

The Insertion of Renewables into the Chilean Electricity Market: How Green?

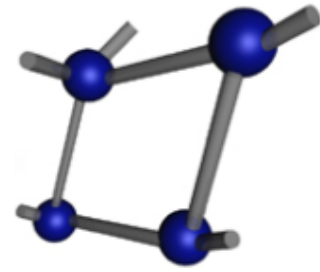
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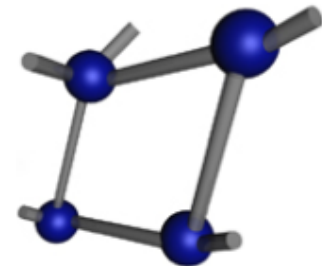
Minneapolis, July 25-29

Presentation Overview



- Chilean electricity market
- Dilema for fast developing countries
- Regulatory framework for renewables
- Investment in renewables
- Future energy supply scenarios
- Challenges

Chilean electricity market (1/5)



Northern Interconnected System (SING)	
Max Demand (MW)	1,900
Sales (GWh)	13,656
Installed Capacity (MW)	3,573
Coverage	Region I - II
Population	5.7%

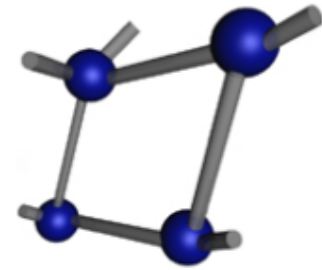
Aysen System	
Max Demand (MW)	21
Sales (GWh)	106
Installed Capacity (MW)	48
Coverage	XI Región
Population	0.6%



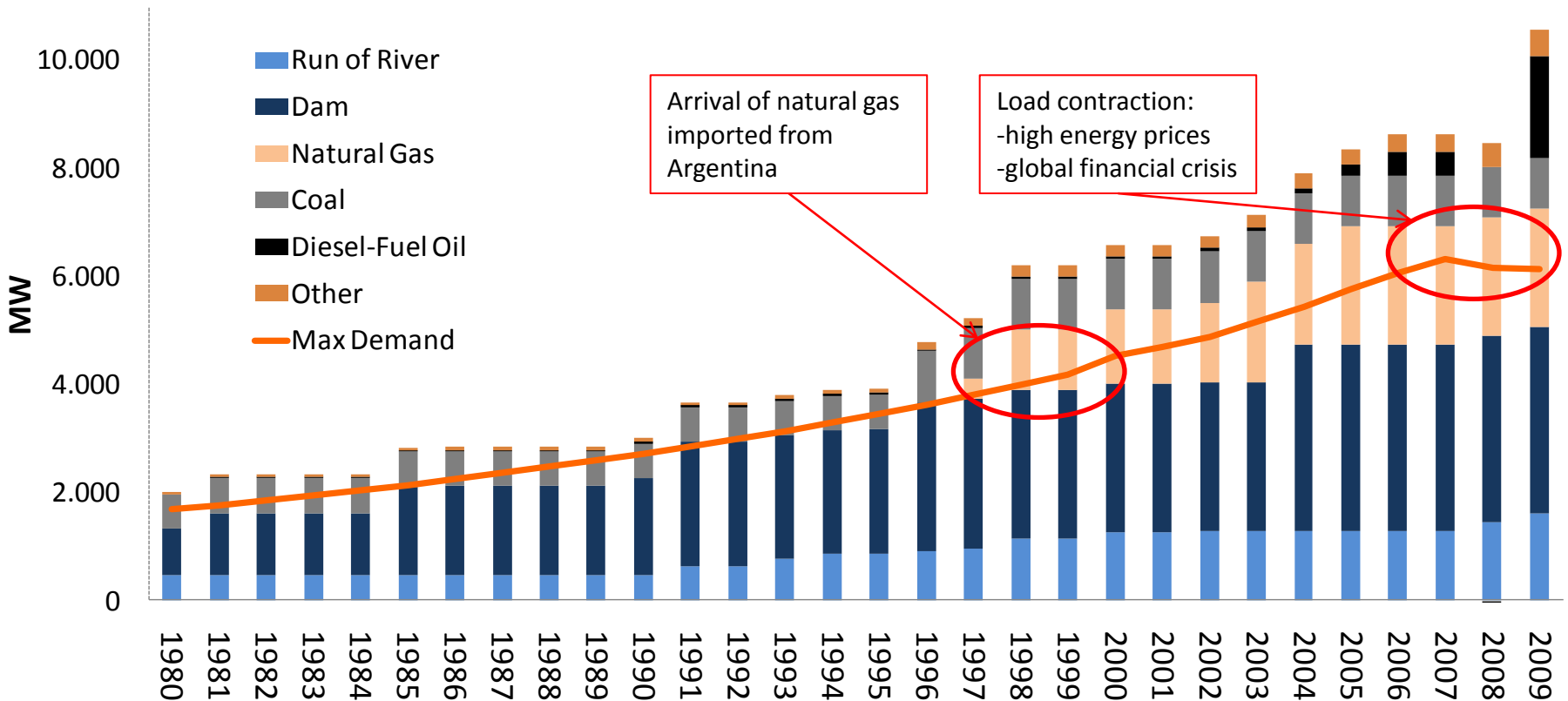
Central Interconnected System (SIC)	
Max Demand (MW)	6,139
Sales (GWh)	39,964
Installed Capacity (MW)	11,147
Coverage	Region III - X
Population	92.6%

Magallanes System	
Max Demand (MW)	45
Sales (GWh)	218
Installed Capacity (MW)	80
Coverage	XII Región
Population	1.1%

Chilean electricity market (2/5)

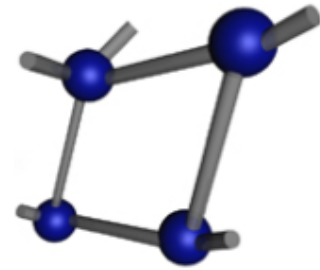


➤ Installed capacity and peak demand in Central System



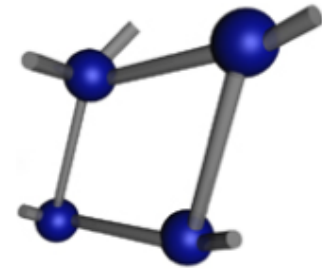
➤ Projected demand growth of 5 % per year 2010-2020

Chilean electricity market (3/5)



