



**COCHILCO**  
Ministerio de Minería

Gobierno de Chile

# Facing the challenge of a new age:

Chile and mining in the 21st century

**COCHILCO – Chilean Copper Commission**

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January 20th, 2015



# Content

1. Mining in Chile, a brief summary.
2. Enviromental and social licenses.
3. Costs and productivity challenges.
4. Final comments



# 1. Mining in Chile, a brief summary

# Mining in Chile, a brief summary

## General facts

Population 2014(e):

- 17,8 million (e)

Surface territorial area:

- 756,950 km<sup>2</sup>

GDP 2014(e):

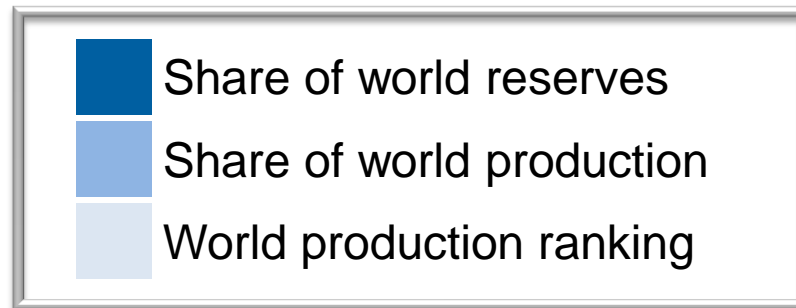
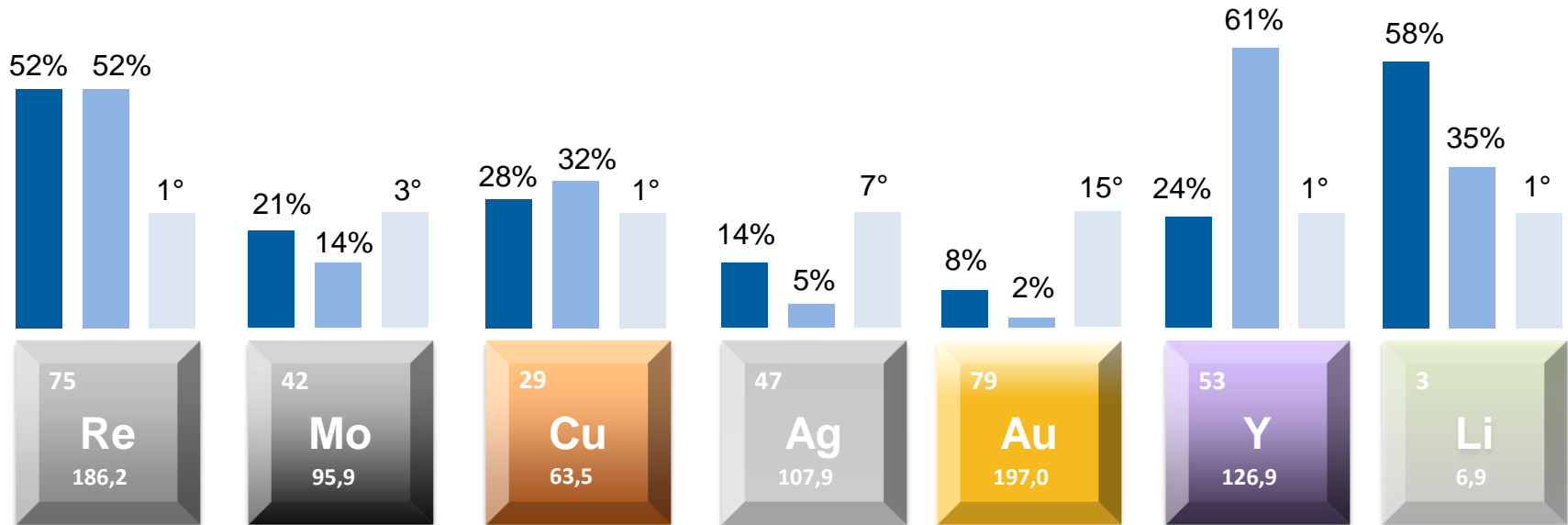
- US\$250 billion
- Mining GDP: 11%



