

ELECTRICITY RENEWABLES AND INTERMITTENCY DEVELOPMENT IN LAC.

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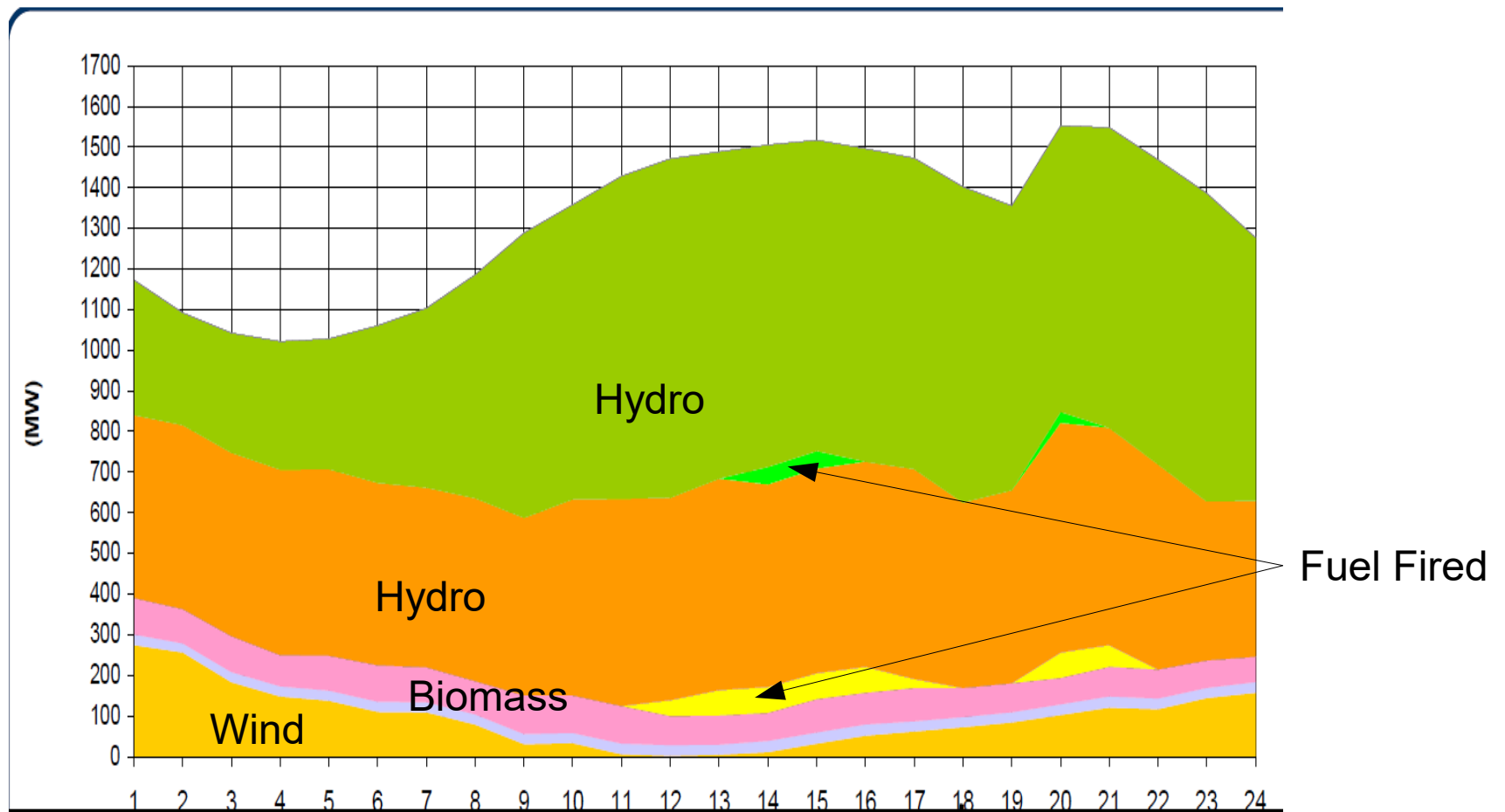


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URUGUAY

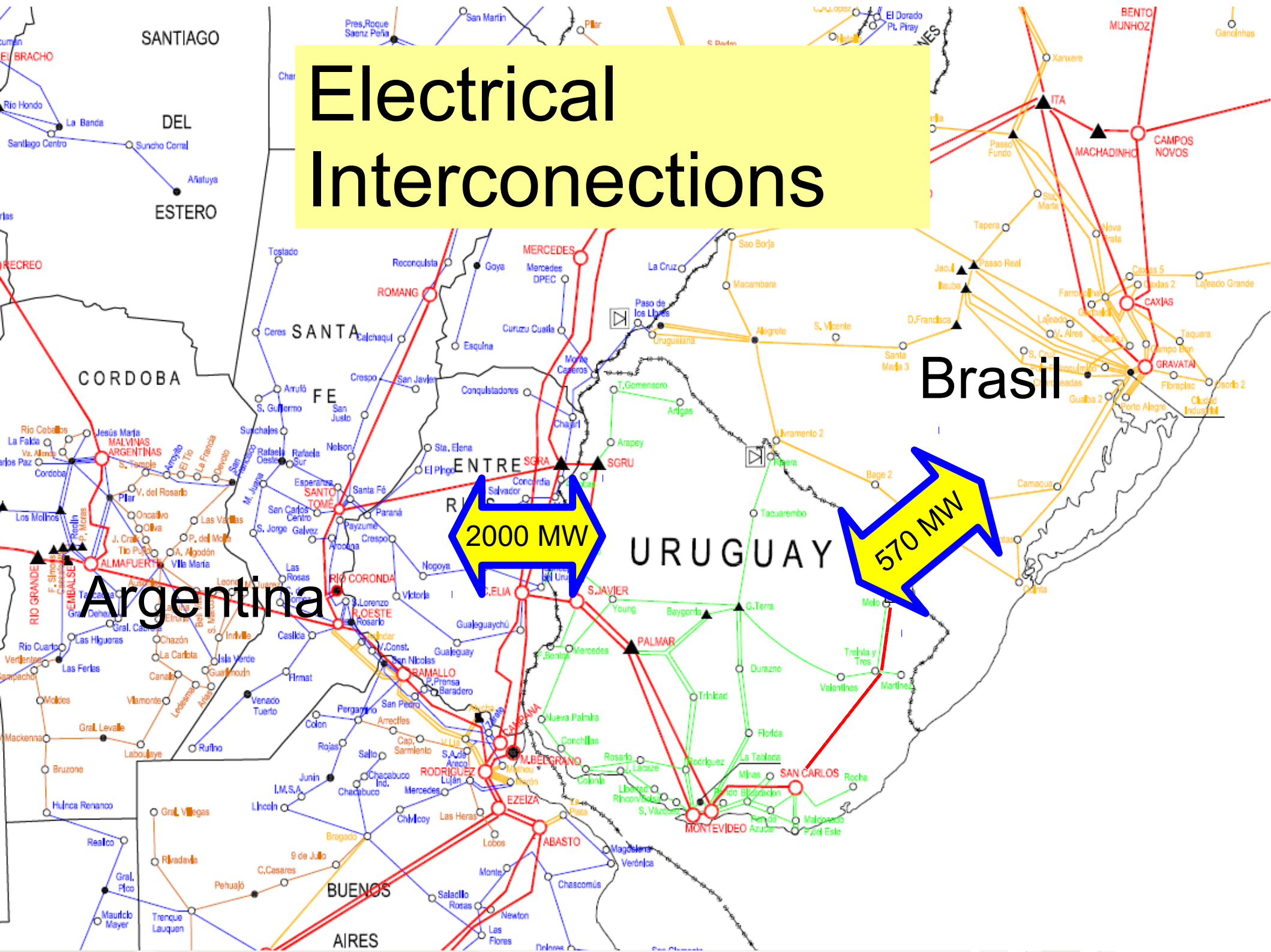


Fundación
Julio Ricaldoni
INGENIERIA EN EL URUGUAY

March 11-2015 Uruguay Power Demand, share by source. (data from the real time executed dispatch)



