

Climate knowledge and hydropower in Latin America



Sebastián Vicuña

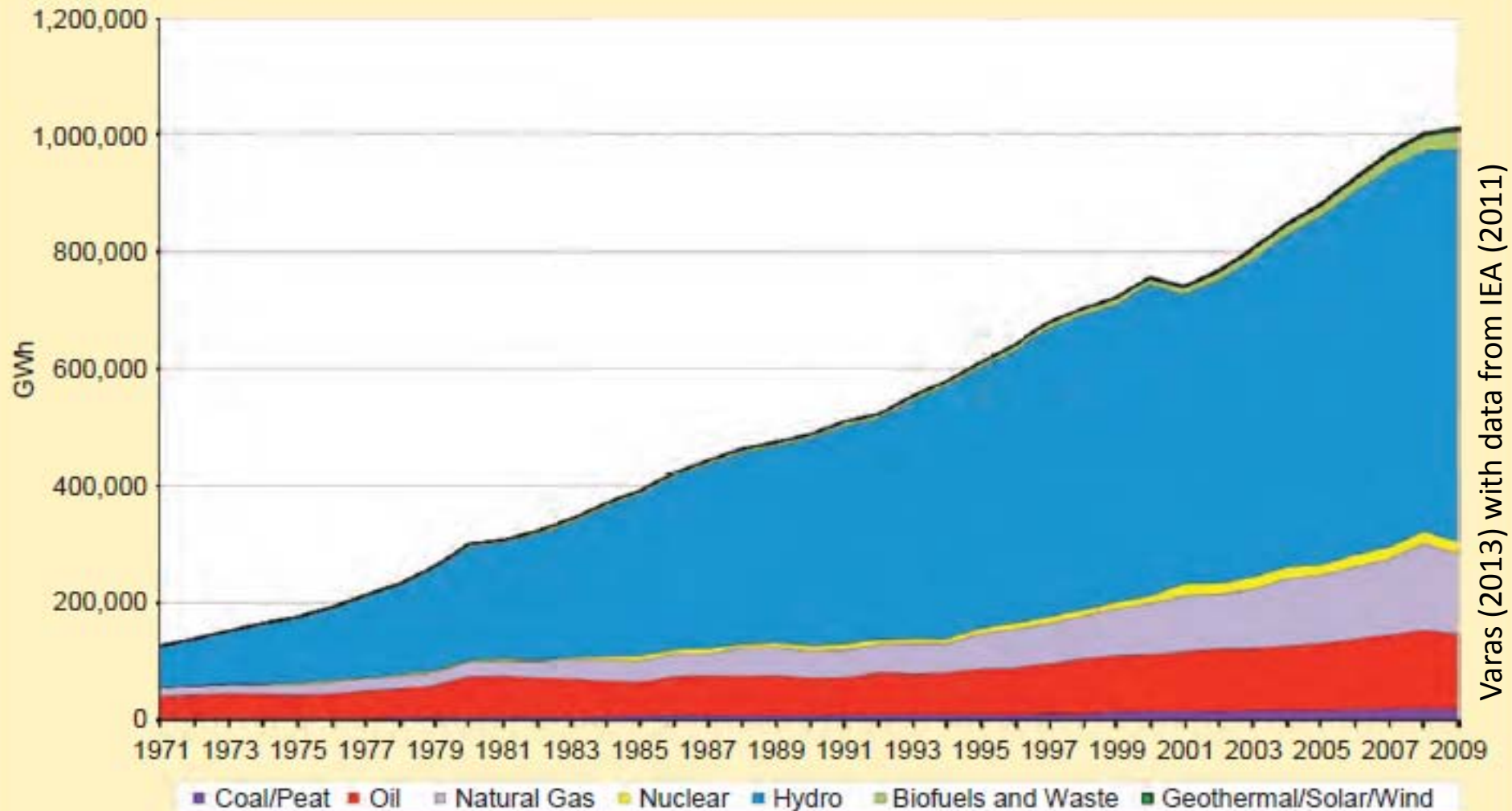
WCRP-LAC

Montevideo, Marzo, 2014

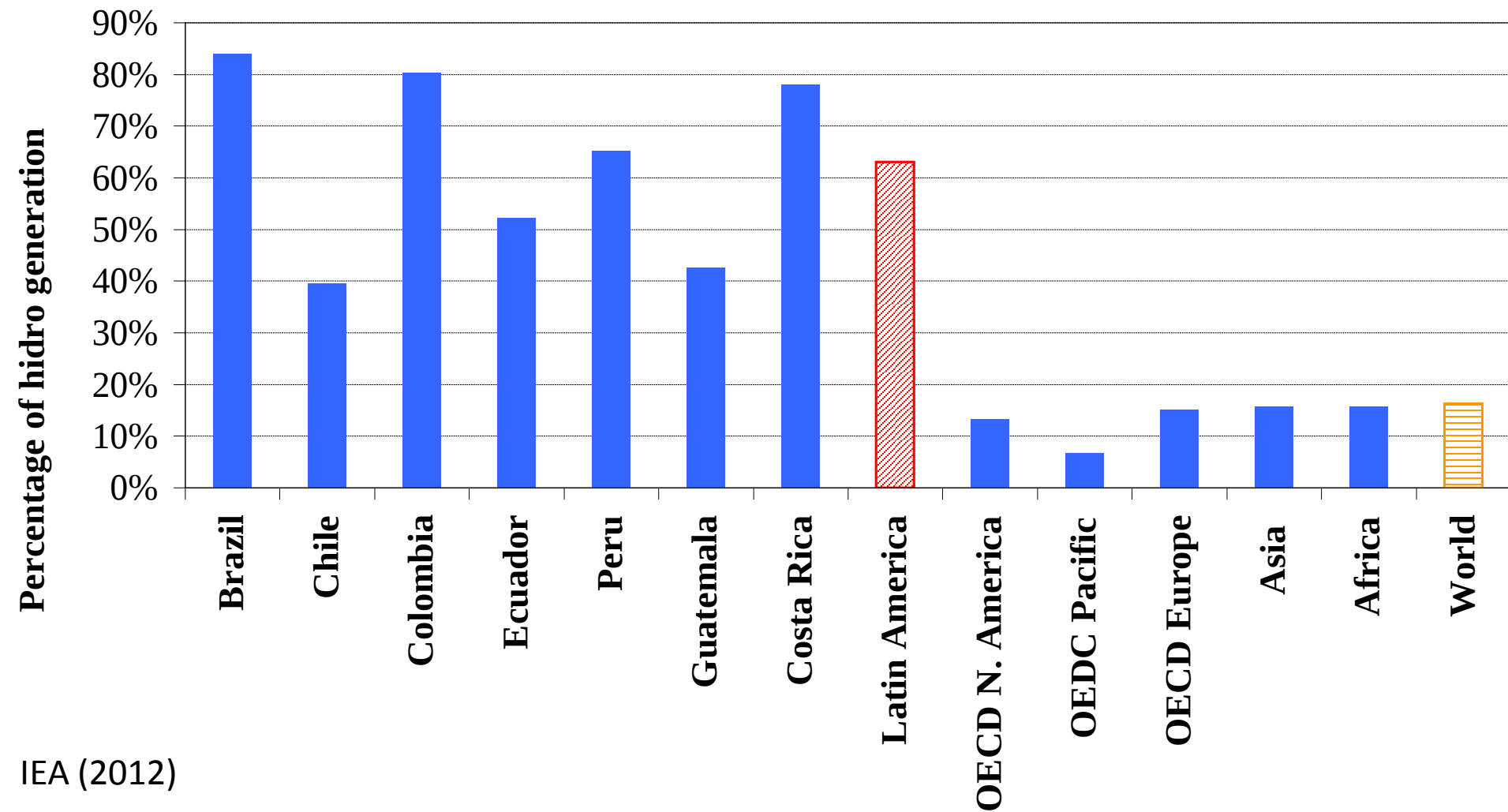
Agenda

