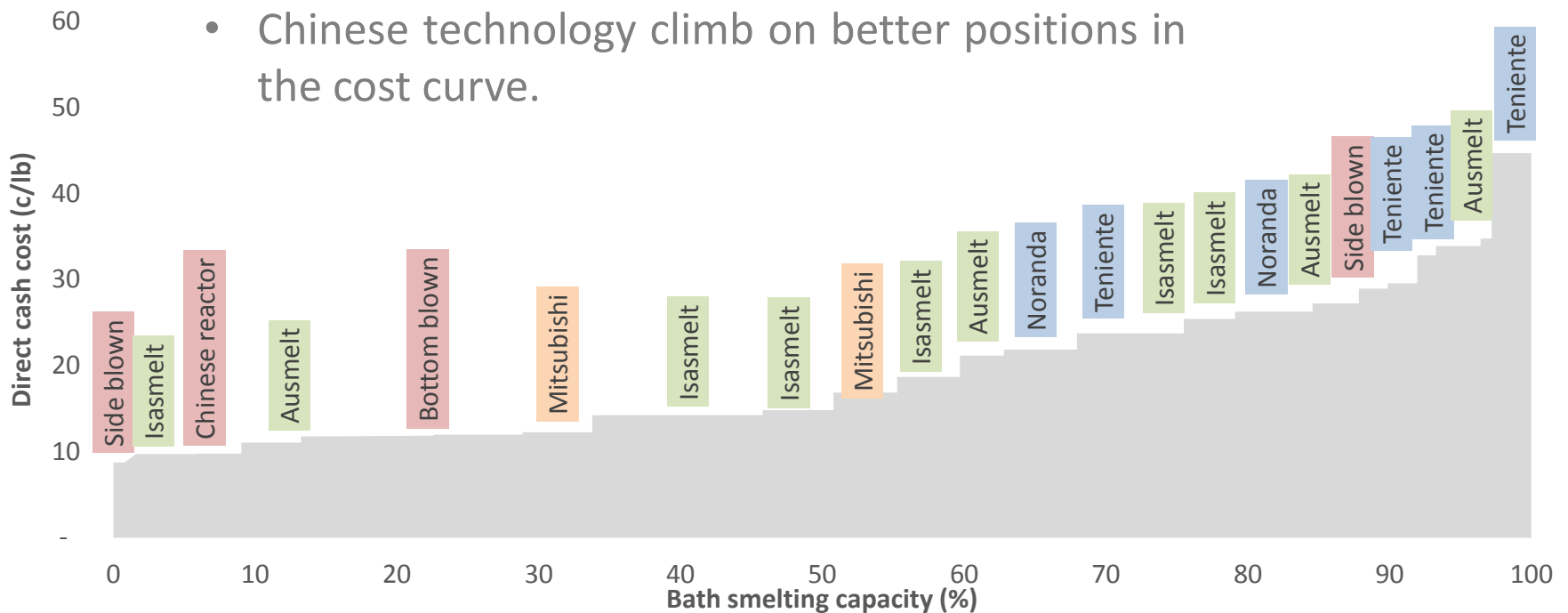
MIXED capacity (17%)  
Average cost: 25.6 c/lb  
Range: 13 to 68 c/lb

OTHER capacity (3%)

\*Including labour, energy, maintenance, consumables and services.

# BATH SMELTING COST DISPERSION

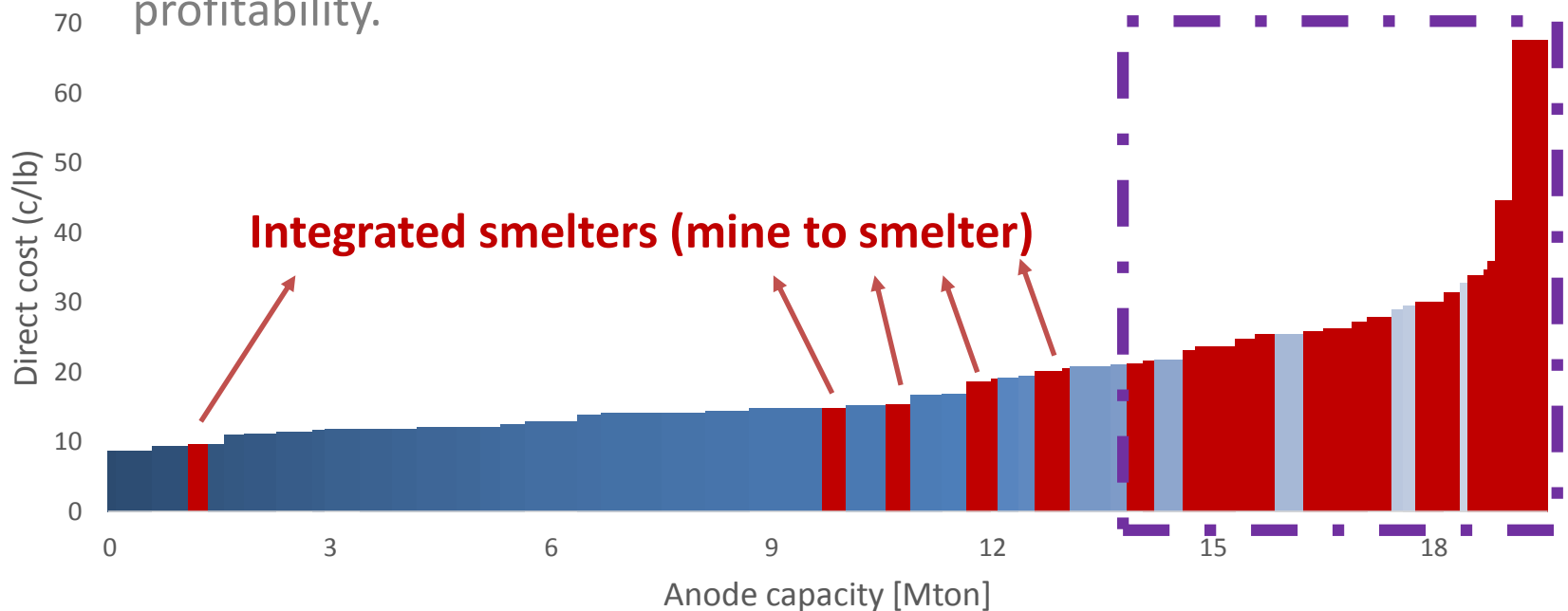
- Great differences between bath technologies.
- Teniente/Noranda technology appears to be **less competitive** as other bath smelters.
- Chinese technology climb on better positions in the cost curve.