*Sources: Central Bank of Chile, National Statistical Institute*

# Mining in Chile, a brief summary

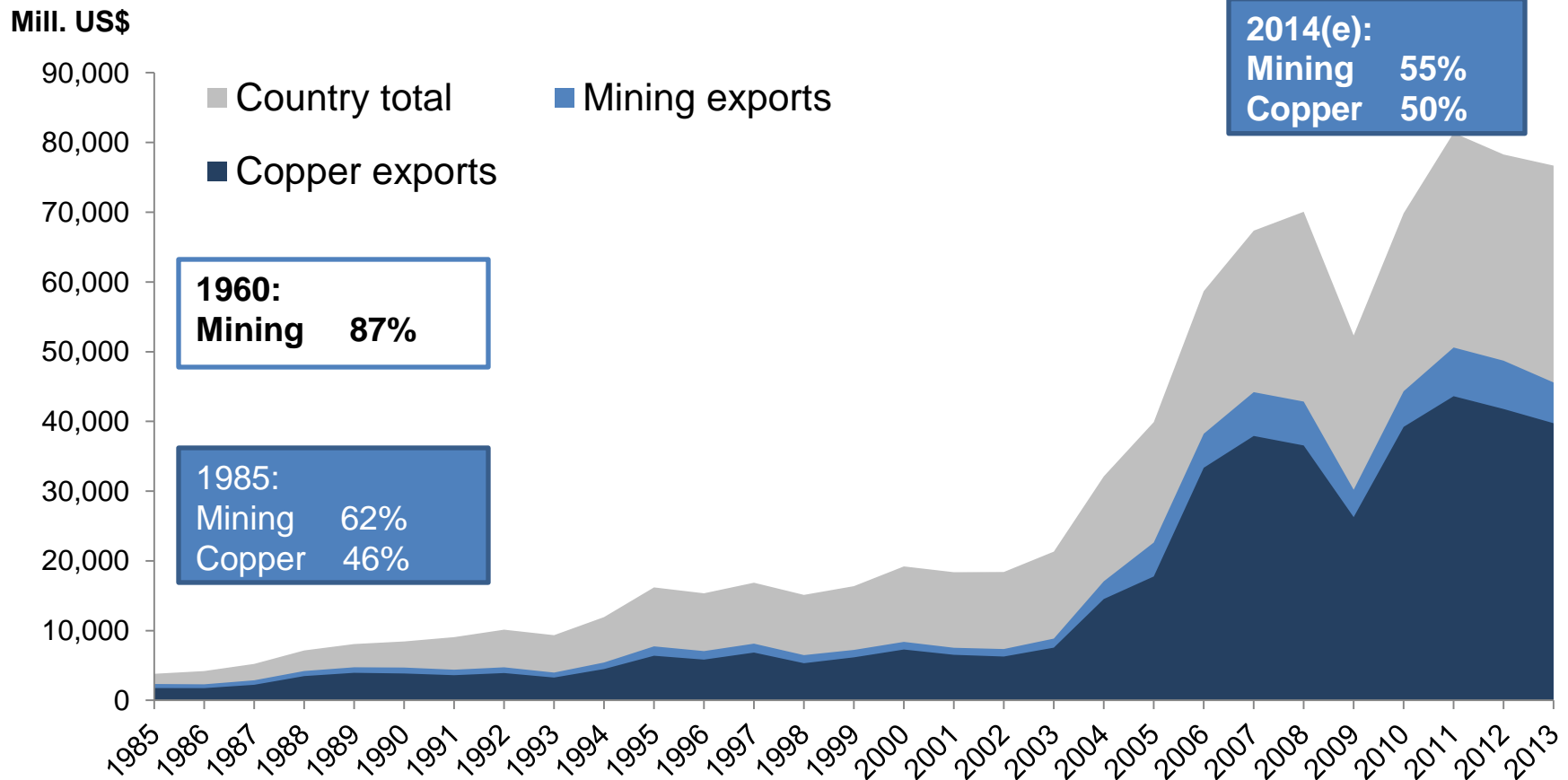
## Mineral endowment



Sources: USGS Mineral Commodity Summaries, COCHILCO

# Mining in Chile, a brief summary

## Mining in exports

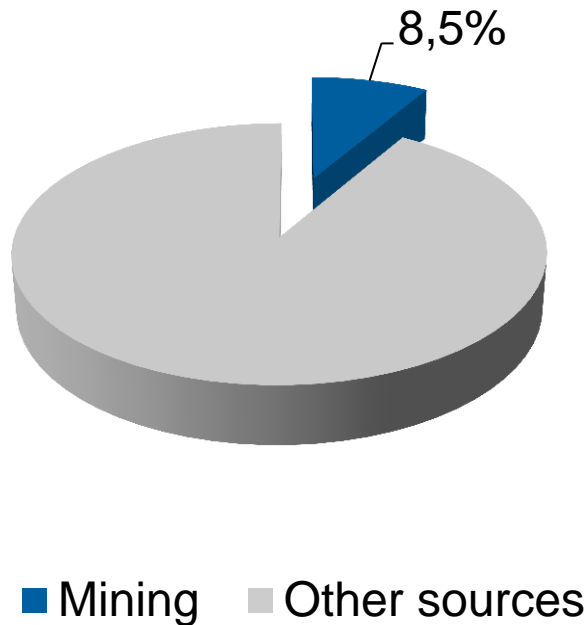


Source: Central Bank of Chile

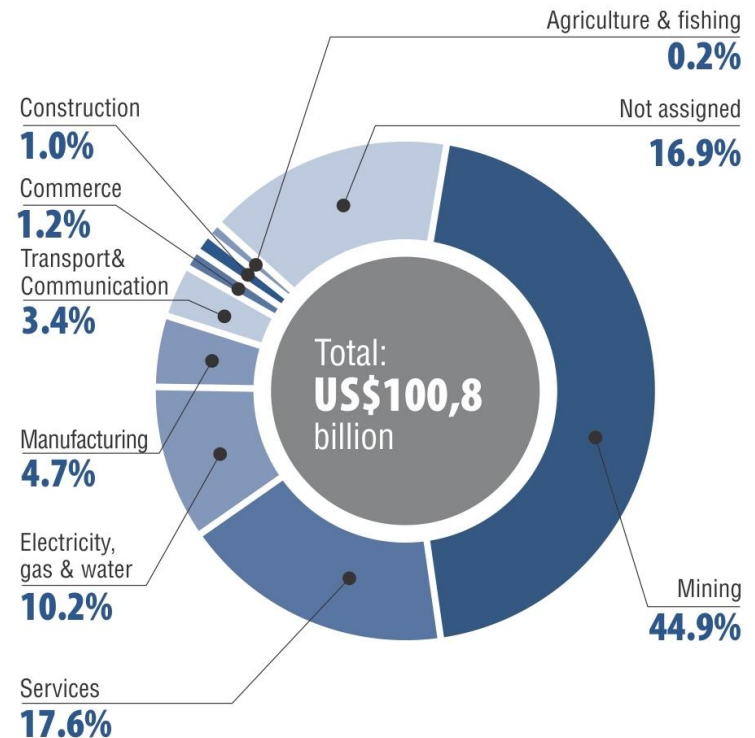
# Mining in Chile, a brief summary

## Fiscal income and FDI

### Fiscal income 2014 (e)



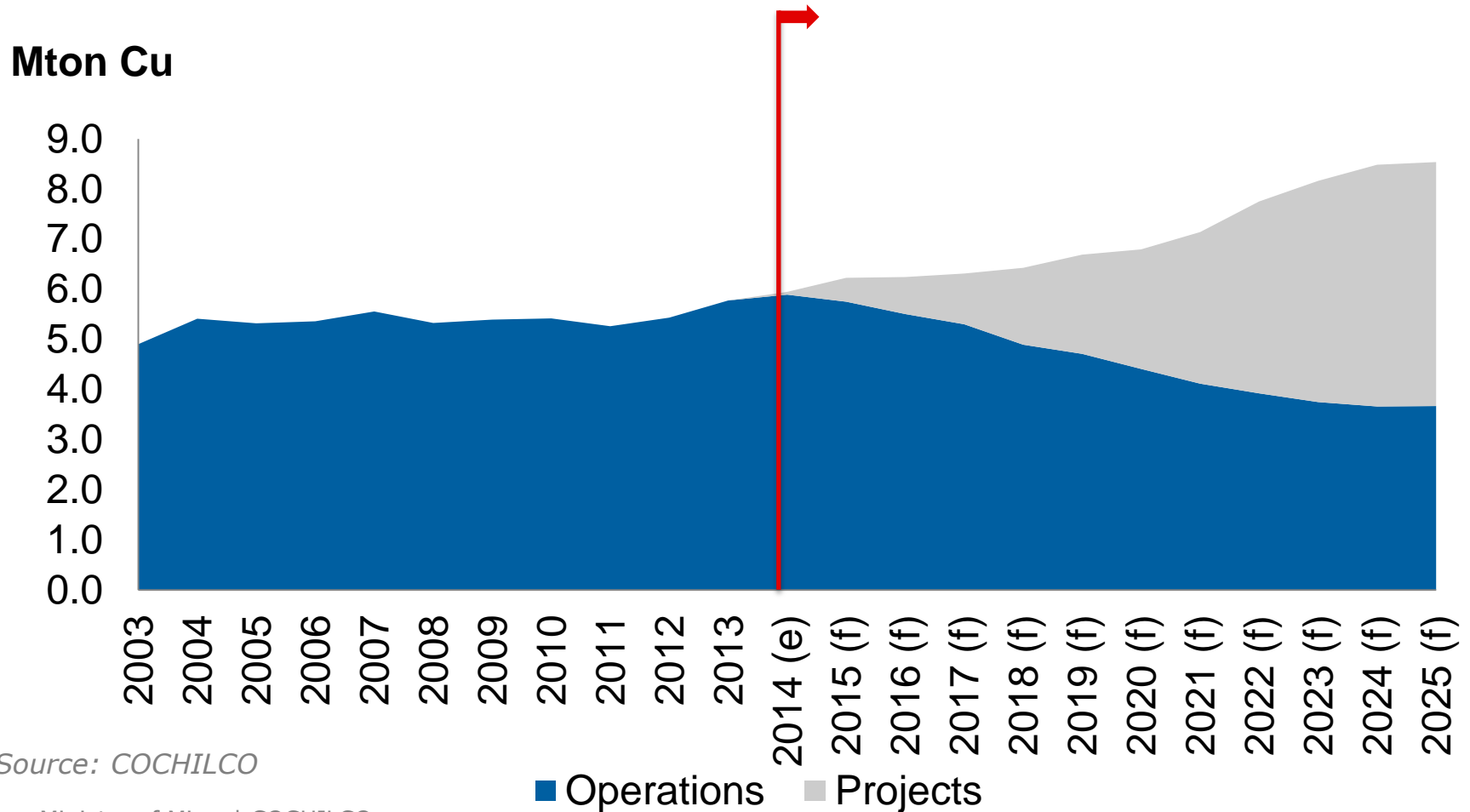
### FDI 2009 - 2013



Sources: Budget Agency, Foreign Investment Committee

# Mining in Chile, a brief summary

Leading copper production, but...



Source: COCHILCO

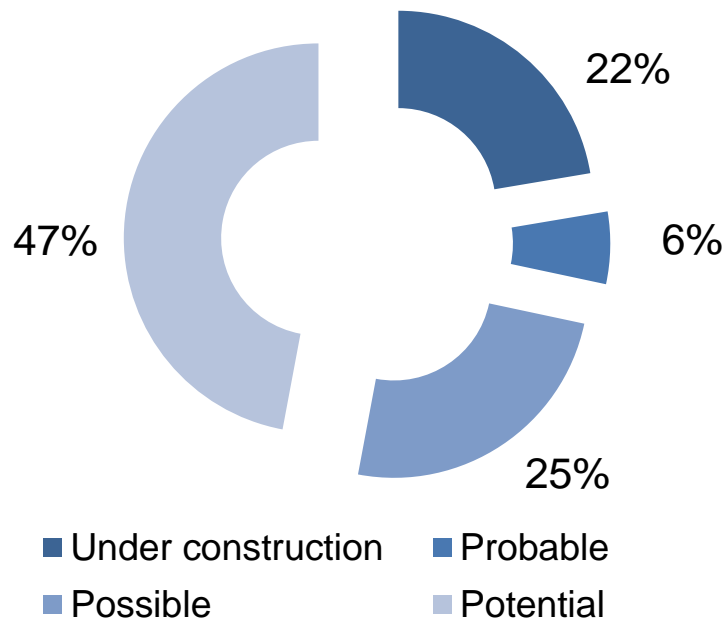
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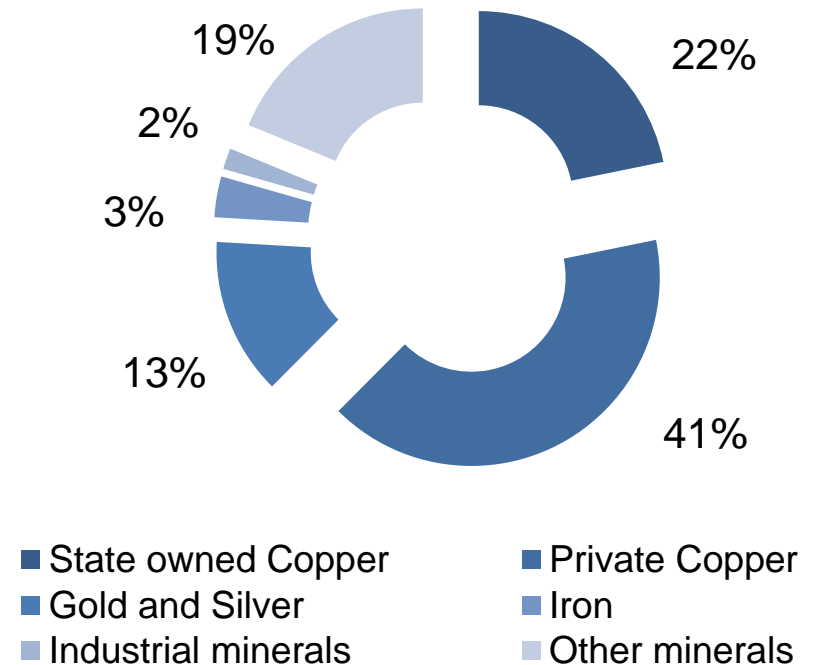
# Mining in Chile, a brief summary

## There's still job to do

**Mining projects 2014 - 2023  
(Mill. US\$104.851)**



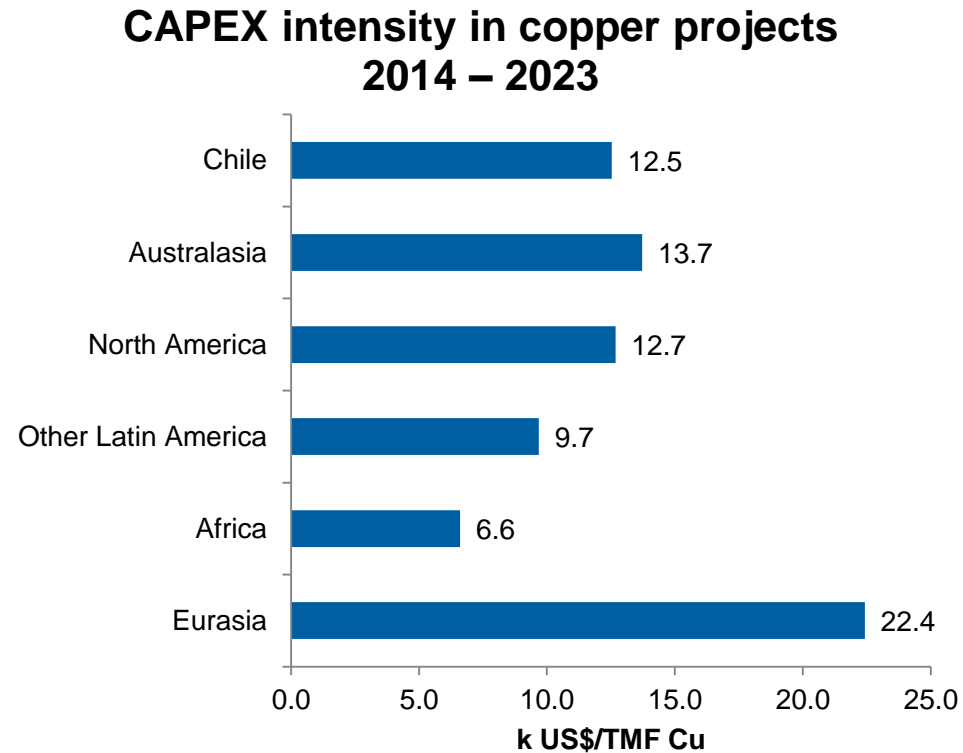
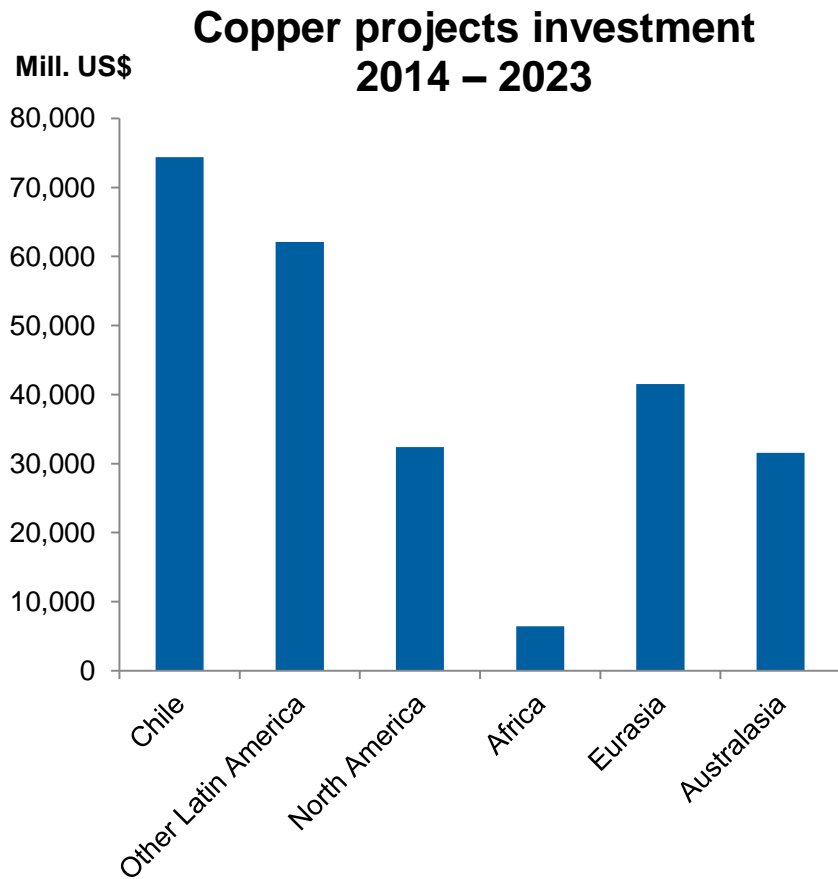
**Mining projects 2014 - 2023  
(Mill. US\$104.851)**



