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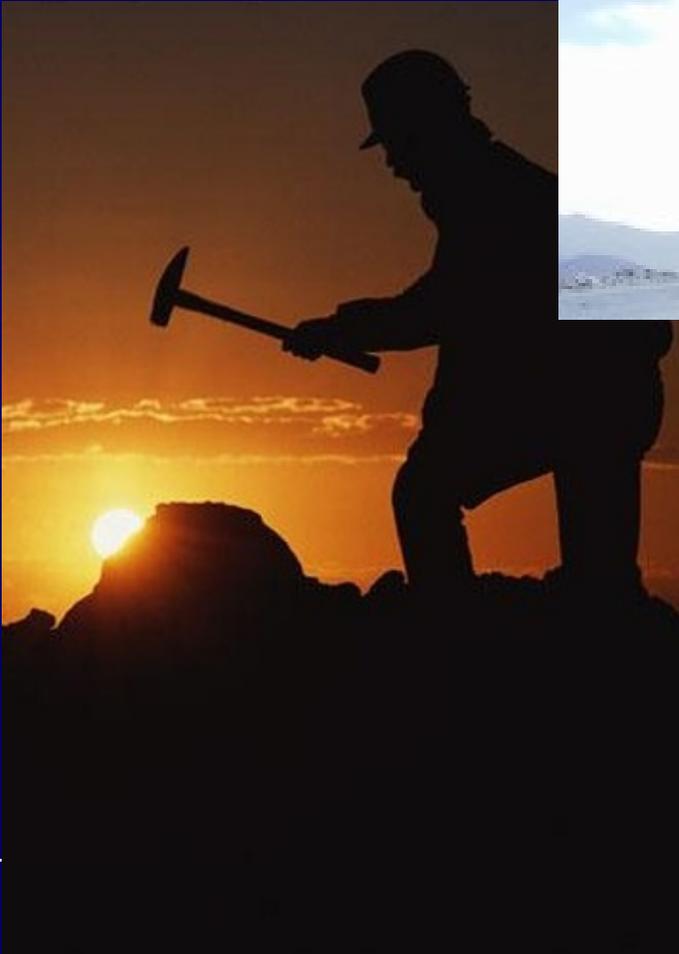
# Water Treatment

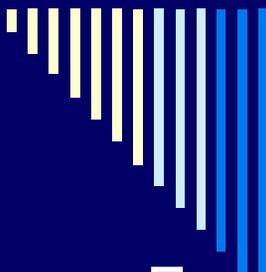
**Chilean  
experience:**

➤ **Water  
Management in  
the Mining  
Industry**

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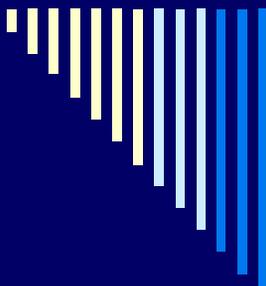
# Mining and Water Resources





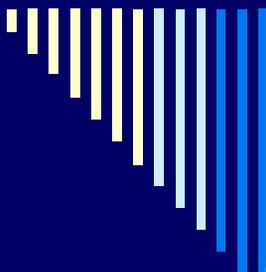
# Mining in Chile

- Essential economic activity:
    - High comparative advantages in developing this activity
    - Historical activity (The Northern region of the country)
    - Currently, the main governmental income
    - A high profitable activity
  - The importance and progress reached by the mining is fundamentally based on :
    - Resources quality, mineral reserve's size y and location
    - The legal frame, that promotes certainty, stability, and safety in the mining activity
    - The appealing opportunities for foreign investment
    - The mining managing capacity, ideal human resources in the operation and service functions.
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- The energy infrastructure and the means of communication by land and sea.



# Mining in Chile: the facts

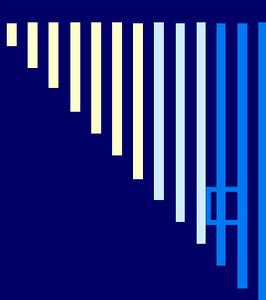
- Chilean production of copper:
  - 35,2% of global copper mine production (1<sup>st</sup>)
  - 12,2% of global copper smelter production (3<sup>rd</sup>)
  - 16,1% of global copper refines production(2<sup>nd</sup>)
- Also an important producer of gold (1,9% world production) and silver (8,5% world production)
- Mining activity:
  - 7,5% of GDP 2003 constant prices and 23% of GDP current prices. (“Central Bank of Chile”, 2006)
    - Copper activity: 6,2% of GDP 2003 constant prices and 21,6% of GDP current prices (2007)
  - 54% of exports value (FOB, “2006 Annual report of Environmental situation”)
  - 51,5% of national mining investment (2006)
  - CODELCO (copper industry) provide a 22.1% of total fiscal revenue. (2006)
- High prices
  - Since 2002 the international copper price has rise a 335% (US\$ 0,76 to US\$3,05 the pound)