Source: Wood Mackenzie (2016)

# THE BUSINESS MODEL IMPLICATION

- Integrated smelters appears in the **last position** in terms of costs.
- High-price cycle decrease competitiveness of integrated smelters. **Effort and investment to mines** to increase profitability.

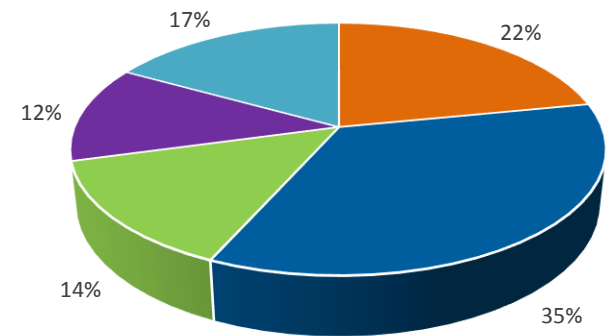
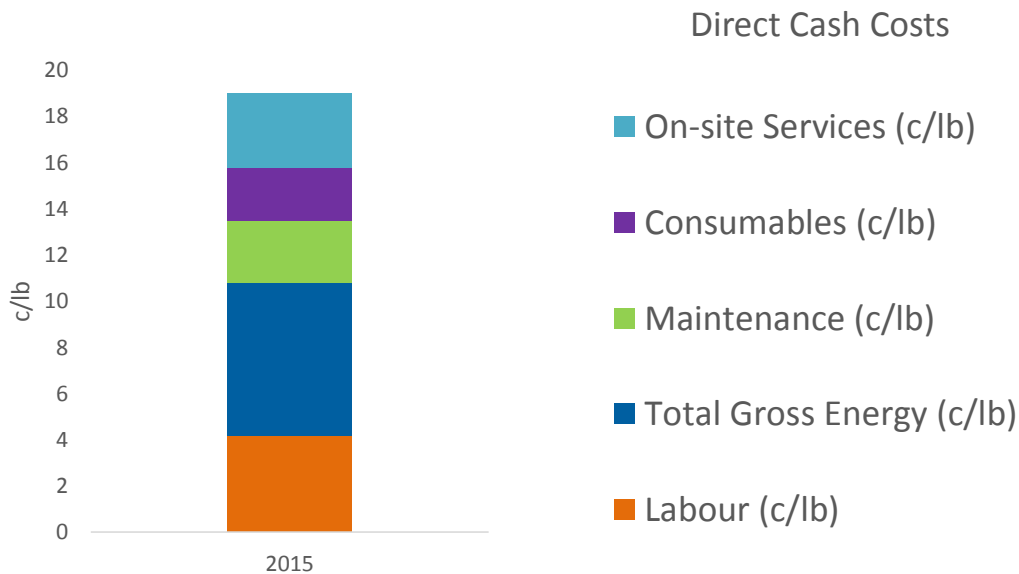


Source: Wood Mackenzie (2016)

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# SMELTING COSTS

- Average direct cash cost was 19 c/lb un 2015. Almost 40% of total capacity was above that cost.
- Energy (power and fuel) is responsible for more than one third of avergae costs.



Source: Wood Mackenzie (2016)

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COPPER CONCENTRATES MARKET



# COPPER CONCENTRATES MARKET

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CONCLUDING REMARKS

# CONCLUDING REMARKS

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- New developments in China appears **attractive** but need **validation in western countries**.
- New smelting capacity would tend to consider bath technology. But not any.
- Change in technology is not the only driver. Non-integrated smelters appears as a better bussiness model.
- Chile in the center of a major challenge: **Teniente bath smelting and integrated smelters** are less competitive than any other.

# THANK YOU!

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