Electrical Interconnections



2000 MW

570 MW

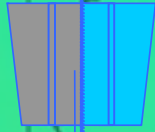
Brasil

Argentina

URUGUAY

Hydroelectric Plants 1541 MW

Salto Grande
(50% UY)
945MW
8 days

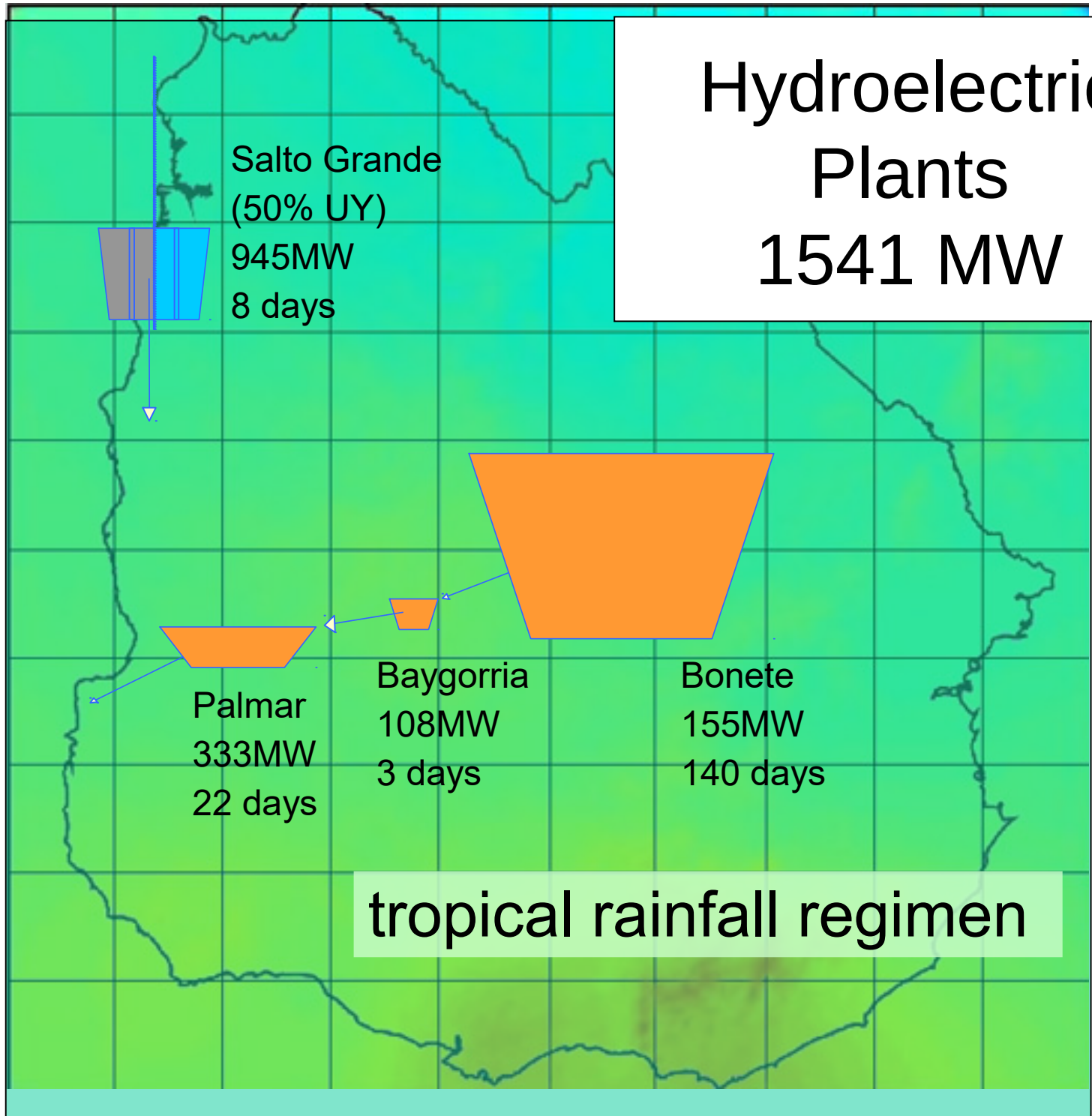


Palmar
333MW
22 days

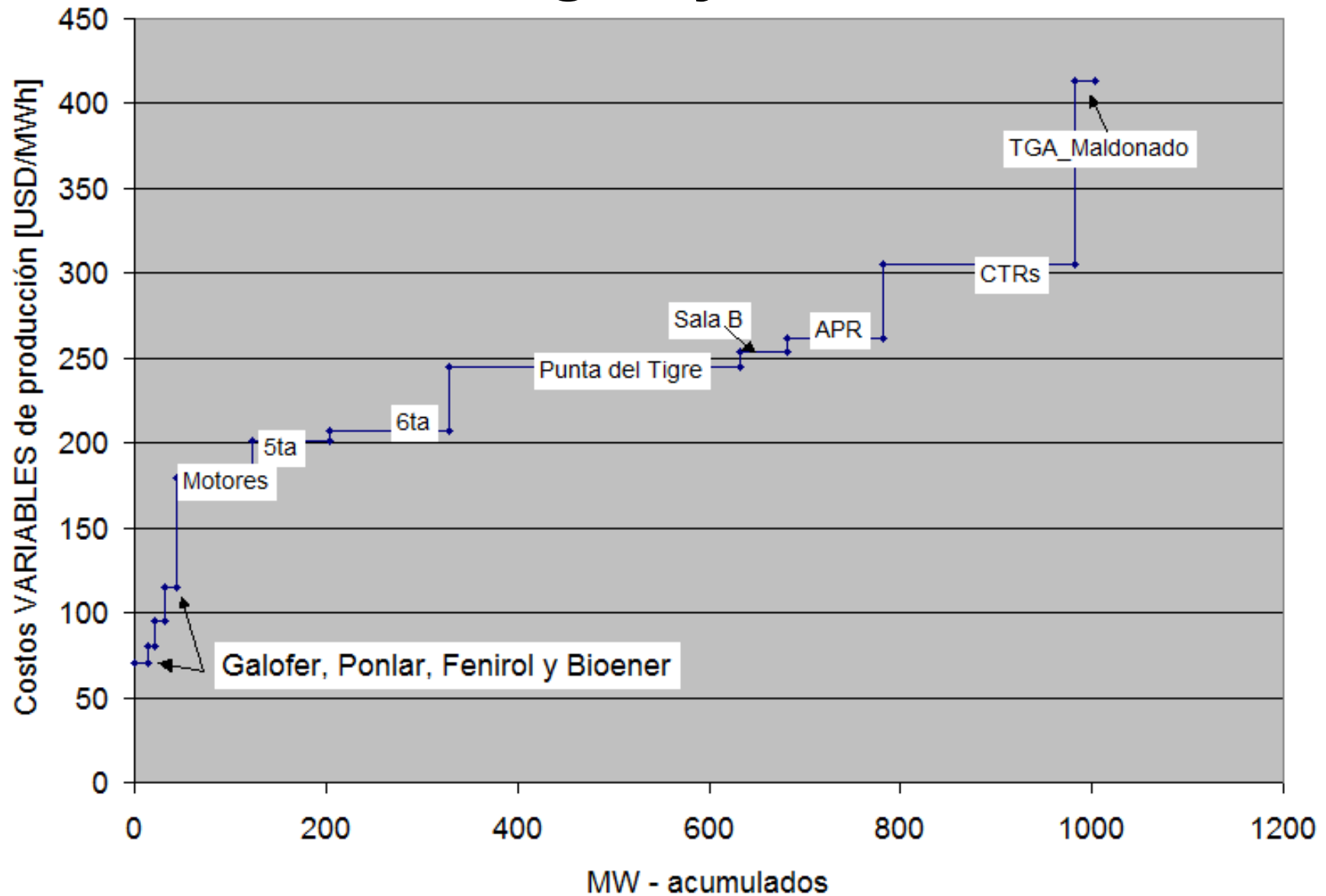
Baygorria
108MW
3 days

Bonete
155MW
140 days

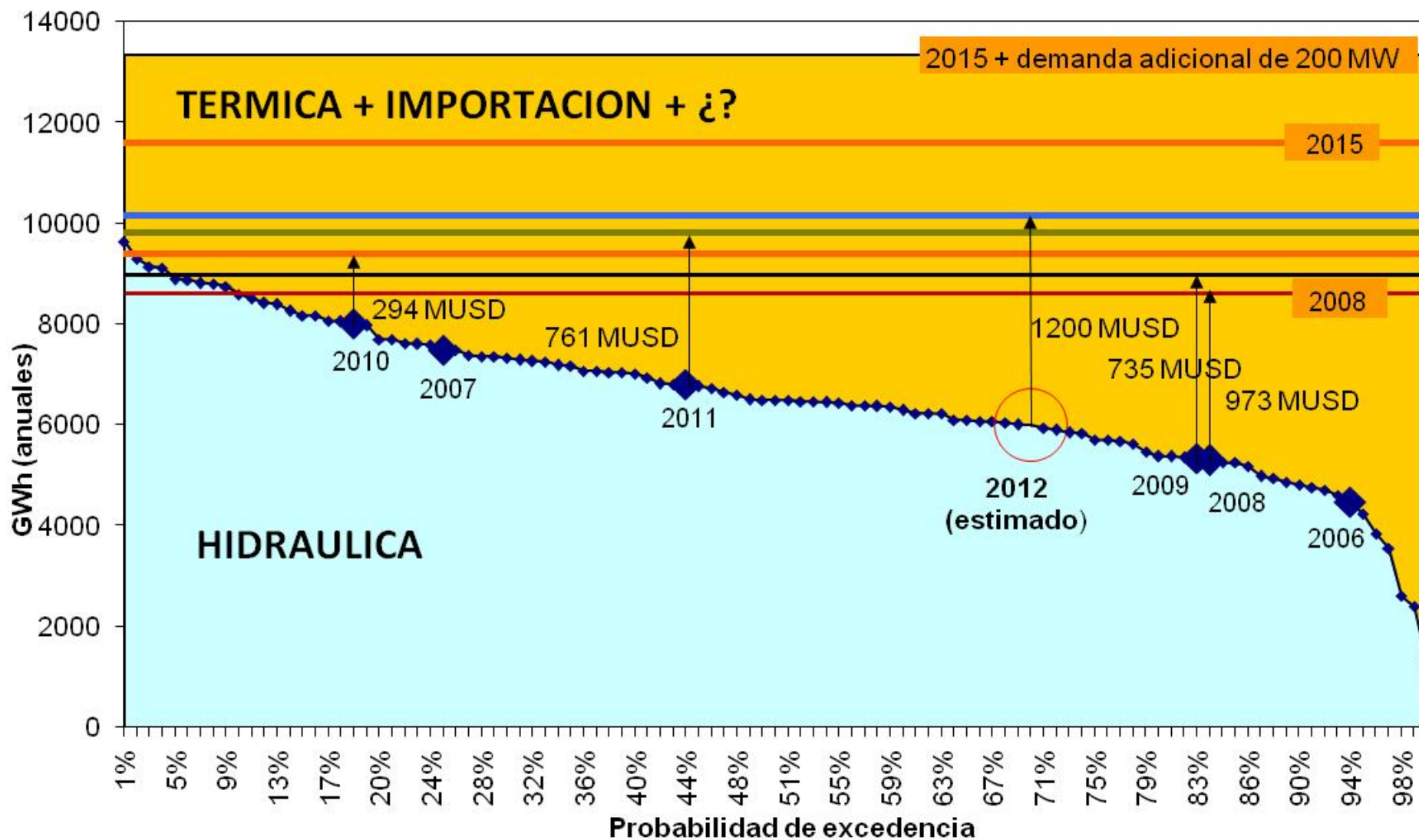
tropical rainfall regimen



Fuel fired installed capacity Uruguay 2012



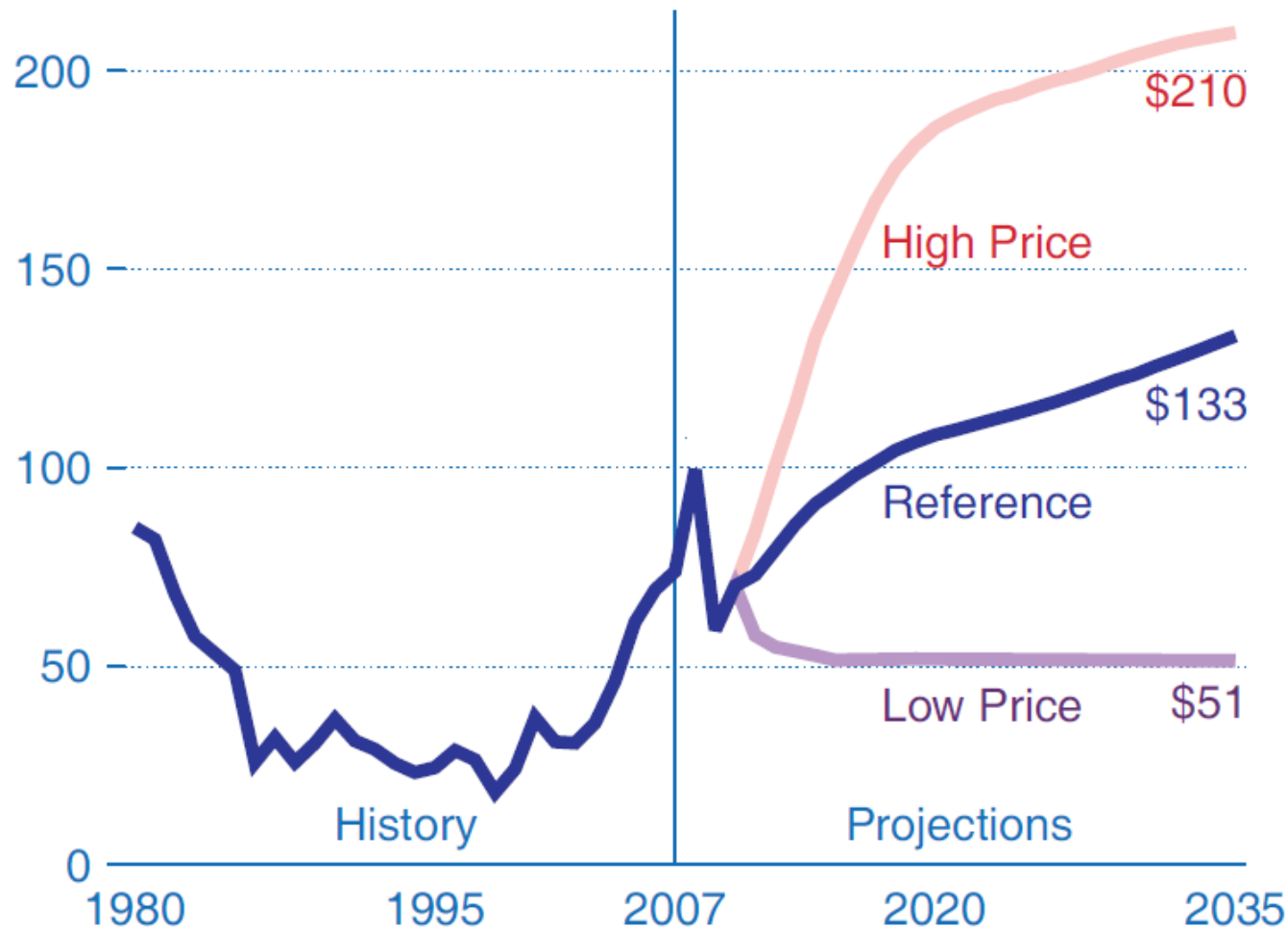
Variability of hydroelectric generation. (picture drawn in 2012)



