



ENAP

Chile – California: Clean Energy Conference

Marcelo Tokman, CEO ENAP

April 18th, 2018



TABLE OF CONTENTS

01

Renewables
in Chile

02

How did we
get here?

03

Challenges for System
Integration of Variable
Renewable Energies

TABLE OF CONTENTS

01

Renewables
in Chile

02

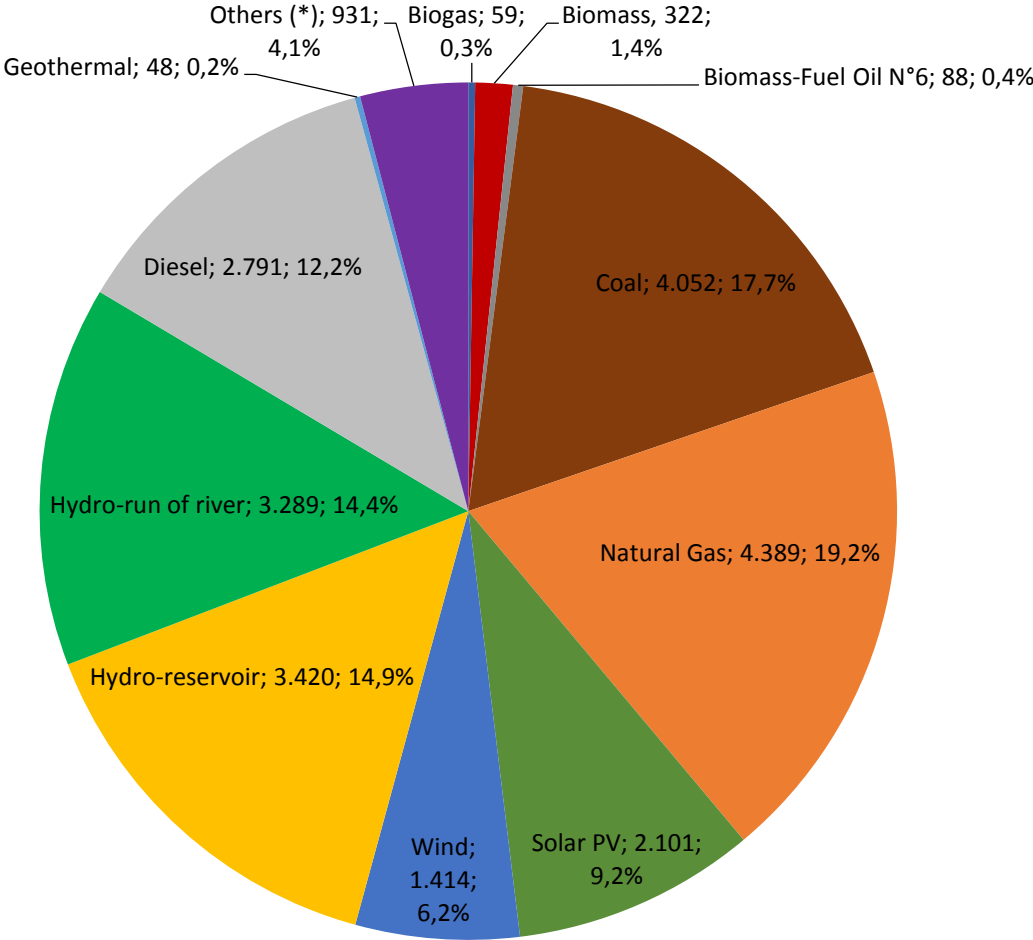
How did we
get here?

03

Challenges for System
Integration of Variable
Renewable Energies

Renewables in Chile: Current Situation

Installed Capacity by Technology (MW), Chilean National Power System 2017



Renewables represent 46,5% of Chile's electric mix and 31,6% if one excludes Hydro-Reservoir.

