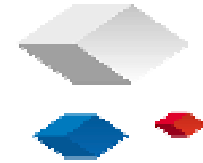


GOBIERNO DE CHILE
COMISION NACIONAL DE ENERGIA

Renewable Energy Portfolio and Wind Energy in Chile

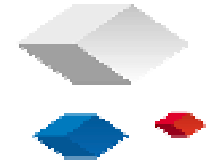
Comisión Nacional de Energía
Berlin, 09.11.2009

Chile overview



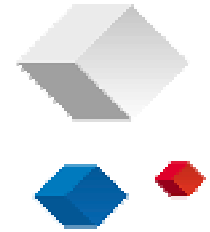
- Chile is situated in the south western part of Latin America between the Andes mountains and the Pacific ocean.
- 4.300 km long and on average 175 km wide
- 17 million population
- Fastest growing economy in Latin America
- High economic and political stability
- Diverse climate and geography
- Immense potential for renewable energy: hydropower, biomass, wind, solar, geothermal, marine energy (waves, currents,

Basic principles of the electricity market



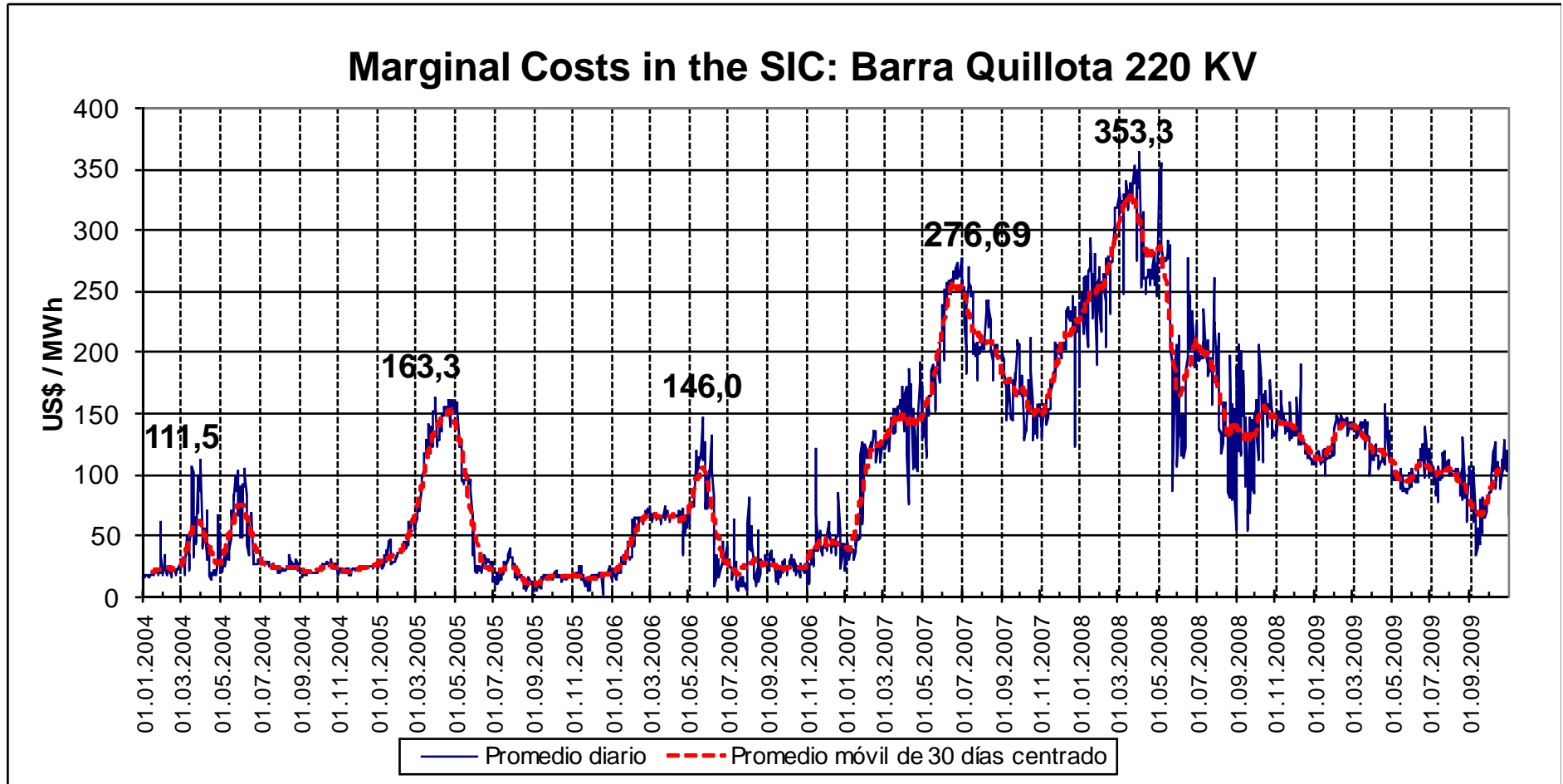
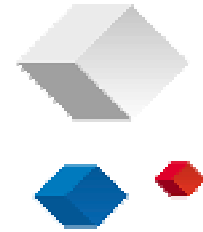
- The Chilean energy policy is structured around two basic principles: economic efficiency and the subsidiary role of the State. The electricity market is **deregulated and privatized**.
- The legislation establishes a separation (unbundling) of the mayor activities: generation, transmission and distribution
- **Transmission** and **distribution** are considered natural monopolies and subject to regulation.
- The **generation** sector is conceived open and competitive.
- Investment is a **free and private initiative**: Investors can freely decide on technology, size, time schedule for entering the market etc.
- The role of the State is **regulation, supervisory control** and the development of **public policies**

Basic principles of the electricity market: energy pricing



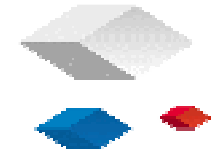
- Generation plants operate under **centralized economic dispatch**. The system operators (CDEC) ensure optimum economic operation of the system, based on **least cost dispatch**. The CDEC determine the **marginal cost (spot price)** on an hourly basis.
- Energy prices of end-users with less than 2.000 kW of connected power (**regulated clients**) are subject to **price regulation**, whereas larger end-users (> 2.000 kW) can freely negotiate energy prices with generation companies and other suppliers.
- The regulated price (nodal price) and is fixed by CNE twice a year, based on marginal cost projections for the next 48 months.