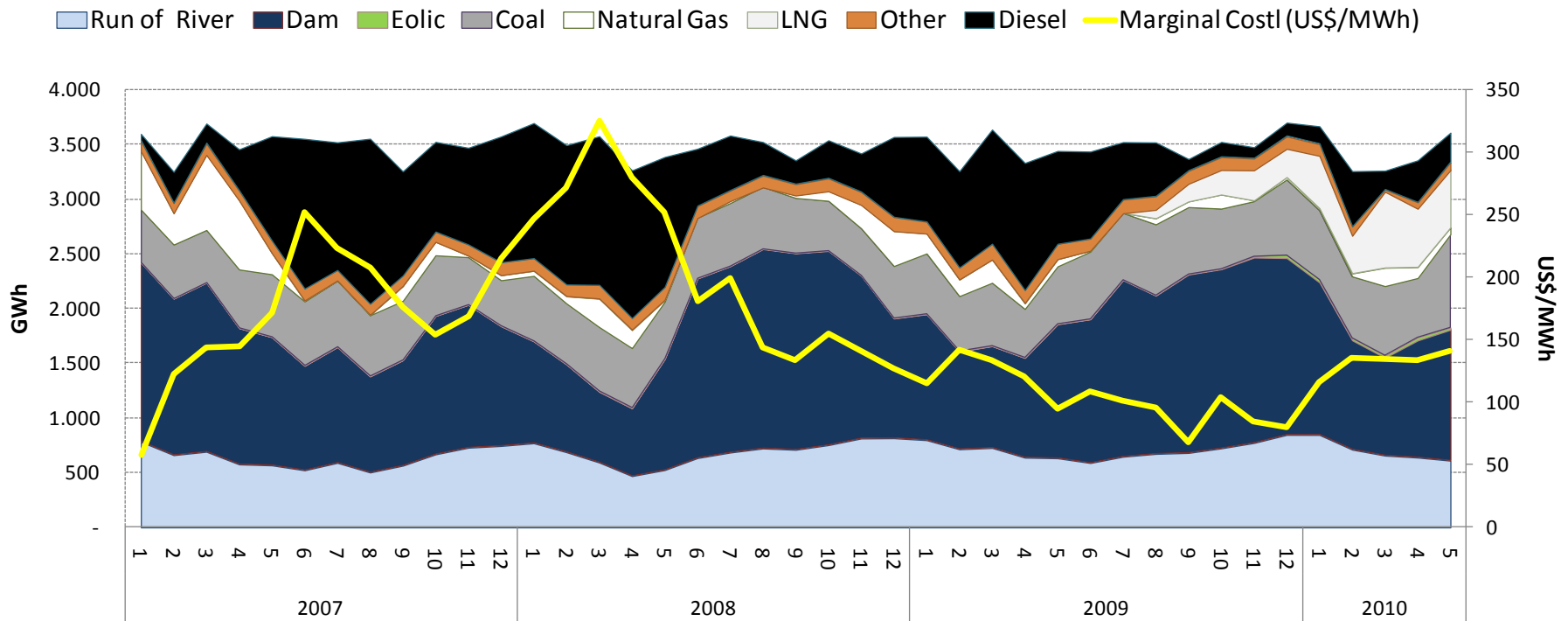
- Electricity sector based on a competitive market
 - Private competitive investment in generation
 - Regulated private investment in T&D
- Energy
 - Prices set in contract auctions (financial)
 - Large consumers (> 2MW) privately auctioned supply contracts
 - Distribution companies auction long term supply contracts in an observed process for regulated consumers(≤ 2 MW)
 - Spot market with marginal pricing
 - Wholesale market with exclusive access to generators
- Capacity payment
 - Price regulated: investment cost of supplying the marginal peak demand

Chilean electricity market (4/5)

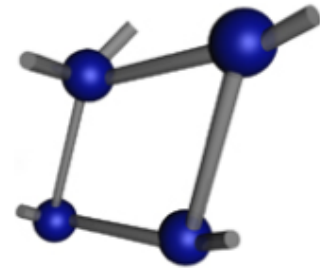


➤ Generation by technology and marginal costs (2007-2010)

- Dependence on hydro and imported fuels
- High volatility of marginal cost
- Highest energy price in the region

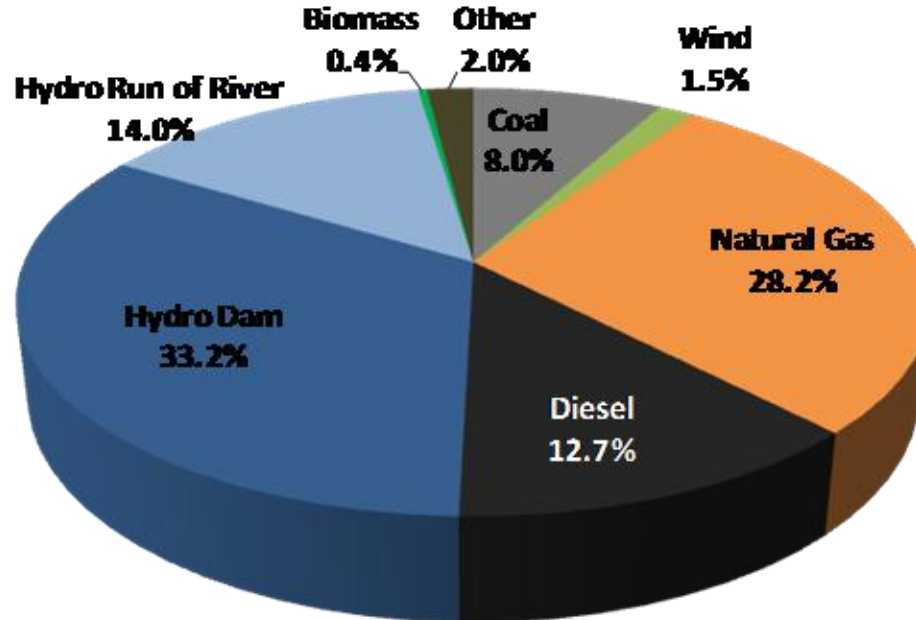


Chilean electricity market (5/5)

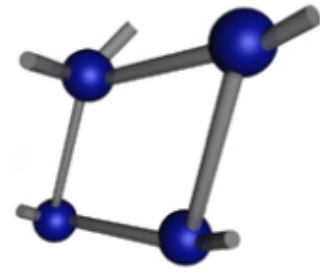


➤ Installed capacity in the central system

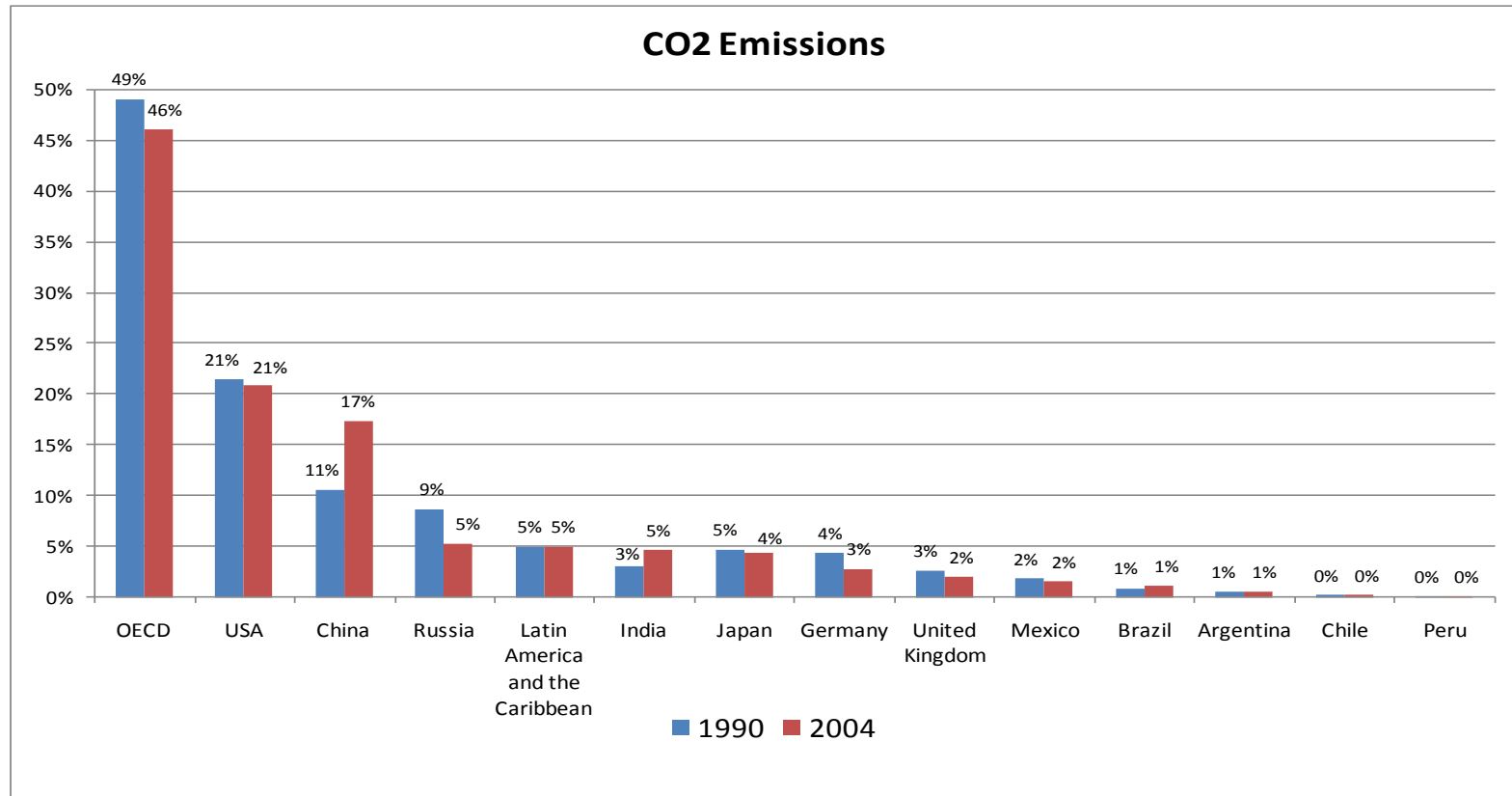
- Low non conventional renewables participation
- High participation of large hydro, both run of river and reservoirs/dam
- Natural gas is being replaced by coal fired plants and hydro