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# Mining in Chile: Geography

- Mineral deposits located in arid zones.
  - The country middle-north regions concentrate the 99% of the exploited mines.
    - North region: dry deserts, steppe; y Middle region: mild climate .
    - Regions II y III, features the highest mine exploitation / water availability relation.
      - High mine activity and lack of water.
  - Plenty of water, but not for mining
    - Water availability for the entire country : 15.000 (daily liters per habitants), the Latin-American highest.
      - Only 220 are used by the mining industry
-



# Mining activity in Chile: Production

## □ Metallic minerals:

- Iron, copper, molybdenum, silver, gold, zinc and magnesium exploitation.
- Copper and iron concentrated most of the 90% of extraction.
- High productive activity
  - Great importance as a GDP percentage and exports.
  - Projection: A rise in the mineral extraction in mine that are already use and an increment of new projects.

## □ Integral mining activity

- Most of mines had a metal processing plant nearby and a melting plant.

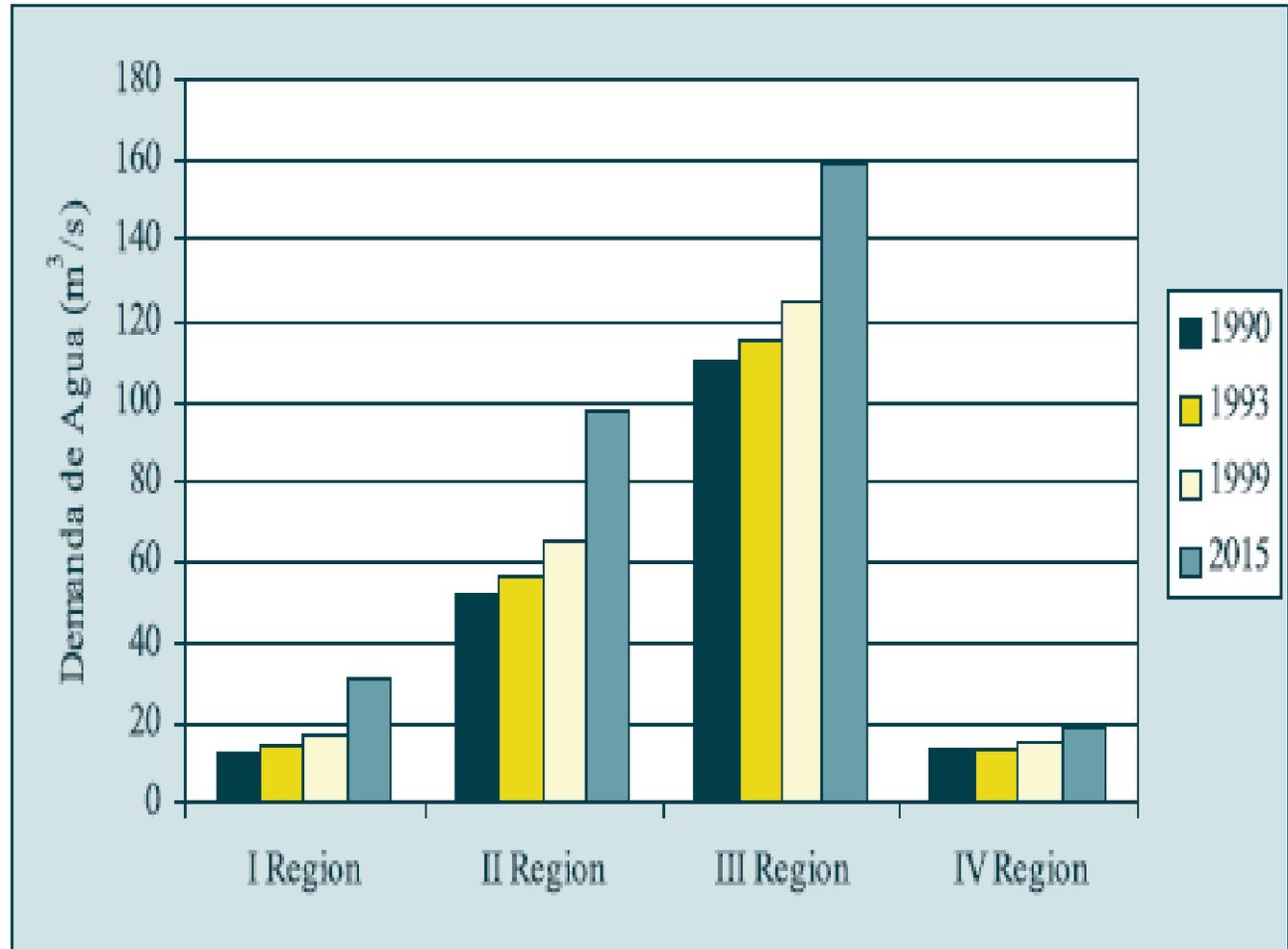
## □ Water

- Scarce resource: Mining activity are made in desert regions.
  - Important input:
    - Fundamentally extracted of underground water napes.
    - Ground water represents minor sources
- 
- Water consumption has increase the last years.

# Water demand for Mining

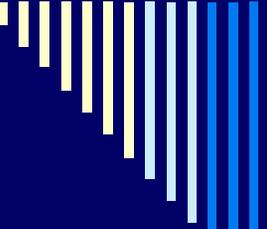
**Figura 7.13**

Demanda de agua en minería,  
por región.



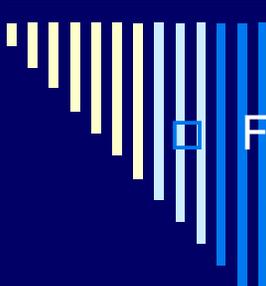
Fuente: DGA, 1996.

- I to IV regions: The most important regions for mining activity, and the most deserted ones.



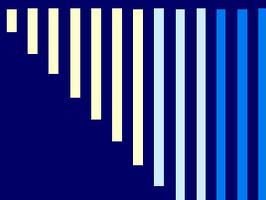
# Mining activity in Chile: the use of water usage in the productive process

- Human consumption in camps
    - Usage: drink, washing, irrigation, bathing y feeding.
    - Represents between the 1% and the 1,5% of the whole water consumption.
  - Mine consumption
    - Usage:
      - Open pit mines: To reduce the road's suspension dust.
      - Underground mines: Little consumption. The problem is to extract filtered water from the ground
  - Minerals processing plant
    - It is use in the minerals' milling, crushing, floating (see next point), classification and thickening process