Evolution of spot prices 2004-2009 (USD/MWh)

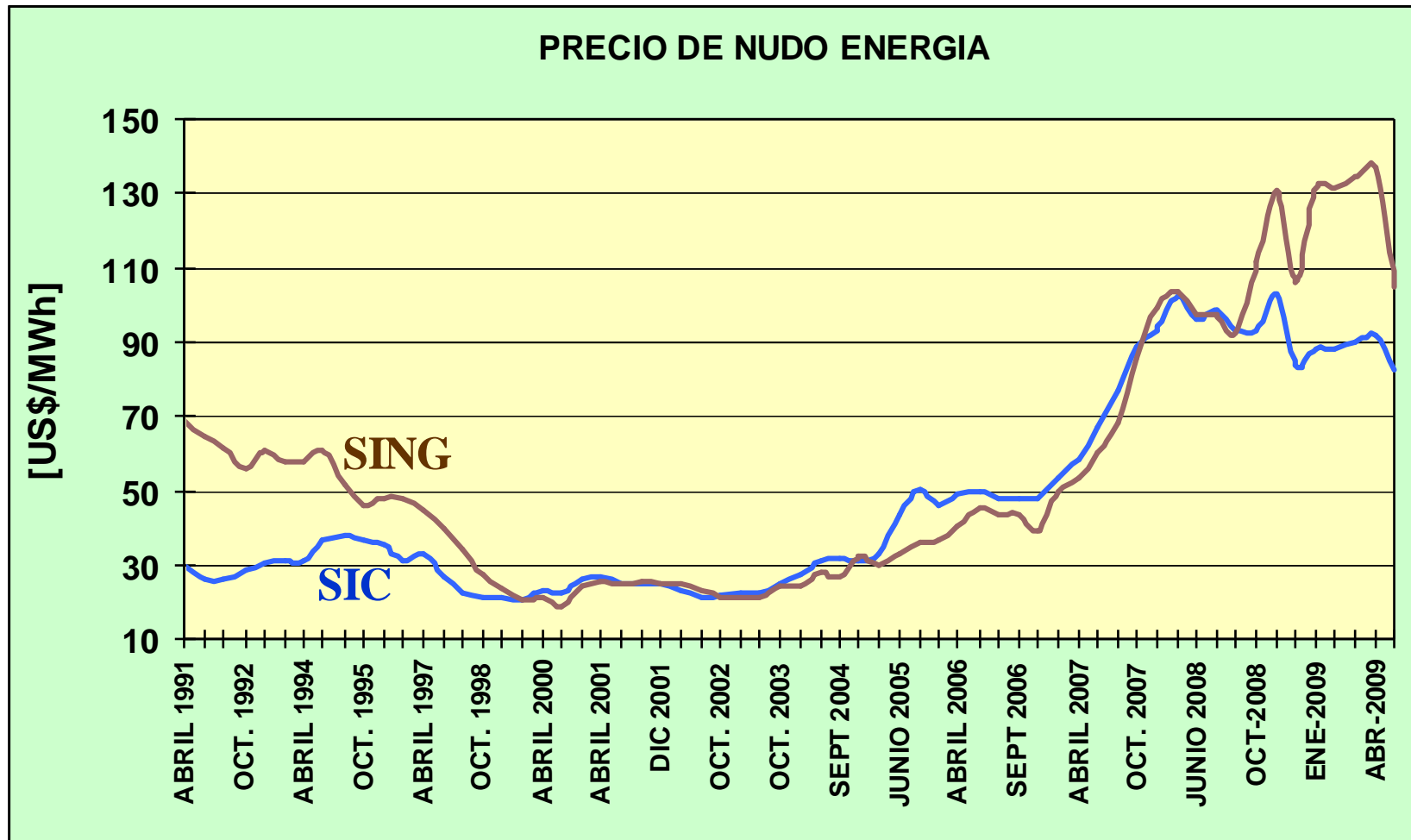


Average annual marginal cost SIC 2006-2009: 45, 170, 203, 108 USD/MWh

Evolution of regulated energy prices (USD/MWh)

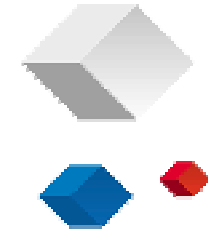


During the last years a sharp increase of national and international energy prices has been observed.



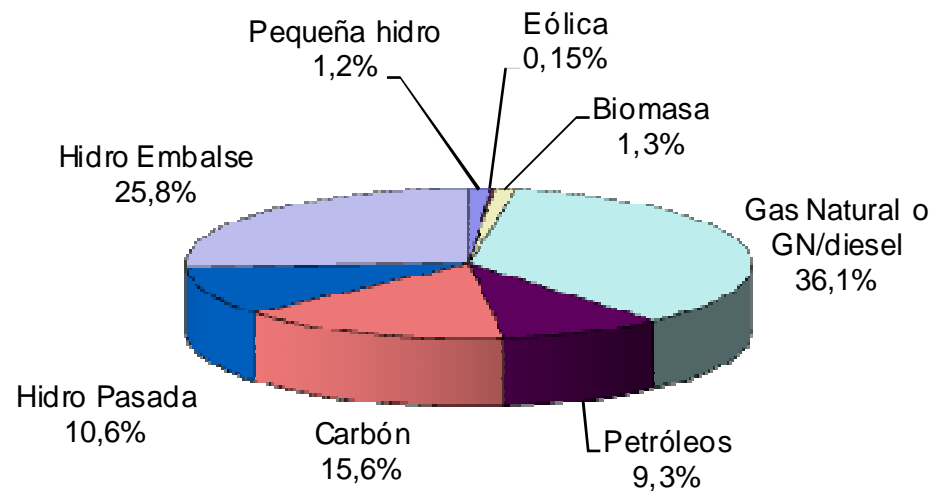
Source: CNE

Renewable Energy: participation in power generation



The national power generation has a high participation of renewable energies. In 2007, 38% of the total capacity was provided by renewable energy.