Petroleum forecast

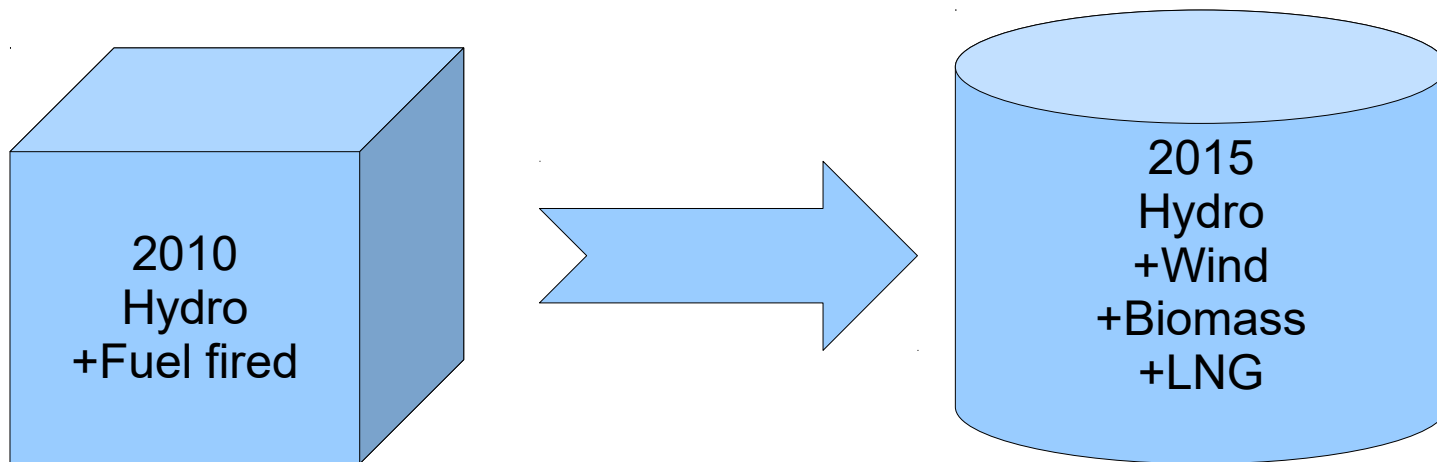
mmm more variability than renewables !!!

Figure 32. World oil prices in three cases, 1980-2035 (2008 dollars per barrel)



Uruguay 2010

Changing the power generation matrix



Investment planning optimization minimizing the expected future cost & risk

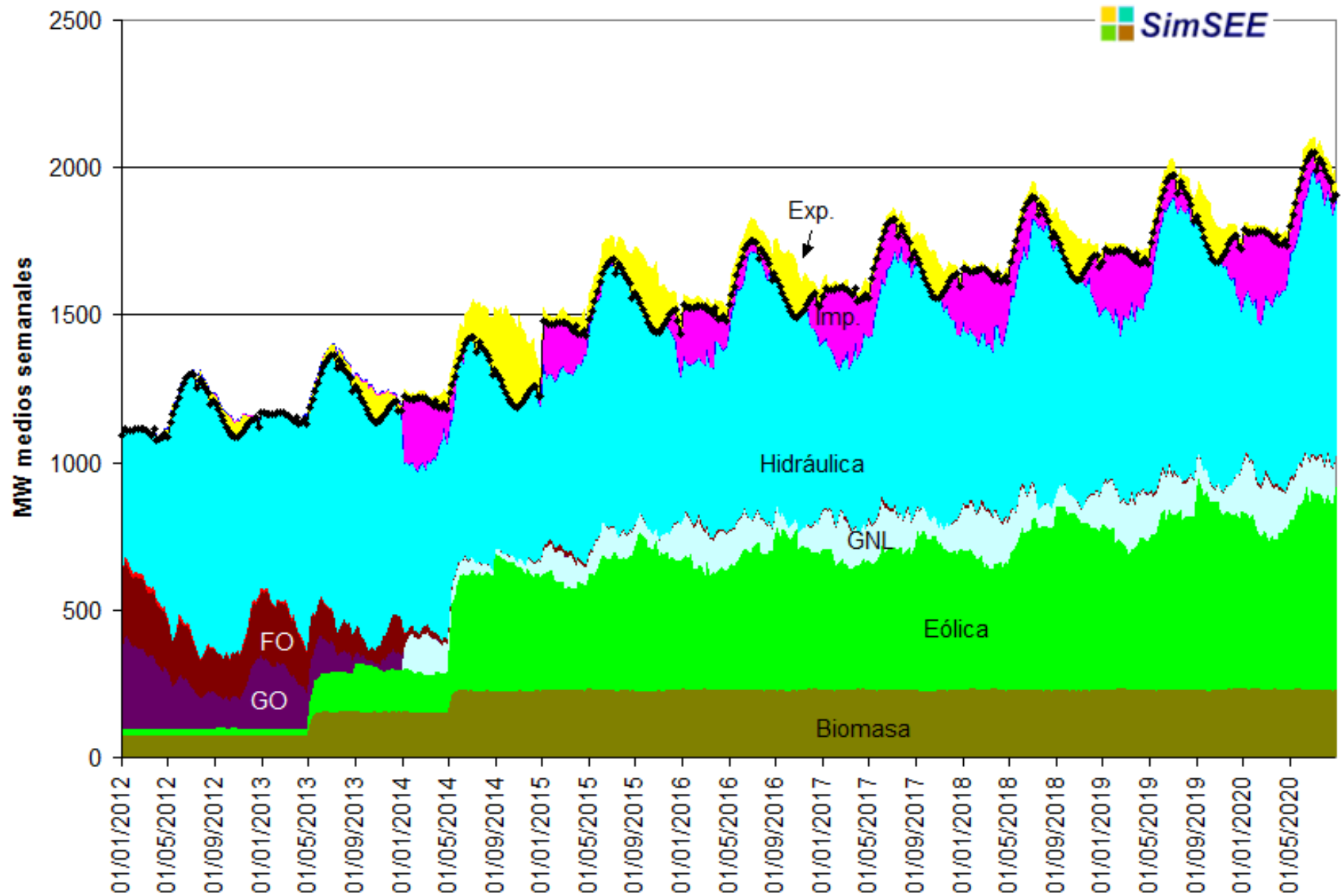
1200 MW of wind

200 MW of Biomass + Solar

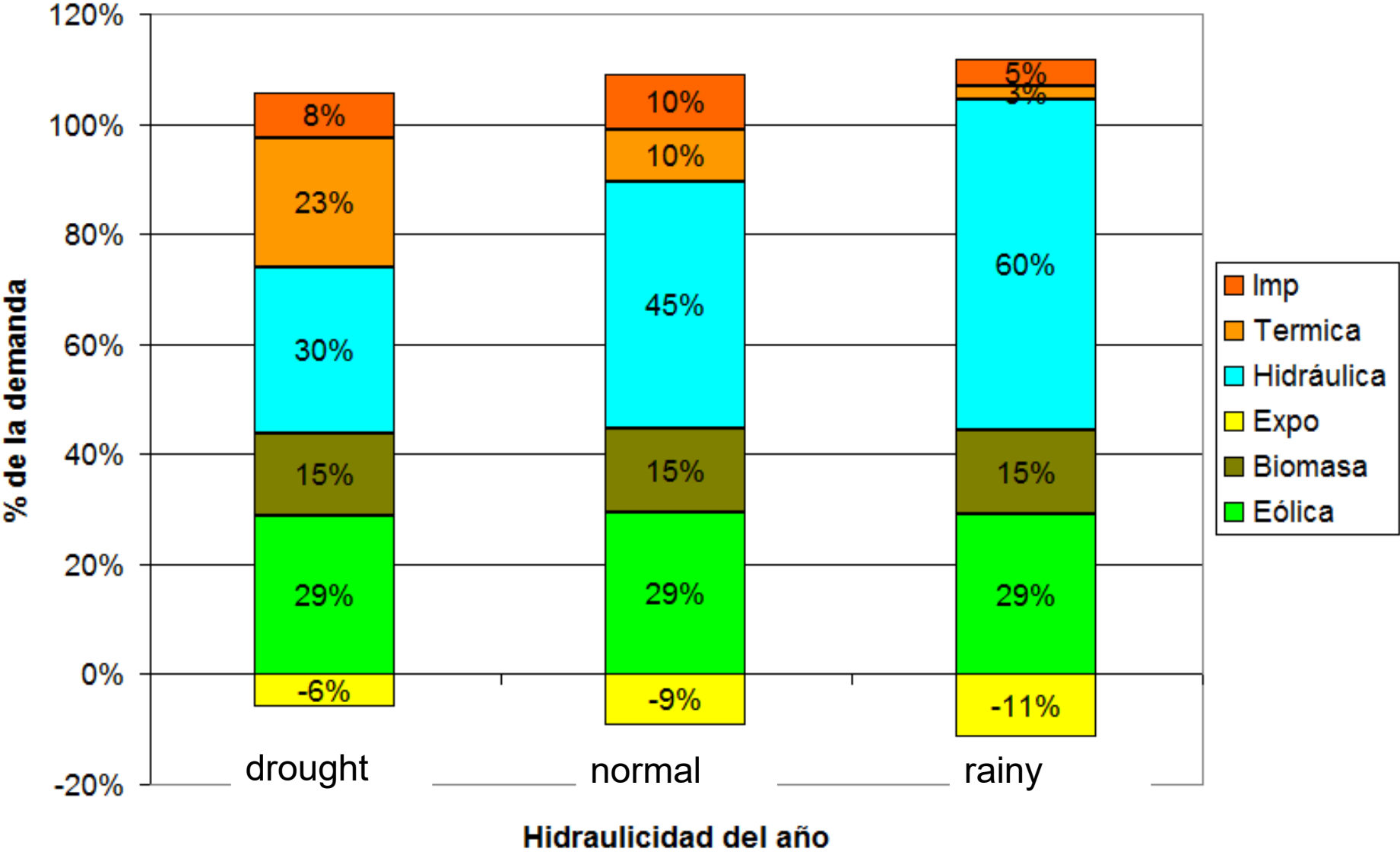
540 MW of Combined Cycle (Natural Gas)