Source: COCHILCO

# Mining in Chile, a brief summary

## And it's a global challenge

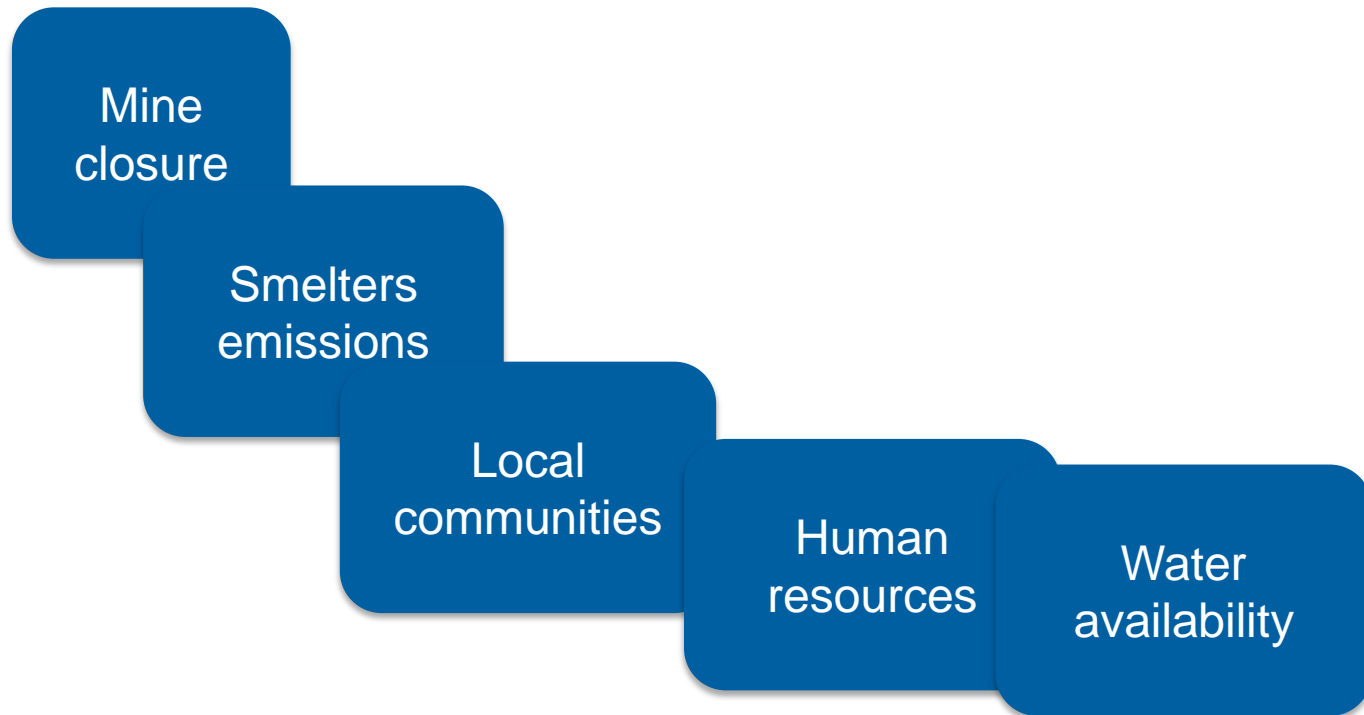


Source: COCHILCO, WoodMac

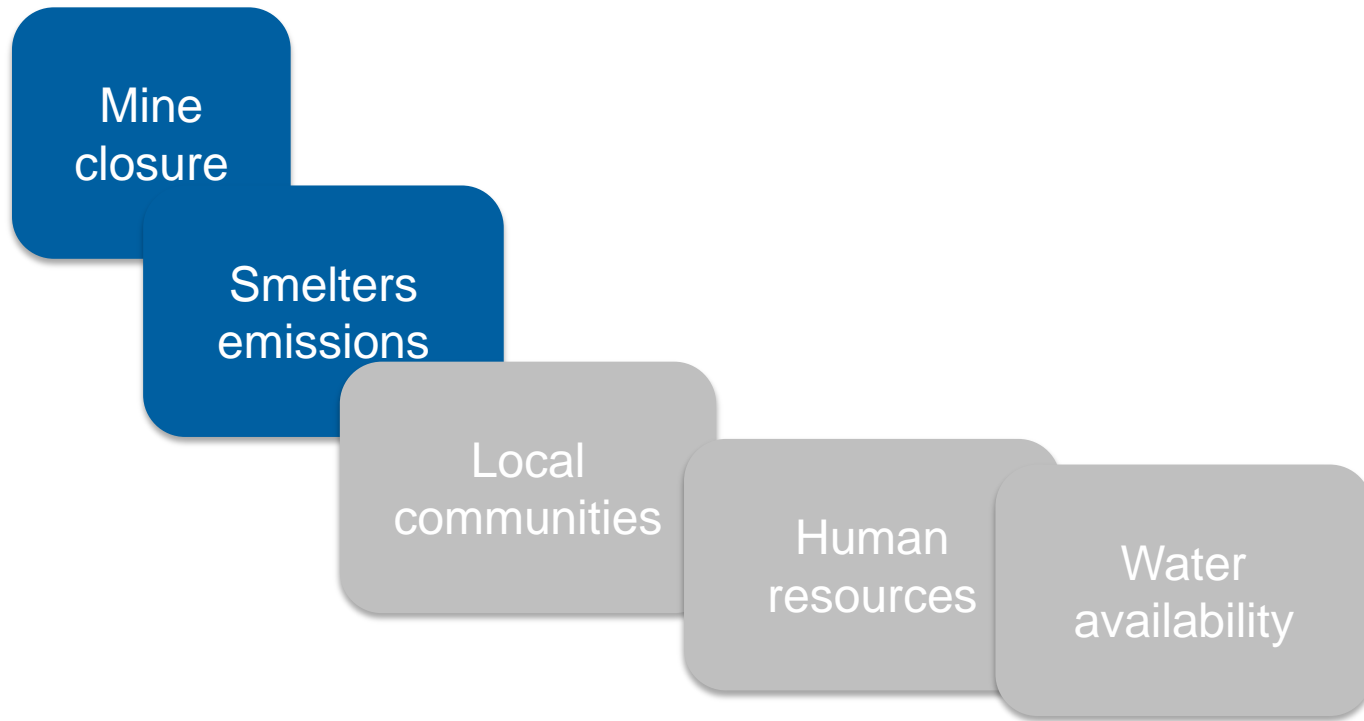


## 2. Enviromental and social licenses

# Environmental and social licenses



# Environmental and social licenses



# Environmental and social licenses

## Mine closure

- Improvement in legal framework in 2011 lead to new obligations to mining operation related to mining closure.
- In 2014 more than 100 mining operations submit their closure plan.
- Expected value of first approach reach Mill. US\$ 12.238.

*Source: National Service of Geology and Mines*

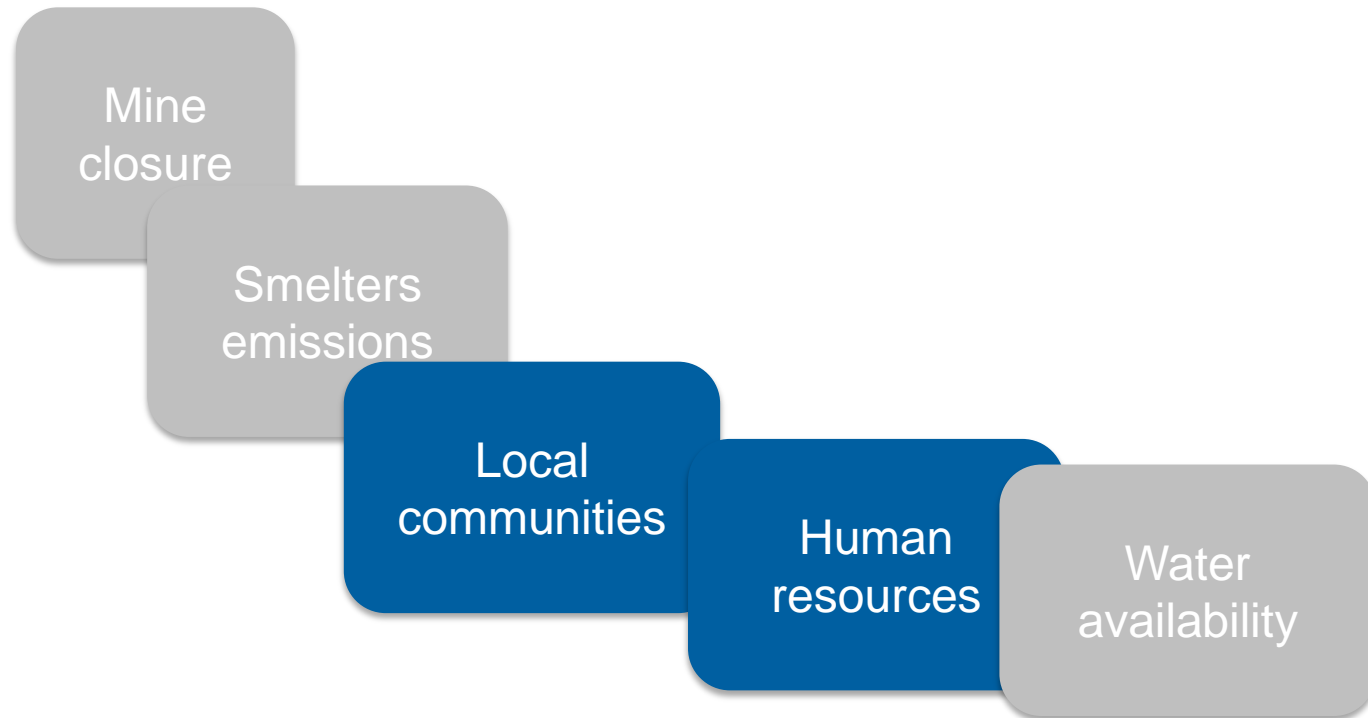
# Environmental and social licenses

## Smelters emissions



- In 2013 new policy for smelters emissions was defined.
- To meet regulations chilean smelters would require major investment in their acid plants and infrastructure.
- There are 7 smelters in Chile with 1,6 Mton anode production.

# Enviromental and social licenses





# Environmental and social licenses

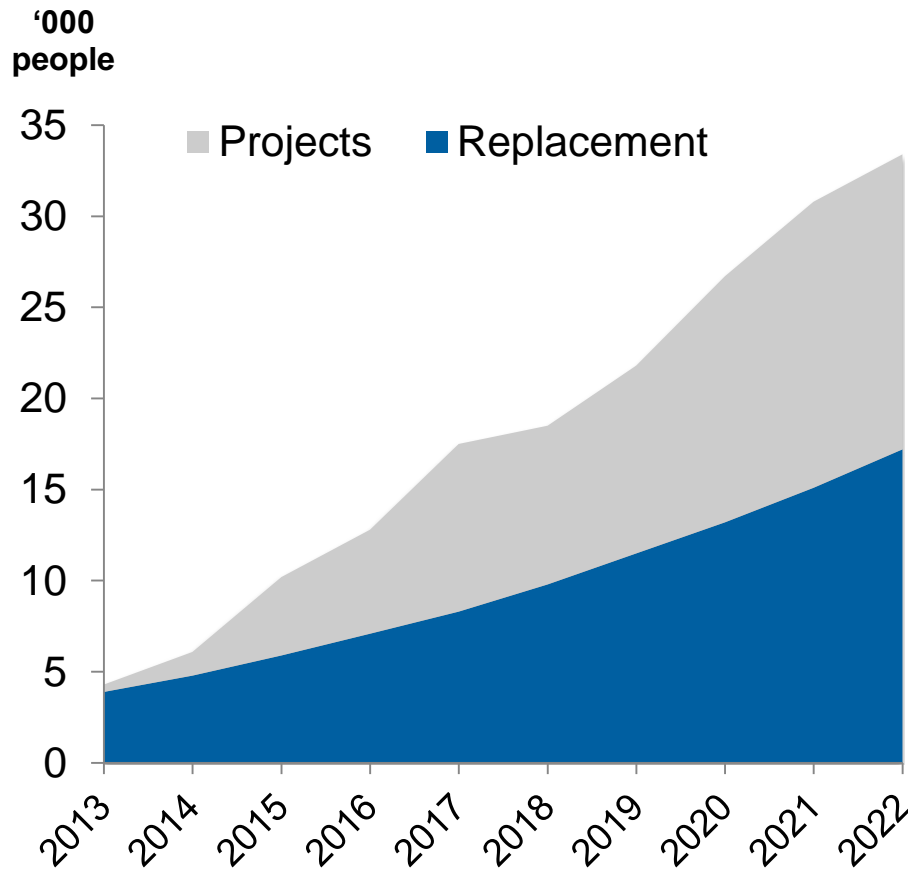
## Local communities

- Several projects have to deal in a new way with society.
- Empowered citizens, social awareness, search for mutual benefit and legal framework (C169).



