

Social and environmental challenges in power system development in Chile

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Shaping the Future Energy Industry



The power of social movements



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The power of social movements



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Social rejection

Brazil

Hydroelectric Belo Monte – 11,000 MW





The power of social movements



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Social rejection

Argentina - Brazil
Hydroelectric Garabí – 1,600 MW





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Social rejection

Perú

Hydroelectric Inambari – 2,000 MW





- Economy, society and energy development
- Social challenges and energy policy
 - Diagnosis
 - Actions taken to face the crisis
 - Results and challenges
- Final remarks



Chilean Electricity Systems (June 2013)



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| | | | Gross Capacity | Electricity Generation | Maximum demand | Population |
|---|--|---------------------------|------------------|------------------------|-----------------|--------------|
| SING <i>Sistema Interconectado Del Norte Grande</i> | | Arica y Parinacota | 3,955 MW | 14,830 GWh | 2,016 MW | 5.7% |
| | | Tarapacá | 21.4% | 23.2% | | |
| | | Antofagasta | | | | |
| | | | | | | |
| SIC <i>Sistema Interconectado Central</i> | | Atacama | | | | |
| | | Coquimbo | | | | |
| | | Valparaíso | | | | |
| | | Región Metropolitana | 14,345 MW | 48,868 GWh | 6,185 MW | 92.6% |
| | | Lib. Gral. Bdo. O'higgins | 77.7% | 76.3% | | |
| | | Bío-Bío | | | | |
| | | Araucanía | | | | |
| | | Los Ríos | | | | |
| | | Los Lagos | | | | |
| SEA <i>Sistema de Aysén</i> | | Aysén | 47 MW | 98 GWh | 20.4 MW | 0.6% |
| | | | 0.3% | 0.2% | | |
| SAM <i>Sistema de Magallanes</i> | | Magallanes | 118 MW | 260 GWh | 50.2 MW | 1.1% |
| | | | 0.6% | 0.4% | | |

Source: CDEC, 2013

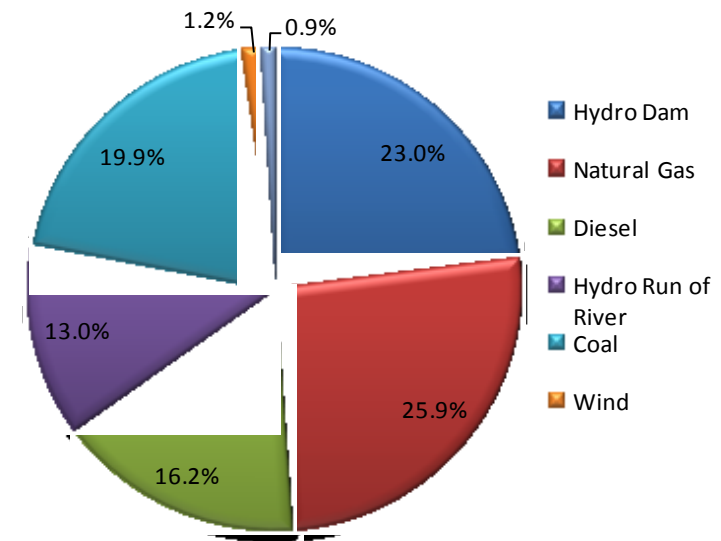


Quick overview: Chilean electricity market



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- Based on a competitive market
 - Private competitive investment in generation
 - Regulated private investment in T&D
- Generation developers decide upon private assessment what, where, when and how much new capacity is needed.
- Technology neutrality except for renewable quota (10%)
- Must comply with environmental regulation by applying for licence.
- Little or no land use regulation.



