

# AUCKLAND PECC SEMINAR-WATER ENERGY NEXUS

## COMPETING USE OF WATER FOR ENERGY AND IRRIGATION THE CASE OF CHILE

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# **COMPETING USE OF WATER FOR ENERGY AND IRRIGATION THE CASE OF CHILE**

## **OVERVIEW**

- **ENERGY CONSUMPTION AND HIDROELECTRIC POWER**
- **WATER RIGHTS FOR HYDROPOWER AND IRRIGATION**
- **MULTIPURPOSE PROYECTS**

# COMPETING USE OF WATER FOR ENERGY AND IRRIGATION

## THE CASE OF CHILE

### ENERGY CONSUMPTION AND HIDROELECTRIC POWER

- IN 1940 CHILE STARTED A PROGRAM OF HIDROELECTRIC PROYECTS CARRIED OUT BY AN STATE RUN ELECTRICITY COMPANY.
- UNTIL 1975 PROYECTS CONSIDERED MULTIPLE USE-ELECTRICITY, IRRIGATION, FLOOD CONTROL. DESIGN AND CONSTRUCTION BY THE STATE.
- BETWEEN 1940 AND 1989 4200 MW OF HIDROELECTRICITY WERE DEVELOPED, FOR A TOTAL DEMAND IN THE CENTRAL SYSTEM OF 7000 MW (APROX)

COMPETING USE OF WATER FOR ENERGY AND IRRIGATION  
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## ENERGY CONSUMPTION AND HIDROELECTRIC POWER

CONSUMO BRUTO ENERGIA PRIMARIA (TERACALORIAS)		
ENERGETICO	1990	2008
PETROLEO CRUDO	64,767	110,420
GAS NATURAL	18,770	24,795
CARBON	26,046	43,695
HIDROELECTRICIDAD	7,713	20,898
LEÑA	26,603	51,170
BIOGAS	176	0
<b>TOTAL</b>	<b>144,075</b>	<b>250,977</b>

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## THE CASE OF CHILE

### ENERGY CONSUMPTION AND HIDROELECTRIC POWER

#### Capacidad y Generación por Sistema 2008

Sistema	Potencia Bruta Instalada [MW]	Potencia Bruta Instalada [%]	Generación Bruta [GWh]	Generación Bruta [%]
Interconectado				
SING	3,602	25.2%	14,488	23.8%
SIC	9,386	65.7%	41,971	69.0%
AYSEN	50	0.4%	139.5	0.2%
MAGALLANES	80	0.6%	249.2	0.4%
AUTOPRODUCTORES	1,179	8.2%	4,010.4	6.6%
TOTAL	14,296	100.0%	60,858	100.0%

# COMPETING USE OF WATER FOR ENERGY AND IRRIGATION THE CASE OF CHILE

## INSTALLED CAPACITY BY TYPE OF PLANT (MW)

	SING	SIC	SISTEM A AYSEN (****)	SISTEM A MAGALLANES	TOTAL SISTEMAS	UTOPRODUCTORE	TOTAL PAIS
<b>1990</b>	<b>N/D</b>	<b>3,195.1</b>	<b>N/D</b>	<b>45.5</b>	<b>3,240.6</b>	<b>1,185.4</b>	<b>4,426.0</b>
%TÉRMI CA		27.4%		100.0%	30.3%	91.9%	45.3%
%HIDRO		72.6%		0.0%	69.7%	8.1%	54.7%
<b>1995</b>	<b>1,156.9</b>	<b>4,083.6</b>	<b>N/D</b>	<b>49.3</b>	<b>5,289.8</b>	<b>659.2</b>	<b>5,949.0</b>
%térm ica	98.8%	22.4%		100.0%	39.8%	85.5%	44.8%
%hidro	1.2%	77.6%		0.0%	60.2%	14.5%	55.2%
<b>2000</b>	<b>3,040.9</b>	<b>6,652.8</b>	<b>20.1</b>	<b>64.5</b>	<b>9,778.3</b>	<b>591.7</b>	<b>10,370.0</b>
%térm ico	99.6%	40.0%	76.3%	100.0%	58.6%	86.4%	60.2%
%hidro	0.4%	60.0%	23.7%	0.0%	41.4%	13.6%	39.8%
<b>2005</b>	<b>3,595.8</b>	<b>8,288.3</b>	<b>33.463</b>	<b>64.7</b>	<b>11,982.3</b>	<b>1,023.9</b>	<b>13,006.1</b>
%térm ico	99.6%	43.4%	41.5%	100.0%	60.5%	91.6%	63.0%
%hidro	0.4%	56.6%	58.5%	0.0%	39.5%	8.4%	37.0%
<b>2008</b>	<b>3,601.9</b>	<b>9,385.7</b>	<b>50.446</b>	<b>79.6</b>	<b>13,117.6</b>	<b>1,178.8</b>	<b>14,296.4</b>
%térm ico	99.6%	47.5%	55.0%	100.0%	62.2%	93.0%	64.7%
%hidro	0.4%	52.5%	45.0%	0.0%	37.8%	7.0%	35.3%