- The role of hydropower in Latin America
- Climate knowledge and hydropower
- Conclusions

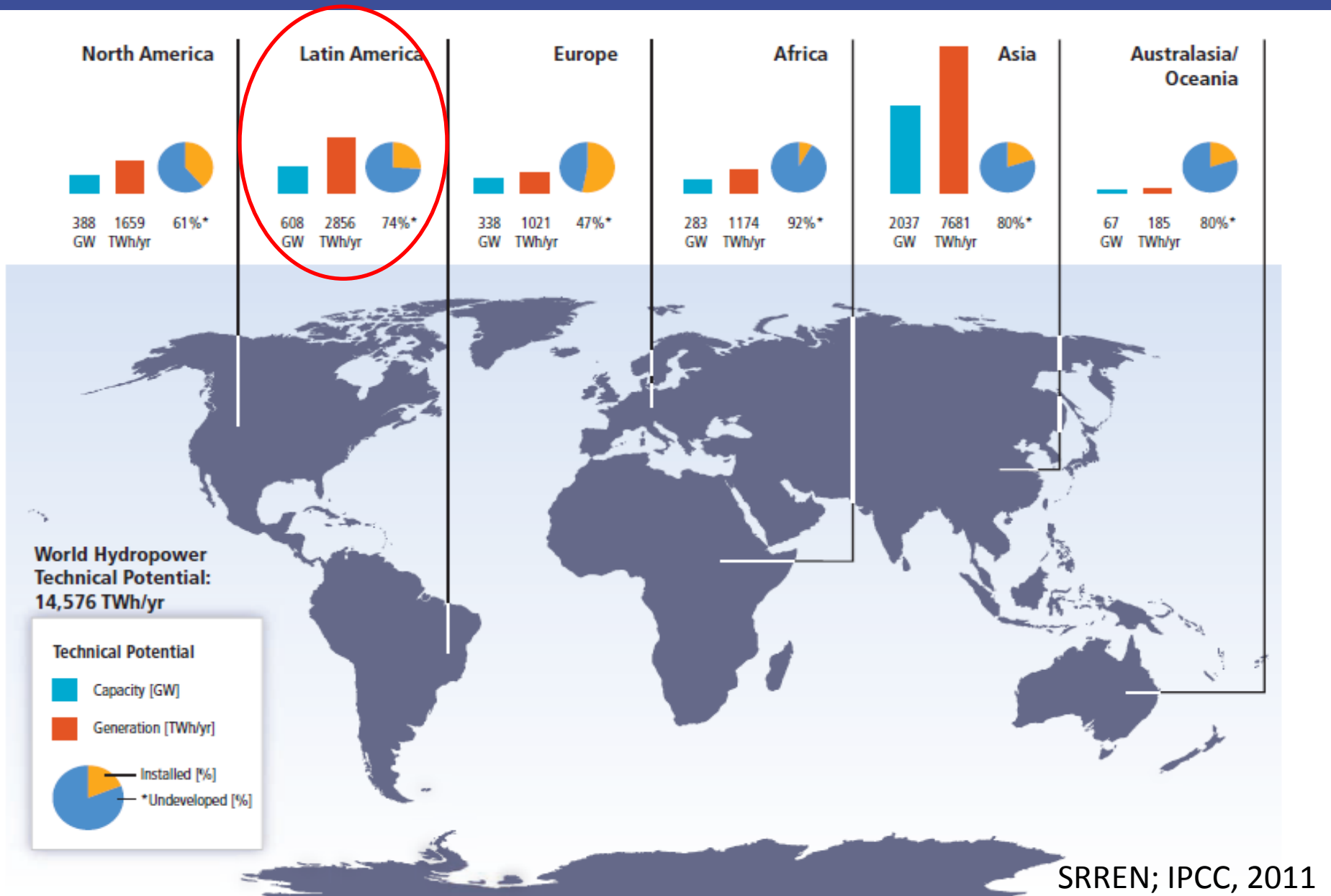
Hydropower is by far the most important source of electricity in Latin America