Installed net capacity per
technology year 2011
Source: CNE, 2012

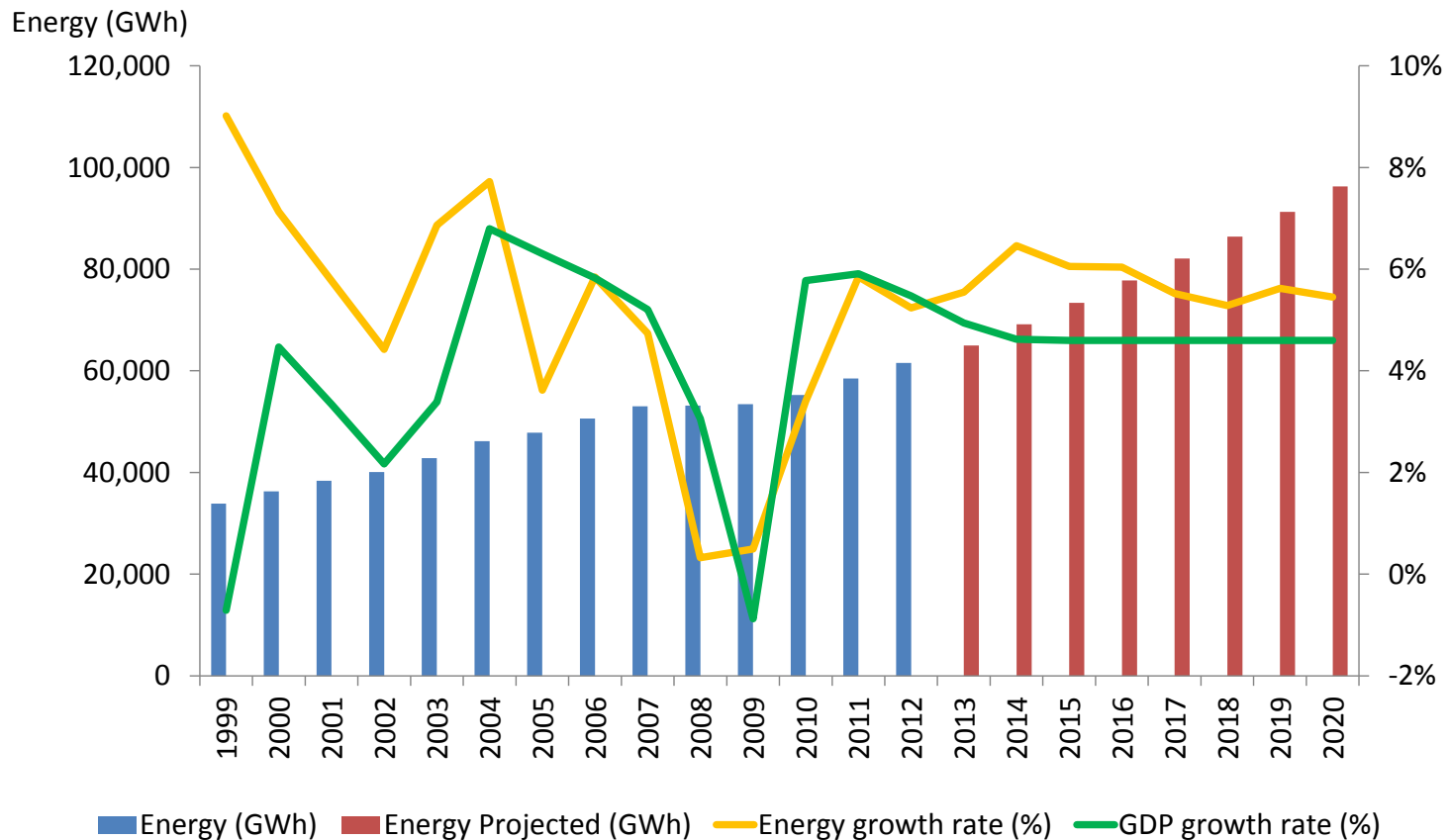


Economy targets: grow, grow, grow...



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- **Policy Target:** grow 6 % per year in order to reach the currently GDP per capita of Portugal and the Czech Republic.



Source: Banco Central, CNE June 2013

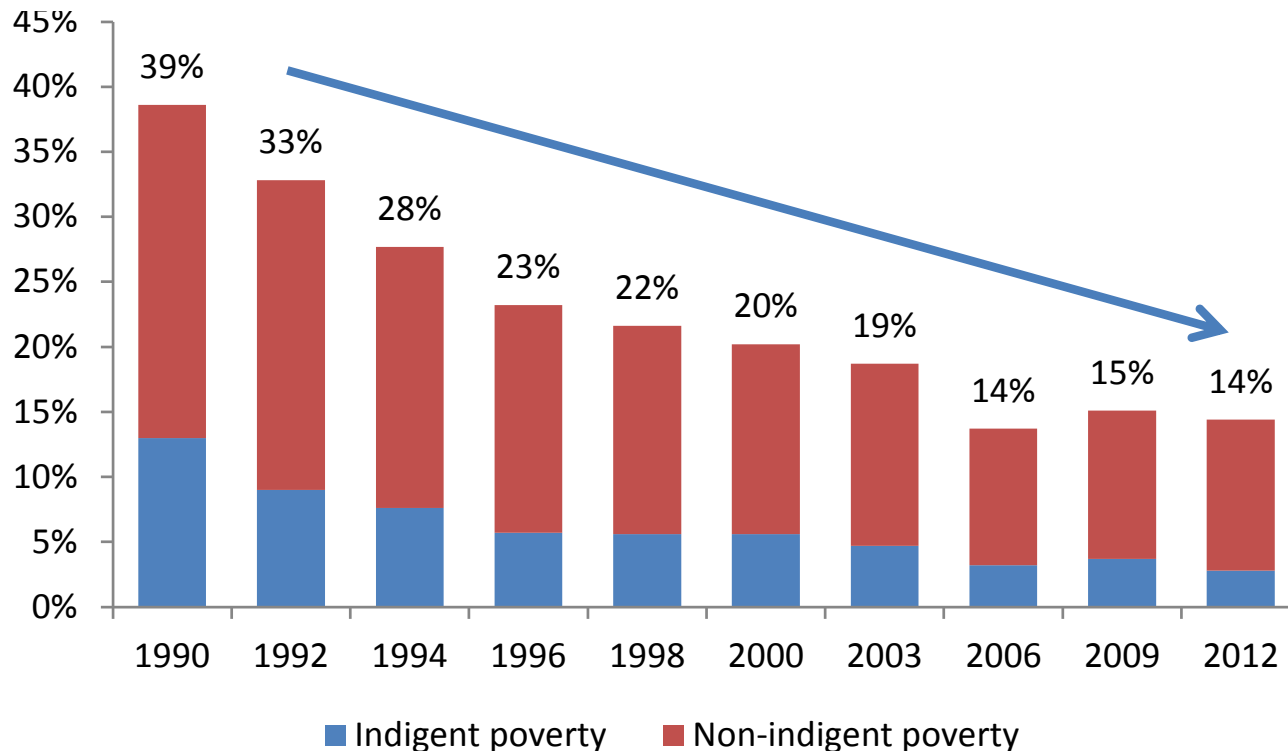


But...outstanding social challenges



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- Even though poverty rates have been steadily declining, 14% of the population still lives in poverty conditions.