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## ENERGY CONSUMPTION AND HIDROELECTRIC POWER

BETWEEN 2010 Y 2020 ELECTRICITY DEMAND IS EXPECTED TO GROW 14500 MW, THAT CAN BE SUPPLY BY

- 10 % (1500 MW) ENERGY EFICIENCY.
- AT LEAST 3000 MW HIDROPROYECTS WITH REGULATION
- AT LEAST 1000 MW RUN OF THE RIVER HIDRO
- AT LEAST 3000 MW WIND, SOLAR, GEOTHERMAL, BIOMASS
- BETWEEN 1000 AND 2000 LNG

THIS STILL LEAVES BETWEEN 4000 AND 5000 MW COAL!!!

**BUSINESS AS USUAL CALLS FOR 8000 MW COAL!!!**

**THEN, BUSINESS AS USUAL IS NOT VIABLE ENVIRONMENTALLY,  
SOCIALLY, OR ECONOMICALLY**



# COMPETING USE OF WATER FOR ENERGY AND IRRIGATION THE CASE OF CHILE

## ENERGY CONSUMPTION AND HIDROELECTRIC POWER

- IN 1989 THE STATE OWNED LARGEST GENERATION CO. AND OWNER OF HYDRO PLANTS WAS PRIVATIZED
- DURING THE 90'S HYDRO PROYECTS IN ENDESA'S PORTFOLIO CONTINUED BEING DEVELOPED BY THE PRIVATIZED CO.
- PRIVATIZATION INCLUDED WATER RIGHTS ORIGINALLY ASIGNED TO THE STATE CO.
- 90% OF THE WATER RIGTHS RELATED TO ECONOMICALLY VIABLE PROYECTS WERE TRANSFERED TO THE NEW PRIVATE CO.
- THIS AFFECTED THE POTENTIAL COMPETITIVENESS OF THE GENERATION MARKET.