A regasification plant of LNG

Changing the power generation matrix

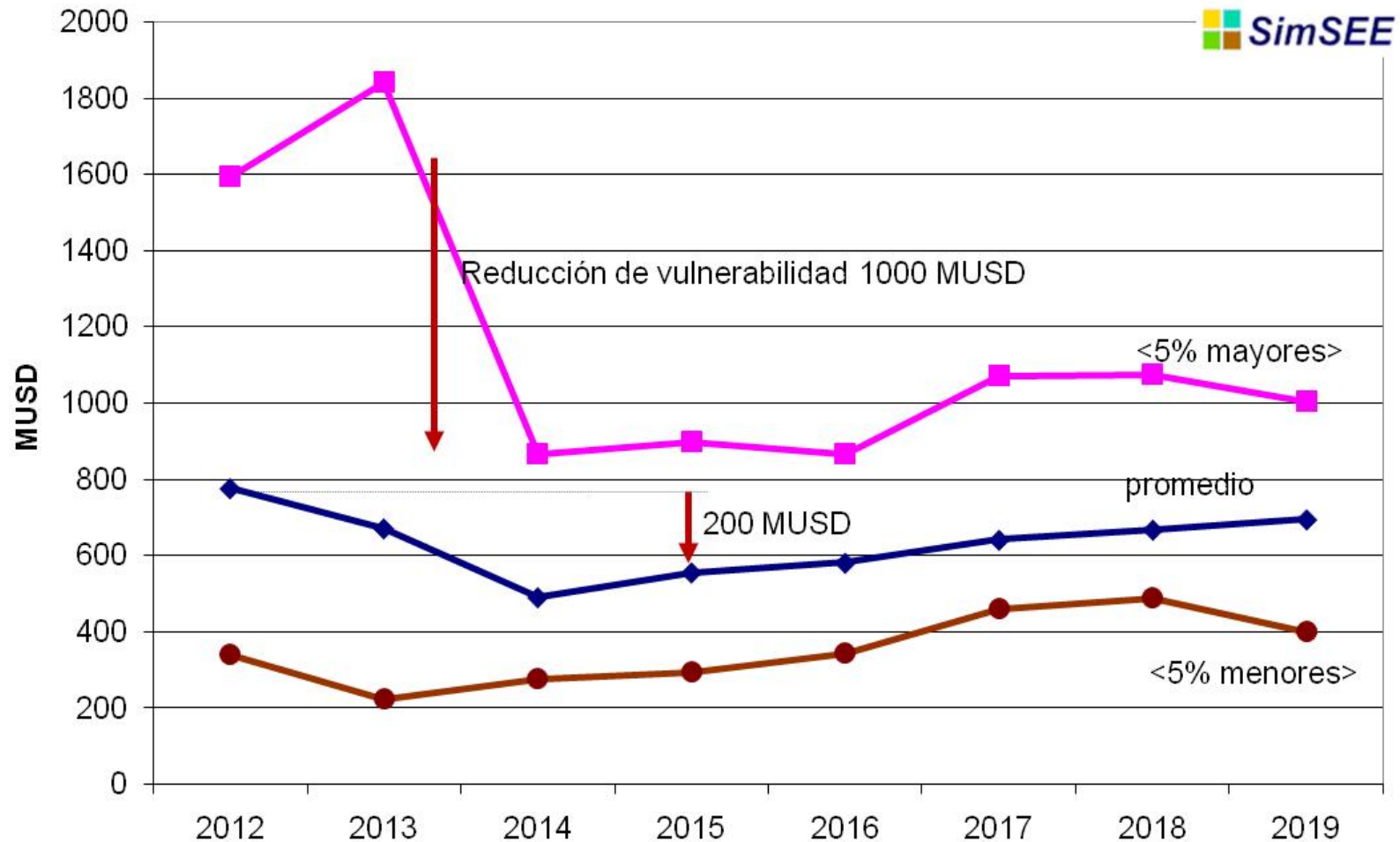


Power generation by source depending on rainfall



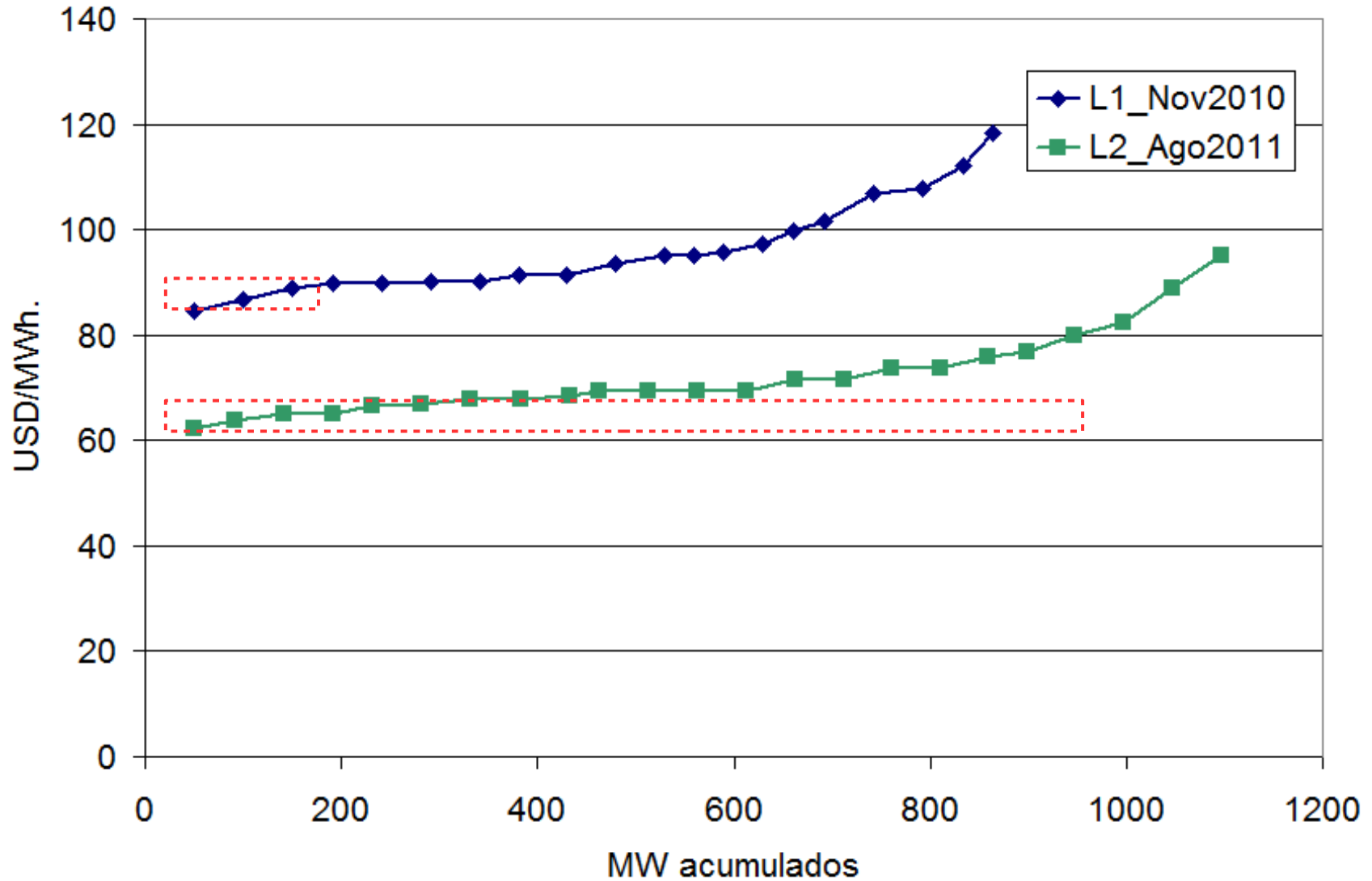
The design – 2010-2011

CAD = Combustibles + Compras a agentes nacionales + Importación
(dólares 2011 sin IVA).

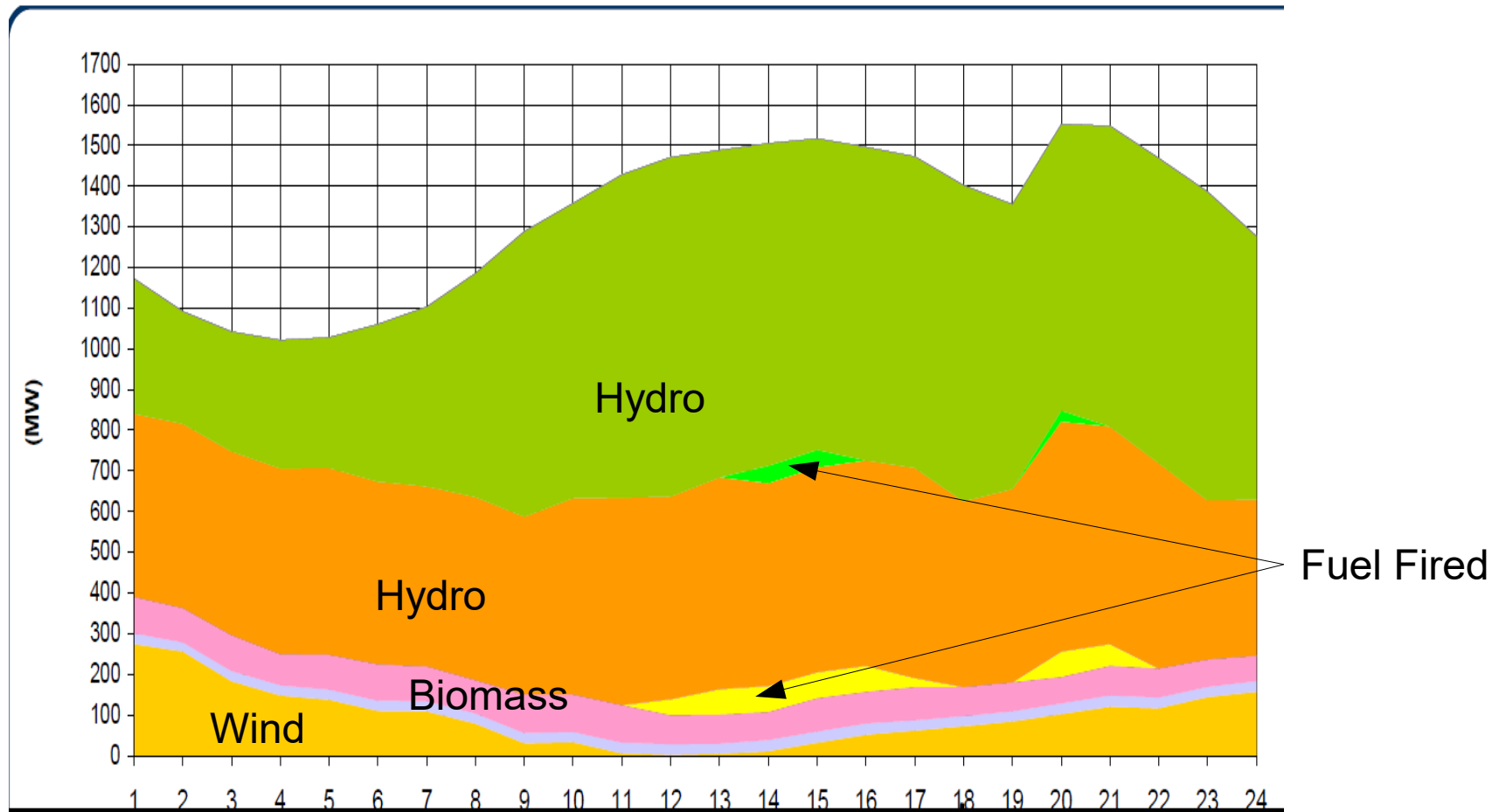


Wind power biddings

20 years PPA, each offer is for 50 MW.