Source: CASEN Survey 1990-2012

- Chile has one of the world's highest Gini (inequality) index.



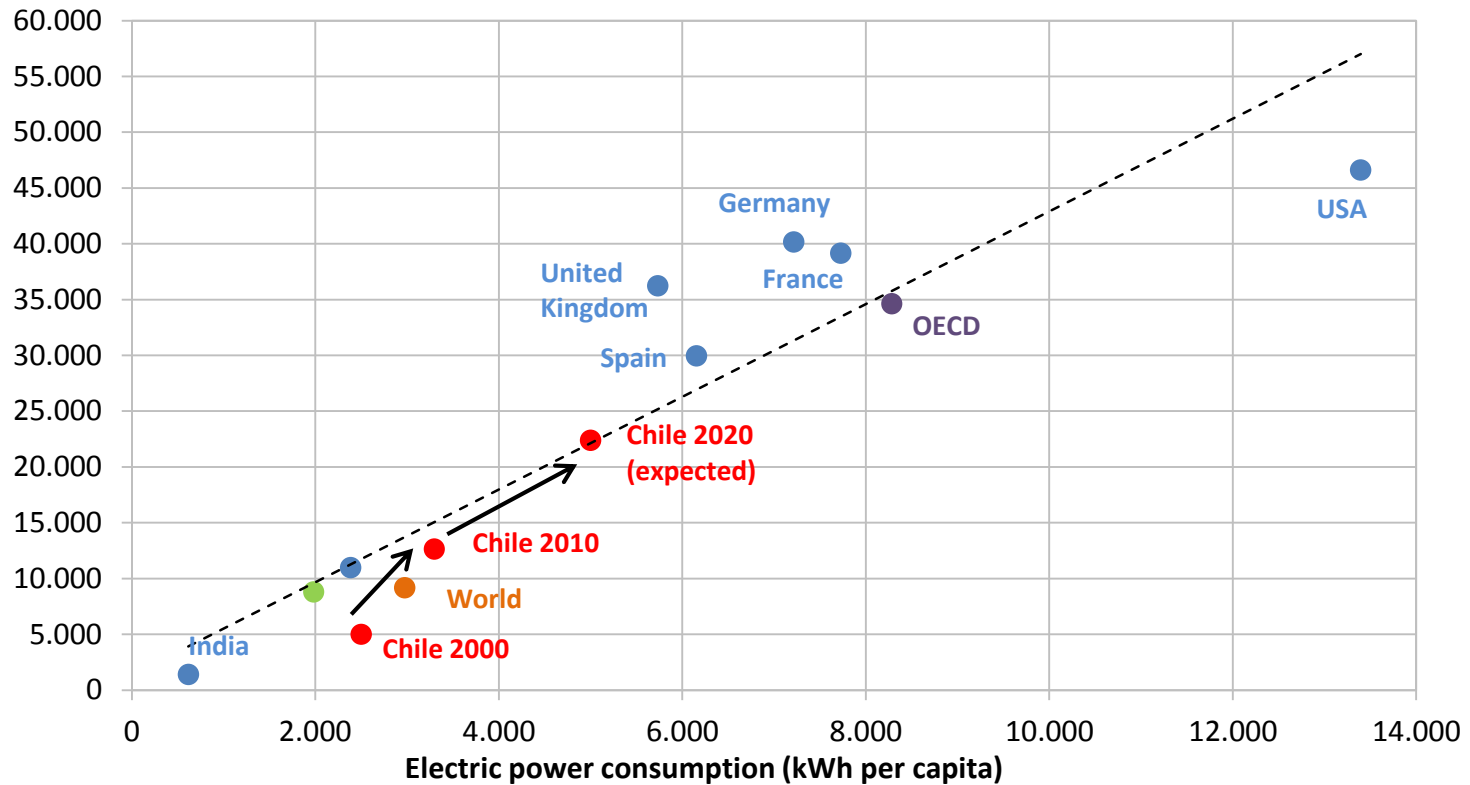
Chile and the world (2012)



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GDP per capita

(US\$ at current price 2013)