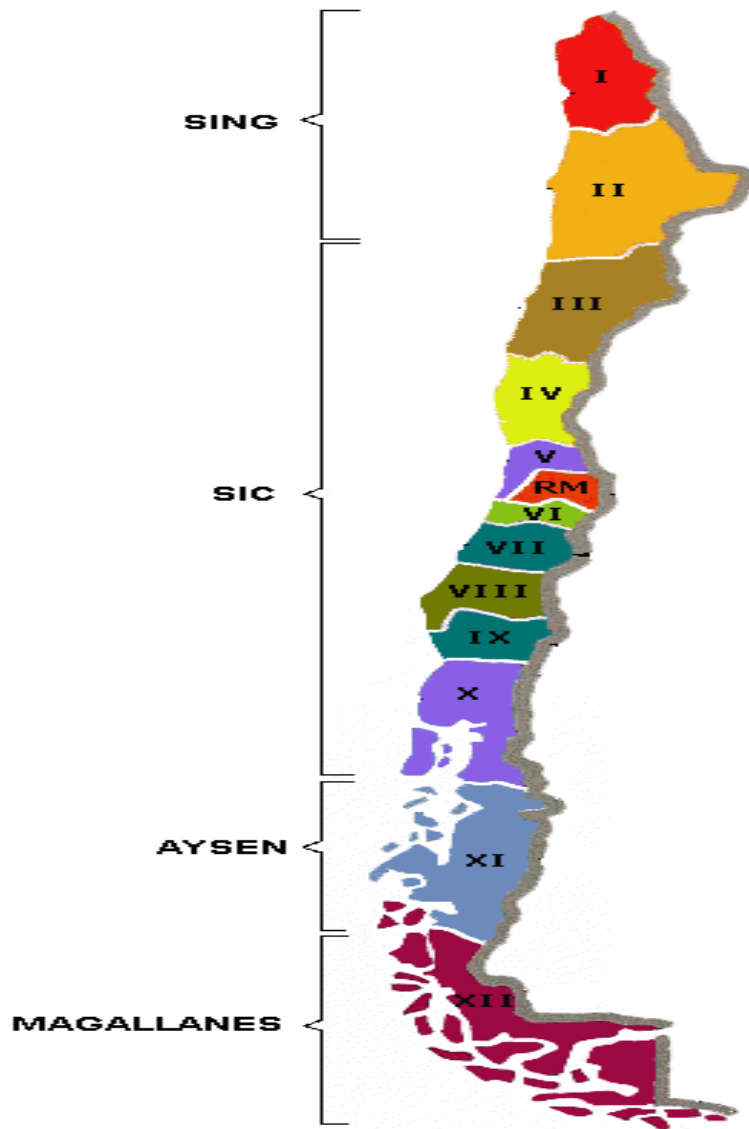
# **COMPETING USE OF WATER FOR ENERGY AND IRRIGATION THE CASE OF CHILE**

## **WATER RIGHTS FOR ENERGY AND IRRIGATION PRESENT SITUATION**

- WATER RIGHTS CAN BE CONSUMPTIVE OR NON-CONSUMPTIVE
- HYDROELECTRICITY IS NON CONSUMPTIVE
- IRRIGATION IS CONSUMPTIVE
- NON CONSUMPTIVE IMPLY THE DEFINITION OF A VOLUME TO BE DRAWN IN A POINT, AND RETURNED IN ANOTHER POINT OF THE RIVER.
- CONFLICT CAN BE KEPT AT A LOW LEVEL IF THE WATER MARKET WORKS.
- REQUESTS OF NEW RIGHTS ARE PUBLIC-HAVE TO BE ADVERTIZED, AND THERE IS A PROCEDURE TO OPPOSSE WHEN THERE IS CONFLICT BETWEEN USERS.
- IF THERE ARE CONFLICTS BETWEEN DIFFERENT REQUESTS, THE RIGHTS HAVE TO BE AUCTIONED.

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## THE WATER RIGHTS MARKET



**VERY LIMITED HYDRO CAPACITY  
IN THE NORTH**  
(I TO IV REGIONS)

**MOST INSTALLED HYDRO  
CAPACITY VII TO X REGIONS**  
(CENTRAL INTERCONNECTED  
SYSTEM)

**FUTURE POTENTIAL MOSTLY VIII  
TO XI REGIONS**  
(XI HAS TO BE CONNECTED TO  
SIC)

**DAMS PROYECTED IN XI  
REGION-3500 MW IN THREE  
RIVERS BETENN 2011 AND 2016**

## THE WATER RIGHTS MARKET

IN THE SIC (CENTRAL INTERCONNECTED SYSTEM) THE RIGHTS FOR THE MOST ECONOMICALLY ATTRACTIVE SITES HAVE BEEN ALLOCATED

THE **1981** WATER LAW ALLOWED COMPANIES TO KEEP THEIR RIGHTS WITHOUT USING THEM, INDEFINITELY. THIS GAVE MARKET POWER TO THE LARGEST GENERATOR, OWNER OF MOST WATER RIGHTS (DELAYS IN PROJECT CONSTRUCTION IMPLIED HIGHER PRICES)