# Enviromental and social licenses

## Human resources



- Almost 35 thousand new jobs in mining:
  - Safety.
  - Disruptions.
  - Work expectancy.
  - Relation with academic institutions.



Source: Mining Council

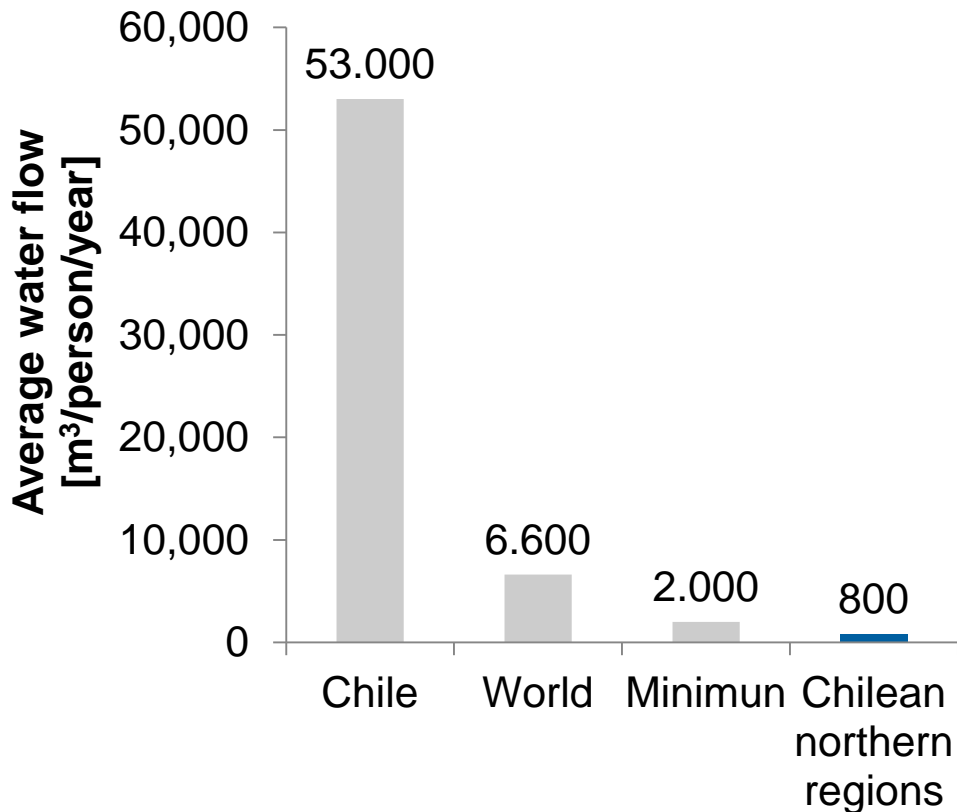
# Enviromental and social licenses



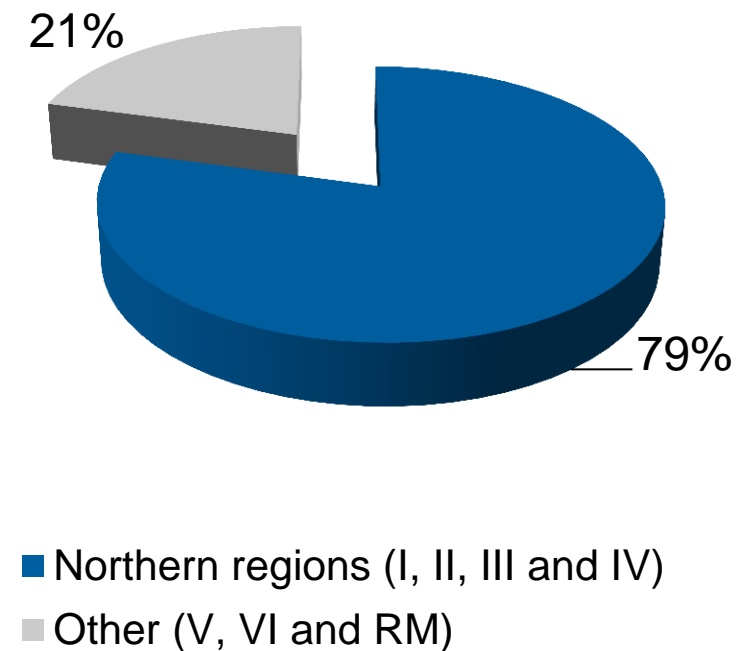
# Environmental and social licenses

## Water availability

### Water availability in Chile



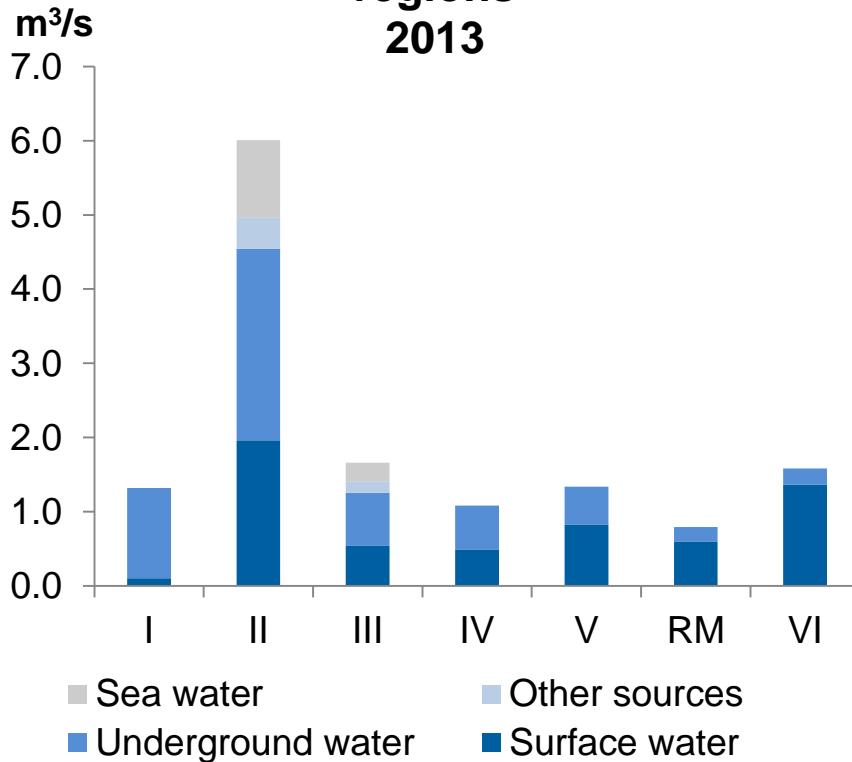
### Copper production by region 2013



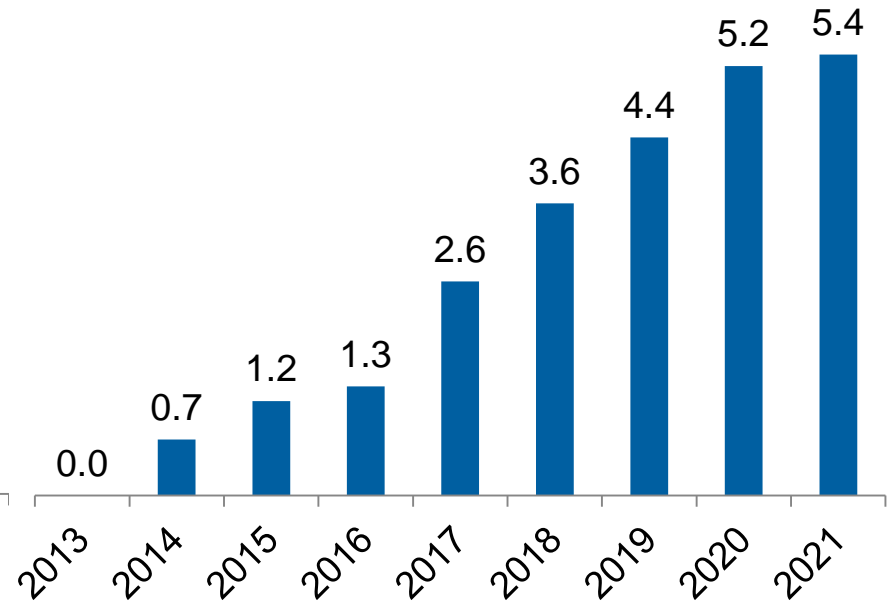
# Environmental and social licenses

## Water availability

**Water for mining in selected regions 2013**



**Forecast of sea water consumption for new mining projects**

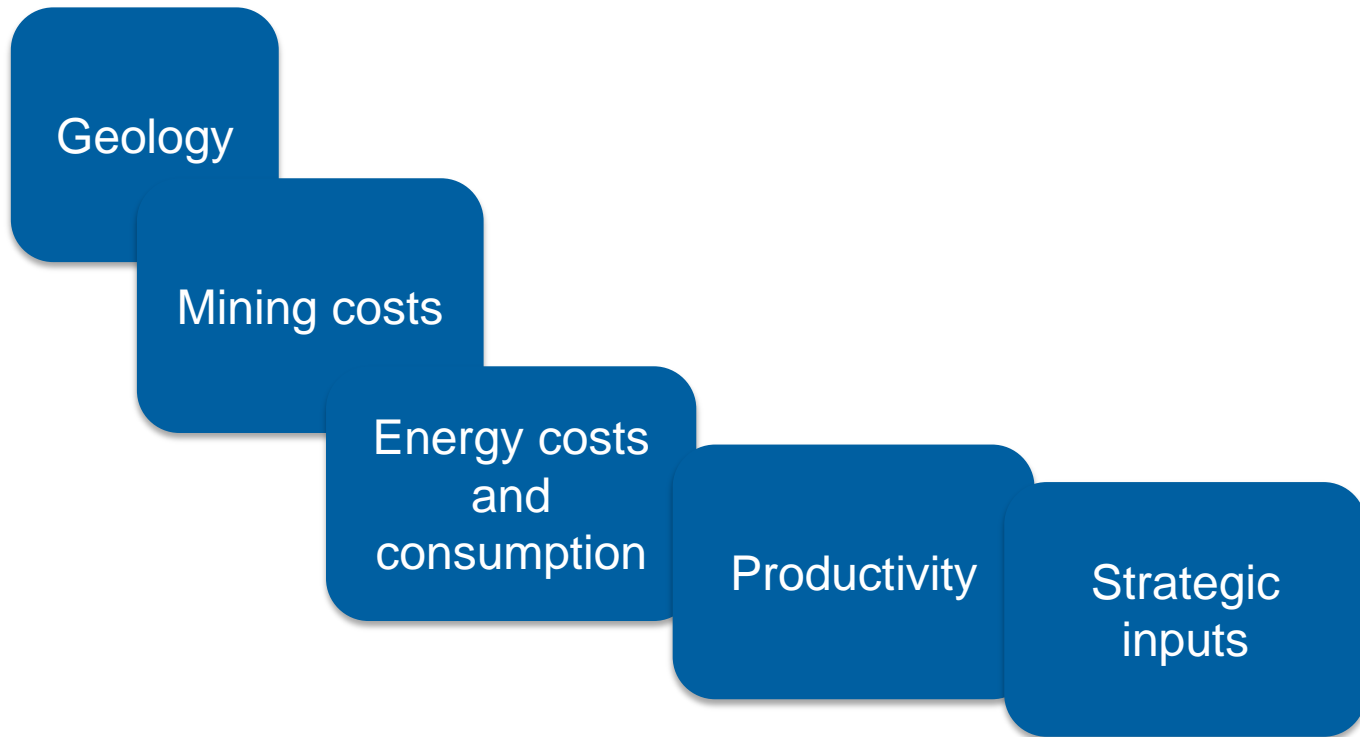