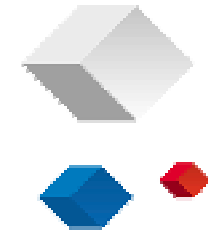
However **Non-Conventional Renewable Energy (NCRE)** contributed only 2,7% to the total capacity. NCRE excludes large hydro > 20 MW.



Fuente: CNE

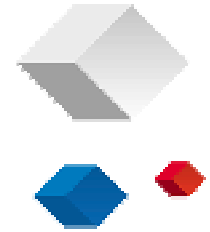
Installed generation capacity in the interconnected systems

Total capacity 2007: 13.137 MW



<p>SING</p> <p>27,4%</p>		<p>3.602 MW</p> <ul style="list-style-type: none"> NCRE 0,4% Conventional 99,6%
<p>SIC</p> <p>71,4%</p>		<p>9.386 MW</p> <ul style="list-style-type: none"> NCRE 3,3% Conventional 96,7%
<p>Aysén</p> <p>0,4%</p>		<p>50 MW</p> <ul style="list-style-type: none"> NCRE 45,0 % Conventional 55,0%
<p>Magallanes</p> <p>0,8%</p>		<p>99 MW</p> <ul style="list-style-type: none"> NCRE 0,0 % Conventional 100%

Fuente: CNE

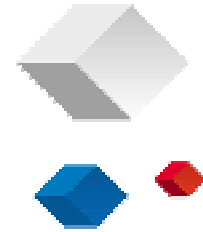


NCRE support: main lines of action

The Chilean Government is implementing a comprehensive policy framework for renewables, in particular in order to enhance energy security and environmental sustainability. Major lines of action are:

- Improving the regulatory framework of the electricity market in order to create non-discriminatory access of NCRE to the electricity market.
- Implementation of financial and other support mechanisms in order to encourage investment and to remove barriers that are hindering renewable energy development.
- Initiatives at the demonstration and R&D level.
- Strengthening the institutional framework: creation of the Energy Ministry and the Renewable Energy Center.

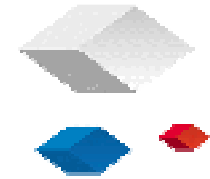
Legal changes



Laws 19.940 and 20.018 improve the technical and economic viability of small renewable projects:

- **Access to the energy markets** is secured for **any generator**, regardless of its size, ownership and level of connection
- Generation projects < 9 MW selling energy on the spot market are entitled to a price stabilization mechanism
- Open access to the distribution network for small generators (< 9 MW).
- **Total or partial exemption from wheeling charge on main transmission lines** for renewable generators smaller than 20MW
- Simplified commercial treatment for small generators (< 9 MW)

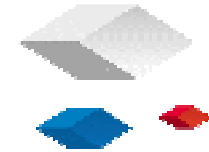
Renewable Energy Law 20.257



NCRE Obligation:

- All electricity companies selling energy in the interconnected systems (SIC, SING) **from 1 January 2010 onwards** need to demonstrate that a percentage of their commercialized energy each year is generated from NCRE sources.
- The obligation lasts for 25 years until 2035
- The annual renewable energy obligation is:
 - 2010 – 2014: **5%**
 - 2015 - 2024: annual increase of 0,5% (2015: 5,5%; 2016:6%; ..)
 - From 2024 onwards: **10%**.
- Only new projects are eligible, that have been connected to the electricity grid after **1 January 2007**.
- Companies will be **penalized** by paying a penalty charge **if they fail to comply** the required NCRE share.

NCRE support: main lines of action

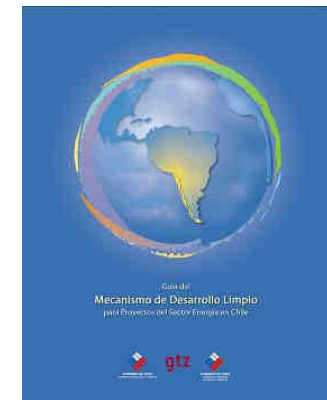


Specific instruments for the promotion of private investment

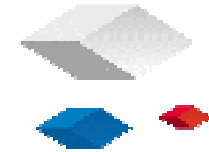
- Subsidies for pre-investment studies (up to 60.000 USD)
- Subsidies for advanced studies (feasibility, engineering) up to 160.000 USD
- Special credit lines for NCRE projects with preferential conditions on rates and periods
- International promotion (road shows, international conferences, matchmaking)

Other instruments under preparation

- Guarantee funds (2009)
- Funds for risk capital (2009)
- Support to the inter-connectivity of projects sharing common transmission lines (2009)
- Contingent subsidy to cover the risk of geothermal exploration (2009)