March 11-2015 Uruguay Power Demand, share by source. (data from the real time executed dispatch)



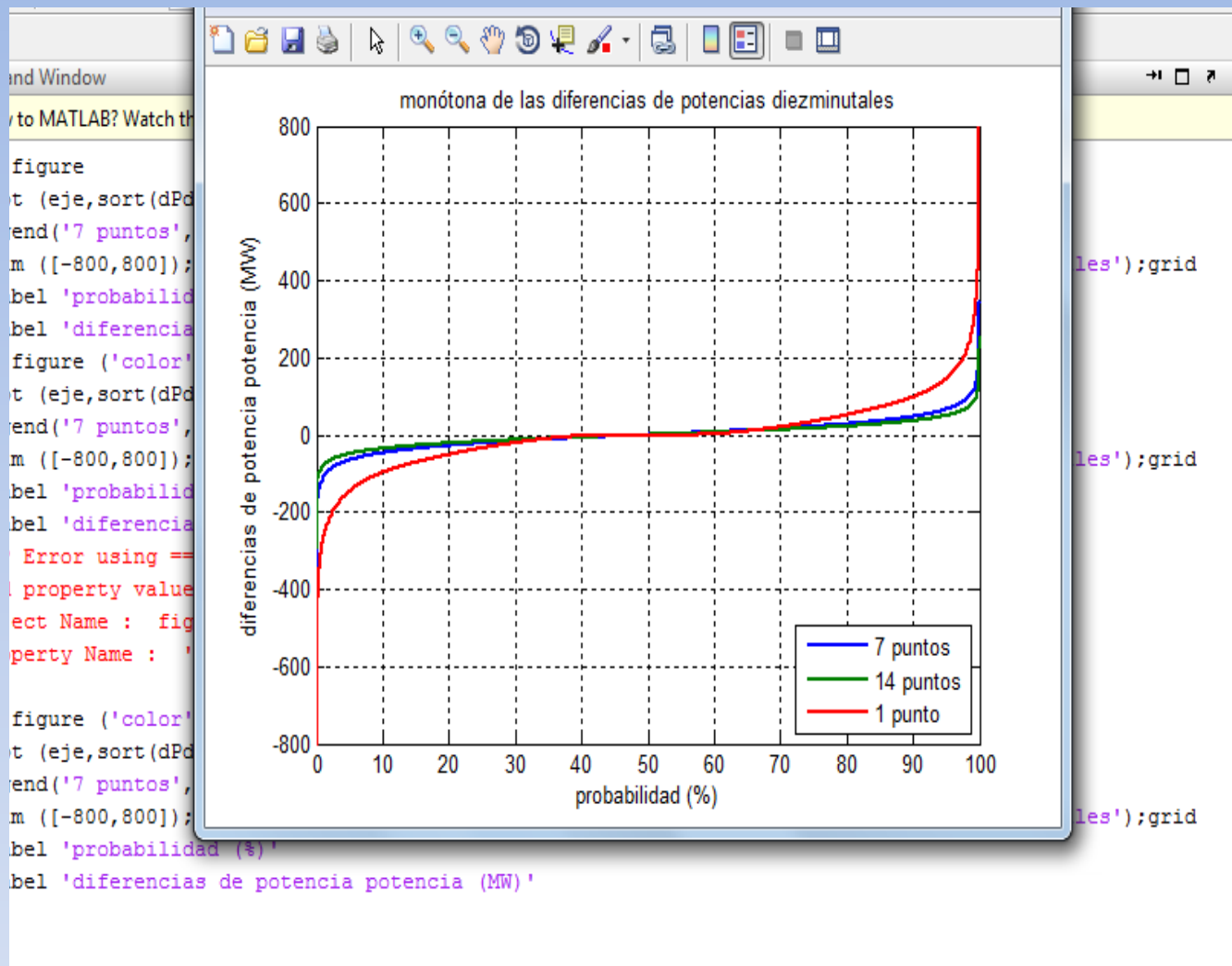
INTERMITTENCY

different sources of variability need different filtering capabilities.

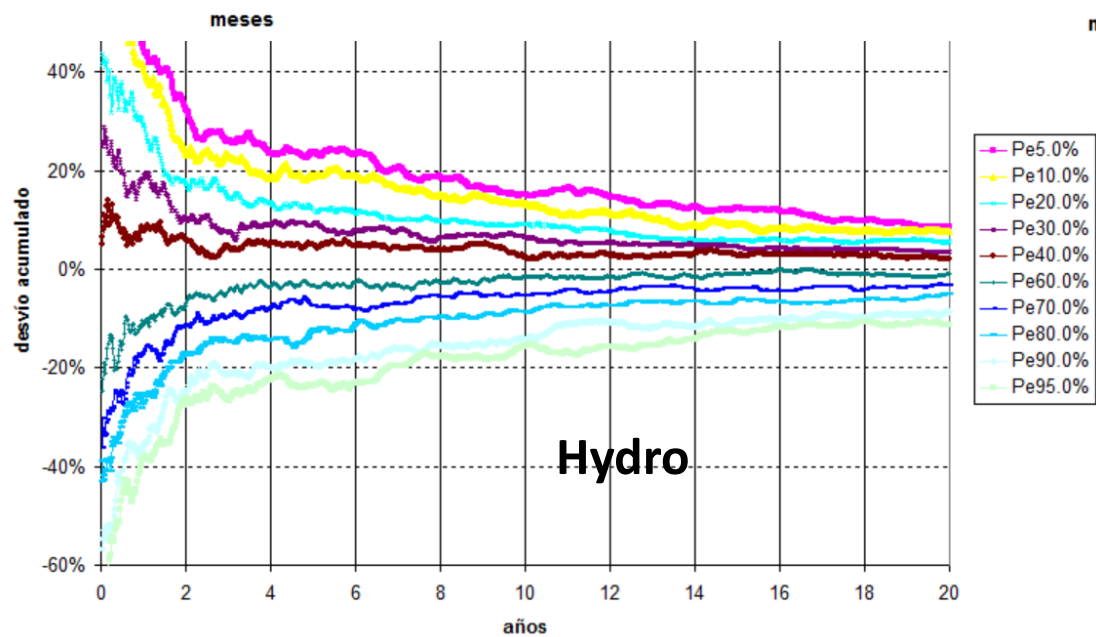
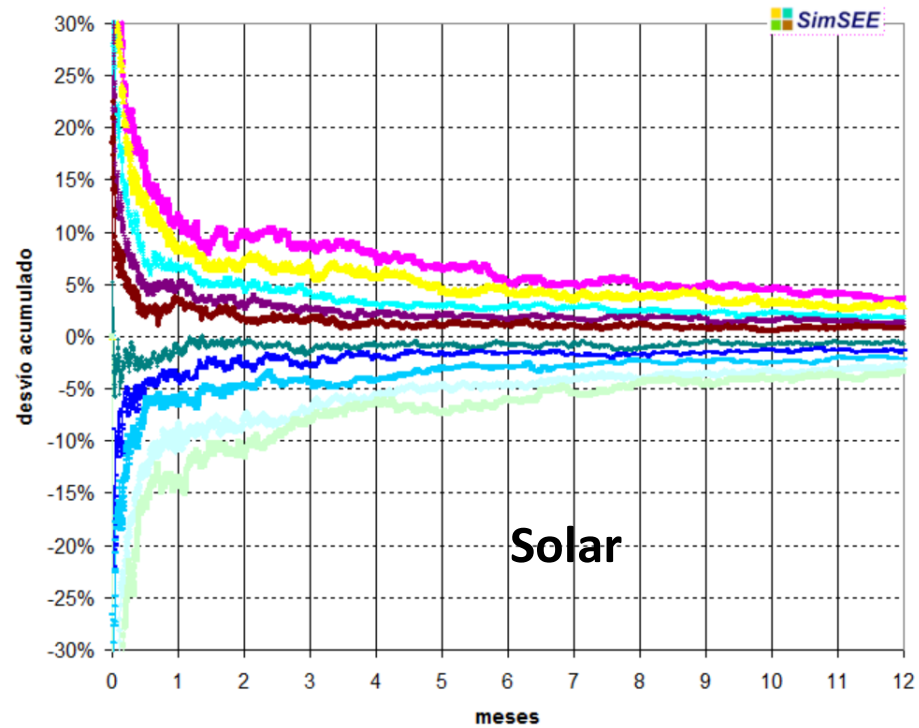
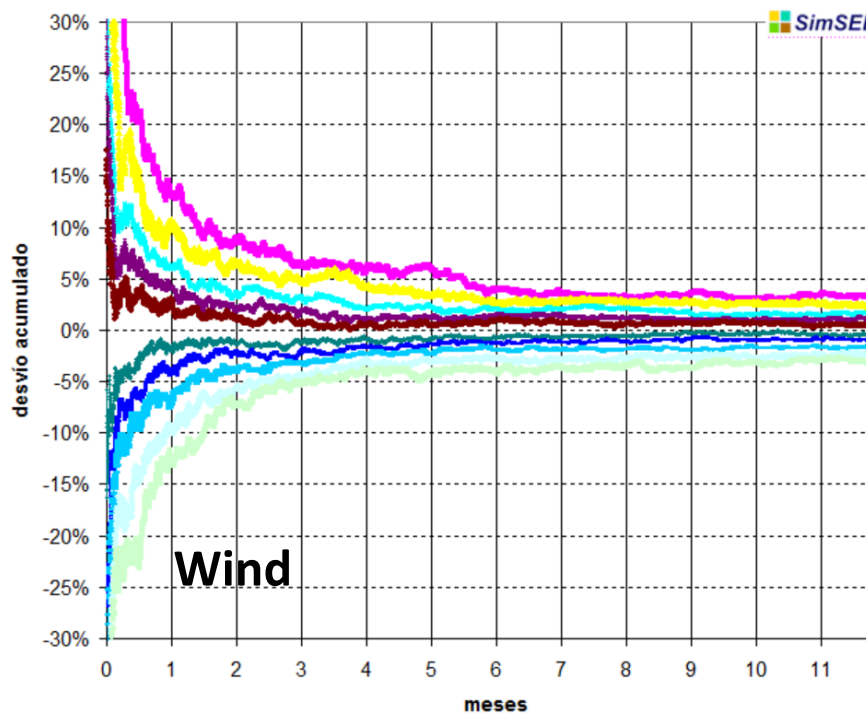


- Hydro
- Wind
- Solar

2- VARIABILIDAD DE MUY CORTO PLAZO (10min-1 hora)

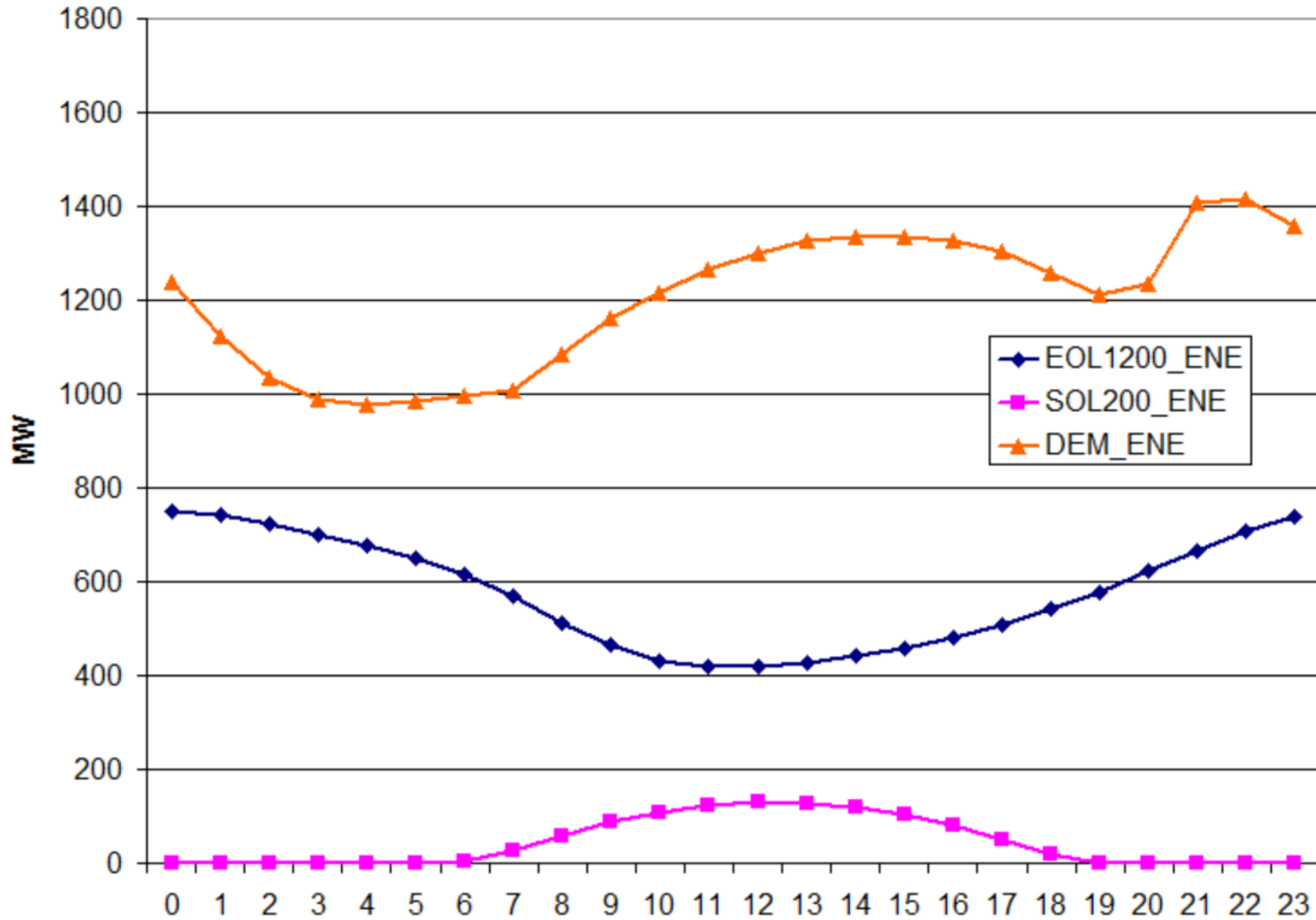


La variabilidad de la generación eólica en el cortísimo plazo (plazos de hasta 1 hora) no representa problemas de manejo para el sistema. Se observa que esta variabilidad es menor cuanto más **distribuidos** se encuentran los parques.