With a relative importance higher than
anywhere in the world



With still a lot of untapped potential to develop



Large hydropower projects in Latin America

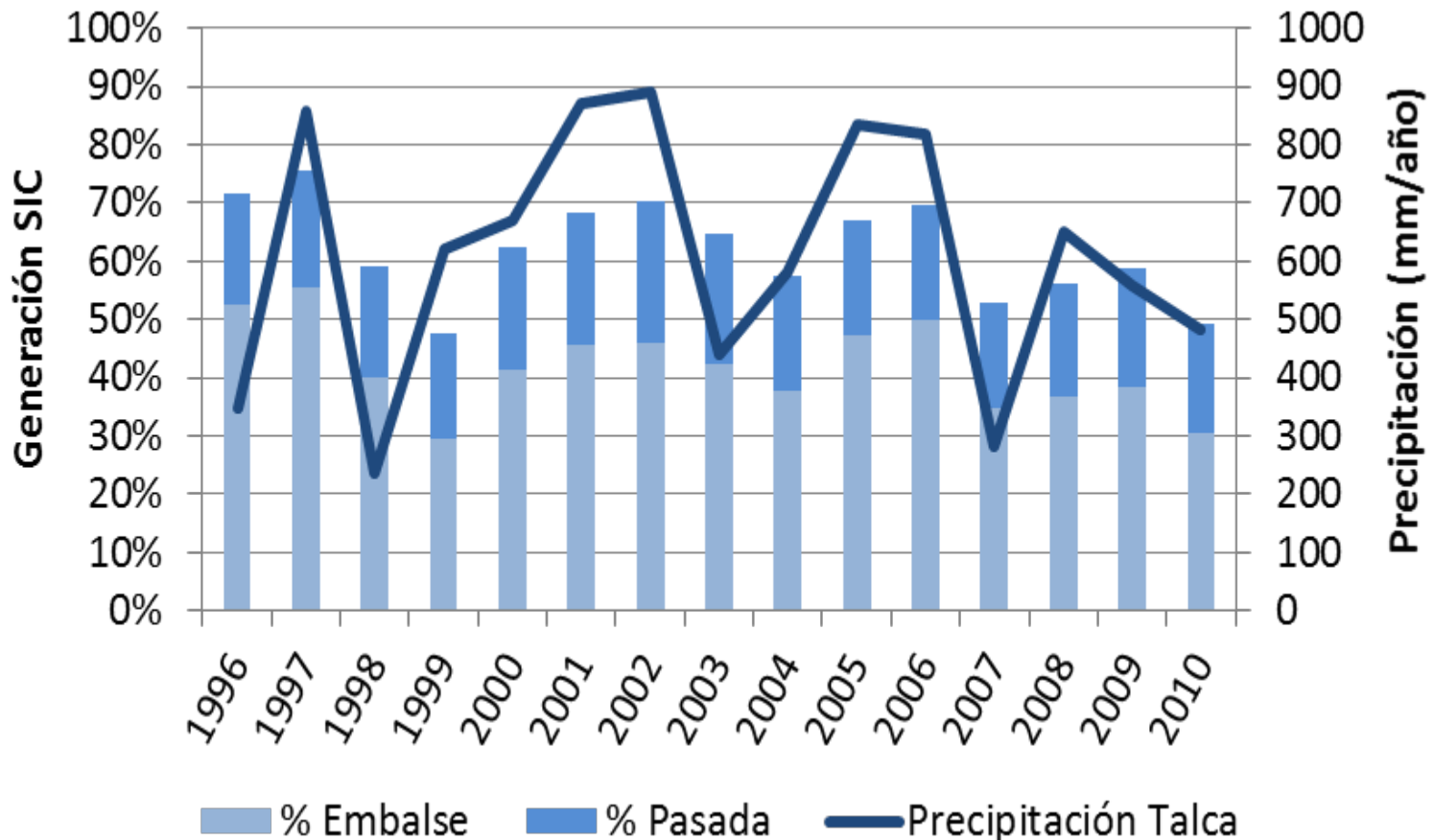


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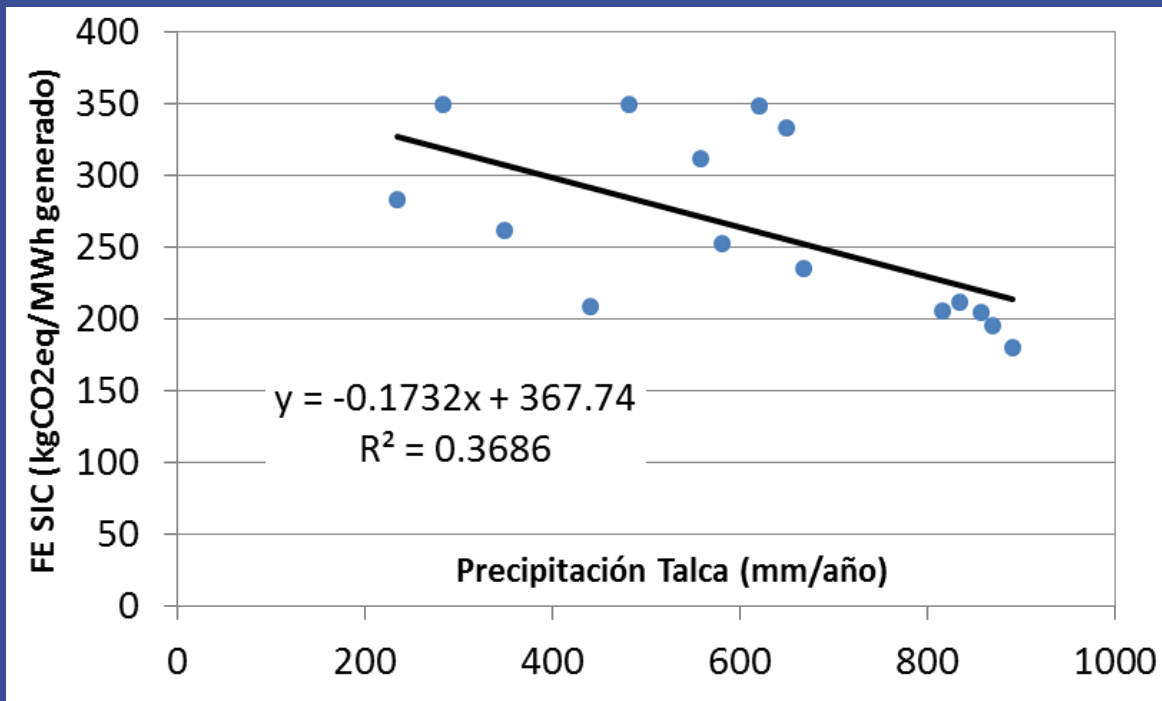
The water-energy-climate nexus is evident when we consider hydropower generation