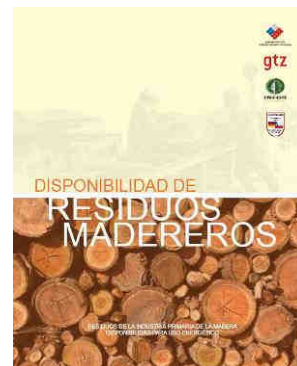
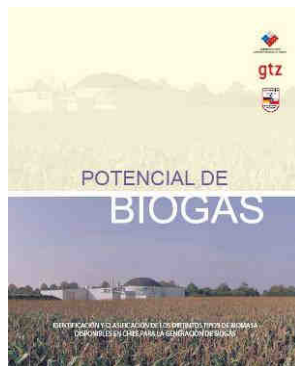
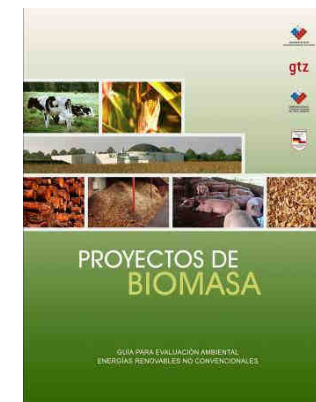
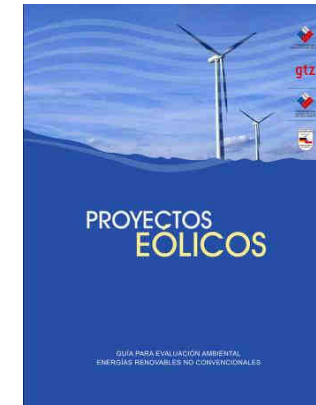


NCRE support: main lines of action



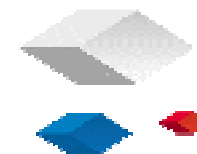
Information for project developers

- Evaluation of renewable resources: biomass, biogas, wind, solar, including studies, modelling and measurements.
- Data base of the potential for small hydro projects using irrigation works.
- Manuals for the environmental impact assessment of wind-power and biomass projects.
- Models for the technical and economic evaluation of NCRE projects.



Non-Conventional Renewable Energy (NCRE)

What has been achieved?



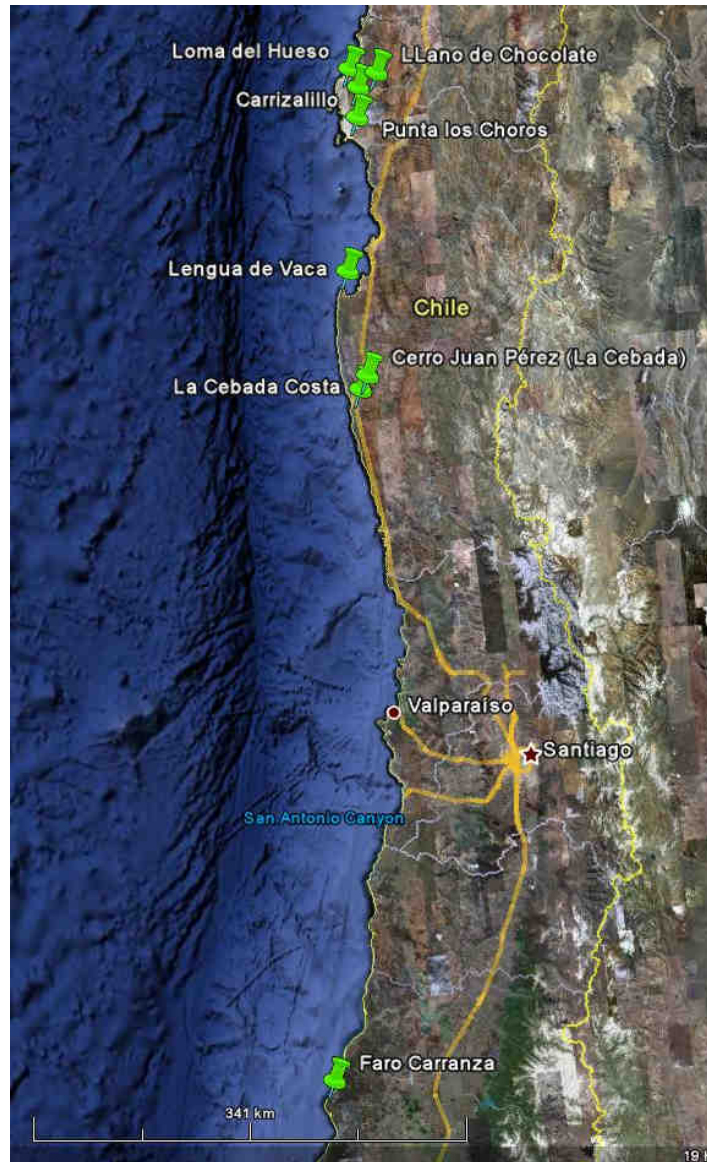
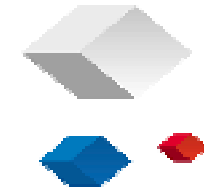
Projects approved through the environmental impact assessment system (SEIA):

Type	Approved		In Process		Total	
	Nº	MW	Nº	MW	Nº	MW
Small Hydro	31	263	7	40	38	304
Wind	20	1368	8	688	28	2057
Solar	0	0	1	9	1	9
Biogas	0	0	1	28	1	28
Biomass	6	112	0	0	6	112
Total	57	1743	17	766	74	2509

Since 2007 NCRE projects with a total capacity of 108,2 MW have started operation, 254,6 MW are under construction. The generation capacity of NCRE will have doubled within 2-3 years.