Renewables in Chile: Current Situation

Renewables Continue Growing Fast

Technology	Under Environmental Evaluation	Under Construction	Approved
	Capacity (MW)	Capacity (MW)	Capacity (MW)
Solar (PV + CSP)	2.805	321	18.387
Natural Gas	2.174	0	5.189
Wind	1.344	600	9.225
Coal	0	375	7.030
Diesel	221	331	2.528
Geothermal	50	0	120
Hydro	58	1.055	3.894
Biomass/Biogas	30	0	463
TOTAL	6.682	2.682	46.836

- Renewable projects under construction (1.975 MW) represent 74% of total projects under construction.
- 68% of all projects approved or under environmental evaluation are renewable projects .

Renewables in Chile: Current Situation

Renewables are Very Competitive

Year	Awarded Energy	Average Price	NCRE Projects Awarded	Solar PV Average Price	Wind Average Price
	GWh/year	US\$/MWh	%	US\$/MWh	US\$/MWh
2016	12.430	47,6	53%	29,1	47,5
2017	2.200	32,5	100%	33,4	32,1

- Wind and Solar have become the most competitive technologies in the latest tenders of the distribution companies.

TABLE OF CONTENTS

01

Renewables
in Chile

02

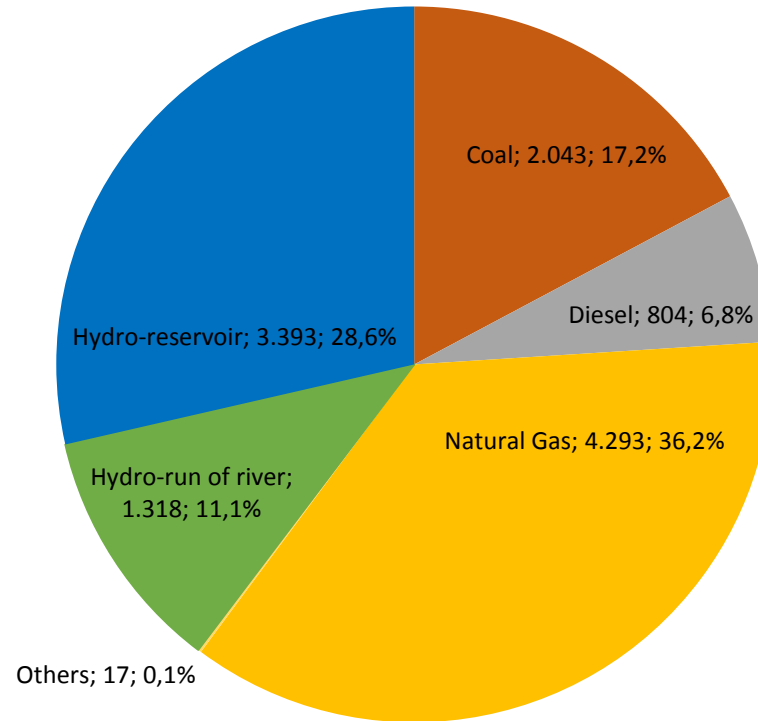
How did we
get here?

03

Challenges for System
Integration of Variable
Renewable Energies

Renewables in Chile: How did we get here?