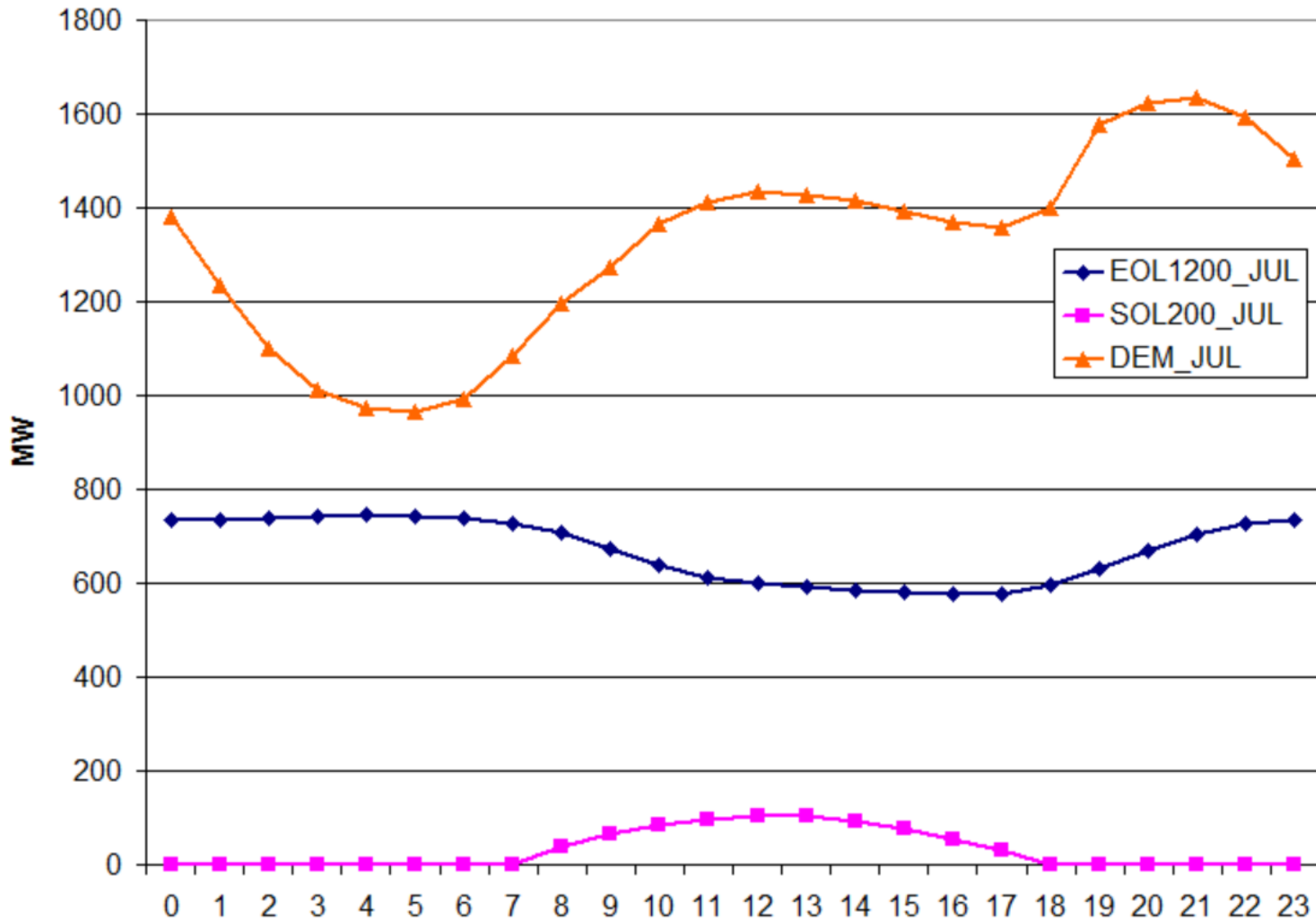


- Pe5.0%
- Pe10.0%
- Pe20.0%
- Pe30.0%
- Pe40.0%
- Pe60.0%
- Pe70.0%
- Pe80.0%
- Pe90.0%
- Pe95.0%

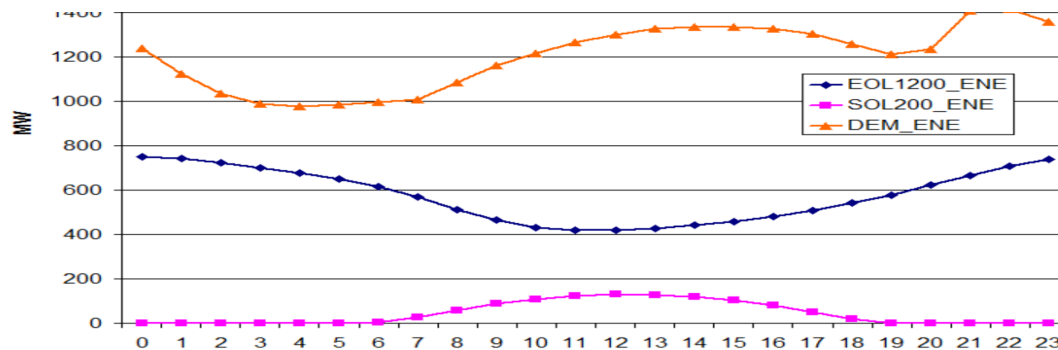
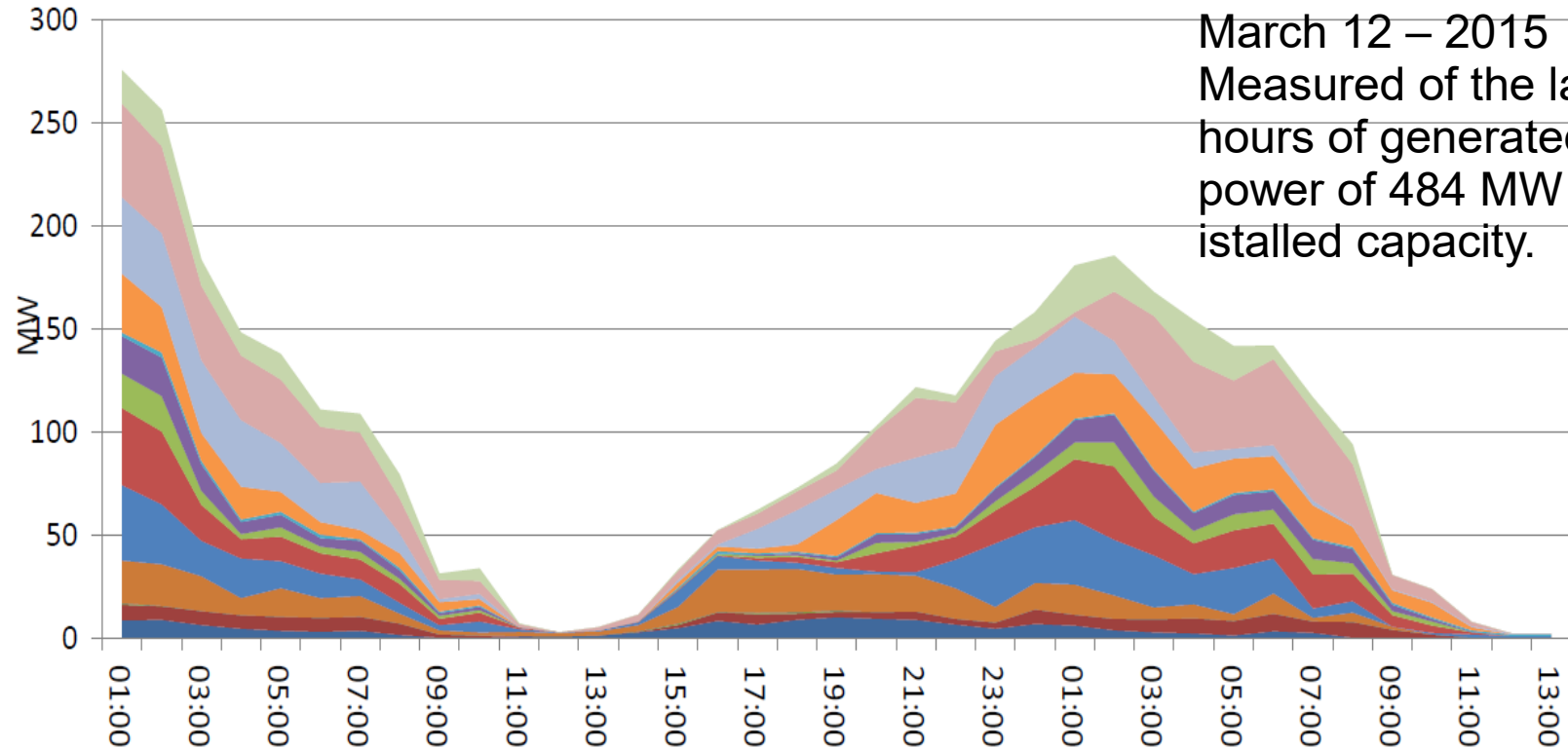
Summer daily profile.