Source: World Bank, INE July 2013

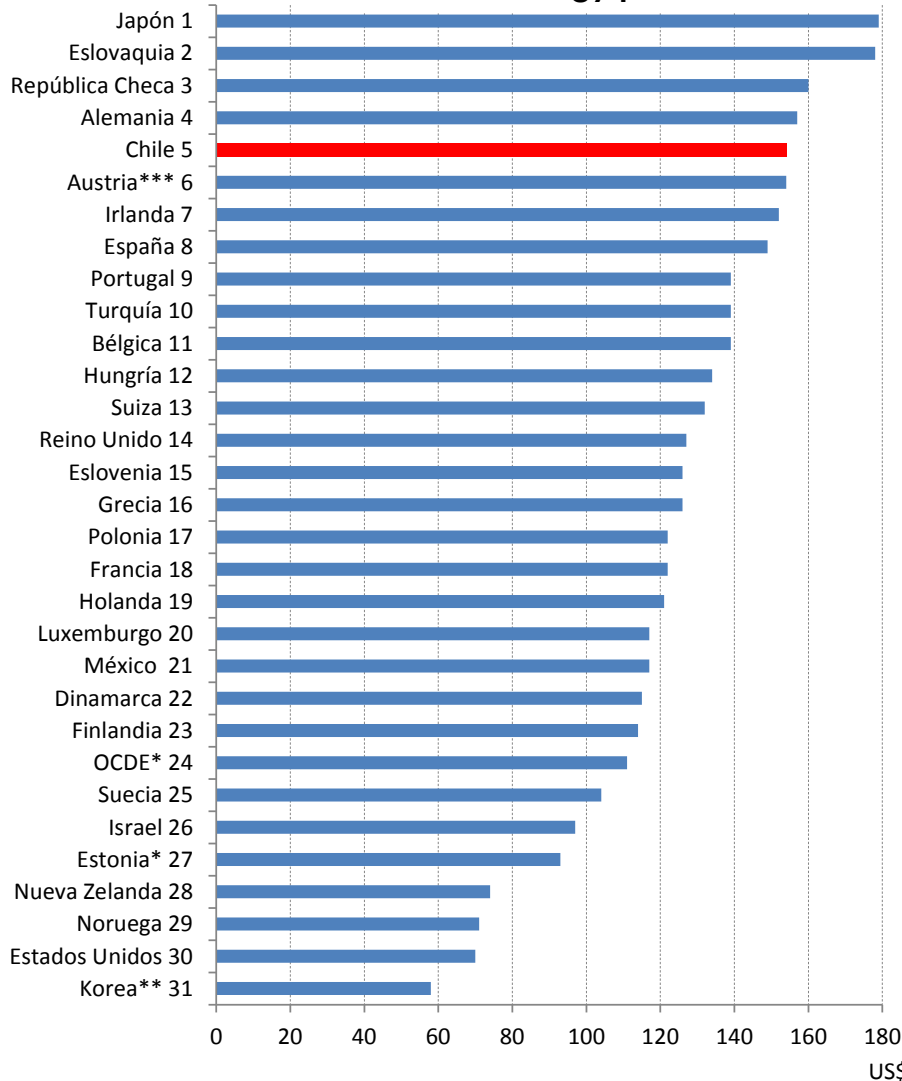


But...can Chile's electricity market foster such development?



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Industrial energy price



Residential energy price



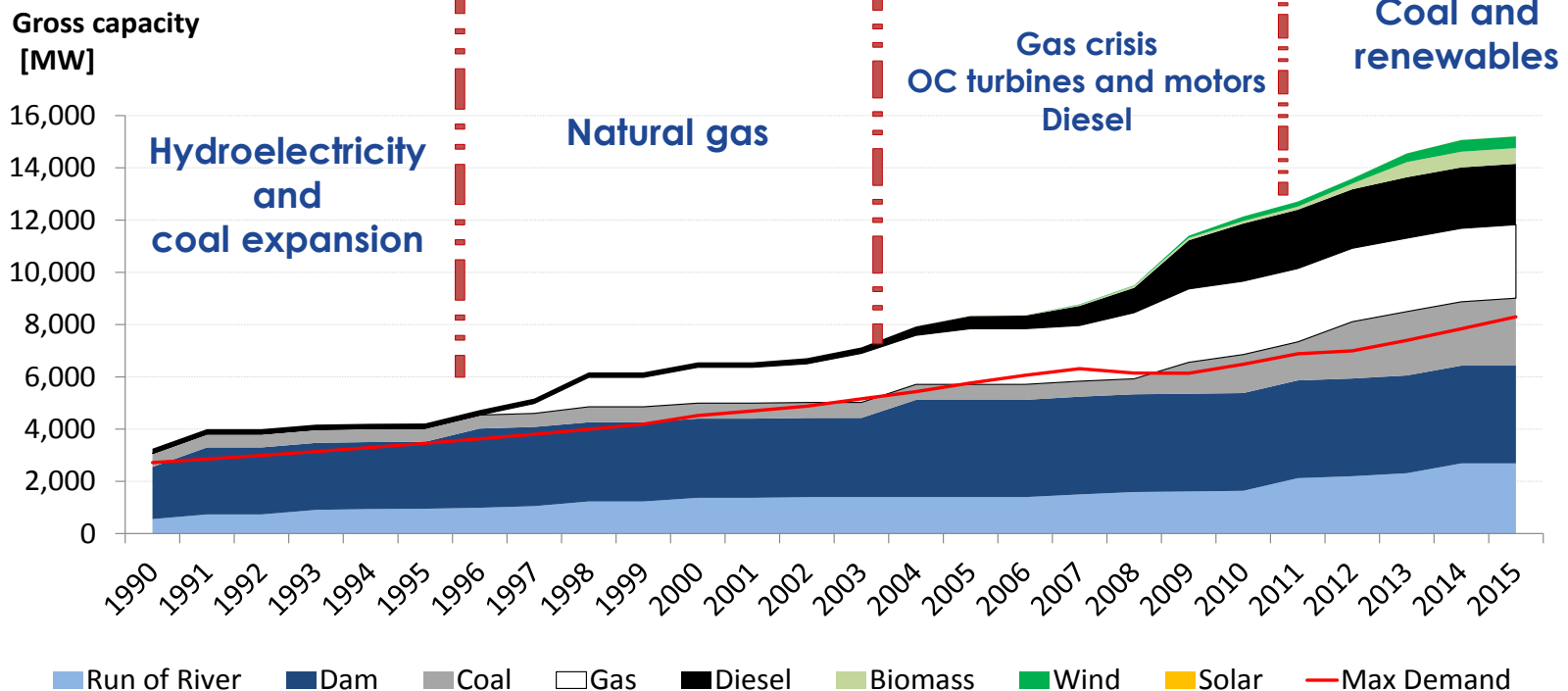
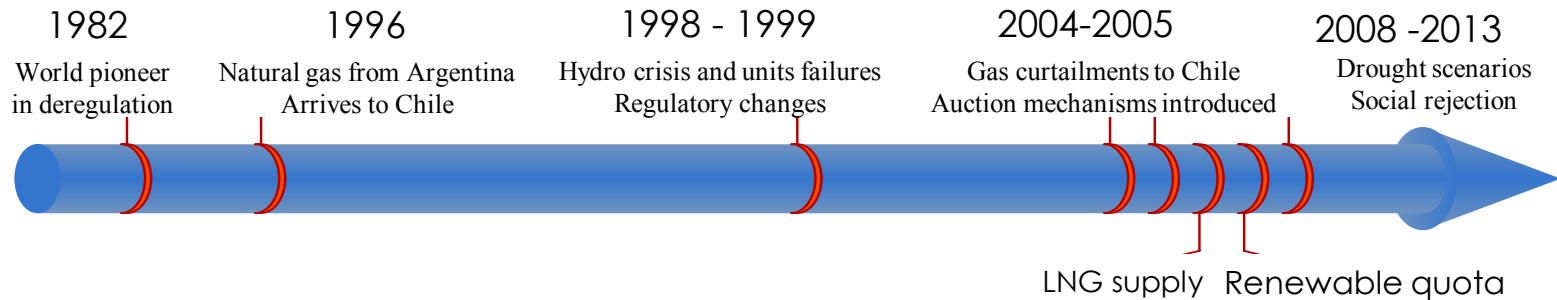
Source: IEA, OCDE 2011