Dilemma for fast developing countries (1/4)

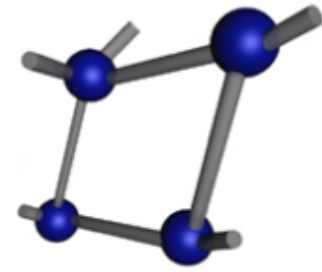


➤ Almost nil contribution to global emissions

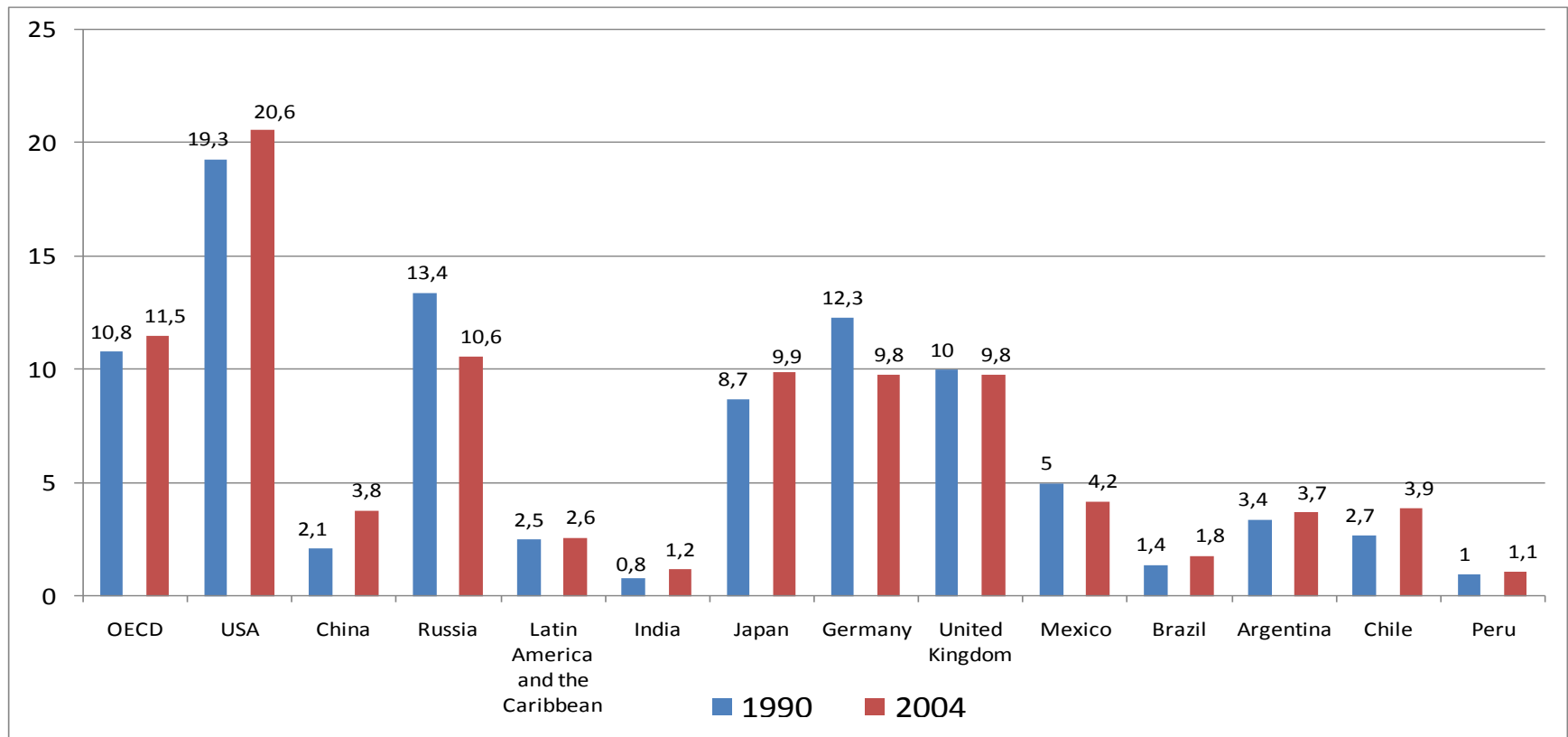


Source: Human Development Report 2007/2008

Dilemma for fast developing countries (2/4)

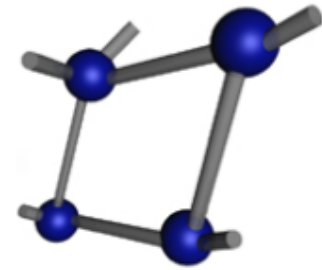


➤ But in terms of CO2 emissions per capita



Source: Human Development Report 2007/2008

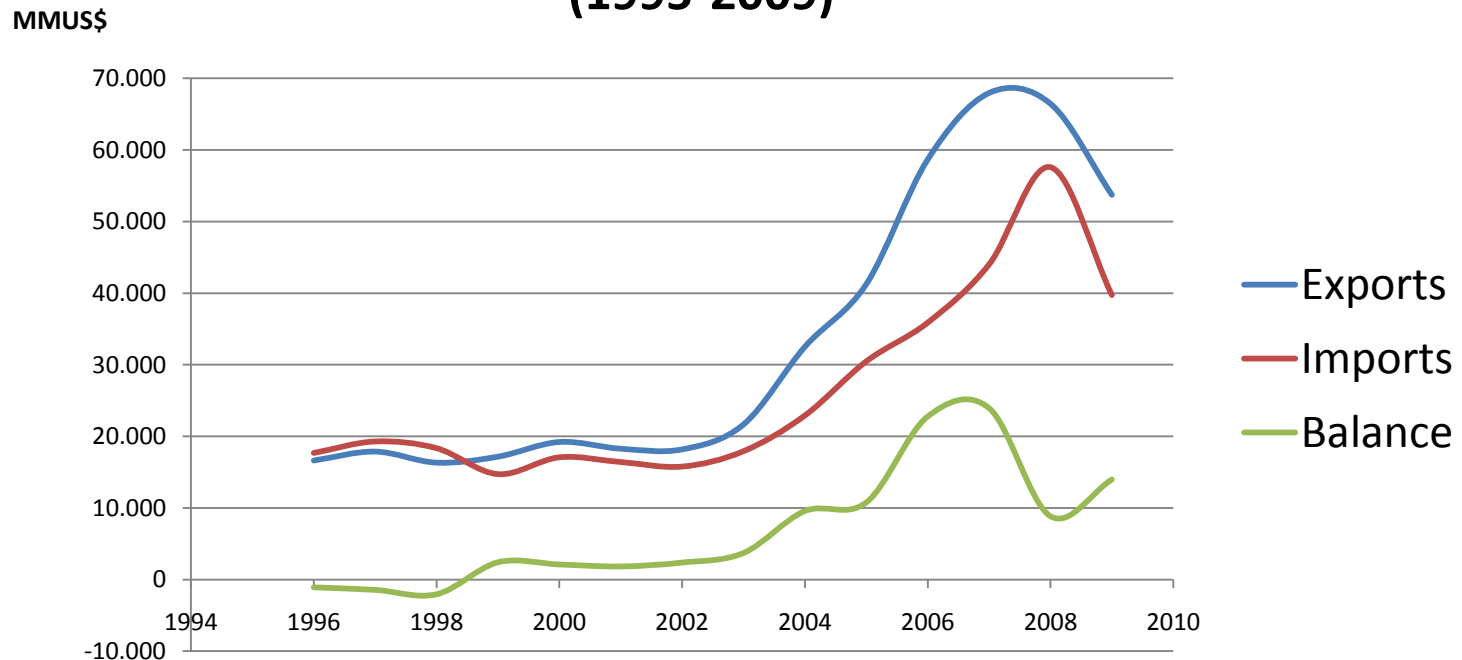
Dilemma for fast developing countries (3/4)