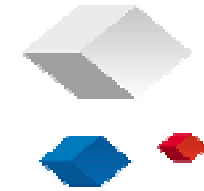
Wind Measurements 2006



- 8 wind stations (2 with 50m, 6 with 20m)
- Installed in 2006 (CNE/GTZ/UNDP)
- Still in operation



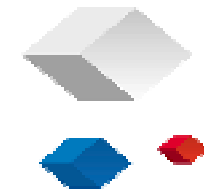
Model of Wind Potential (2008)



- High resolution wind (and solar) potential model
- 1 x 1 km²
- Weather and Research Forecasting Model (NCAR)
- Publicly accessible:
www.cne.cl
"Explorador Eólico Solar"
- To be extended to southern Chile



Model of Wind Potential



Mapa **Satélite** Híbrido Relieve

Ubicación del sitio:

Longitud: -71.65

Latitud: -31.04

Variables incluidas:

- Velocidad del Viento (10m)
- Velocidad del Viento (75m)
- Dirección del Viento (75m)
- Densidad del Aire
- Radiación Solar Global Horizontal
- Temperatura (2m)

Meses incluidos:

mar jun sep

dic todos

Reportes de esta sesión

Generar Reporte

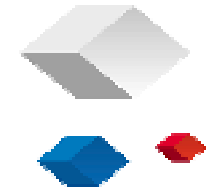
- Coordinates of selected point on the map
- Variables required.
- Evaluation period
- Generate report and data series of model

Google 10 mi 10 km

KMZ MAPAS

Imágenes ©2009 TerraMetrics - Términos de uso

Model of Wind Potential



COMISION NACIONAL DE ENERGIA

Reporte Energía Renovable

Departamento de Geofísica

Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile

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Ciclo diario de la Radiación global	9

Resumen del documento

La información presentada en este informe se basa en simulaciones atmosféricas efectuadas con el modelo WRF (Weather Research and Forecasting), preparadas para la Comisión Nacional de Energía.

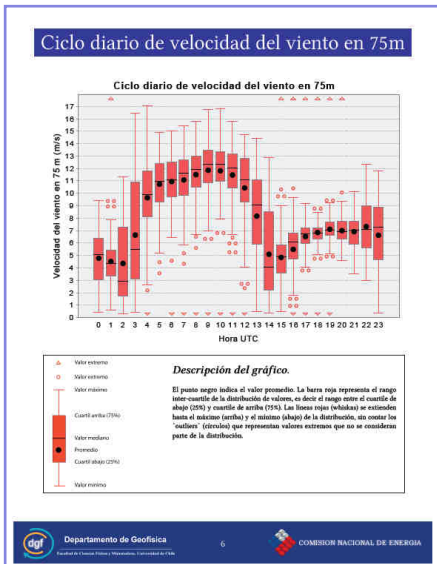
Información del Sitio

Latitud: 22.5° Sur
 Longitud: 69.06° Este
 Elevación: 75.0

Informe de Velocidad del viento en 75m

La siguiente tabla muestra el valor medio, mínimo y máximo de cada mes simulado por el modelo.

Mes	Medio (m/s)	Min (m/s)	Máx (m/s)
Marzo	7.36	0.28	17.07
Junio	8.73	0.32	15.44
Septiembre	8.53	0.49	16.8
Diciembre	7.35	0.29	14.74
Todos	7.99		

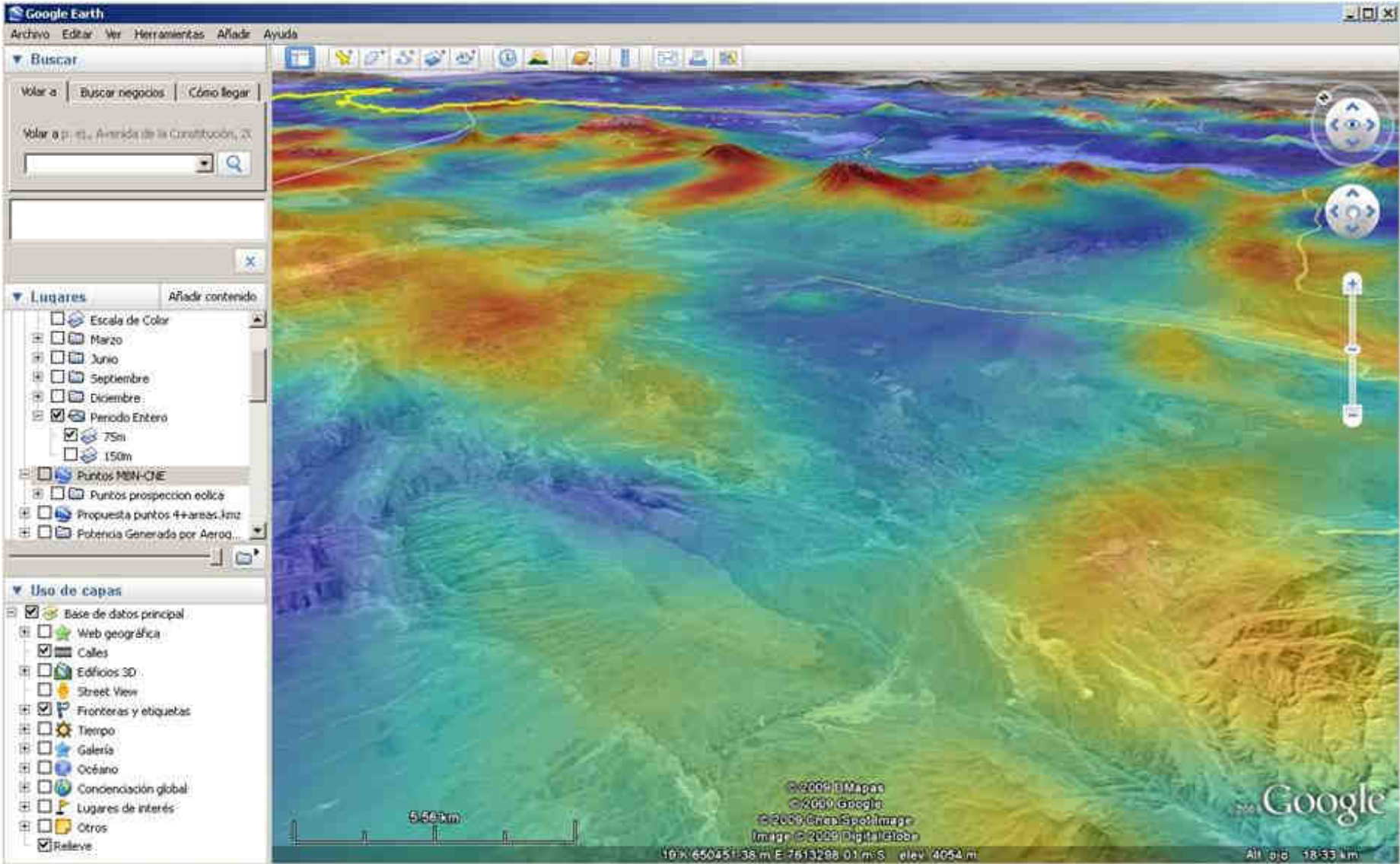
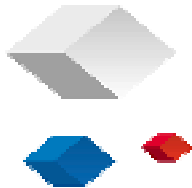