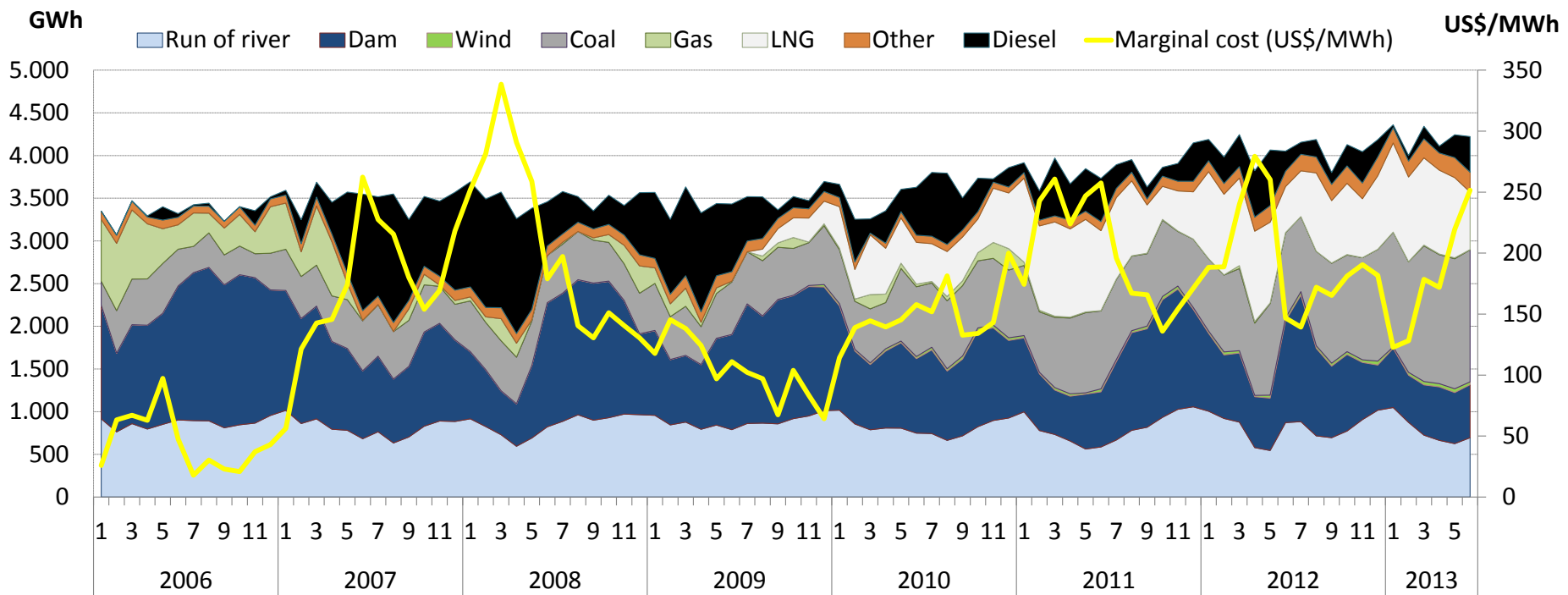
Milestones in the Chilean electricity system: market mechanisms



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- High energy prices for the past seven years.
- Perfect storm or market failure?