➤ Economy growth relies on exports

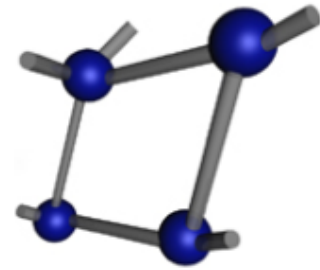
- Access to international markets

**Chile trade balance
(1995-2009)**



Source: Chilean Central Bank

Dilemma for fast developing countries (4/4)



U.S. climate bill needs strong border measure: Senator Baucus

Tue Nov 10, 2009 11:48am EST

"The United States must include a tariff or some other "border measure" to protect U.S. manufacturers from unfair foreign competition as part of legislation to address climate change"

Europe

France's carbon tax

Taming the carbonivores

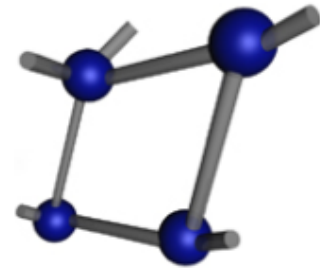
Sep 17th 2009 | PARIS

From *The Economist* print edition

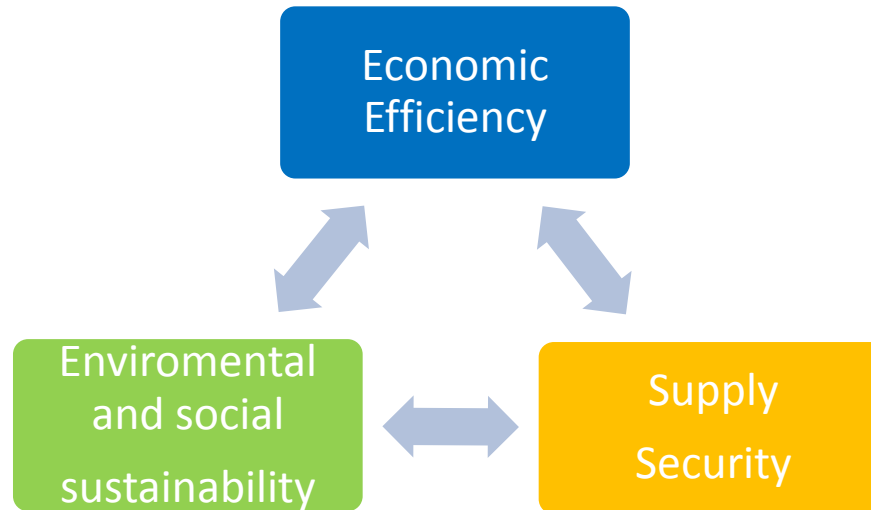
Hot air over a tentative carbon tax

"Mr Sarkozy says he will now push for a Europe-wide carbon tax on imports from countries that "do not respect any environmental or social rules". That leads some to suspect that his ultimate objective is to create a pretext for protectionism."

Basic energy policy principles

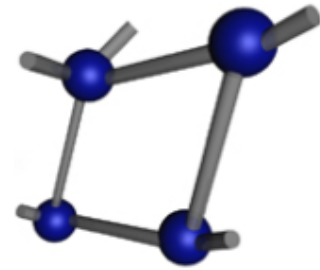


- Energy policy making has three basic principles to balance:



- Very different contexts and emphasis depending of the region or countries:
 - Developed world
 - Fast growing economies
 - Third world countries

Renewable energy in Chile



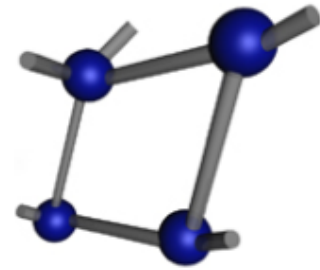
➤ Non Conventional Renewable Energy (NCRE) as defined by law

Biomass	Hydro (≤ 20 MW)
Geothermal	Solar
Wind	Tidal

➤ ¿Why pursue higher renewable energy penetration in Chile?

- Diversification of energy matrix and supply security
- Environmental sustainability
- Chile has a very high NCRE potential

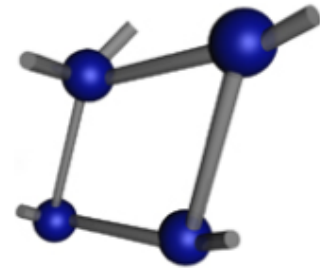
Renewable energy potential in Chile



Technology	Estimated Potential [MW]
Geothermal	2.000
Wind	6.000
Biomass	1.000
Mini Hydro	2.600
Solar	-
Total	11.600

Source: National Energy Commission

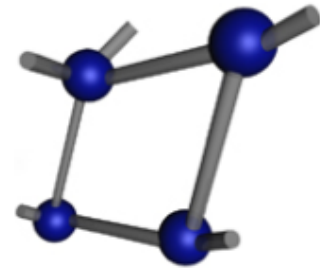
Regulatory framework for renewables



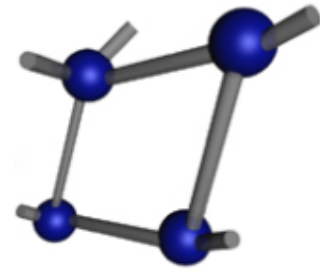
NCRE

- **Incentives created to introduce NCRE in Chile:**
 - Law N°19.940 (2004): Market access and trunk transmission
 - Law N°20.018 (2005): Reserved 5% market share of energy auctioned by distribution companies for regulated consumers
 - Bylaw DS-N°244 (2008): Grid connection procedures
 - Law N° 20.257 (2008): Market share equivalent to 5% of energy withdrawals, increasing up to 10% in 2024