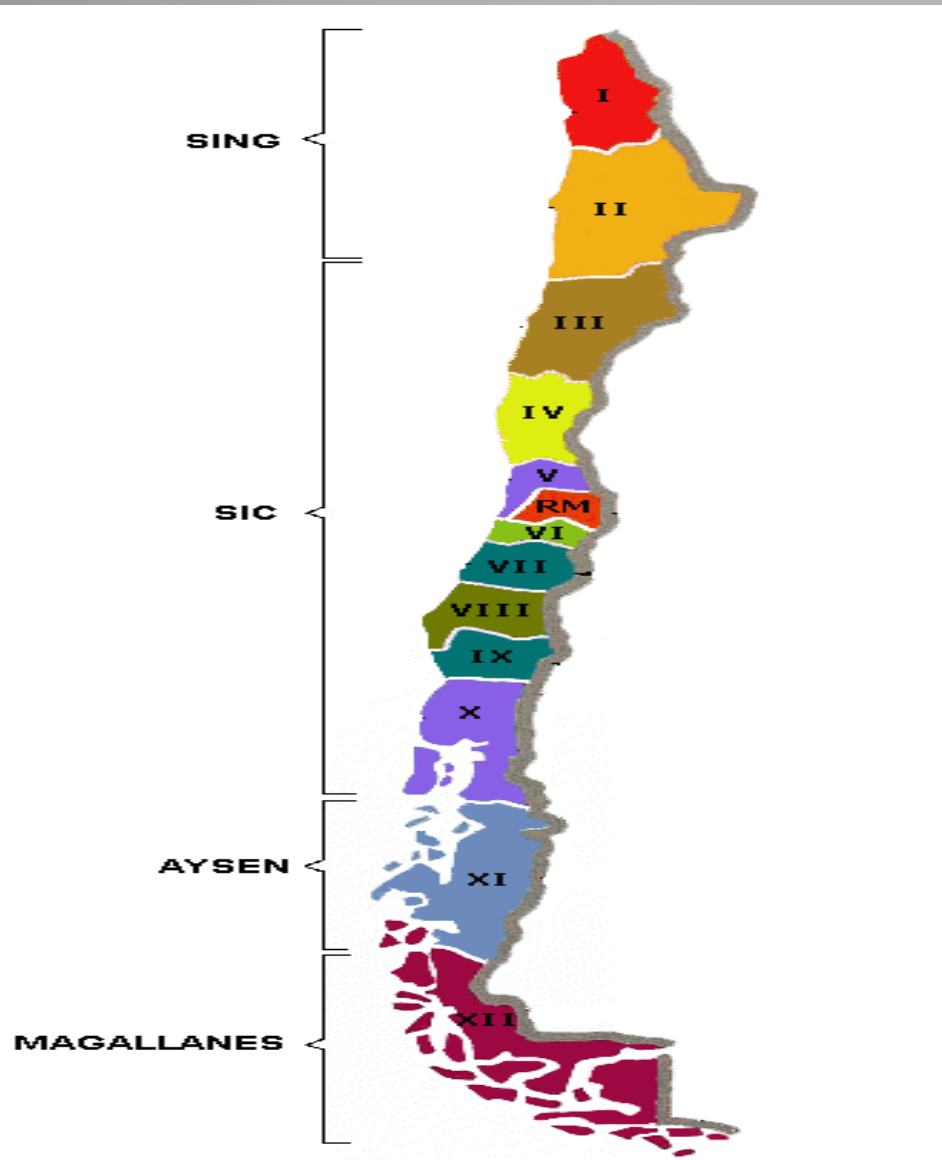
THE **2005** REFORM INTRODUCED A TAX ON NON USED NON CONSUMPTIVE WATER RIGHTS

THIS HAS PROVIDED INCENTIVES FOR TRANSFERENCES OF RIGHTS- THROUGH AUCTIONS OF THOSE THAT HAVE ECONOMIC POTENTIAL. NON USED RIGHTS CAN BE RETURNED TO THE STATE, AND THE PUBLIC WATER AGENCY ORGANIZE THE AUCTIONS.