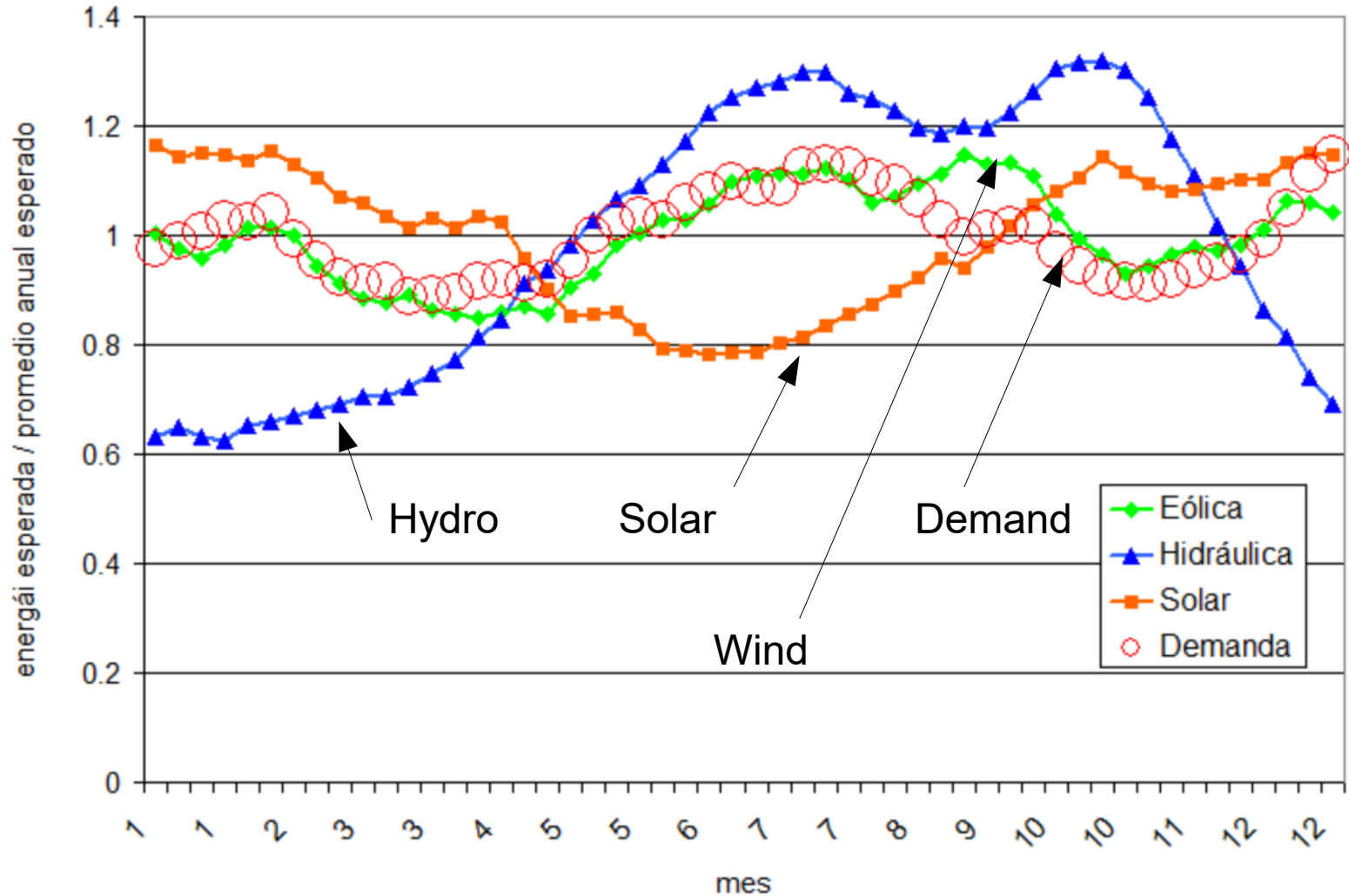
Winter daily profile.



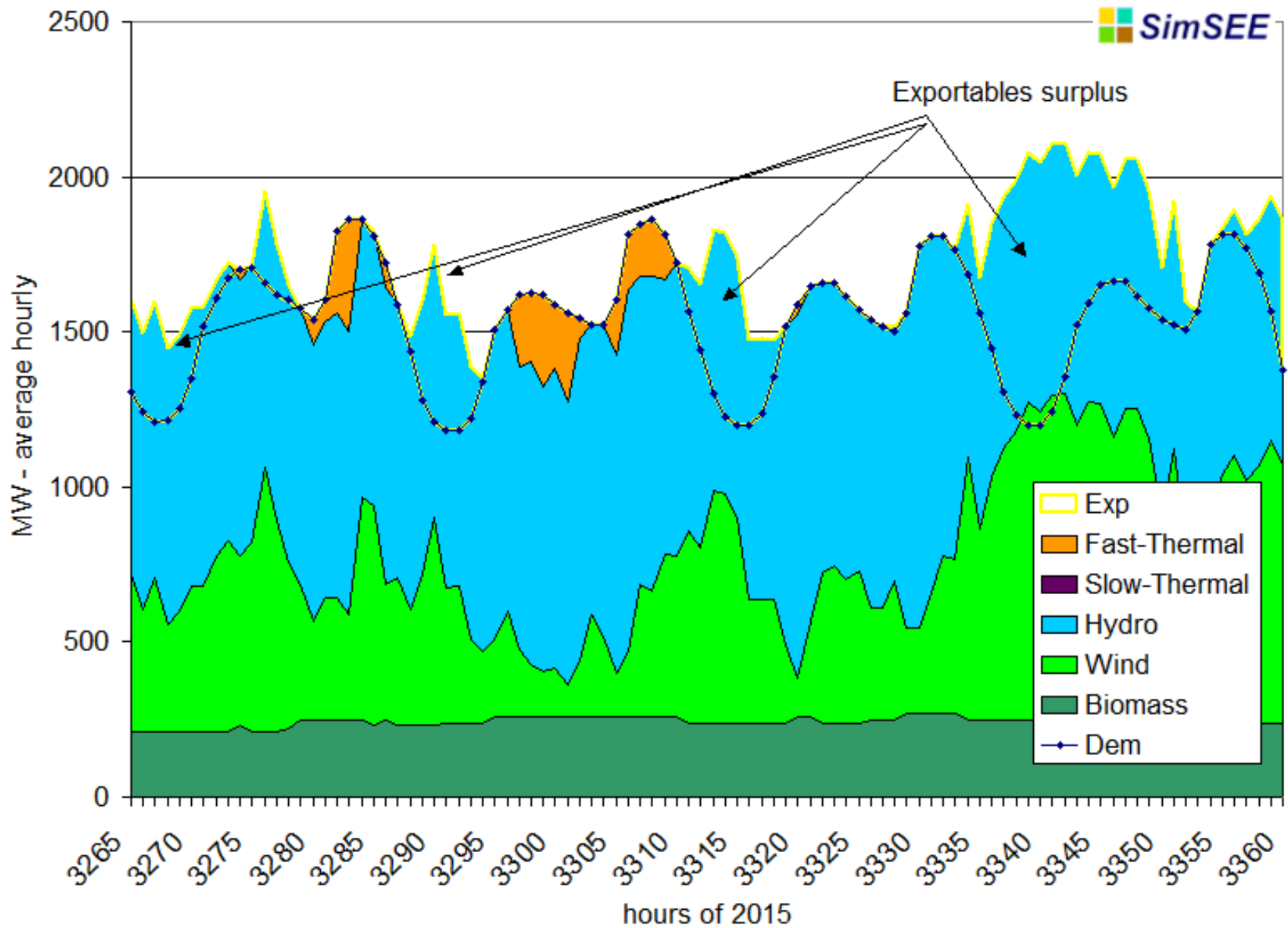
An example of real time profile.



Annual profiles in per unit of the expected daily generation.



Generation by source on a specific stochastic realization
days of springer with high values of inflows to the hydroelectric plants.



The value of a day ahead forecast Demand, Wind and Solar

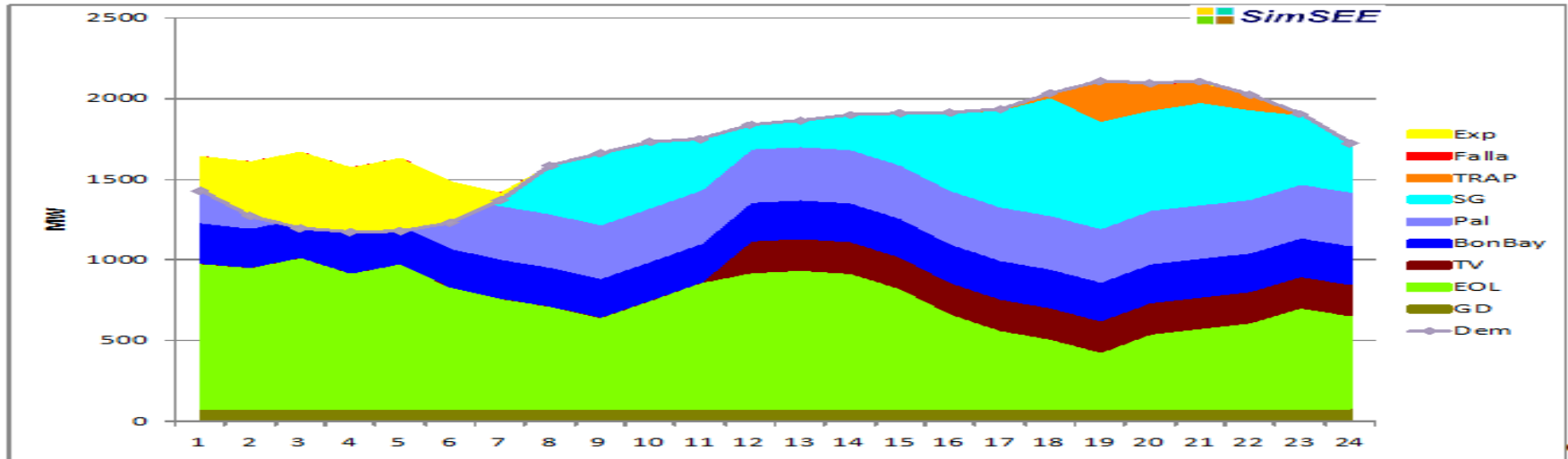


Fig. 4. MIO next-day-generation program

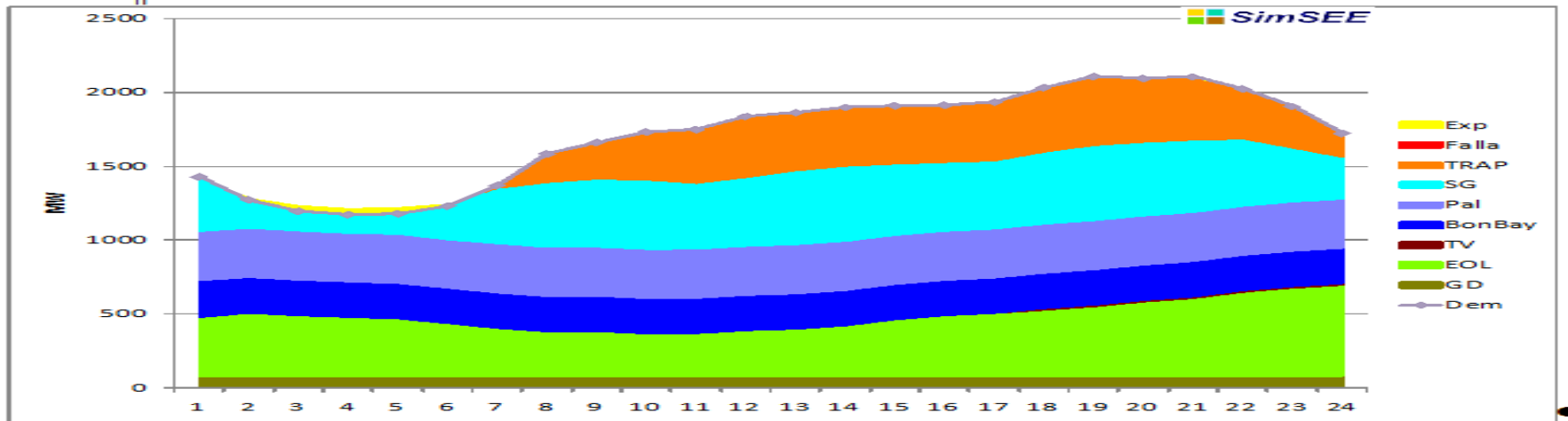


Fig. 5. LIO next-day-generation program

Day ahead, Spot price forecast.