    - The rates of water recovering vary between 30 and 85%, depending of the mineral and the plant. Because the evaporation and ground absorption, there is a great water waste unutilized in the rest of the process.
    - In this stage is possible to reduce the water consumption in the most quantity, potentially.
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## Continuation, Mining activity in Chile...

- Flotation: In this stage the mineral is separated from the wastes.
    - The mineral float and the waste don't. this depends of the mineral.
    - The sewages are conducted to Water Residual Dumps (represents the 95% of water consumption for a plant)
    - The Waste Residual Dumps' water traditionally doesn't use for agricultures purposes, but there are cases in which they do.
  - The raw mineral or mineral concentrate transport
    - There are two ways of mineral transport:
      - Trucks and trains: In this process the water spend depends is use for human consumption, the oil refinery and production, and maintenance. The water spend depends of the distance to the plant.
      - Mineroducto: The water consumption is least, because not depends of the distance between the mine and the plant.
        - Isn't much utilized
        - Represents between the 4 y 6% of total water spend.
  - Smelting plants
    - Usage: gas chill, oxygen production y gas wash.
    - Represents the 26% of water consumption..
      - The spend may vary by the plant location: A plant near the coast, can use and return almost the whole sea water after the process.
  - Electrolytic Refinery
    - Specially in the copper industry in this process the water permits the impureness elimination.
    - There is a lot of water waste in the solutions dilution and evaporation process.
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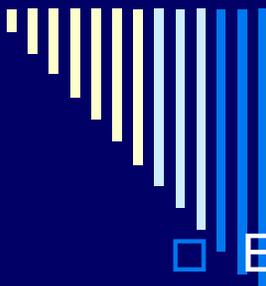
# Legal Framework: Water Usage Rights

## □ Water Code

- Establish tradable Water rights for water usage.
  - The right owner has the right to use the water stream.
    - The rights are given by the Government
  - The State only has a subsidiary, promoter and regulatory role.
    - Regulate the water rights correct use.
    - Guaranteed all the basics service related to water.
    - Regulate the rights ownership and transaction.
    - Imposes ecologic and environmental norms.
- Code's fails
  - Very few agents poses a major percentage of the rights.
  - The legal changes seek solve this trouble.