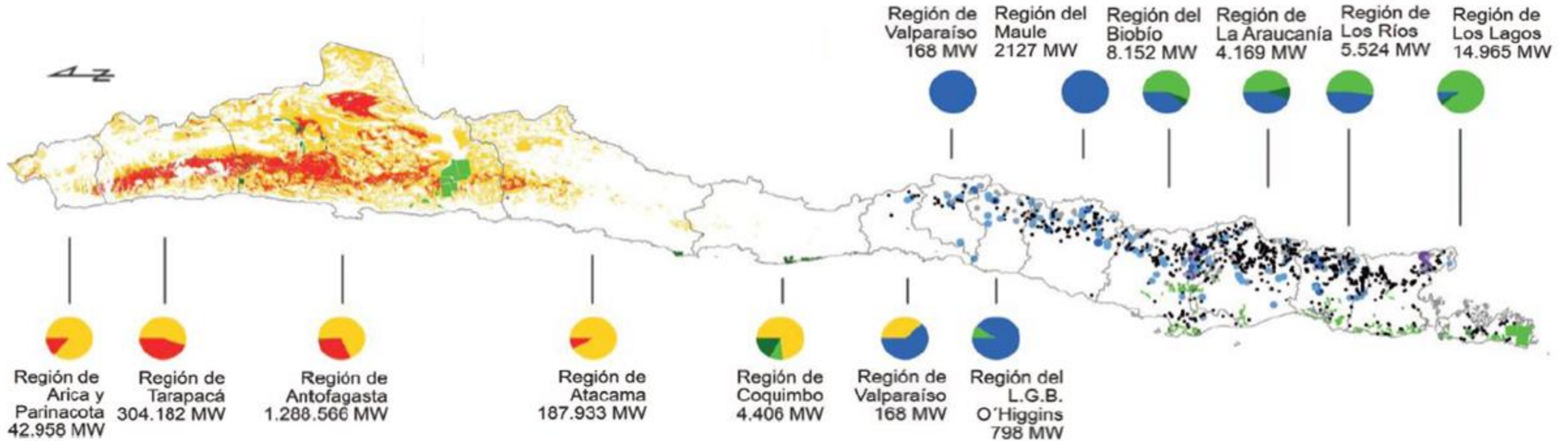
Installed Capacity by Technology (MW) - Chilean National Power System 2006



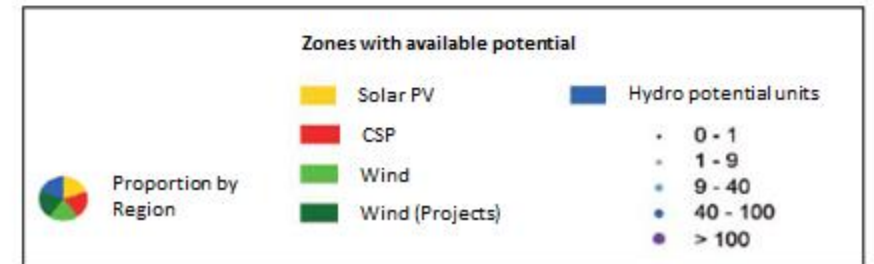
■ Coal ■ Diesel ■ Natural Gas ■ Others ■ Hydro-run of river ■ Hydro-reservoir

Almost no NCRE in 2006. First wind park in the SIC, Canela, was built in 2007.