Source: COCHILCO

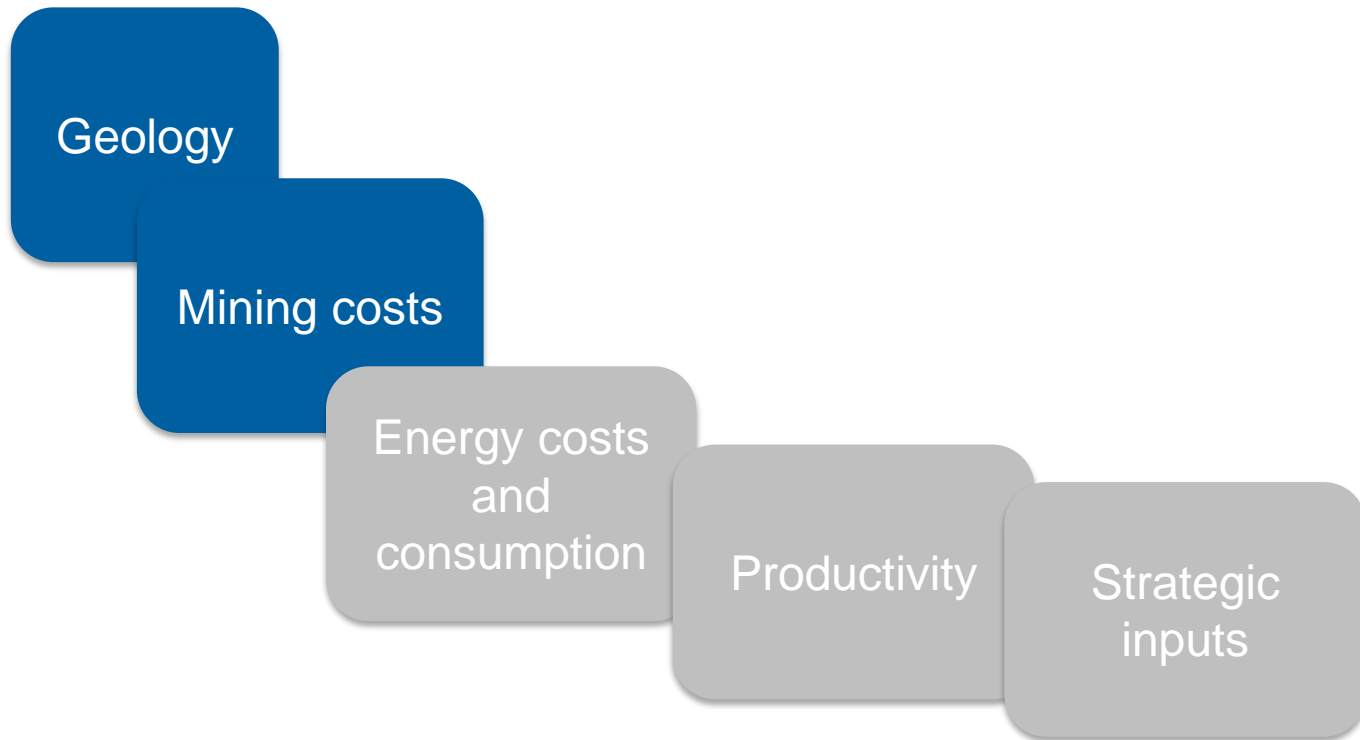


### 3. Costs and productivity challenges

# Costs and productivity challenges



# Costs and productivity challenges

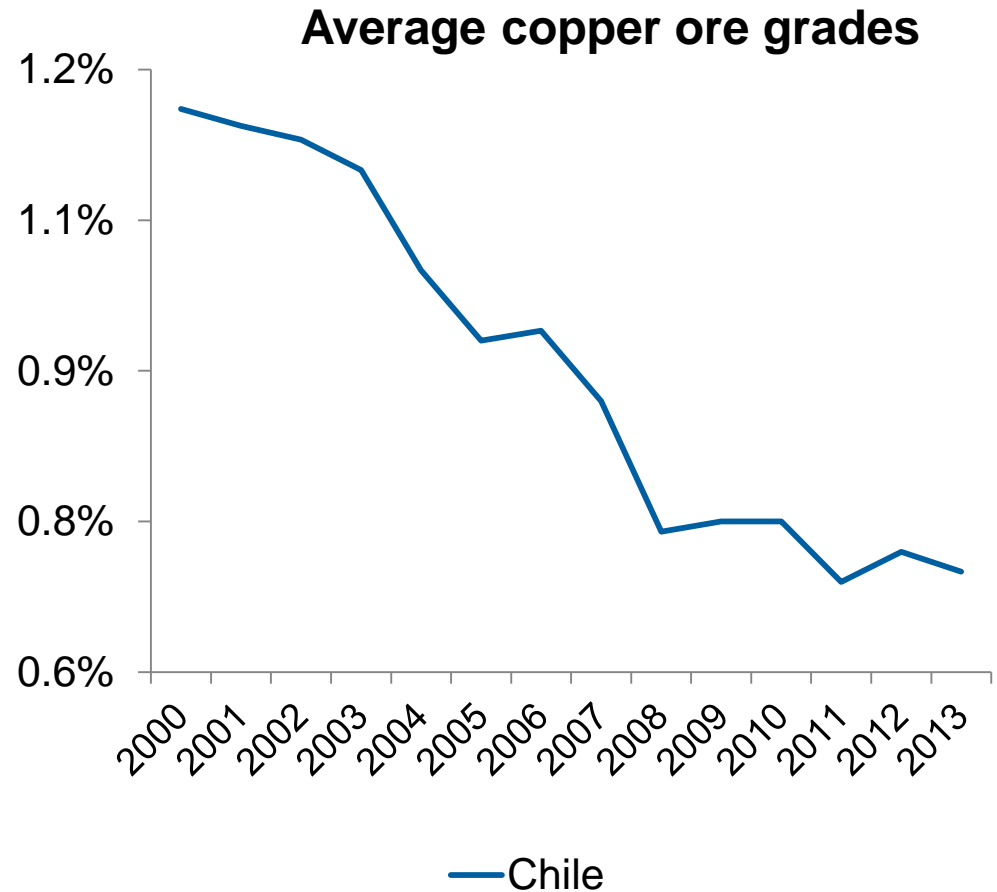




# Costs and productivity challenges

## Geological context

- Mine production driven by natural conditions:
  - Lower ore grades.
  - Deeper mines.
  - Longer hauling distance.
  - Higher Altitude.
  - Deposits near populated cities.

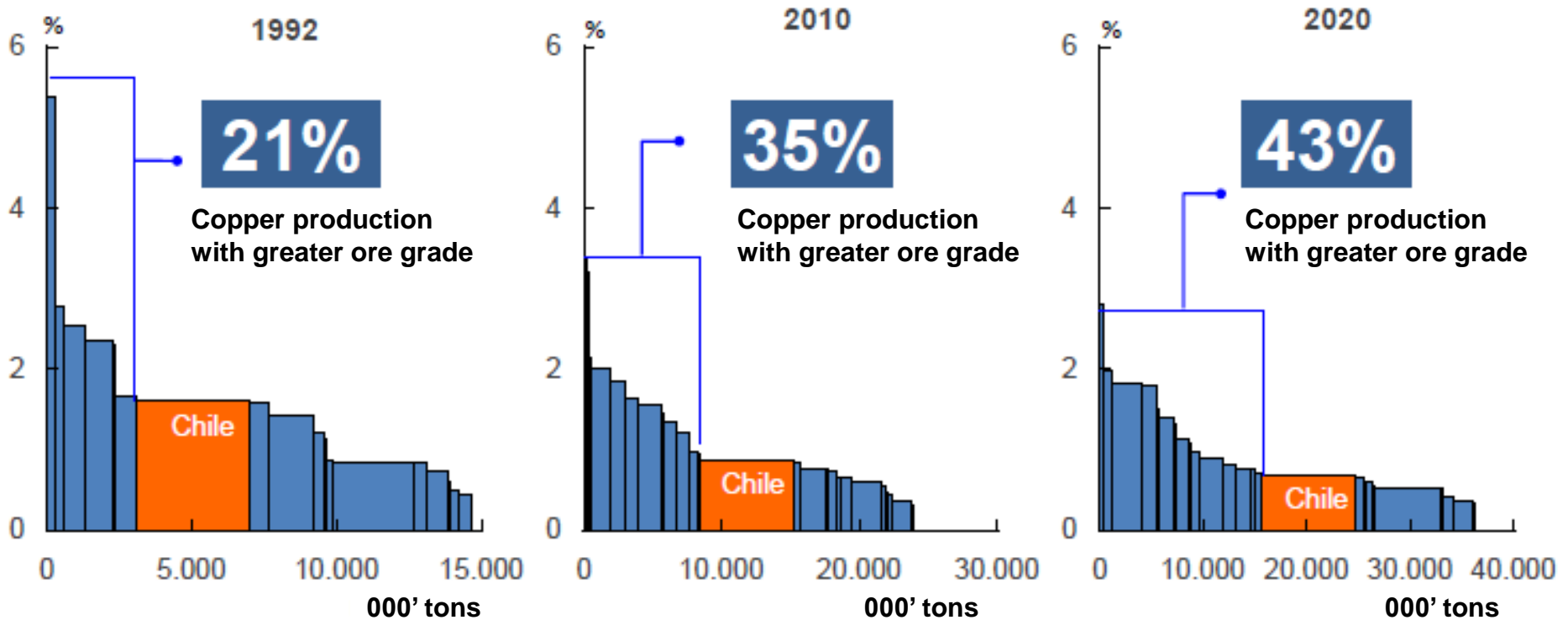


Source: COCHILCO

# Costs and productivity challenges

## Geological context

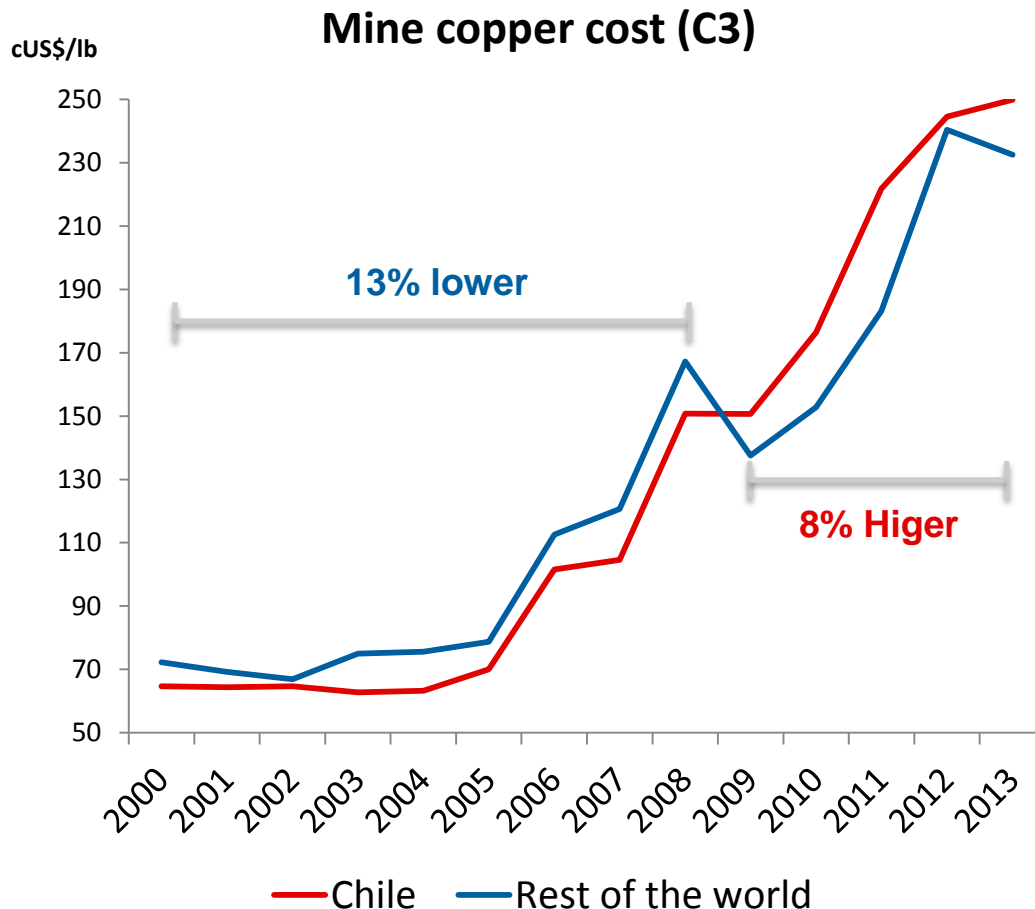
### Average ore copper grade and production