Relation between precipitation and relative hydropower generation in central Chile



The water-energy-climate nexus is evident when we consider hydropower generation

Relation between precipitation and Chile generation system CO₂ emission factor



MAPS-Chile, 2014

Generation system	Emissions (g CO ₂ /kWh)
Hydropower	≈ 10*
Coal	≈ 1000
Natural Gas	≈ 500

* Depends on type and location of HP system

Climate change impacts could reshape the value of hydropower

Climate model based consensus on the hydrologic impacts of climate change to the Rio Lempa basin of Central America

E. P. Maurer¹, J. C. Adam², and A. W. Wood³

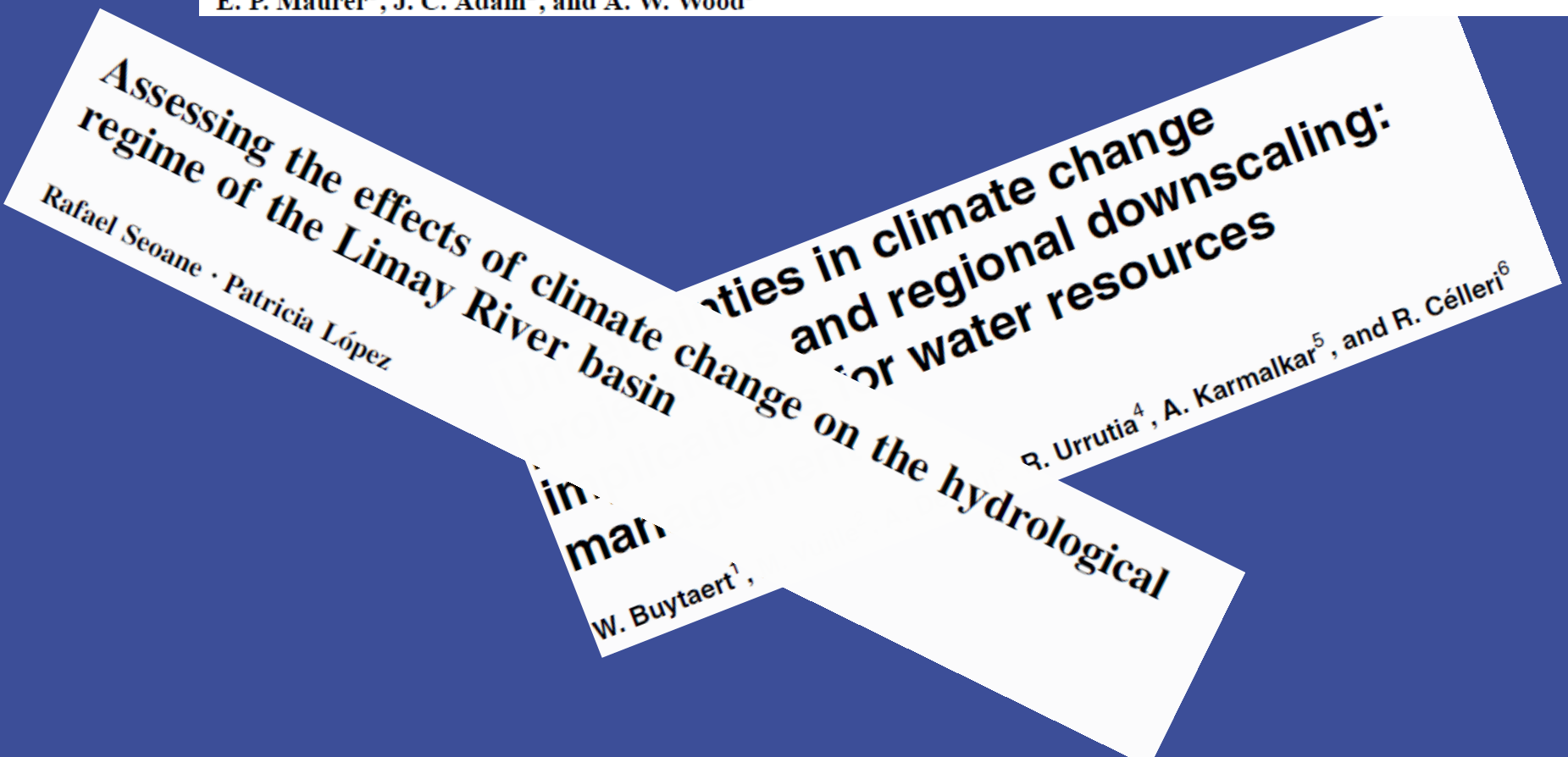
Uncertainties in climate change projections and regional downscaling: implications for water resources management

W. Buytaert¹, M. Vuille², A. Dewulf³, R. Urrutia⁴, A. Karmalkar⁵, and R. Céleri⁶

Climate change impacts could reshape the value of hydropower

Climate model based consensus on the hydrologic impacts of climate change to the Rio Lempa basin of Central America

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Assessing the effects of climate change on the regime of the Limay River basin

Rafael Seoane · Patricia López

Variations in climate change and regional downscaling: for water resources

R. Urrutia⁴, A. Karmalkar⁵, and R. Céleri⁶

Impacts of climate change on the hydrological regime of the Limay River basin

W. Buytaert¹, J. C. Adam², and A. W. Wood³

Climate change impacts could reshape the value of hydropower

An approach to estimating hydropower impacts of climate change from a regional perspective

James McPhee¹, Eduardo Rubio-Alvarez¹, Rodrigo Meza¹, Alvaro Ayala¹, Ximena Vargas¹, and Sebastian Vicuna²
E. P. Maurer¹, J. C. ...