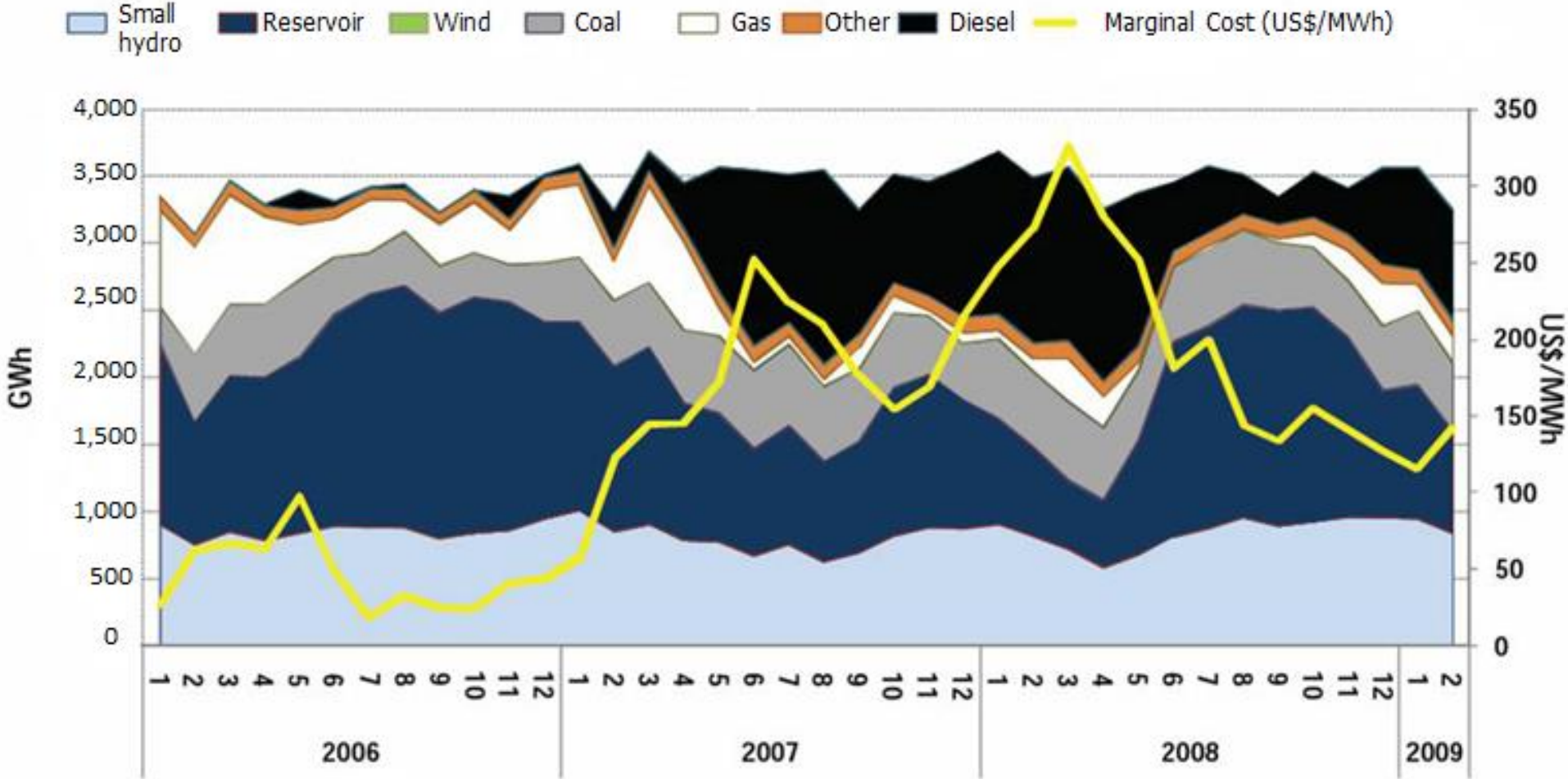
Renewables in Chile: Enormous Potential



- Atacama Desert (140.000 kms²) has solar radiation over 9 KWh/m².
- Patagonia has on shore wind resource above 14 mts/sec.
- Relevant hydro, geothermal, biomass, waste to energy and ocean energy.



Renewables Were Already a Competitive Alternative



Due to the Gas Crisis in Chile and the fall in costs of renewable technologies, renewables were already a competitive alternative.



However, Renewables Faced Several Barriers

- Scarce Information Available.
- Uncertainty Regarding Permitting for new technologies.
- Regulatory Framework needed adaptation.
- Precarious Infrastructure.
- Difficulties to access financing.
- Uncertainty over technological options.
- Few local providers.
- Tenders not Designed to fit Generation Profile.



Policy Choice: Promote Competitive Renewables by Removing Barriers, Not by Subsidizing