Source: CDEC-SIC, June 2013



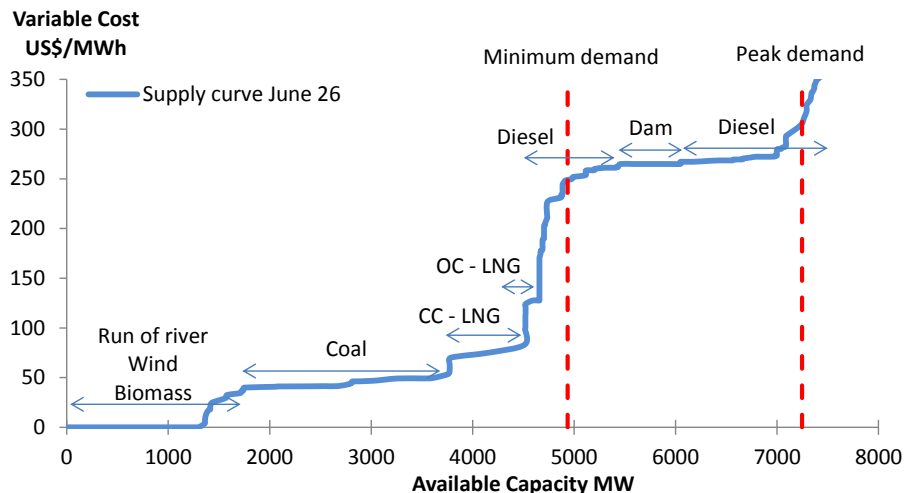
Short term challenges Chilean central system



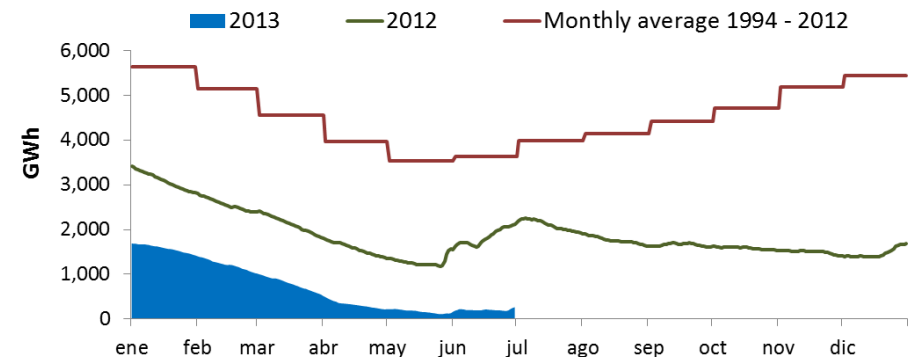
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- Spot price reached 312 US\$/MWh in June 2013
 - Low reservoir levels → High water value
 - Power plant failures: Nehuenco II (398 MW) and Santa Maria (342 MW)
 - Several power plants shut down for maintenance

Supply and demand curve - June 26, 2013



Storage level of the main reservoirs in the Chilean electric system



Source: CDEC-SIC, June 2013



However, widespread rejection to power plants...



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HidroAysén



Hydroelectric - 2,750 MW
Investment 3,200 MMUS\$
May 2012

Barrancones



Coal-fired - 540 MW)
Investment 1,100 MMUS\$
April 2009



However, widespread rejection to power plants...



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Including renewable projects

Tatio



Geothermal - 40 MW
Investment 180 MMUS\$
July 2010

Pichidegua



Biomass - 35 MW
Investment 95 MMUS\$
October 2010

Chiloé



Wind - 112 MW
Investment 235 MMUS\$
July 2011



Example: Organized opposition to large hydro developments



- HydroAysen project
 - Five hydroelectric plants in two pristine rivers in Patagonia at a cost of \$3.2 billion
 - Total: 2750 MW – (18.430 GWh/year)
 - Flood area: 5.910 ha

The New York Times

The Opinion Pages

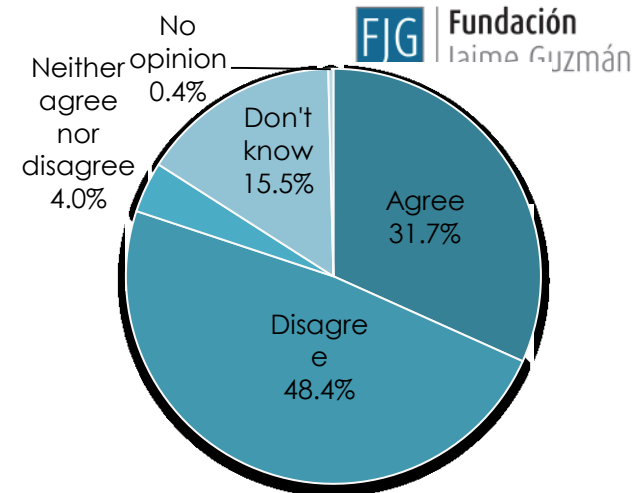
EDITORIAL

Keep Chilean Patagonia Wild

Published: May 23, 2011

An environmental review commission in the Aysén region of southern Chile has made a potentially disastrous decision, [voting to approve the construction of five hydroelectric dams](#), two on the Baker River and three on the Pascua. The damage these dams would do to the environment is tremendous, and their construction — in a largely unspoiled natural haven — would open the way for further development, including more dams.

Do you agree with the construction of HidroAysén?





But what do people want?