Vulnerability of water resources in ... change: generation of hydroelectric power

J. E. OSPINA NOREÑA, C. GAY GARCÍA, A. C. CONDE, V. MAGALHÃES

Effects of climate change on the hydrological cycle and regional water resources in the Limay River basin

Seoane · Patricia López

in ...
man

R. Urrutia⁴, A. Karmalkar⁵, and ...

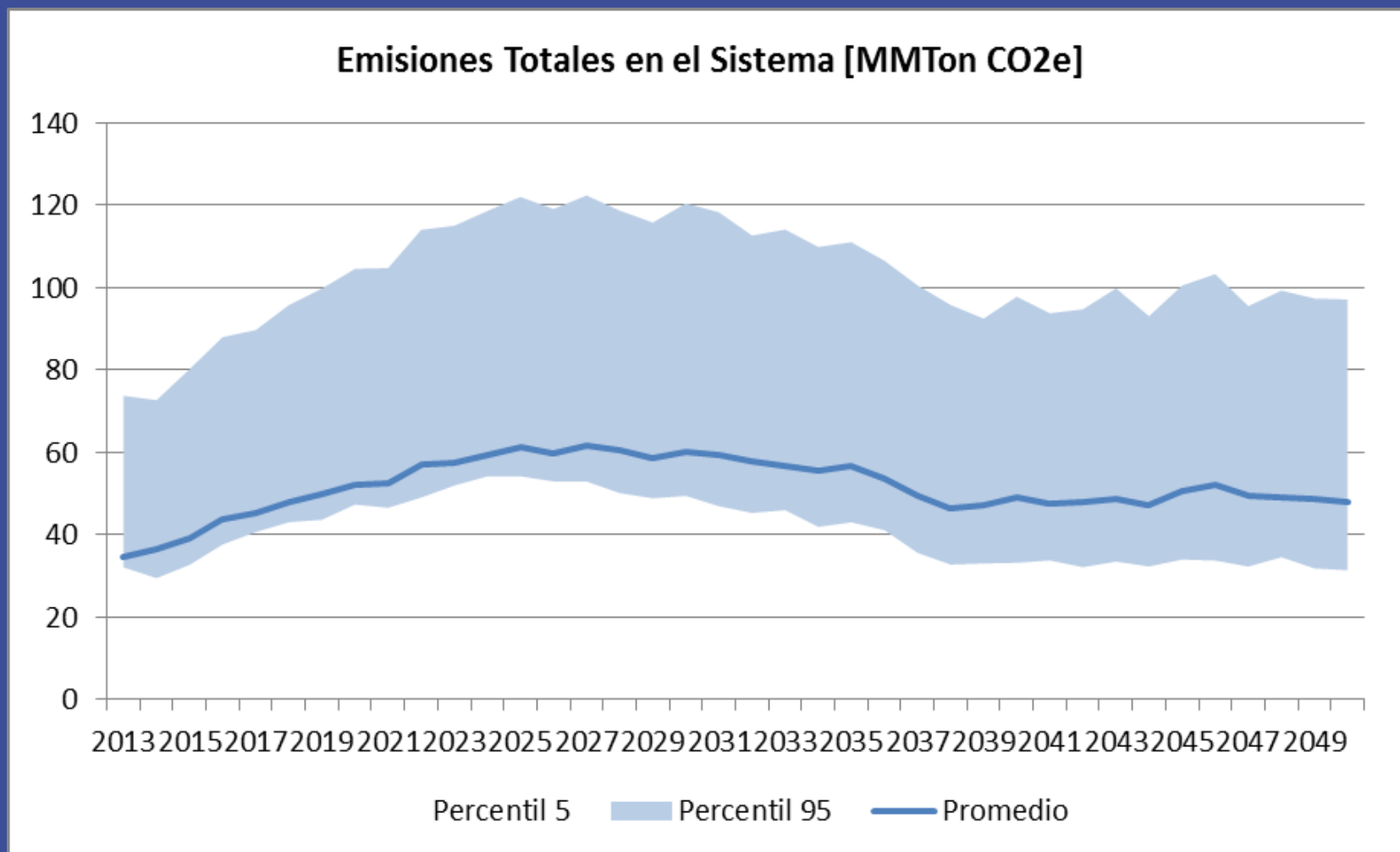
Least-cost adaptation options for global climate change impacts on the Brazilian electric power system

Andre Frossard Pereira de Lucena*, Roberto Schaeffer, Alexandre Salem Szklo

Climate change impacts could reshape the value of hydropower

- New approaches to environmental impact assessment (need for reassessment)
- Uncertainty in future GHG emissions (risk in commitments)

Chilean total electricity related emissions considering climate change (among other sources of) uncertainty



Climate change impacts could reshape the value of hydropower

- New approaches to environmental impact assessment (need for reassessment)
- Uncertainty in future GHG emissions (risk in commitments)
- Hydropower systems reoperation

Maule system

Potential: 870 MW

Laguna Maule: 1.416 Mm³.