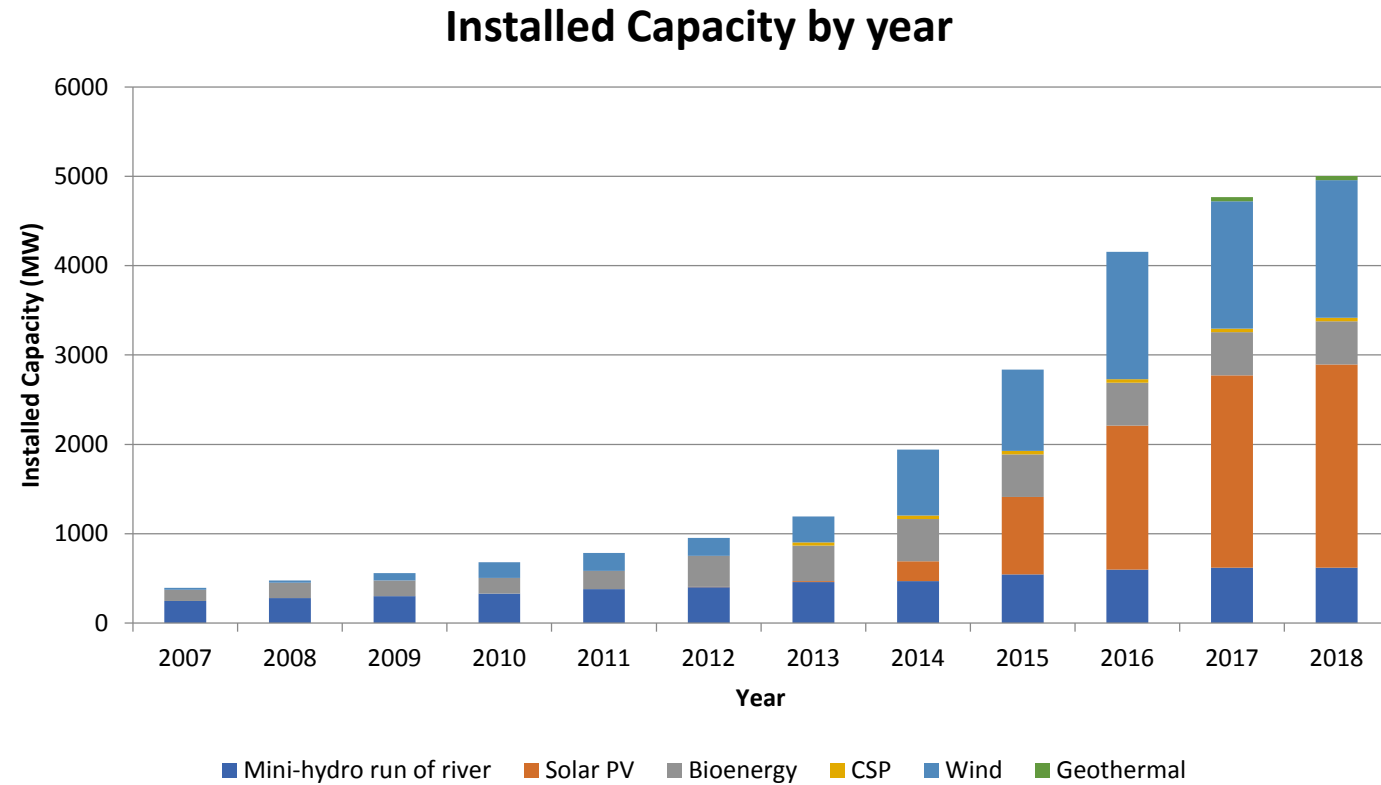
- Creation of the Ministry of Energy and the Renewable Energies Center.
- Improvements to the Regulatory Framework: Ley Corta and Ley de Renovables.
- Amendment of Geothermal Concessions Law.
- Funding of Pre-Investment Studies and Engineering by CORFO.
- Facilitating the financing through CORFO credit lines and loan facilities.
- Capacity Building: training and research grants.
- Generation Resource information.
- Guides to Environmental Evaluation.
- Mitigating Geothermal Exploratory Risk Through ENAP.



Policy Choice: Promote Competitive Renewables by Removing Barriers, Not by Subsidizing

- Interconnection of the SIC and SING.
- Transmission Law.
- Law 20-2025.
- Allocation of Public Land for Renewable energy projects.
- Raising awareness online tools Explorers.
- Encouraging distributed generation with Net Billing Law.
- Climate Pollution Tax.
- New Tenders Law.

Rapid Deployment of Renewables



Combination of sound policies and continuous decline in technological costs has resulted in a very rapid growth of renewable energies in Chile.

TABLE OF CONTENTS

01

Renewables
in Chile

02

How did we
get here?