Market share reserved for renewables

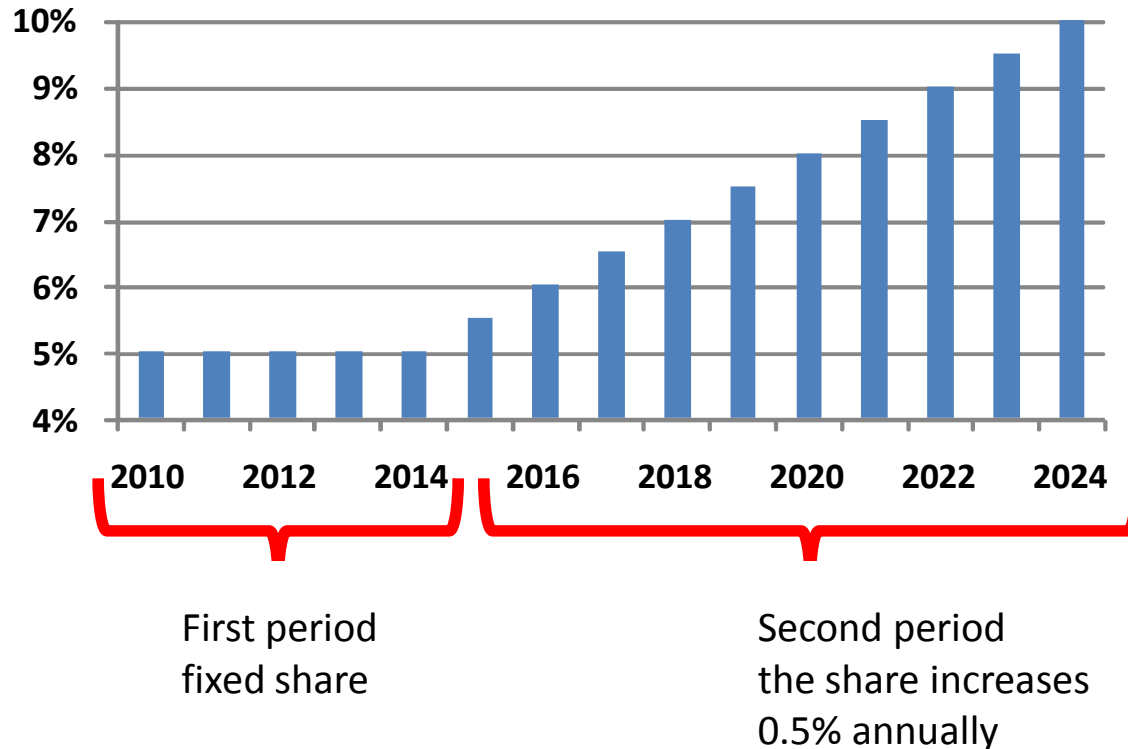


- From January 1st, 2010 initially 5% of the energy withdrawn from wholesale markets to supply contracts must be generated by NCRE.
 - Only for new projects connected after January 1, 2007
 - Obligation for contracts signed after August 31, 2007
 - Transfers between different electrical systems
 - Possibility of postponing compliance for one year (up to 50% of annual requirement)
 - Surpluses from previous years may be credited to the next year

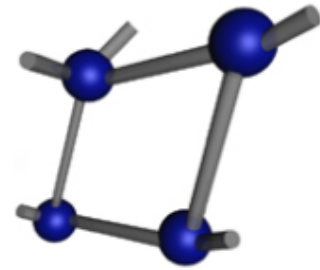


Market share for renewable energy

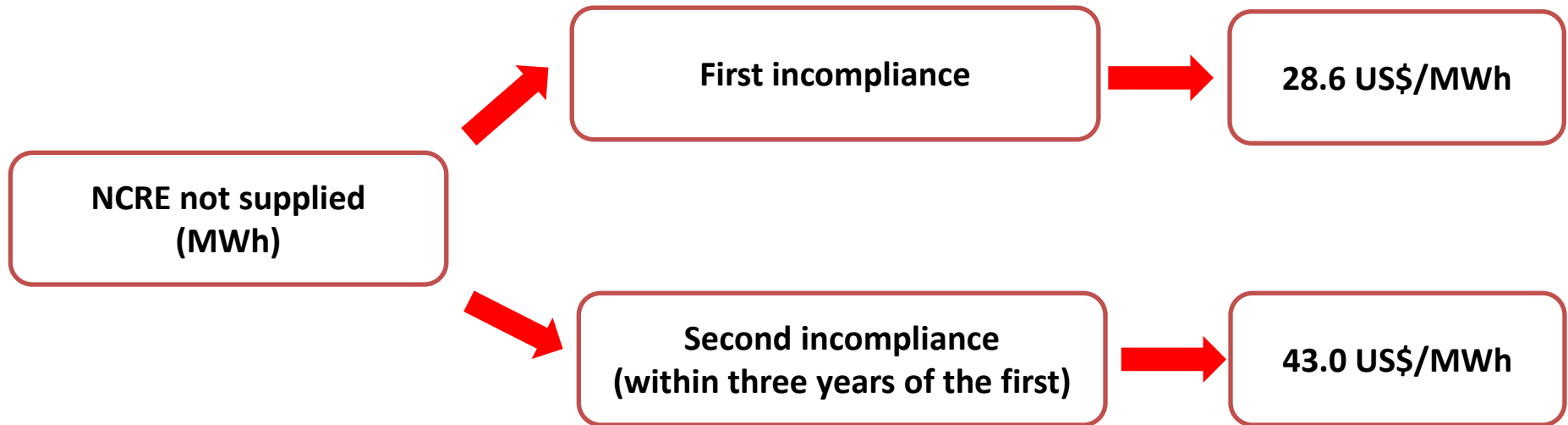
- Percentage of energy withdrawals associated to supply contracts signed after August 31, 2007.



Market share for renewable energy

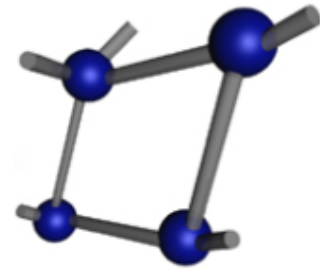


➤ Penalty for not complying with renewables share



Energy prices (june 2010)	US\$/MWh
Average contract price auctioned by distribution companies (1)	82,8
NCRE penalty (2)	28,6
Maximun price renewable energy could get (1) + (2)	111,4

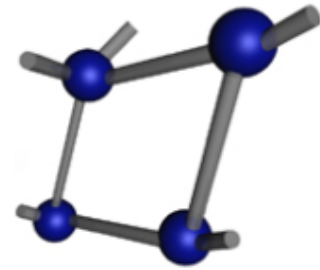
Investment in renewables (December 2009)



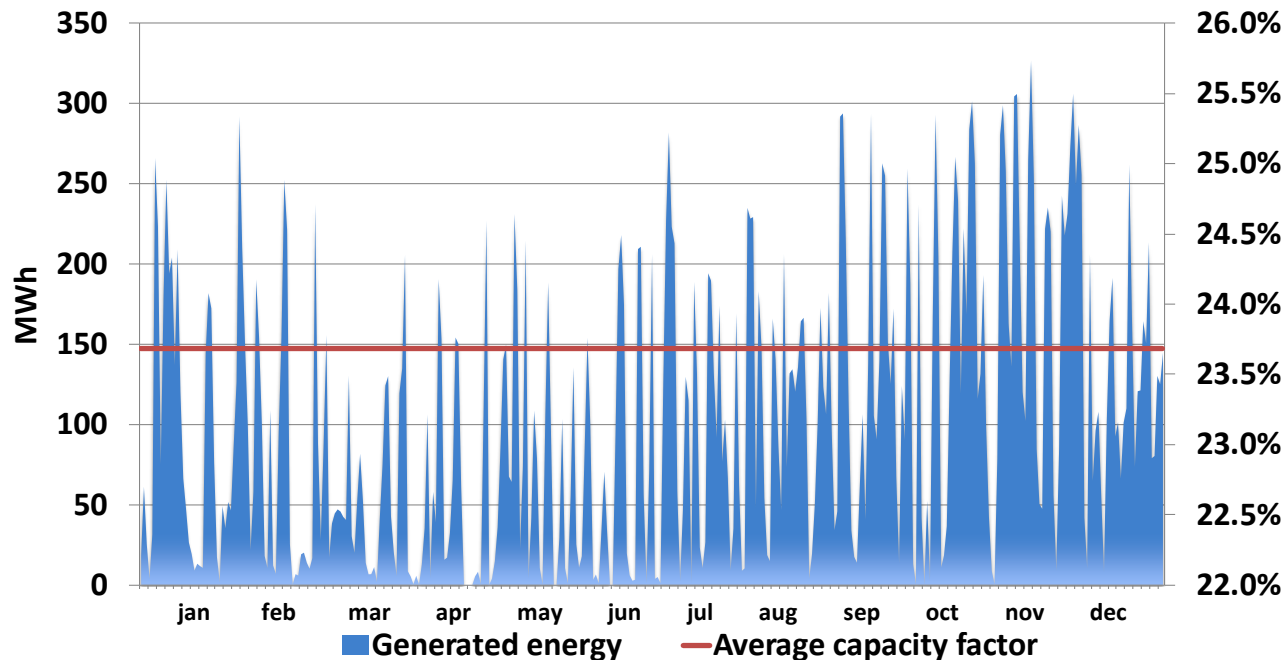
Status	Fuel	Capacity (MW)
In operation	Biomass	-
	Wind	172
	Mini-hydro	46
	Solar	-
	Total	218
Projects with approved environmental licensing	Biomass	211
	Wind	1.079
	Mini-hydro	212
	Solar	9
	Total	1.510
Projects with pending environmental licensing	Biomass	23
	Wind	674
	Mini-hydro	59
	Solar	-
	Total	756
Total Renewables		2.484