Laja system

Potential: 1150 MW

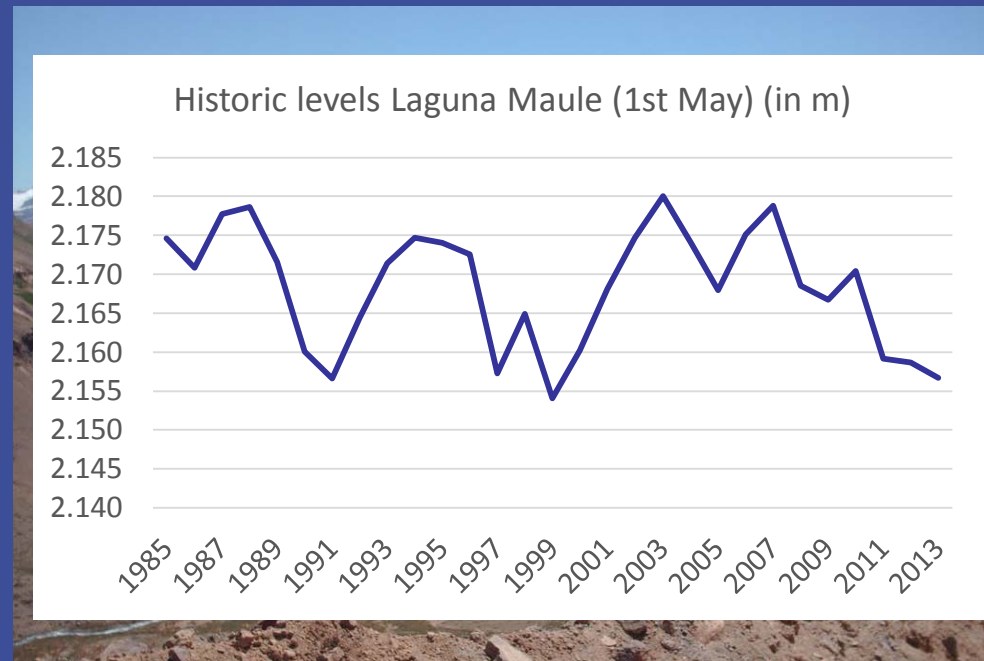
Lago Laja: 5.071 Mm³



Maule system

Potential: 870 MW

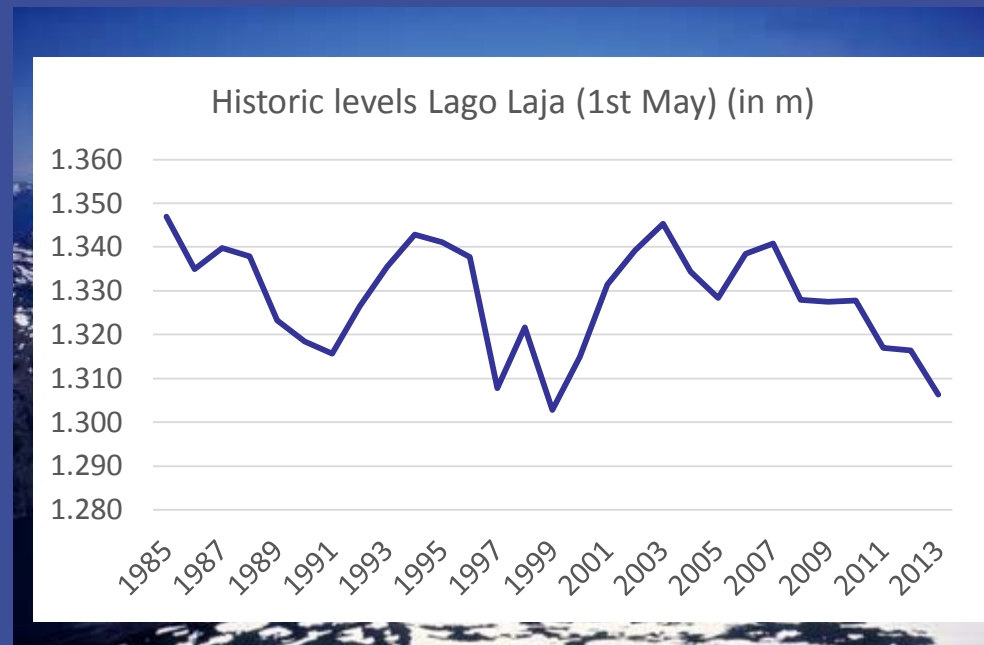
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Maule system

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Operation agreement
between Agriculture and
Hydropower from **1947!**



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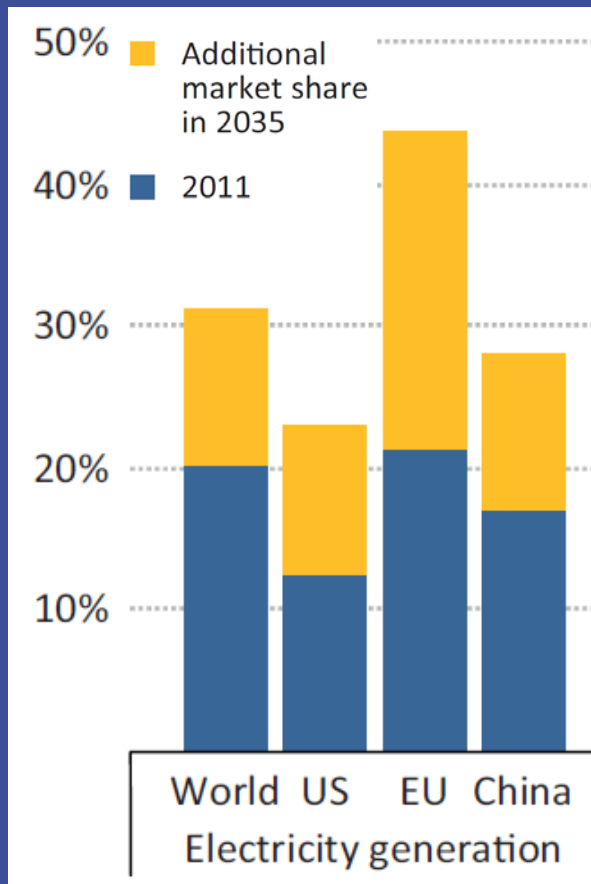
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Operation agreement
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Climate change mitigation (renewable energy) could reshape the value of hydropower