## □ Institutions

- The Sanitary Service Superintendence (SISS) y National Environment Corporation (CONAMA), control the environmental impacts.
  - Water General Department (DGA), control and register the water rights use, and solve the common interest problems.
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# Mining activity in Chile: The conflict

## □ Environmental Impact

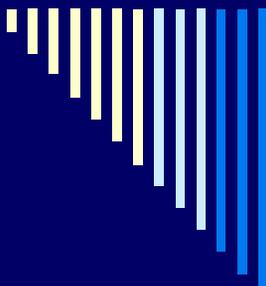
- Of great importance due to the mining activity size.
- Of high impact to the water resource.
  - High participation degree of water in productive process.
  - Lack of water in the extraction and processing zone.
- Until 2005 the ecologic norm about water contamination are too weak.

## □ Rivalry of water resource

- Fundamentally with:
  - Agriculture
  - Human Consumption
- Interest concentration and economic power is bigger in the mining industry relative to the agriculture and domestic interests.
  - Least benefits agents
  - Bigger Politic and economic power
- There isn't an integrated management of the water basin, seeking the whole involve activities development: the water right rules.

# Case Analysis: "Pascua Lama"

- Gold and silver mine project.
  - Open pit mine
  - Located in the Andes chain Mountain, east frontier with Argentina.
- US\$ 1.700 investment.
- Initial duration for extraction of 20 years.
- Three glaciers are affected by the exploitation.
  - There are of fundamental importance for water supply in the Huasco valley.
    - For human consumption and, fruits, "pisco" and wine production.
  - The project was rejected by the ecologic communities and the environmental authority. Do not approve the environmental impact studies.
- Exploitation Alternatives: costs rising
  - Glacier movement (rejected)
  - Underground exploitation (water contamination risk)
- Project approve :
  - With the condition to not move, modify and contaminate the glaciers.
  - But still persists problems of premature melting of glaciers because of mining activity.



# Water Rights in practice

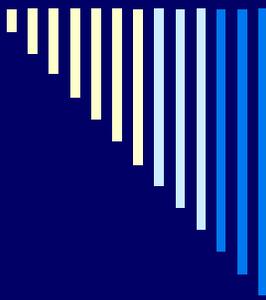
- Public Choice problems

- Mining

- They had the most water rights for the resource use in the mine exploitation and metal manufacturing zone
    - Are an important activity to the region and the country
    - They are only a few companies and had legal representation.

- Agricultures and citizens

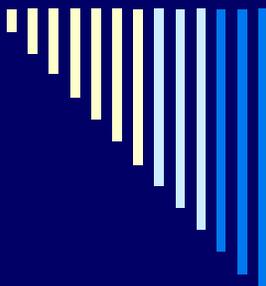
- Are a small number, they hasn't legal representation, must pay to the rights owners fro water consumption.
- Until 2005 there isn't exist a relation between ground and underground water flows. Those are connected and utilized of different usages.



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# Water Rights in practice

- Water rights mobility from small agricultures to great mining companies.
  - Lack of authority's concrete control faculties.
  - Rivalry problems for the water resource:
    - I, II and III region: Desert Zone where an excess of water demand is present. The main conflict here is between the domestic consumption and the mining companies
    - IV, XIII and VI region: Temperate Zone favorable to agriculture. The water demand for mining purposes compete with agricultural irrigation.
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# Challenges and projections

- Recently (2005) a modification to de Water Code (1980) had been promulgated
  - The changes were made in order to:
    - Promote the water resource's exploitation and utilization. The water rights owner got to pay a fee if they not use the resource.
    - Increment the environmental requirements and set priority parameters for the water right's use
- Basin Integrated Management
  - The objective is manage the hydrographic basin in a integrated way in order to preserve the water resource and adjacent ecosystems
    - The objectives are many
      - Environment protection
      - Resource preservation: Ground, forest, water, etc.
    - It has been implemented only in preservation and protection projects
    - A project who deals with the coexistence of many and opposite economics activities hasn't been implemented yet.
    - No project who has the regulation of water rights possession or the demand of water stability for different activities as a main feature has been presented.