Source: Environmental Impact Evaluation System (SEIA), Systeem

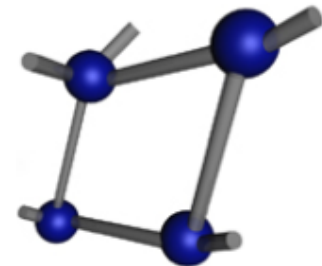
Investment in renewables



- Energy generated in Canela wind farm: not always what was expected, only 23.5 % capacity factor

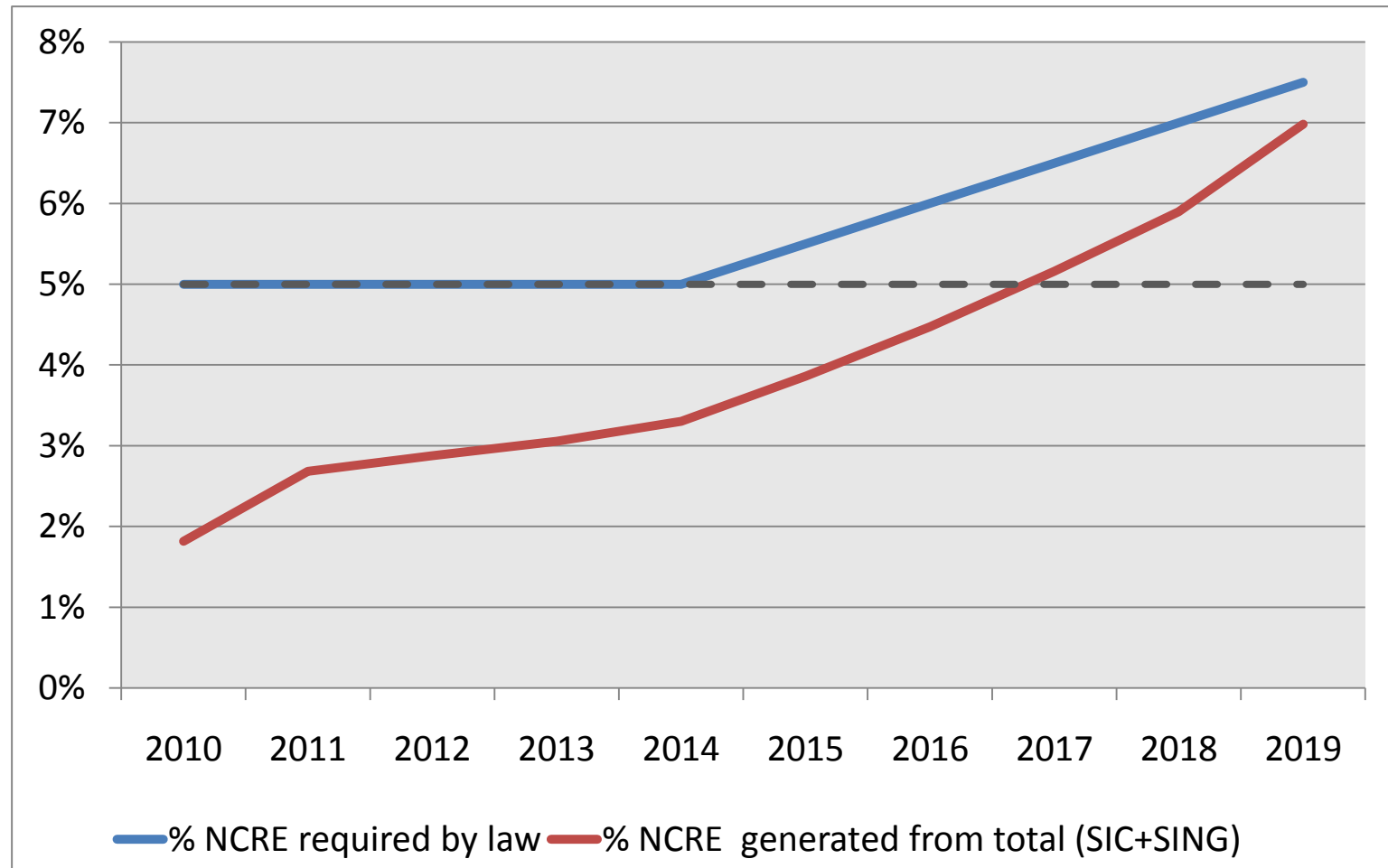
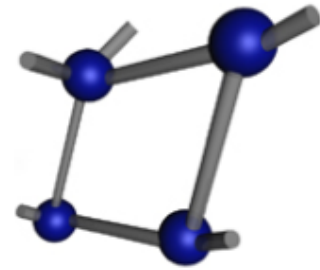


Results of first 4 months of application of NCRE share law

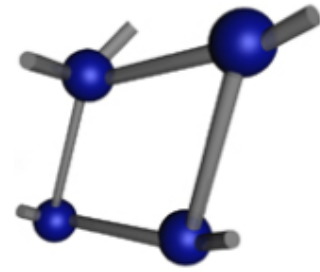


	jan 10	feb-10	mar-10	apr 10
Total generation				
SIC (MWh)	3.663	3.252	3.258	3.352
SING (MWh)	1.212	1.126	1.263	1.250
Total gross generation (MWh)	4.875	4.378	4.521	4.602
Total net generation (MWh)	4.631	4.159	4.295	4.372
Total energy contracted subject to NCRE credit (MWh)	937	893	823	991
ERNC credit obligation	5%	5%	5%	5%
ERNC credit obligation (MWh)	47	45	41	50
NCRE generation valid for credit (MWh)	101	78	67	77
Percentage from total net generation	2,2%	1,9%	1,5%	1,8%
NCRE surplus generation (MWh)	54	33	25	27

Estimated energy required to comply with legal obligation in the future

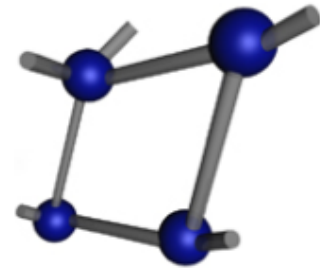


Challenges for higher renewable penetration (1/2)



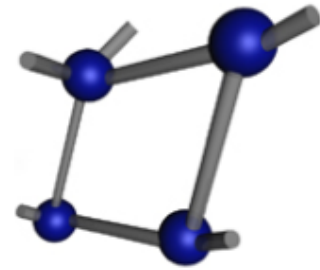
- Financing and business model
 - Normal risk: Production estimate based on resource prediction, average production and confident scenario
 - Extraordinary risk: no guaranteed price for renewable energy
 - Hydro: can obtain energy contracts and stabilize income
 - Wind: given it is variable resource, no clients willing to sign contracts, hence business model based on spot market with high volatility, i.e. no financing based on merchant plan
- NCRE penalty (credit) does not have a fixed value
 - No real value for securing financing
 - Excess offer for a limited demand
- Long time to obtain permits, increases costs and often discourages investors
 - Environmental license (common to all technologies)
 - Other permits, such as water rights