DIRECT SALES ARE ALSO ALLOWED

# COMPETING USE OF WATER FOR ENERGY AND IRRIGATION THE CASE OF CHILE

## THE WATER RIGHTS MARKET



**CONFLICTS BETWEEN USERS  
ARE THE NORM IN THE NORTH  
(I TO IV REGIONS)**

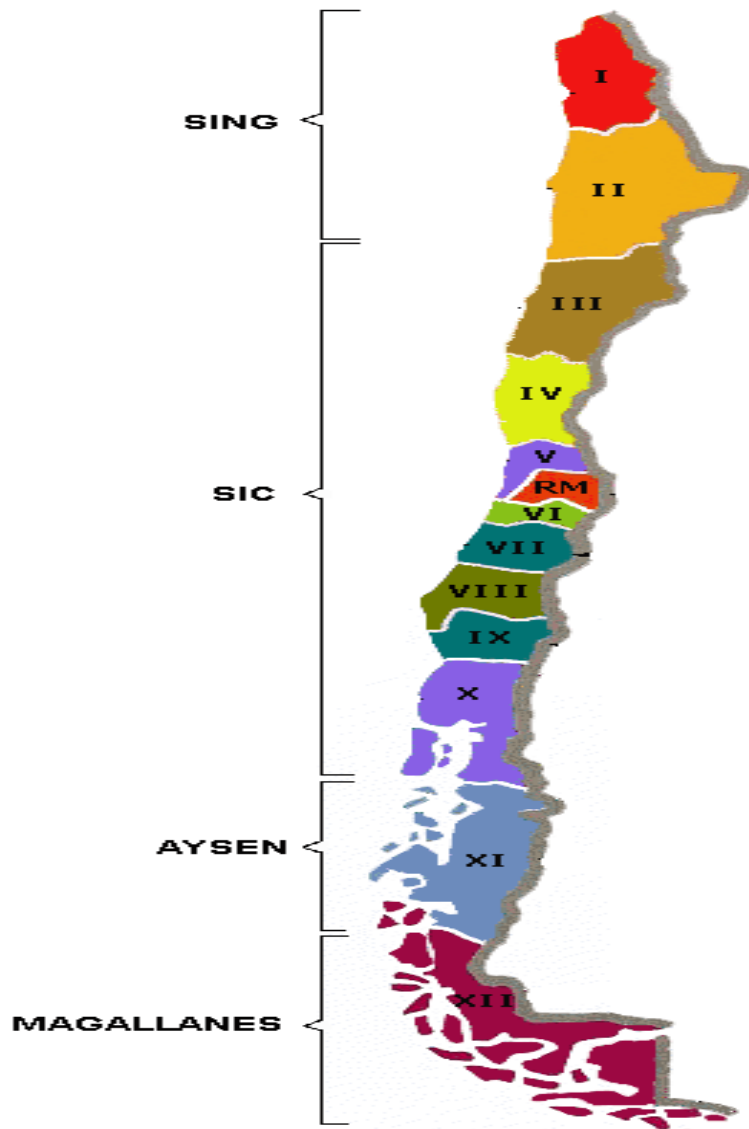
**CENTRAL REGIONS PRESENT  
CONFLICT OVER OPERATION OF  
DAMS ( IMPACT OF WATER  
RELEASE ON WET SEASONS).  
(VII TO X REGIONS)**

**FUTURE POTENTIAL MOSTLY VIII  
TO IX REGIONS  
(XI HAS TO BE CONNECTED TO  
SIC)**

**MOST DAMS SITES ARE HIGH IN  
THE MOUNTAINS.  
AGRICULTURE IS MAINLY ON  
THE CENTRAL PLAINS**

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## THE WATER RIGHTS MARKET



**CENTRAL AND SOUTH REGIONS  
PROYECTS ARE OPPOSED BY:**

- THE ECOLOGIST MOVEMENT,
- THE AQUICULTURE INDUSTRY,
- OWNERS OF LARGE PRIVATE PARKS IN THE FAR SOUTH .
- HIGH INCOME TOURISM

## **MULTIPURPOSE PROJYECTS**

UP TO 1989, BEFORE PRIVATIZATION, MULTIPLE USE OF RESERVOIRS WAS CONSIDERED WHEN DESIGNING HYDRO PROJYECTS.