Informe de Radiación global

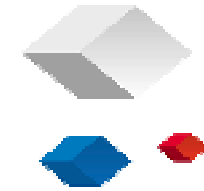
La siguiente tabla muestra el valor medio, mínimo y máximo de cada mes simulado por el modelo.

Mes	Medio (kWh/m2 día)	Min (kWh/m2 día)	Máx (kWh/m2 día)
Marzo	7.57	N.A.	N.A.
Junio	4.78	N.A.	N.A.
Septiembre	7.23	N.A.	N.A.
Diciembre	8.95	N.A.	N.A.
Todos	7.1		

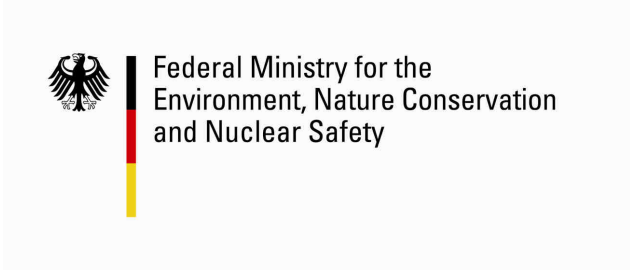
Model of Wind Potential



Wind Measurements 2009



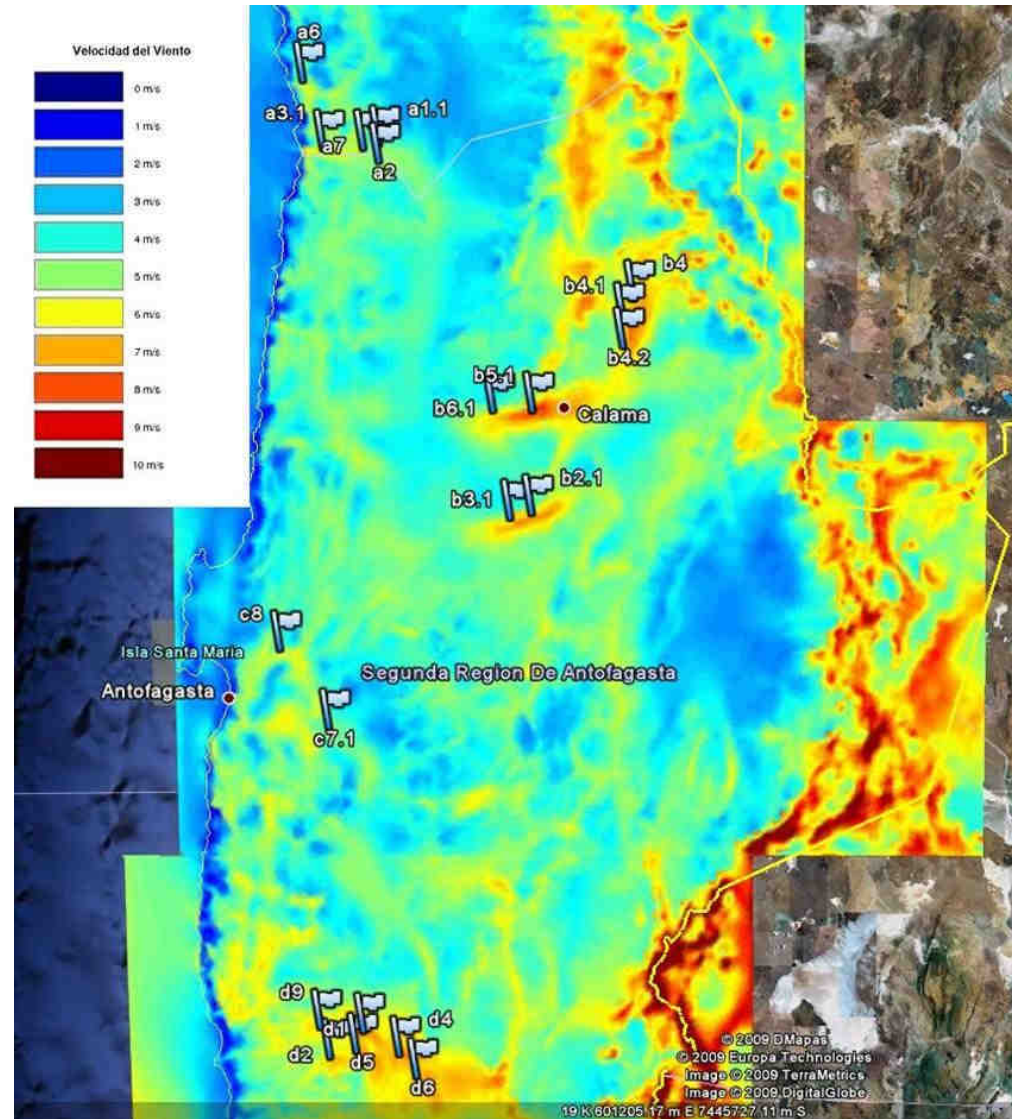
- Wind measurement campaign at 20 sites in Antofagasta Region
- CNE/GTZ supported by:



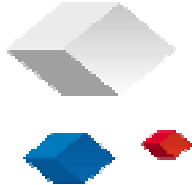
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

→ International Climate Initiative

- In operation since July 2009
- 80 m towers and pre-feasibility studies for best 2 sites

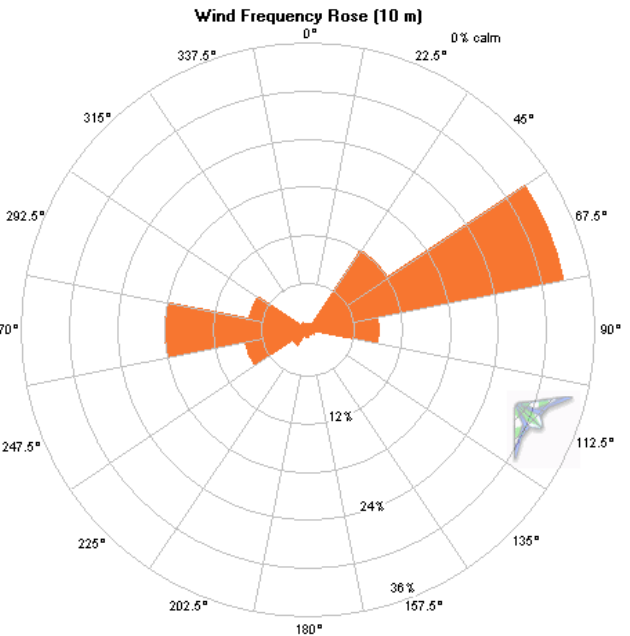
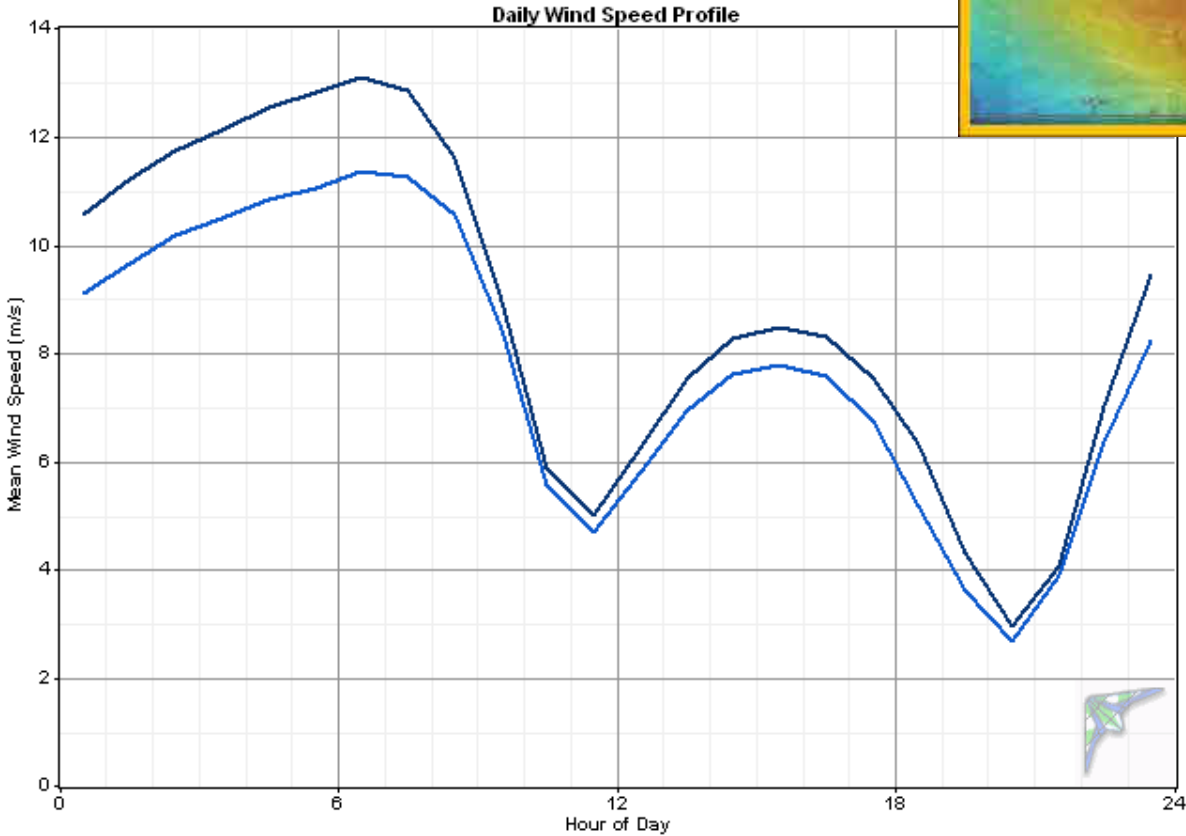
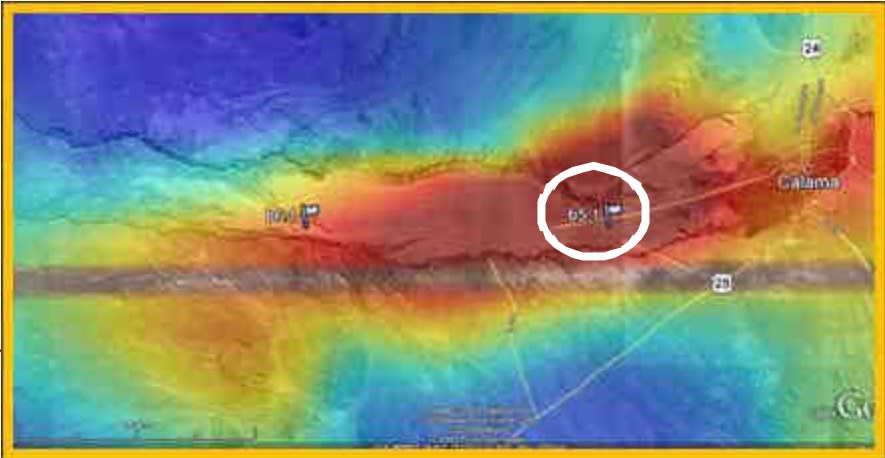