Challenges for higher renewable penetration (2/2)



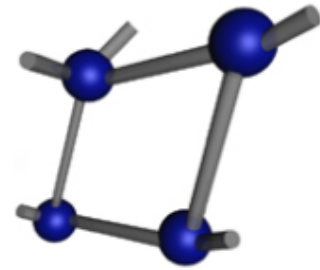
- Transmission access
 - Resources are many times located in isolated areas or near weak rural lines that need strong investment to allow connection
 - High connection cost to be paid by NCRE due to long distance to main transmission systems
- Connection to distribution grid
 - Although regulated process exist, still long and difficult process with distribution companies
 - Information asymmetry still exercised
- Renewable resources information
 - No detailed resource map of renewable energy
 - Investors must perform their own scouting

Future energy supply scenarios

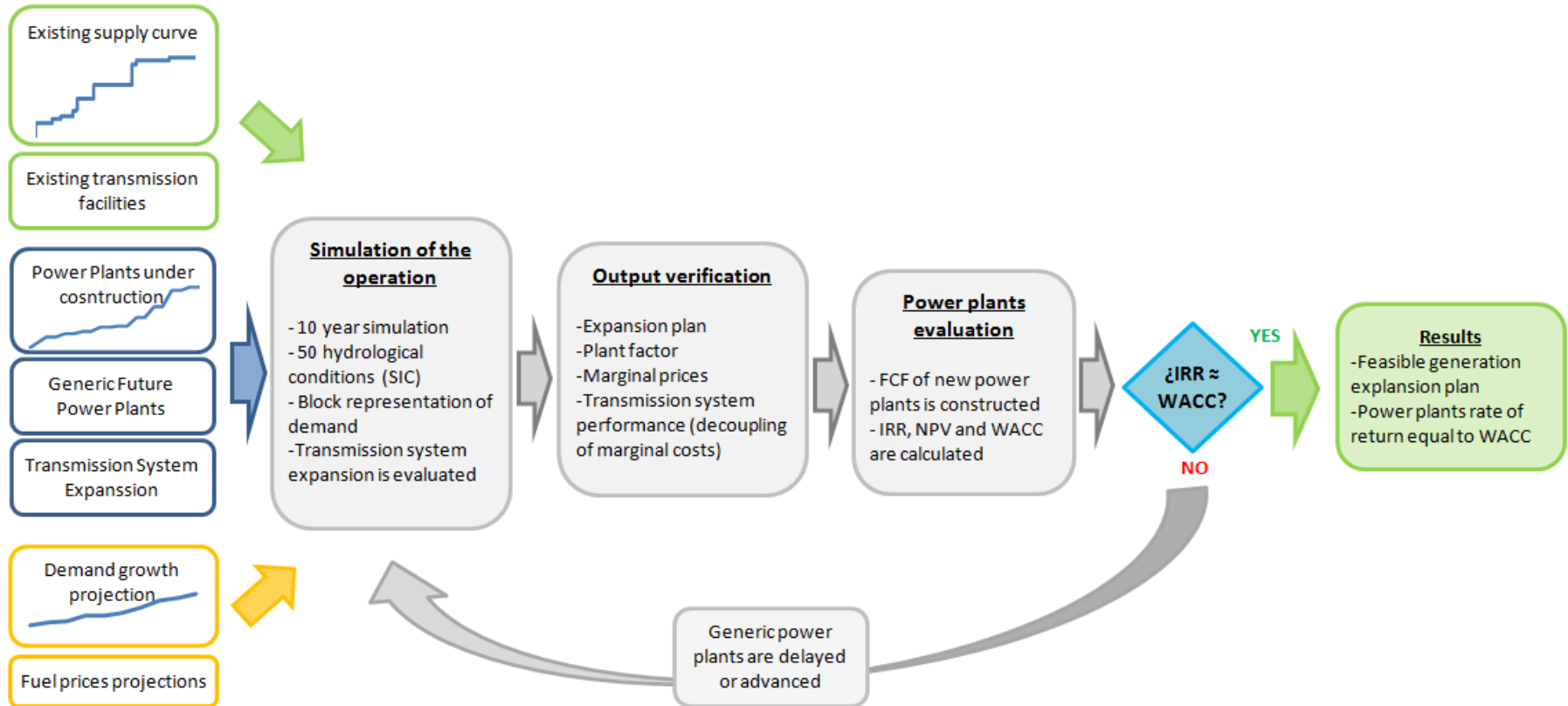


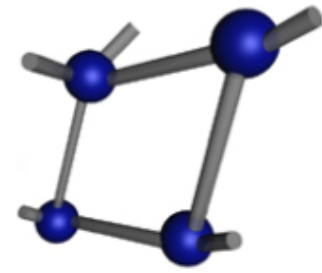
- Projection of future development of the energy market until 2030
- Two scenarios are presented
 - Business as usual as a base case
 - Similar composition of current technologies
 - Renewable scenario with 20 % penetration by the year 2030
- Investment model was used to simulate investors behavior in a competitive privately driven market
- Hydrothermal dispatch model
- Other considerations
 - 5 % demand growth
 - 1 % annual energy efficiency from 2020
 - Transmission comes in time when needed from 2020 onwards
 - Large hydro in Patagonia are developed
 - Fuel prices constant
 - Technology cost constant