Source: WoodMac

# Costs and productivity challenges

## Mining costs

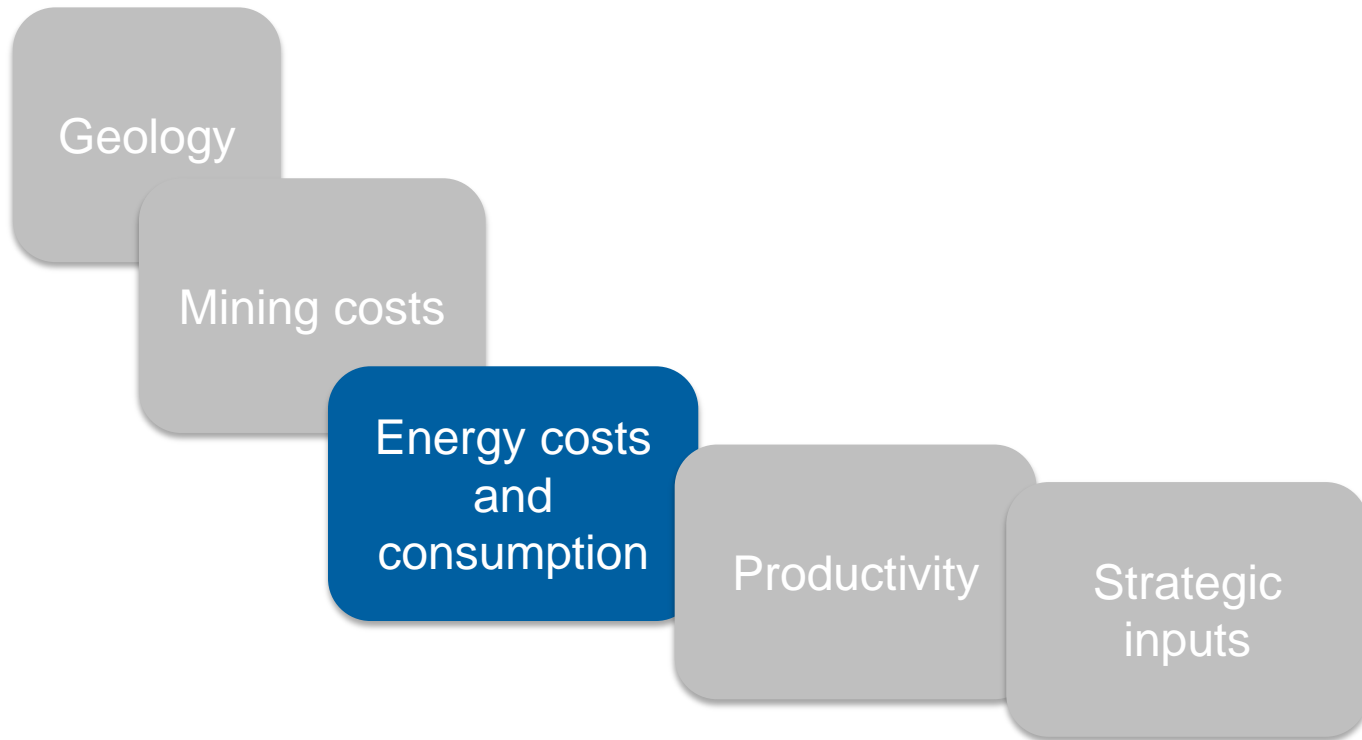


- Higher cost in high price scenario:
  - Price for strategic inputs.
  - Productivity awareness.

Source: COCHILCO, WoodMac

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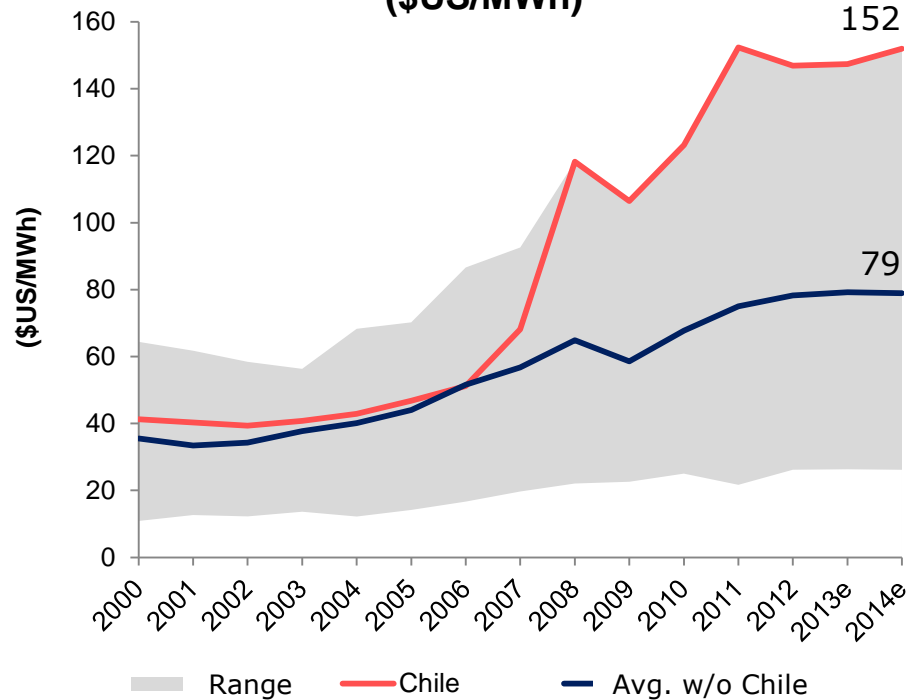
# Costs and productivity challenges



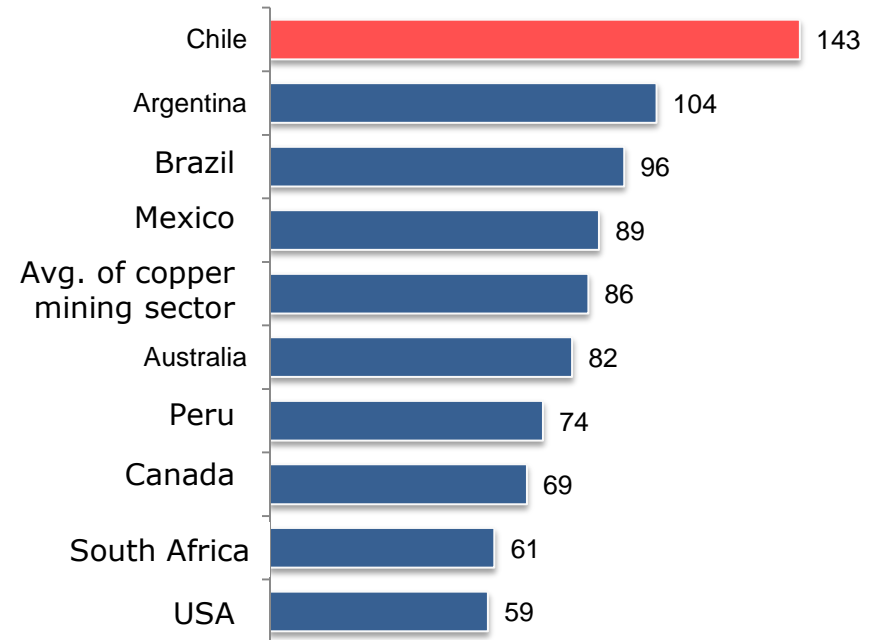
# Costs and productivity challenges

## Electric energy costs

Comparison of electricity costs in the mining industry, 2000 – 2014\*  
(\$US/MWh)



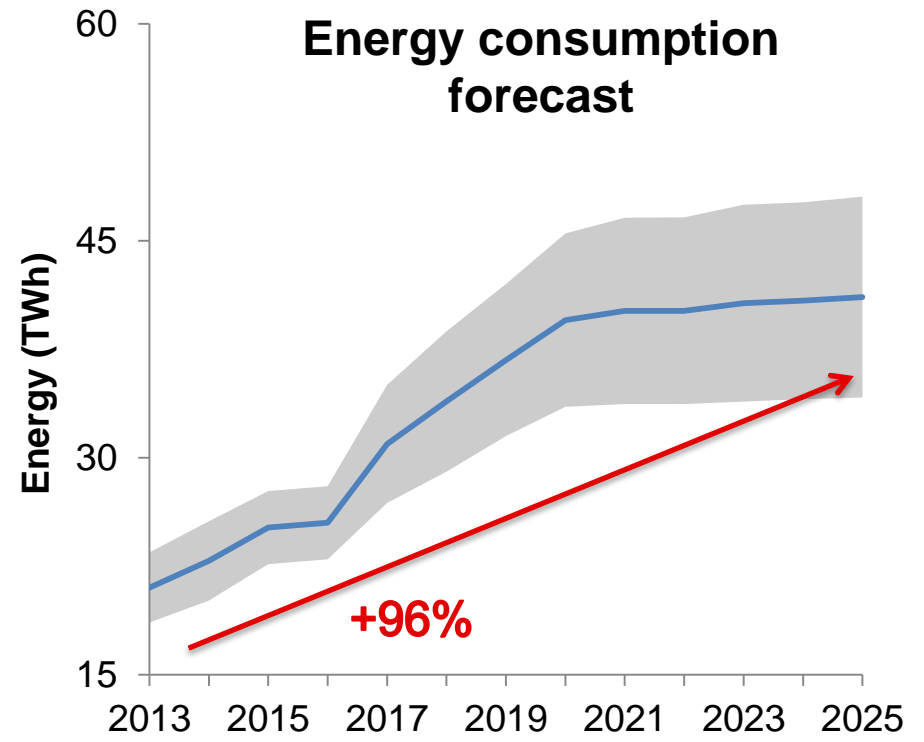
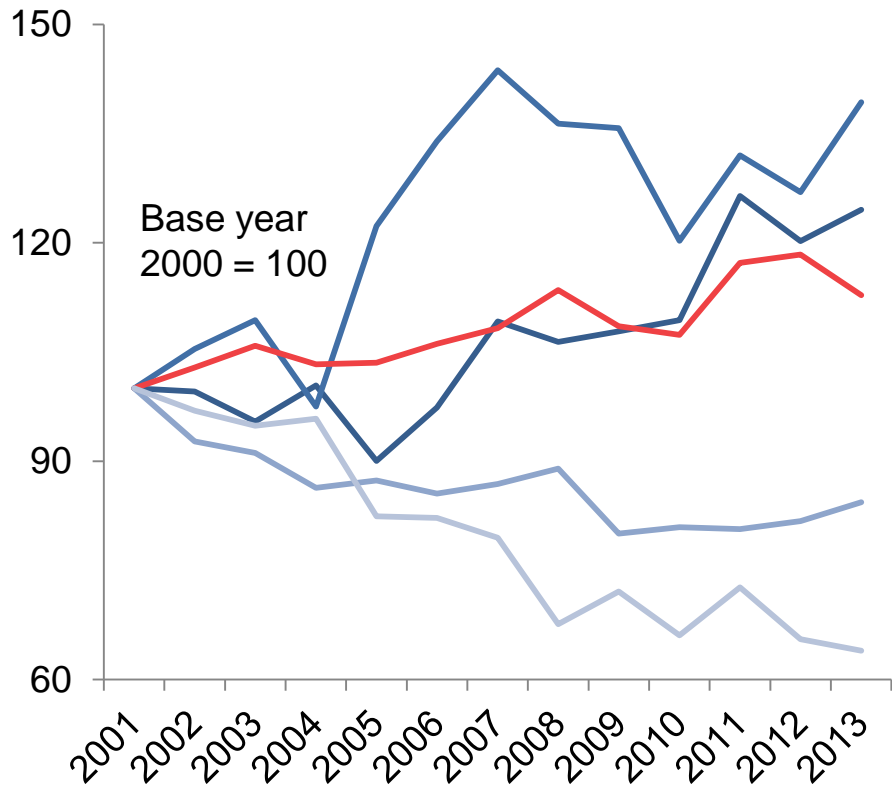
Unit cost of electric power in some mining countries in 2012 (\$US/MWh)