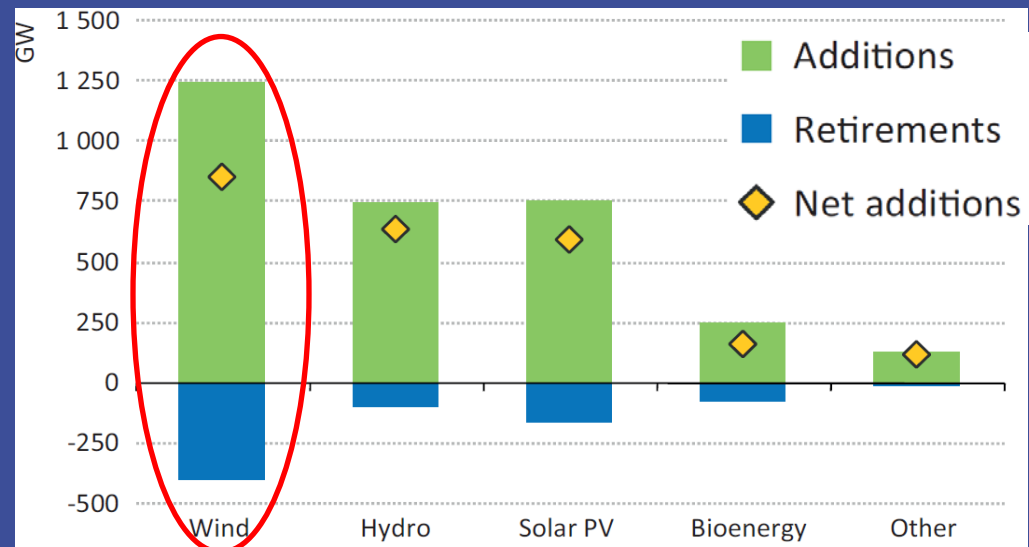
Renewable energy share in total primary energy



Region	Share of renewables total generation		Share of variable* renewables in total generation	
	2011	2035	2011	2035
Latin America	69.0%	71.0%	0.4%	6.2%
World	20.3%	31.3%	2.2%	10.0%

* Solar PV and wind

Renewables-based capacity additions

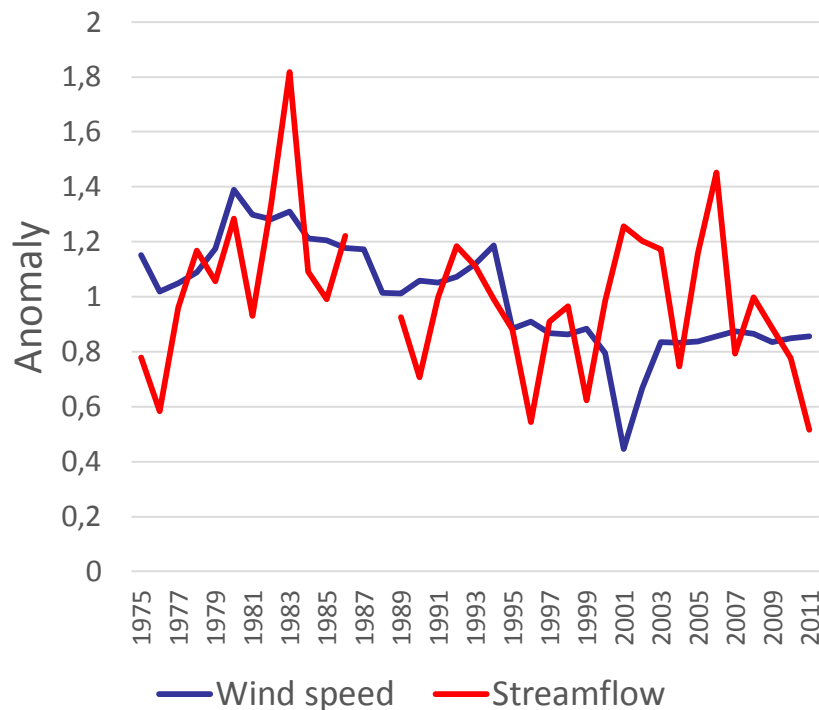


Renewable Energy Outlook, IEA, 2013

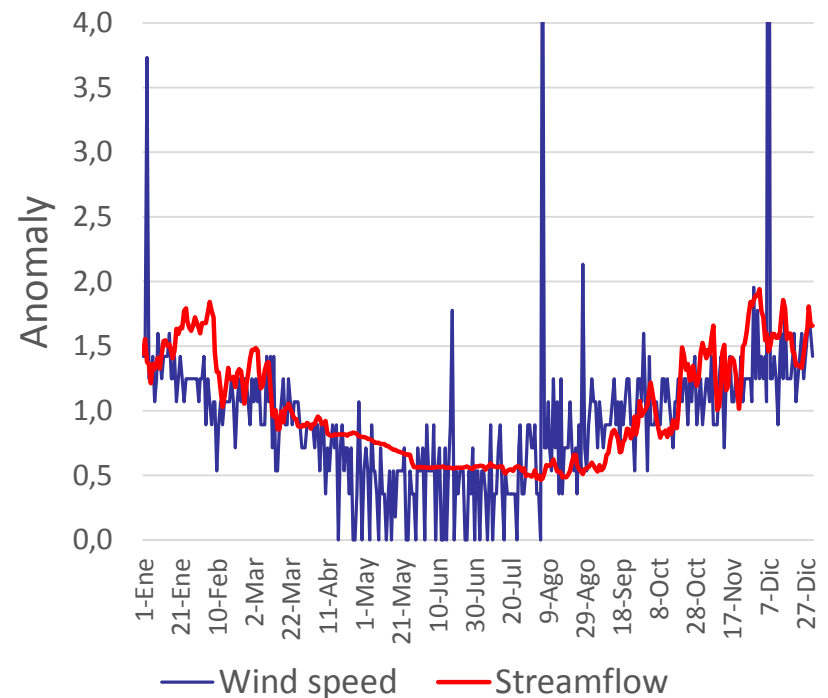
Wind power (wind speed) is more variable than hydropower (water availability) at fine time scales