AFTER PRIVATIZATION, HYDRO PROJYECTS HAVE BEEN DEVELOPED FOR ELECTRICITY ONLY.

FLOOD CONTROL IS NOT BUILT IN THE DESIGN. HOWEVER ENVIRONMENTAL PERMITS HAVE TO ASSURE THAT HYDRO PROJYECTS DO NOT NEGATIVELY AFFECT BASIN BEHAVIOR AND RISE RISK OF FLOODS.

ENVIRONMENTAL PERMITS ARE CONDITIONED TO PROTECTION OF WATER RIGHTS OF OTHER USERS.

THE STATE DEVELOPS SMALL AND MEDIUM SIZE DAMS FOR IRRIGATION PURPOSES EXCLUSIVELY.

## MULTIPURPOSE PROYECTS THE FUTURE

THE RE LAW CALLS FOR 5% OF **NON CONVENTIONAL RE** IN TOTAL PRODUCTION AND ON ENERGY CONTRACTED ON LONG TERM BASIS BY GENERATORS (10% BY 2020)

THIS IS ACTING AS AN INCENTIVE TO WIND, GEOTHERMAL , SOLAR AND SMALL HYDRO

NON COMPLIANCE BY GCO'S WILL BE PENALIZED. THEY ARE PASSING THE RESPONSIBILITY TO LARGE CONSUMERS.

A MARKET FOR TRADE OF RE CERTIFICATES IS EXPECTED

**MULTIPURPOSE PROYECTS ARE BEING CONSIDERED USING IRRIGATION RESERVOIRS (NEW AND EXISTING).**



## FINAL COMMENTS

### ORIGINAL WATER LAW AND POLICY HAD SHORTCOMINGS.

- INCENTIVES TO SPECULATION,
  - MARKET POWER IN THE GENERATION MARKET
  - NON CONSIDERATION OF INDIGENOUS RIGHTS
  - LACK AT THE TIME OF AN EIA SYSTEM
  - LITTLE INFORMATION ON RIGHTS ALLOCATION
  - LACK OF ENVIRONMENTAL CONDITIONS
  - CONCENTRATION OF RIGHTS
- 
- SUBSEQUENT REFORMS ARE DEALING WITH THE SHORTCOMINGS

### CONFLICTS CAN BE DEALT WITH BY:

- GOOD MANAGEMENT OF WATER BASINS,
- BETTER INFORMATION FOR MANAGEMENT,
- MORE TRANSPARENCY AND PUBLIC INFORMATION,
- AND MORE STRICT ENVIRONMENTAL CRITERIA ON THE EIA SYSTEM

## **FINAL COMMENTS**

**BECAUSE OF ENERGY NEEDS AND WATER NEEDS IN THE FUTURE, AND CARBON EMISSIONS CONTROL, CHILE SHOULD DEVELOP MULTIPURPOSE DAMS. BUT**

- THERE IS OPPOSITION FROM THE ECOLOGICAL MOVEMENT**
- THERE ARE CONFLICTS WITH RIGHTS OF WAY FOR TRANSMISSION LINES**

**HIGH CAPITAL COST OF NONCONVENTIONAL RE REPRESENTS HIGHER COSTS FOR THE CONSUMERS. SOCIAL COST**

**COAL REPRESENTS A HIGH ENVIRONMENTAL COST, AND UNCERTAINTY IN PRICES.**

**WHAT SHOULD WE DO? WHERE IS THE BALANCE?**



THANK YOU