\*Argentina, Australia, Brazil, Canada, Chile, China, Congo, Indonesia, Kazakstan, Mexico, Mongolia, Papua NewGuinea, Peru, Philippines, Russia, South Africa, USA, Zambia

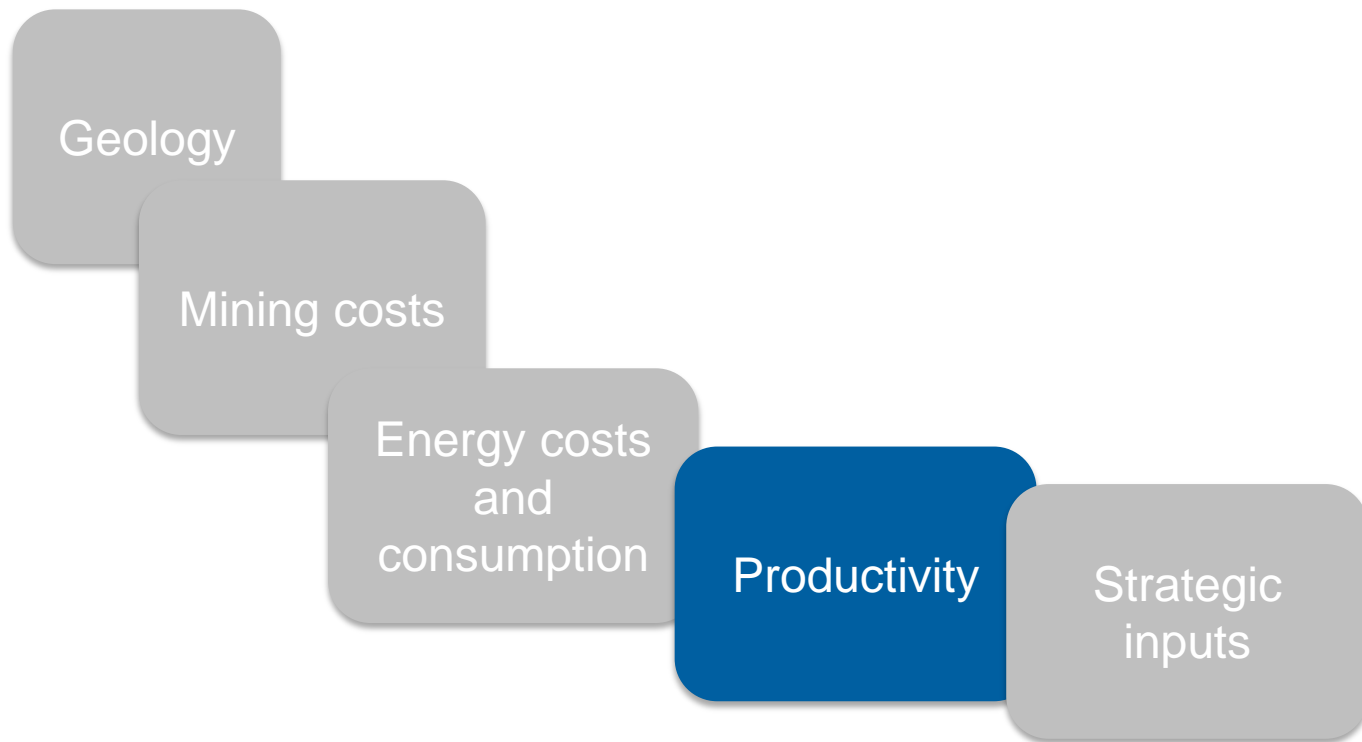
# Costs and productivity challenges

## Energy consumption



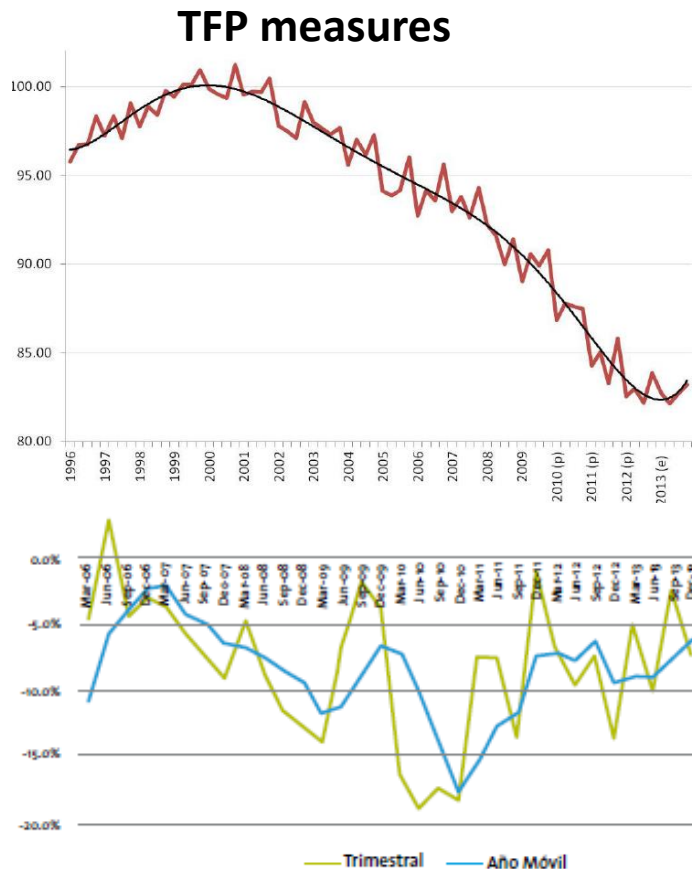
- Open pit [MJ/ton]
- Underground mine [MJ/ton]
- Milling [MJ/ton ore]
- Smelter [MJ/ton con.]
- Leaching [MJ/ton ore]

# Costs and productivity challenges



# Costs and productivity challenges

## Productivity measures



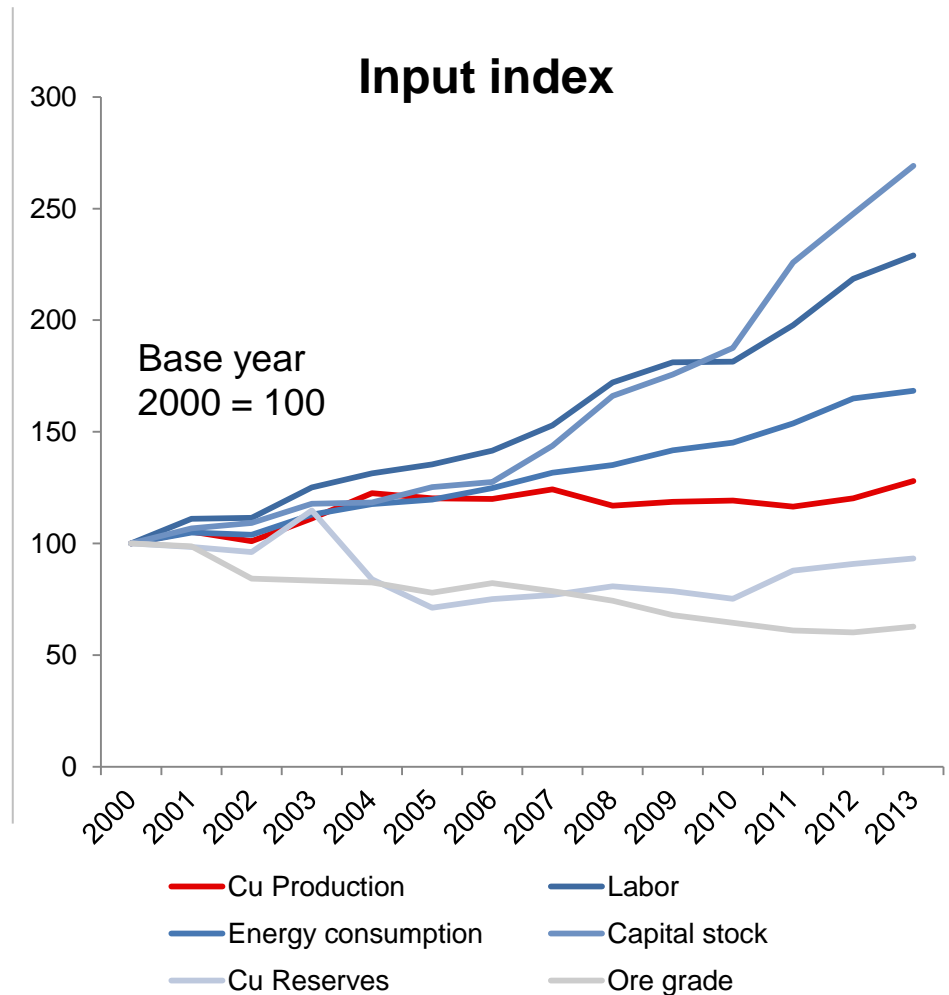
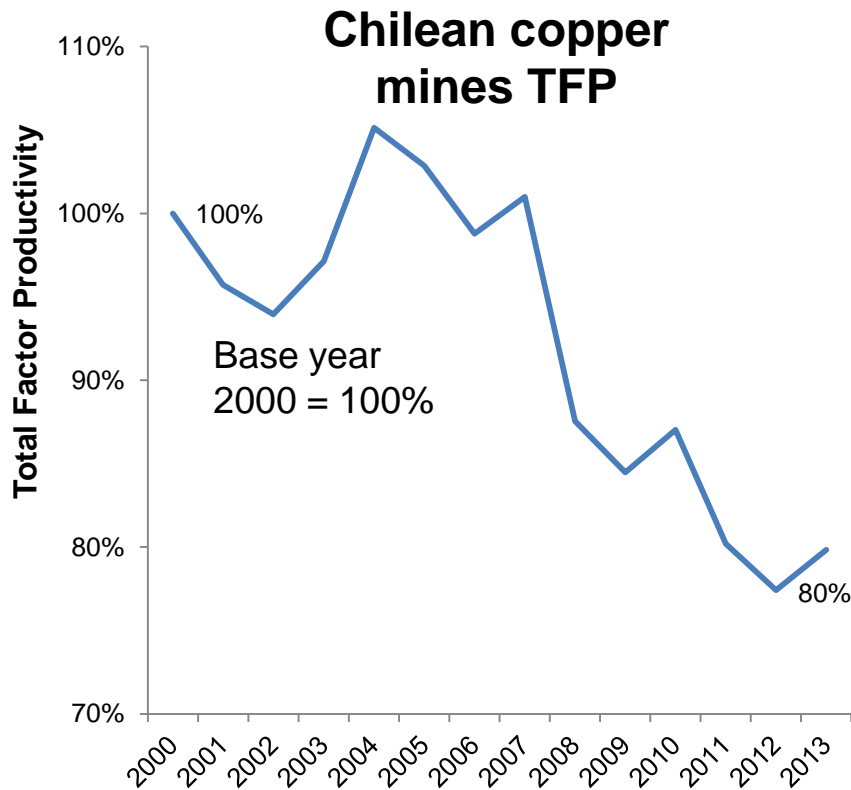
- Productivity concerns led institutions to take into account economic performance of industry.
- During commodities super cycle data shows a clear decline in productivity.