Wind Measurements 2009

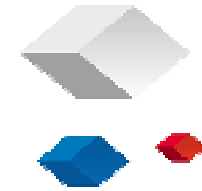


v20 = 8,7 m/s

v10 = 7,7 m/s

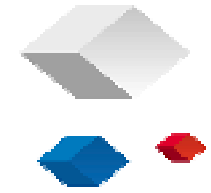


Wind Potential of Chile



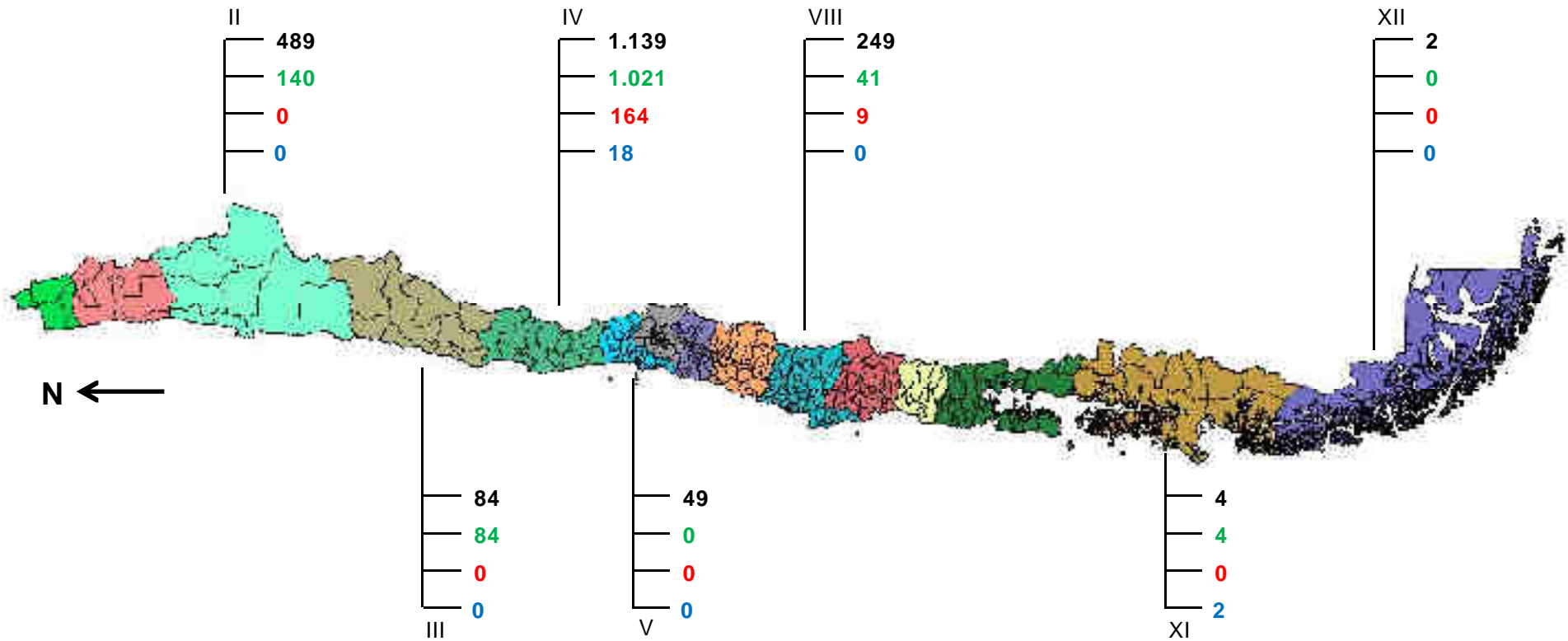
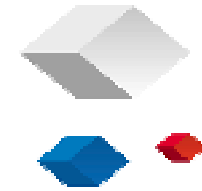
- Theoretical wind potential of tens of GW
- Technical potential largely restricted by geographical conditions (Andes) and current grid limitations
- Huge potential in southern Chile far from demand → studies concentrate on SIC and SING
- Very conservatively, and taking into account the technical and economical potential of areas known to CNE, Chile's wind potential is in the order of 6.000 MW
 - This number will probably grow considerably as studies advance

Technology Transfer



- Political/regulatory changes for the creation of an enabling market environment for renewable energies
 - International B2B-Events
 - Supply of information on RE potentials and administrative procedures
 - Use of public lands for RE-projects
 - Training for local stakeholders
 - Creation of Renewable Energy Center
-
- Build up local knowledge
 - Facilitate investment by national and international companies
 - Accelerate the introduction of new technologies

Wind Energy Projects in Chile

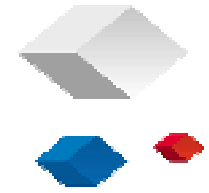


Total:

Registered	2.016 MW
Approved	1.289 MW
In Construction	173 MW
In Operation	20 MW

—————> **193 MW by end of 2009**

Thank You!



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tim-patrick.meyer@gtz.de