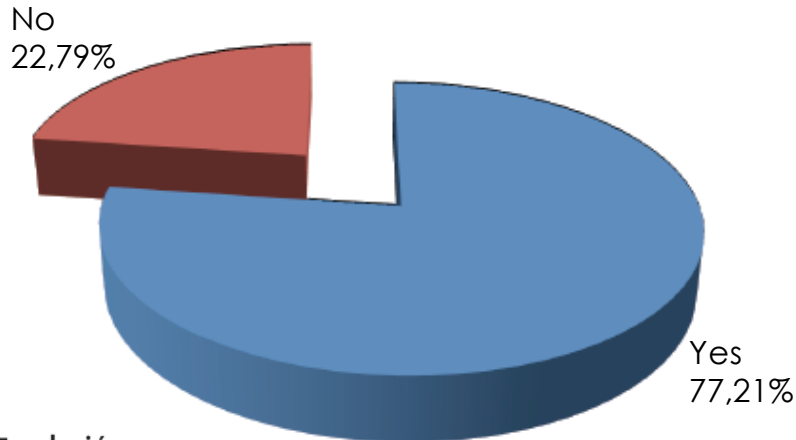


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- Population willing to pay or sacrifice economic growth to protect the environment

But do they know the real cost of electricity?

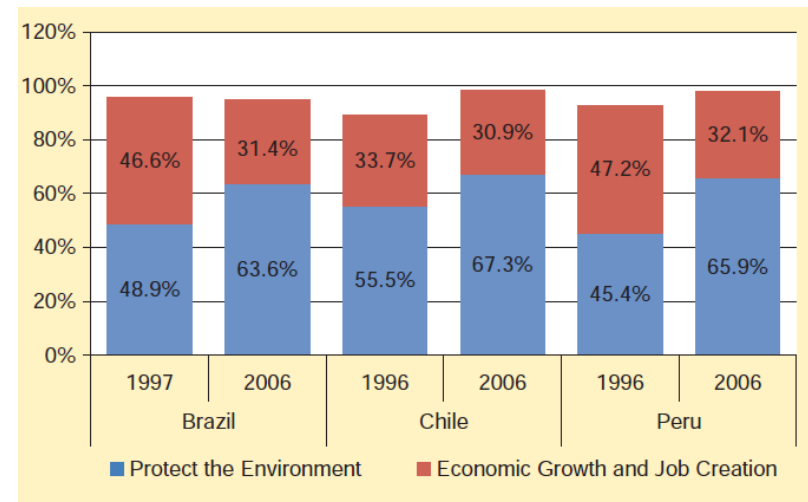
Are you willing to pay more for your electricity bill just to protect the environment?



FJG Fundación Jaime Guzmán

Source: Fundación Jaime Guzmán, Survey 2011

Preferences in Brazil, Chile and Peru



Source: Latin America Goes Electric:
The Growing Social Challenges of Hydroelectric Development,
IEEE power & energy magazine, May -June 2013



Do people understand the real cost of energy?



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- 50.2% of the population believes that solar and coal energy are free.

Perception of Chilean society regarding energy costs of generation technology

| | Coal | Nuclear | Diesel | Natural gas | Hydroelectric | Solar | Wind |
|-------------|------|---------|--------|-------------|---------------|-------|------|
| Expensive | 15% | 65% | 68% | 57% | 54% | 27% | 25% |
| Normal | 21% | 6% | 20% | 29% | 22% | 8% | 12% |
| Free | 57% | 8% | 8% | 11% | 15% | 50% | 42% |
| Don't know | 7% | 20% | 4% | 2% | 8% | 13% | 21% |
| No response | 0% | 1% | 0% | 1% | 0% | 1% | 1% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

FJG | Fundación
Jaime Guzmán

Source: Fundación Jaime Guzmán, Survey 2011

Important gap between the public's expectation and reality.



Litigious scenario faced by projects



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- Several energy projects of different technologies have been trapped in approval processes, and most end up in the judicial system.
- Coal:
 - Castilla (2,100 MW)
 - Pacífico (350 MW)
 - Barrancones (540 MW)
 - Punta Alcalde (740 MW)
- Hydro:
 - HidroAysén (2,750 MW)
 - Cuervo (640 MW)
 - Neltume (490 MW)
- Wind:
 - Chiloé (100 MW)
 - Arauco (100 MW)

Prosecuted projects in recent years

| Technology | Projects | Installed Capacity MW |
|------------|----------|-----------------------|
| Coal | 4 | 3,730 |
| Diesel | 1 | 254 |
| Hydro | 3 | 3,880 |
| Wind | 2 | 200 |
| Geothermal | 1 | 40 |
| Biomass | 1 | 35 |
| Total | 12 | 8,139 |

Source: SEIA, SysteP, press, June 2013

**8,139 MW projects have
been rejected or challenged
in court**



- Direct intervention in blocking previously approved coal fired plant (Barrancones, 350 MW)
- Creation of broad experts commission on energy policy and formulation of National Energy Strategy
 - No direct consequences of these actions
- Proposed regulatory changes
 - Transmission concession Law
 - Transmission Highway
 - Transmission interconnection
 - Increase Renewables Quota
- None really aiming at the main issue: generation adequacy in this new context.



So where are we?