Sources: CLAPES – UC, CORFO – UAI



# Costs and productivity challenges

## Productivity measures

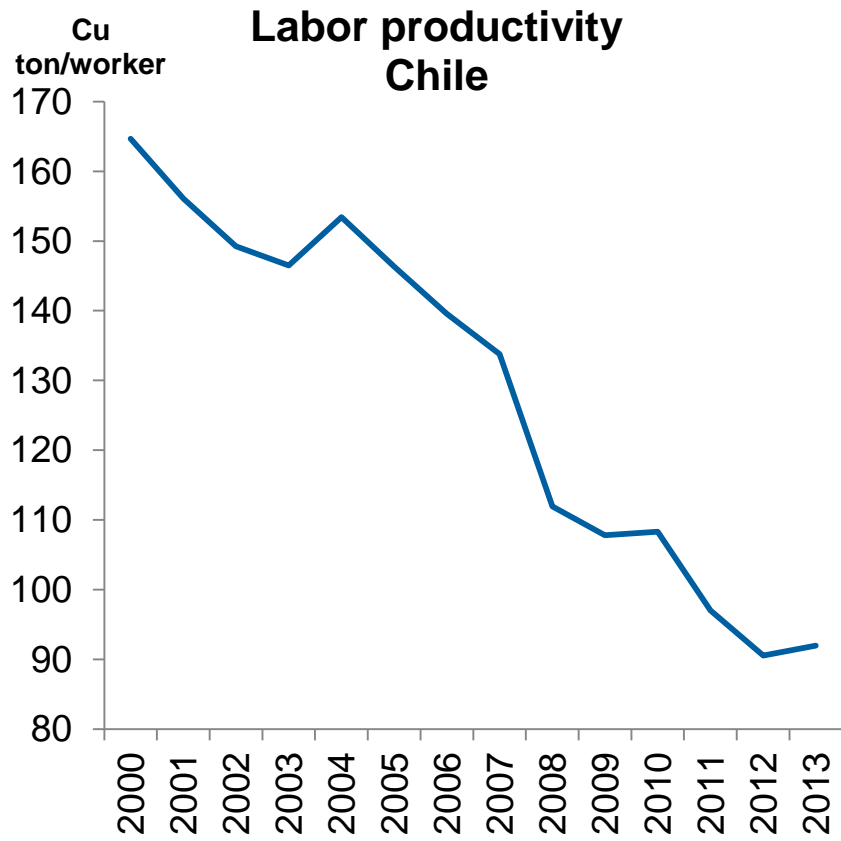


Source: COCHILCO

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# Costs and productivity challenges

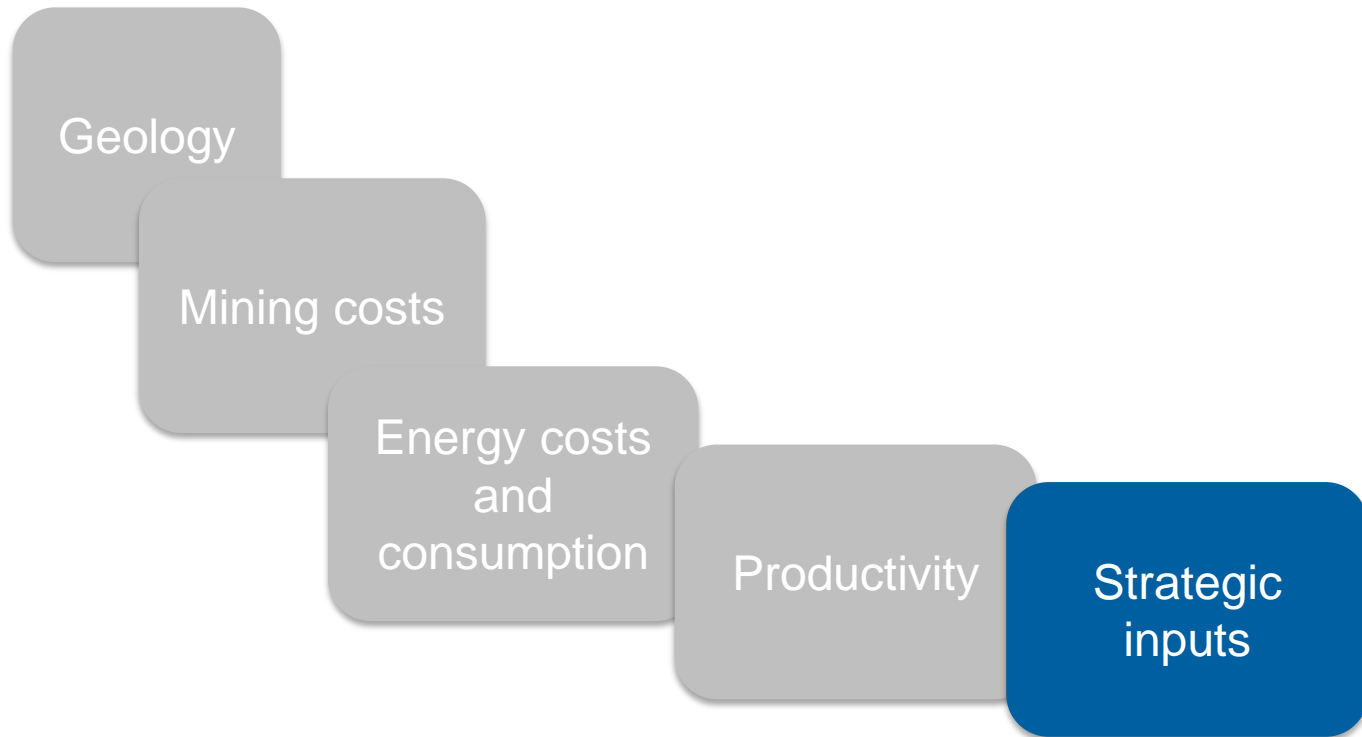
## Productivity measures



Source: COCHILCO, Mining Council

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# Costs and productivity challenges





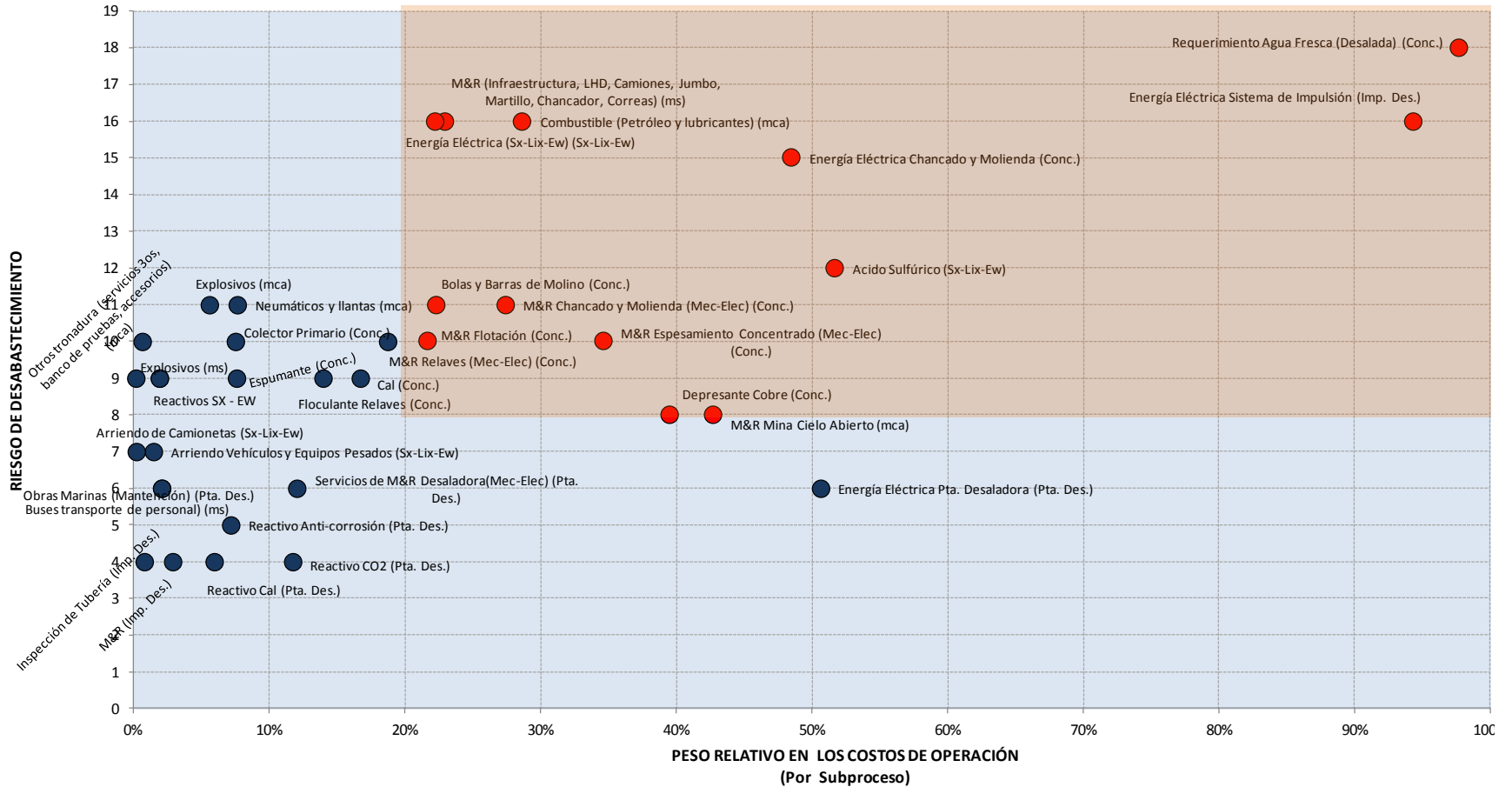
# Costs and productivity challenges

## CAPEX strategic inputs

- Higher share in total cost and higher availability risk:
  - SAG, ball and bar mills (Mill).
  - Milling infrastructure (Mill).
  - Mineral conveyor (Leaching).
  - Geomembrane (Leaching).
  - Trucks and Electric Shovel (Open Pit).

# Costs and productivity challenges

## OPEX strategic inputs



Source: COCHILCO

# Costs and productivity challenges

## OPEX strategic inputs

- Higher share in total cost and higher availability risk for every process:
  - Electric energy (Leaching, Mill, Sea water pumping).
  - Fuel (Open Pit).
  - Fresh water (Mill).
  - Materials and Replacement parts (Underground Mine, Open pit and Mill).
  - Sulphuric Acid (Leaching).
  - Flotation reagents (Mill).
  - Steel balls and bars (Mill).



## 4. Final comments



# Final comments

- Chile has been recognized as a major center for mining investment.
- Mineral endowment and projects support mining production forecasting.
- Challenges arise from several interacting factors:
  - Environmental.
  - Local communities
  - Productivity.
  - Costs

# Final comments

- Lower grades and other natural conditions of deposits encourage the need to sustain mining development.
- Technology, innovation, changes in processes, community relation models and costs restraints are leading efforts of mining activity in Chile.



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