Future energy supply scenarios



➤ Investment model and hydrothermal dispatch



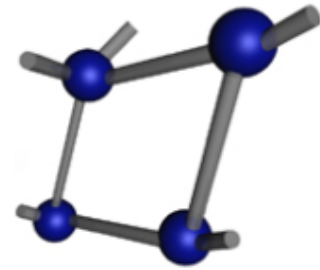


Future energy supply scenarios

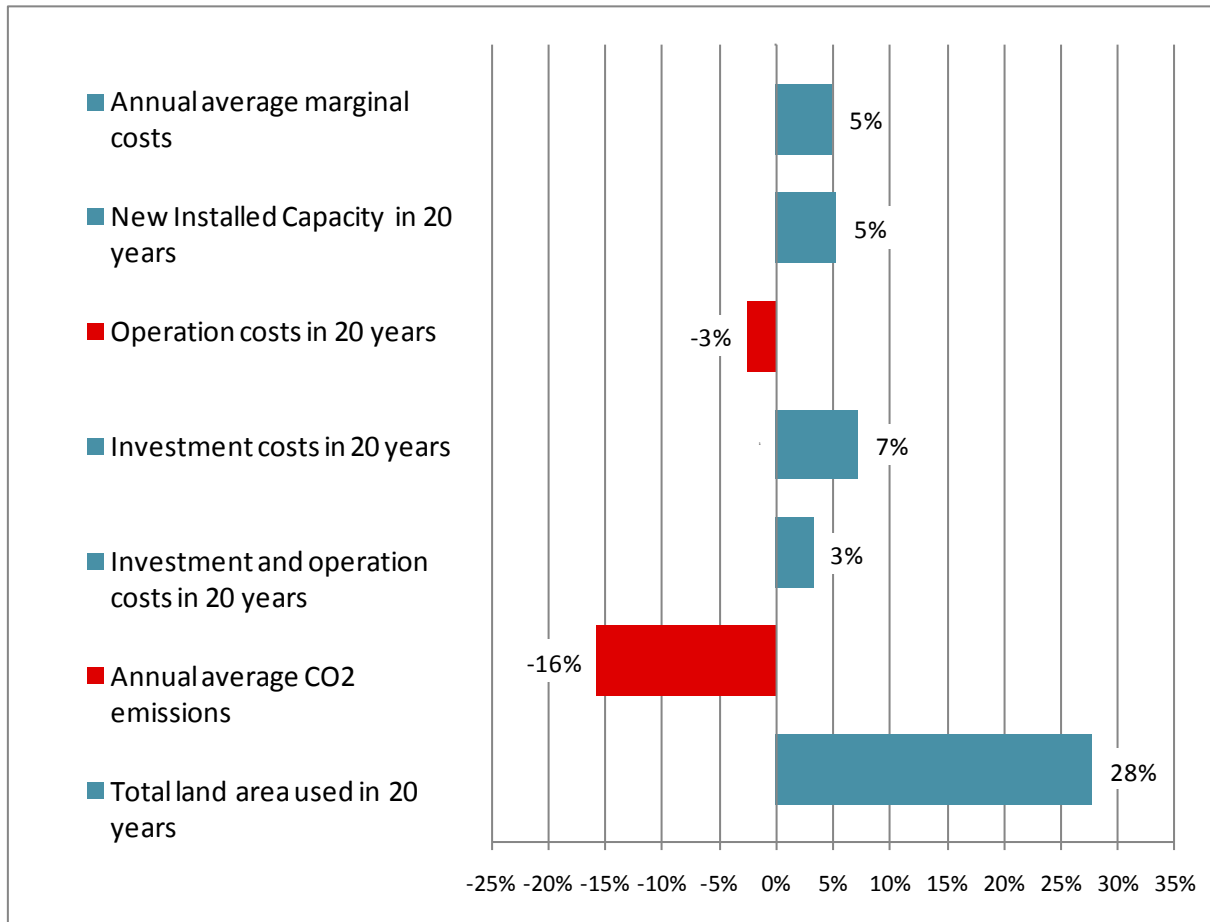
- New investment by technology 2010 -2030 in both cases

Technology	Installed capacity in 20 years [MW]		% of difference
	Base	Renewable	
Run of river	2.772	2.772	0%
Dam	2.750	2.750	0%
Wind	3.276	4.742	45%
Biomass	184	184	0%
Geothermal	635	635	0%
Coal	3.141	2.481	-21%
Dual	1.360	1.360	0%
Diesel	980	980	0%

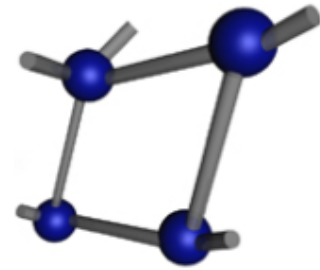
Future energy supply scenarios



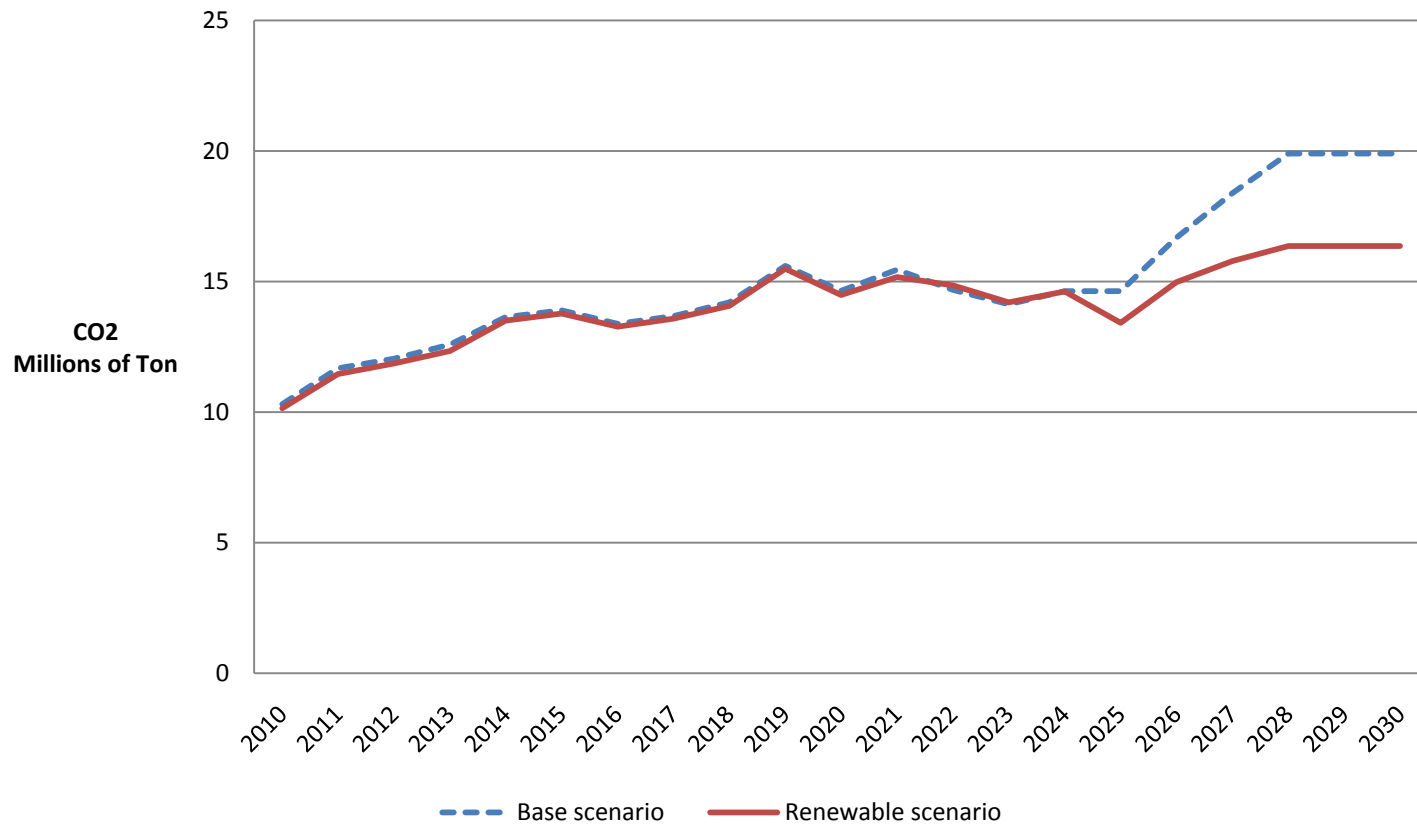
➤ Main results renewable scenario compared to base case



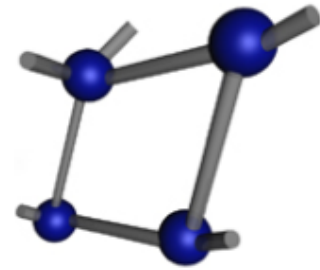
Future energy supply scenarios



➤ CO2 emissions in both scenarios (2010 – 2030)

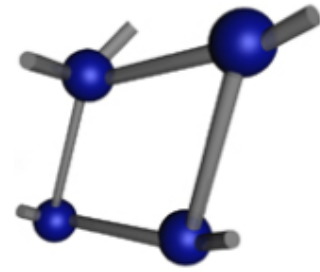


Final remarks



- New government has emphasized a 20 % target by the year 2020.
- Current share mechanism has created great expectations but limited investment. As a result, pressure has been put to create more incentives for renewables.
- A 20 % renewable penetration contributes with a 16 % CO₂ emissions reduction by 2030, but cost 7 % more in investment, marginal prices could rise 5% in average and occupy 28% more land.
- How green can Chile afford?

Further reading



- More information of the Chilean electricity market and renewables:
 - Publications
 - <http://www.systep.cl/publicaciones.php>
 - Monthly reports
 - <http://www.systep.cl/reportes.php>



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