Comparison between wind speed and streamflow timeseries at annual and daily scales (Maipo basin – central Chile)

Annual wind speed and streamflow



Daily wind speed and streamflow



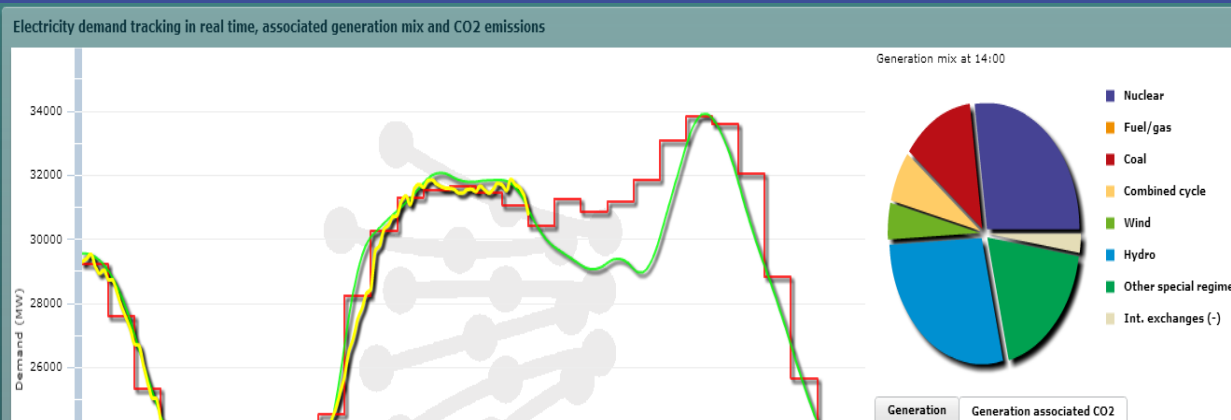
Climate change mitigation (NCRE) could reshape the value of hydropower

- Hydropower ability to quickly react to changes in demand (wind driven supply) would be more valuable in the future
- Needs to more refined real time climate forecast in electricity grid dispatch

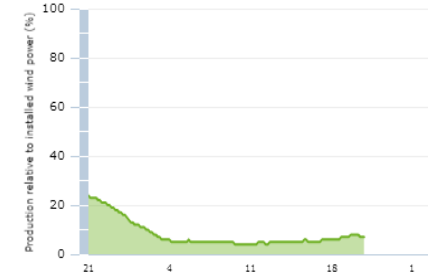
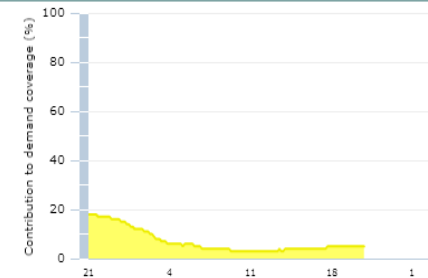
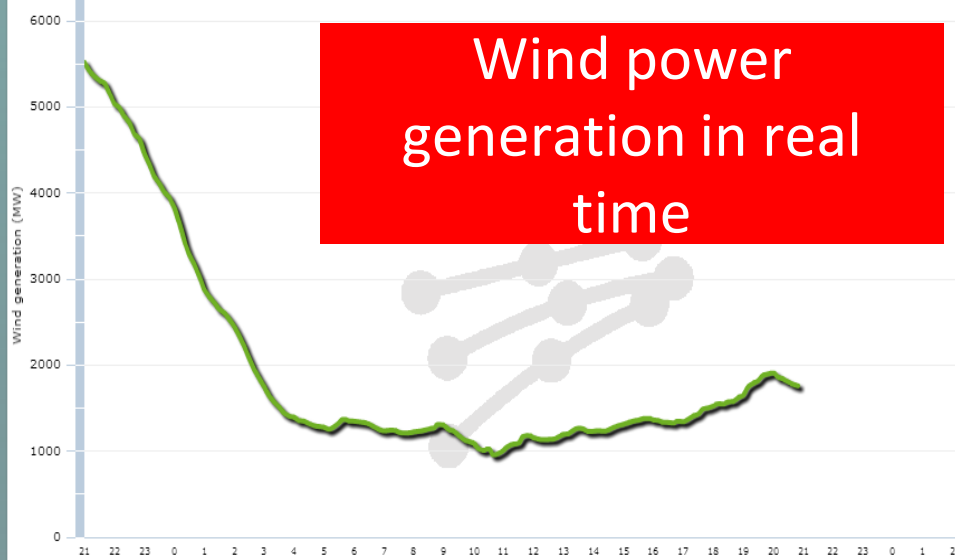
Spain (with 20% of wind power coverage provides interesting experience)

Demand forecast and generation mix in real time

Wind power generation in real time



Wind power generation in real time, relative to the installed wind power and contribution to demand coverage



Estimated wind generation at 20:50 of 03/17/2014 : 1759(MW).

Corresponds to 7 % of the total installed wind power and a contribution of 5 % to the demand covered.

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2014-03-17 Consult selected date Help

Conclusions

- Hydropower plays and will play a significant role in the future of Latin America (more than anywhere)
- At three distinct time scales (daily, decadal, climate change) there are clear niches for new climate knowledge needed to meet this challenge

Gracias...



Araucarias en el PN Nahuelbuta