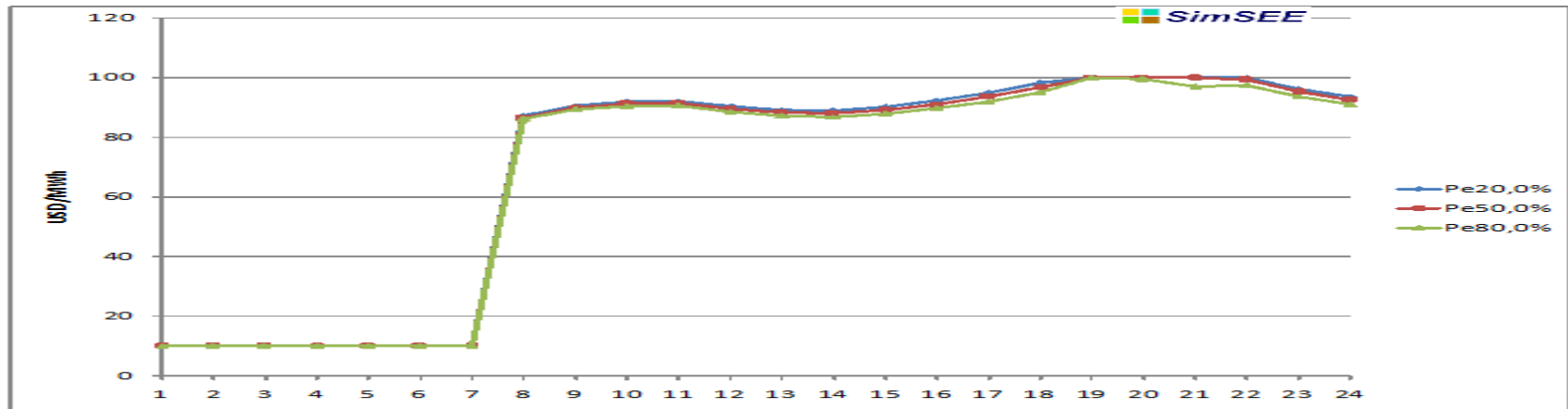


Fig. 6. MIO next-day projected marginal cost

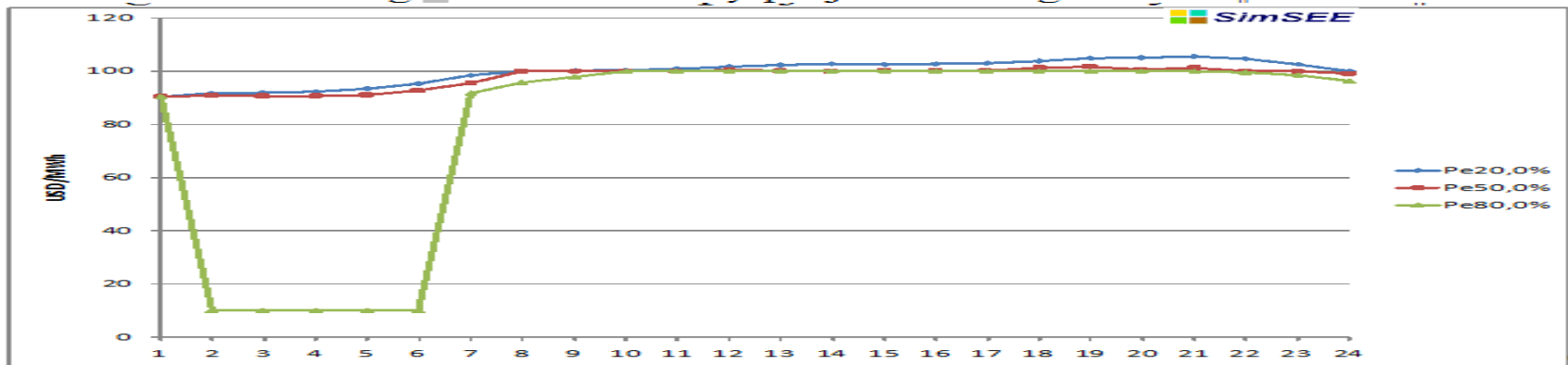


Fig. 7. LIO next-day projected marginal cost

looking to the future
Uruguay ->2040

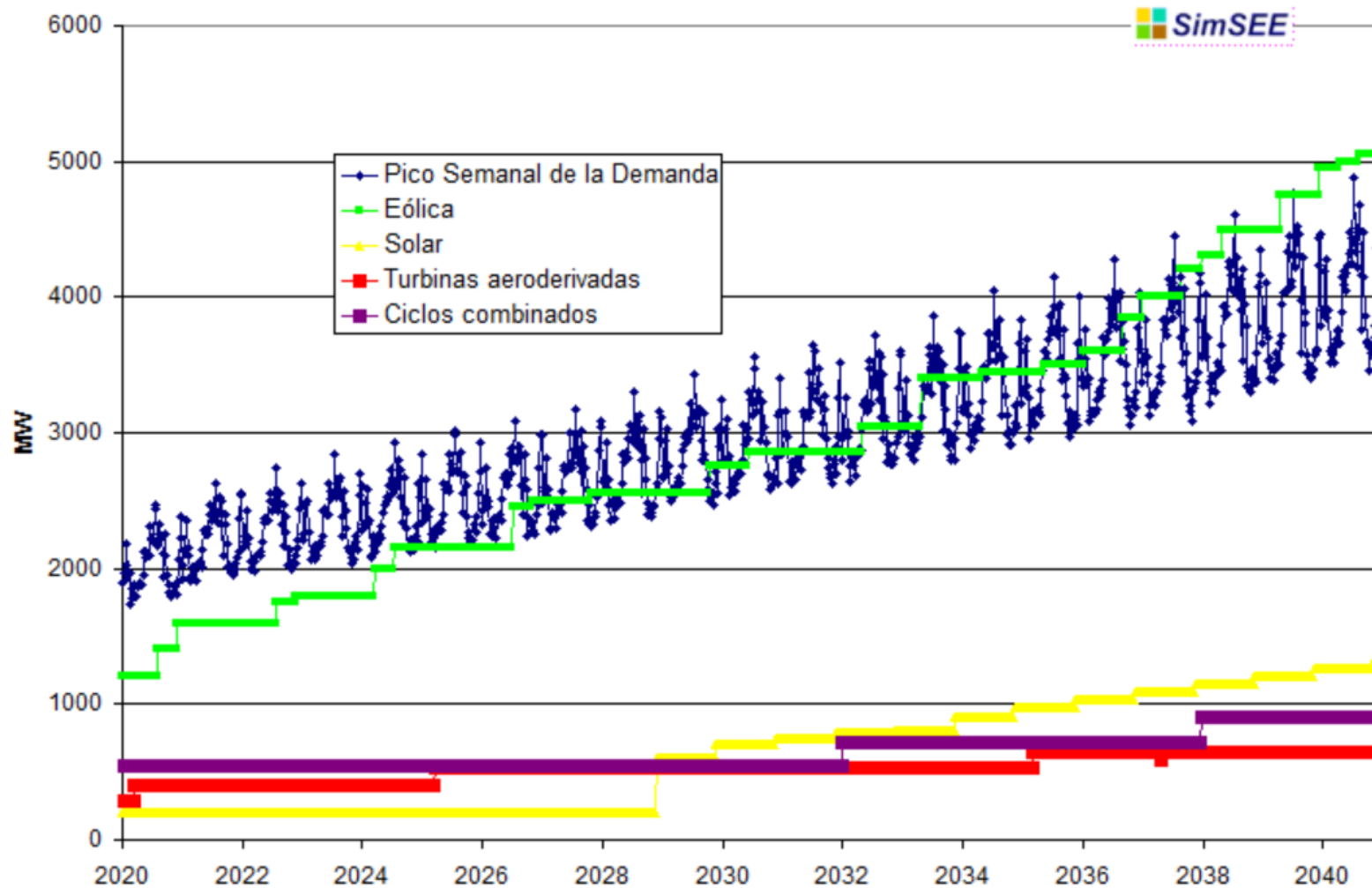


- More renewable,
- some challenges,
 - lot of opportunities

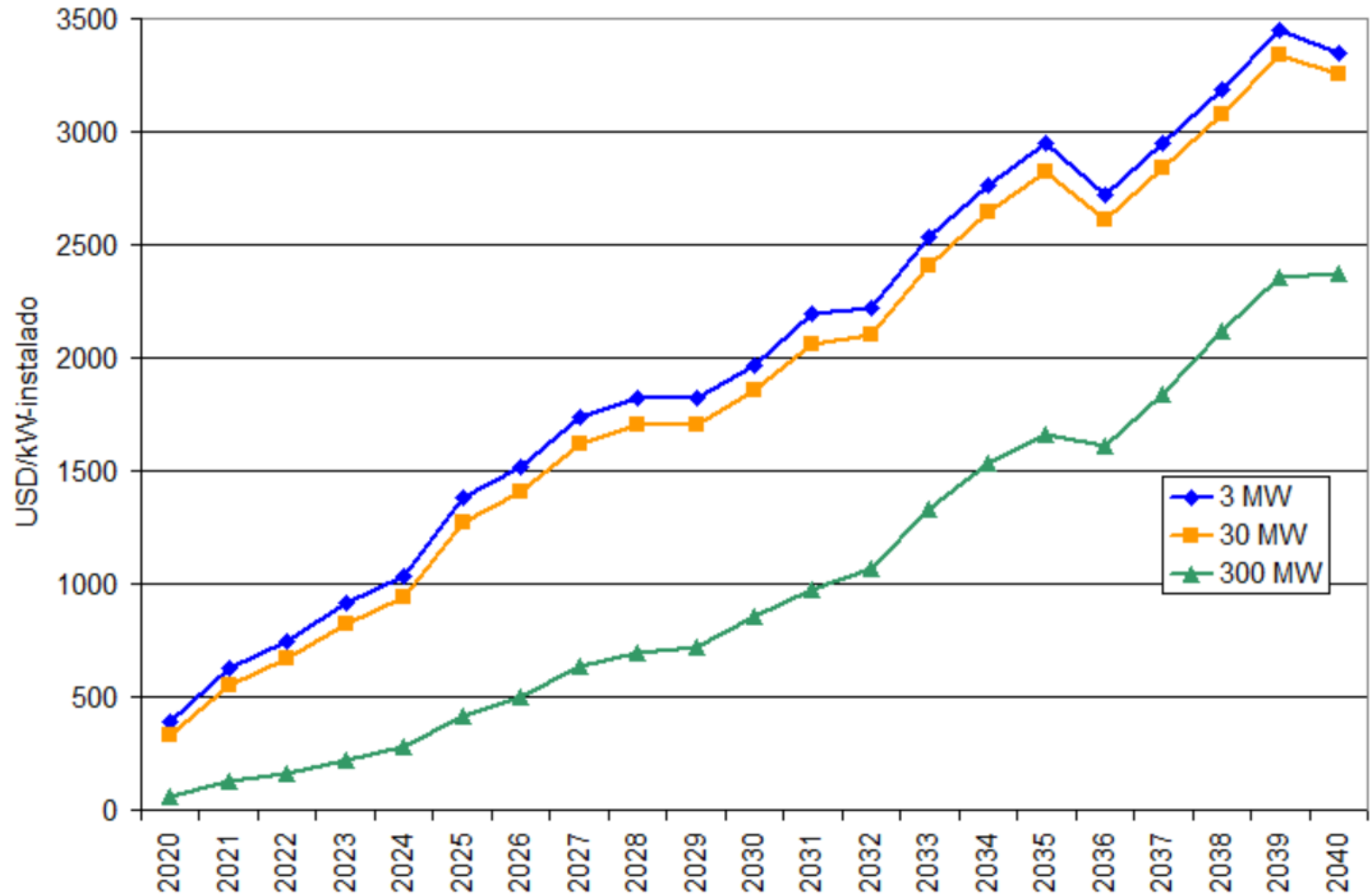
Some challenges and lots of opportunities

- Smart grid
- Demand response in real time.
- Spot price in real time.
- New demands (irrigation, electric-mobility)
- Export opportunities to Brazil and Argentina

Optimal planning of the future investments in power generation. 2020 – 2040



The value of daily filtering capacity.





Thanks for your attention!.