03

Challenges for System
Integration of Variable
Renewable Energies

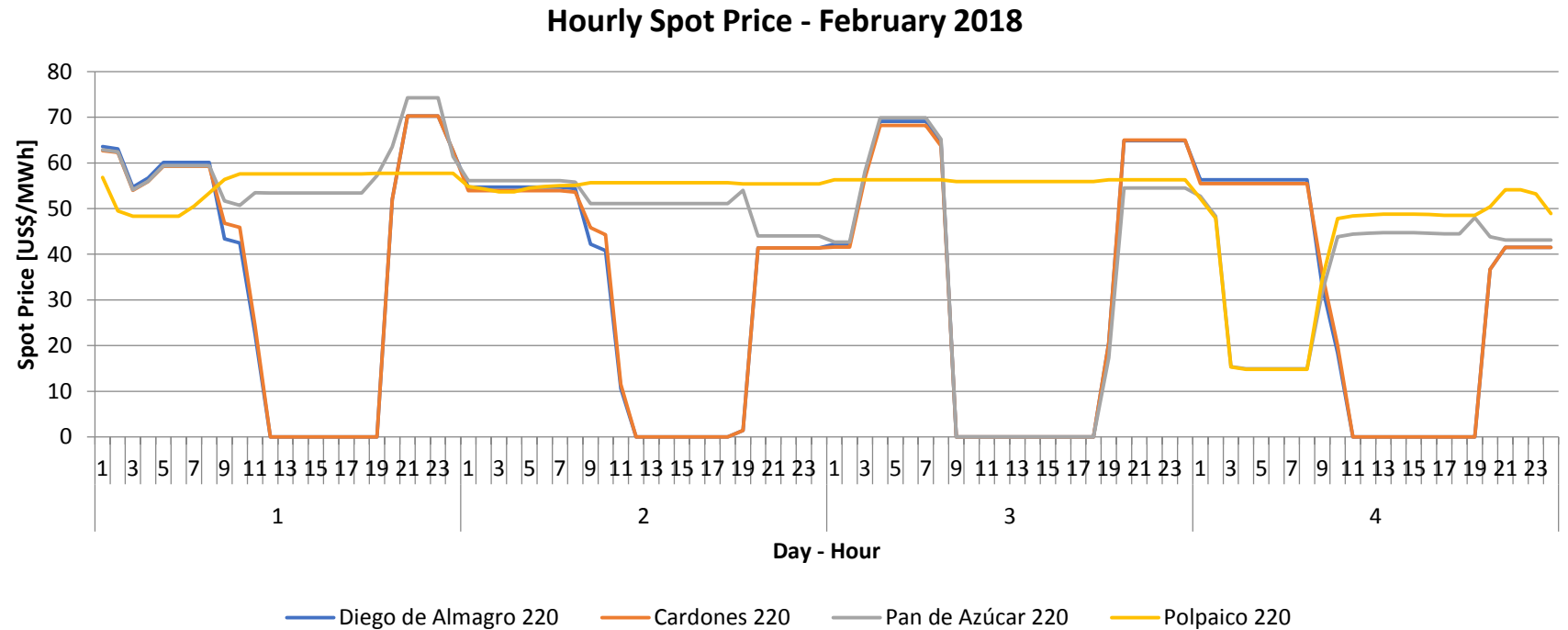
Great Opportunity and Political Commitment to Continue Increasing Renewables

- Untapped potential for solar power and significant wind and hydro (over 1800 GW).
- Rapidly declining technological costs.
- Chile's National Energy Policy 2050 establishes a target of 60% of participation for renewables in 2035 and 70% in 2050.



Difficulties to Continue Increasing the Participation of Variable Renewables

System Integration of Variable Renewables is difficult, especially because of fishbone structure of the electric system with resources located in remote parts of the system with low electricity demand.



In the Norte Chico area, where there are over 3.000 MW of wind and solar capacity for a flat demand of only 1.000 MW, curtailment and 0 spot prizes are very frequent.



Measures to Achieve the Renewable Goals of the National Energy Policy

- Expand transmission capacity to eliminate current bottlenecks.
- Advance in International Integration.
- Implement Advanced System Operation Practices.
- Facilitate Demand Side Response and Storage.
- Continue the Development of Ancillary Services Market.
- Increase Flexibility by Reducing Minimum Generation Requirements of Thermal Units.
- Improve Generation Forecasting Capabilities.
- Altering Reservoir Sizes or Discharge Rates.
- Develop Mechanisms to Introduce Market Signals to Regulated Customers to Promote more Flexibility.



ENAP