Short term

1. Low hydro generation
(4 consecutive dry years)
2. Transmission constraints



Long term

1. Generalized social rejection
due to environmental issues
2. Projects trapped in approval
processes, often in the judicial
system.
3. Regulatory uncertainty



1. High energy prices
2. Almost no forward
contracts offered
3. Uncertain market
development
4. Stalled generation
expansion
5. Reduced reliability



Chile's development is
challenged

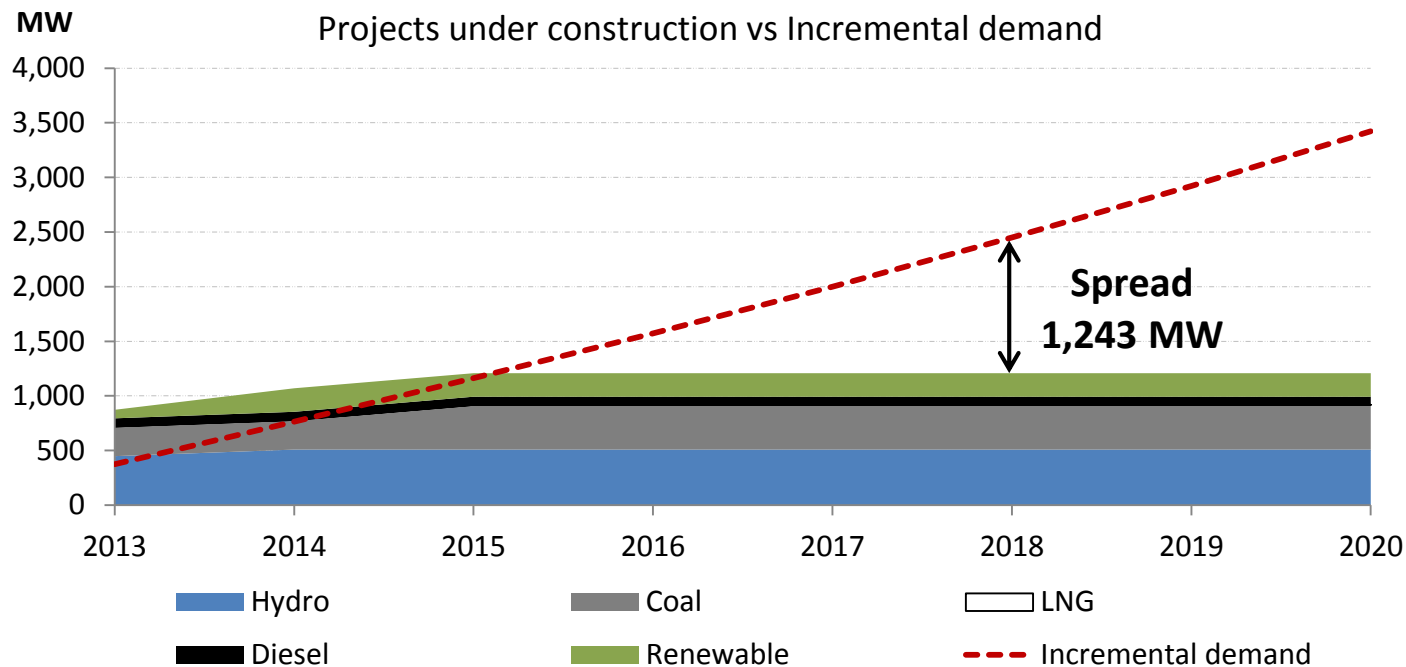


- **Chile has responded to different crisis through intensifying market mechanisms.**
 - However, prices have remained persistently high.
 - Risk in the market has frozen new power expansion.
- **New context: empowered public opinion**
 - Awareness fueled by access to readily available information through internet and social media
 - Organized opposition and political support
 - High expectations, similar to rich countries
- **Open question: Has the market failed in Chile?**



Where are we headed?

- Projects under construction might not be enough to supply incremental demand by 2016



Source: CNE, SEIA June 2013

Gap will probably be filled with expensive LNG, diesel and renewables



What are our options?



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| Technology | Levelized cost [US\$/MWh] | | | Projects with environmental approval [MW] | Projects under environmental evaluation [MW] |
|--------------------|---------------------------|------------|-----|---|--|
| | min | average | max | | |
| Hydro run of river | 75 | 93 | 115 | 1,687 | 1,376 |
| Hydro dams | 75 | 96 | 113 | 2,750 | 0 |
| Coal | 98 | 101 | 105 | 6,500 | 0 |
| Small hydro | 75 | 102 | 140 | 336 | 48 |
| LNG CC | 96 | 105 | 114 | 929 | 1,332 |
| Solar (PV) | 98 | 119 | 147 | 3,714 | 1,878 |
| Wind | 91 | 137 | 184 | 4,660 | 2,101 |
| Geothermal | 112 | 138 | 142 | 120 | 0 |
| Oil fired | 244 | 287 | 329 | 1,683 | 0 |
| TOTAL | | | | 22,380 | 6,735 |

Source: IEA 2011, SEA 2013, CNE 2013, SYSTEP 2013



HELP! What do we do now?





The not so new context...



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- The context for new investments has changed for ever in the developing world (not only for energy)
 - BAU is not feasible anymore
 - New challenges of different nature
- Educate public opinion as early as possible
 - An uneducated public may cripple development
 - Role for governments, but also of the private sector
- Strong political leadership is a must
 - Swift actions and guidance for the market and public opinion
 - Need to develop common vision for the future
 - Danger of partisan positions clouding main issues



- Land use management plans according to national policies
 - Overcome conflictive uses of land (population, tourism, industrial development, indigenous communities, etc.)
- Embrace civil society participation in licensing and approval process
 - Civil society as a partner and not an enemy
- Establish clear mechanisms for compensations to local communities for local impacts
 - National interests complementary to serving local needs

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