Climate information for the energy sector

Climate services in support of the electric sector in Uruguay
From hours to years

Wilson Sierra

MIEMDNE
DIRECCION NACIONAL DE ENERGIA

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Country:	República Oriental del Uruguay
Area	176,215 km^2
Population:	3.3 MM
Density:	18.8 p/km^2
Life expectancy:	76 years
Infant mortality rate:	7.7/1.000
Energy Sector	
Mean annual power demand:	1.100 MW
Electrification:	99,6 %
Peak power demand:	1.918 MW (winter)

Framework and Historical Background

- Uruguay **has no proven** reserves of oil, natural gas or coal

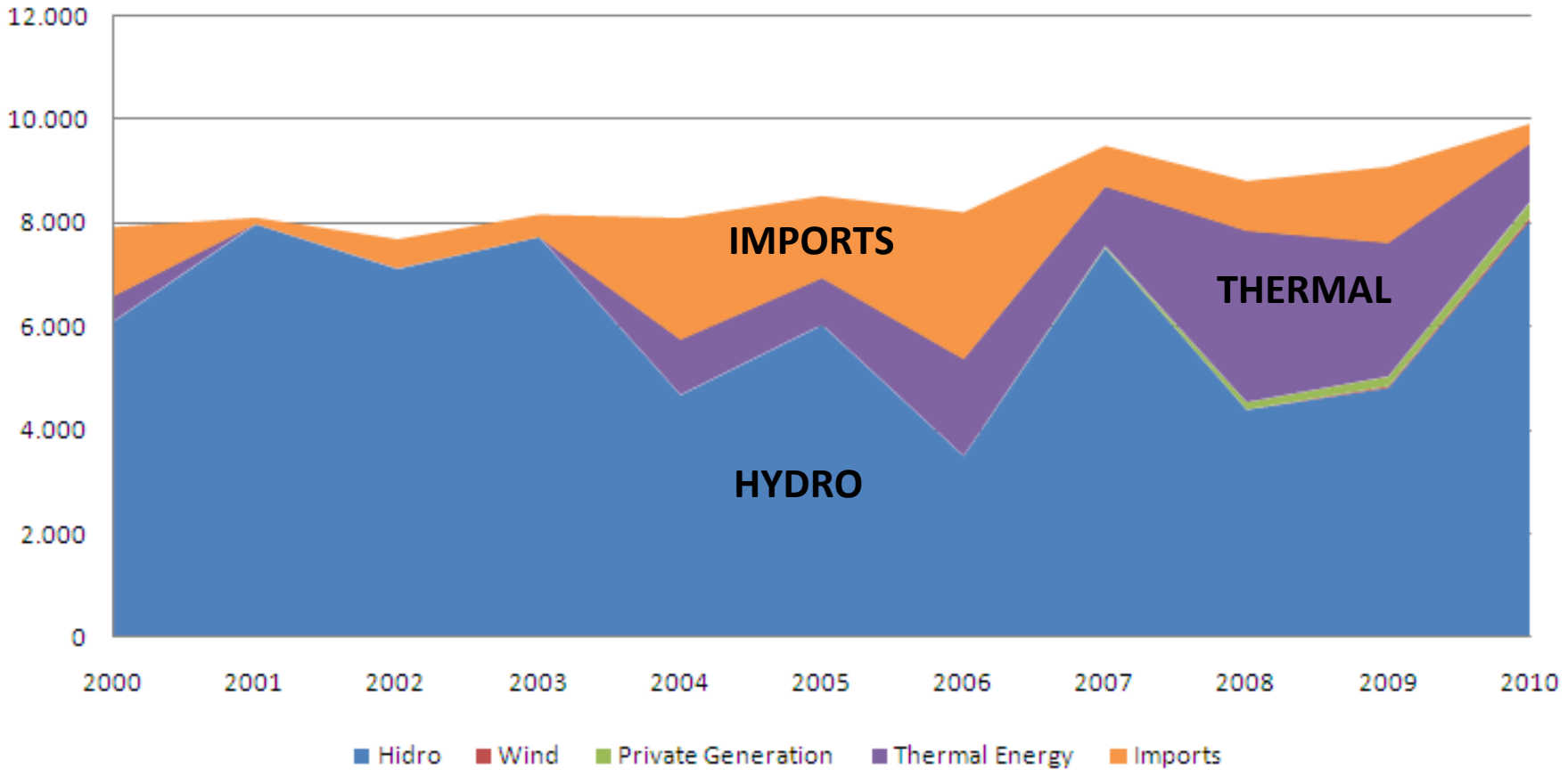
- Almost **no space for new large hydropower** plants (75% of present electric mix)

- Strongly **dependent** on “El niño” events

- No access to natural gas (only one provider)

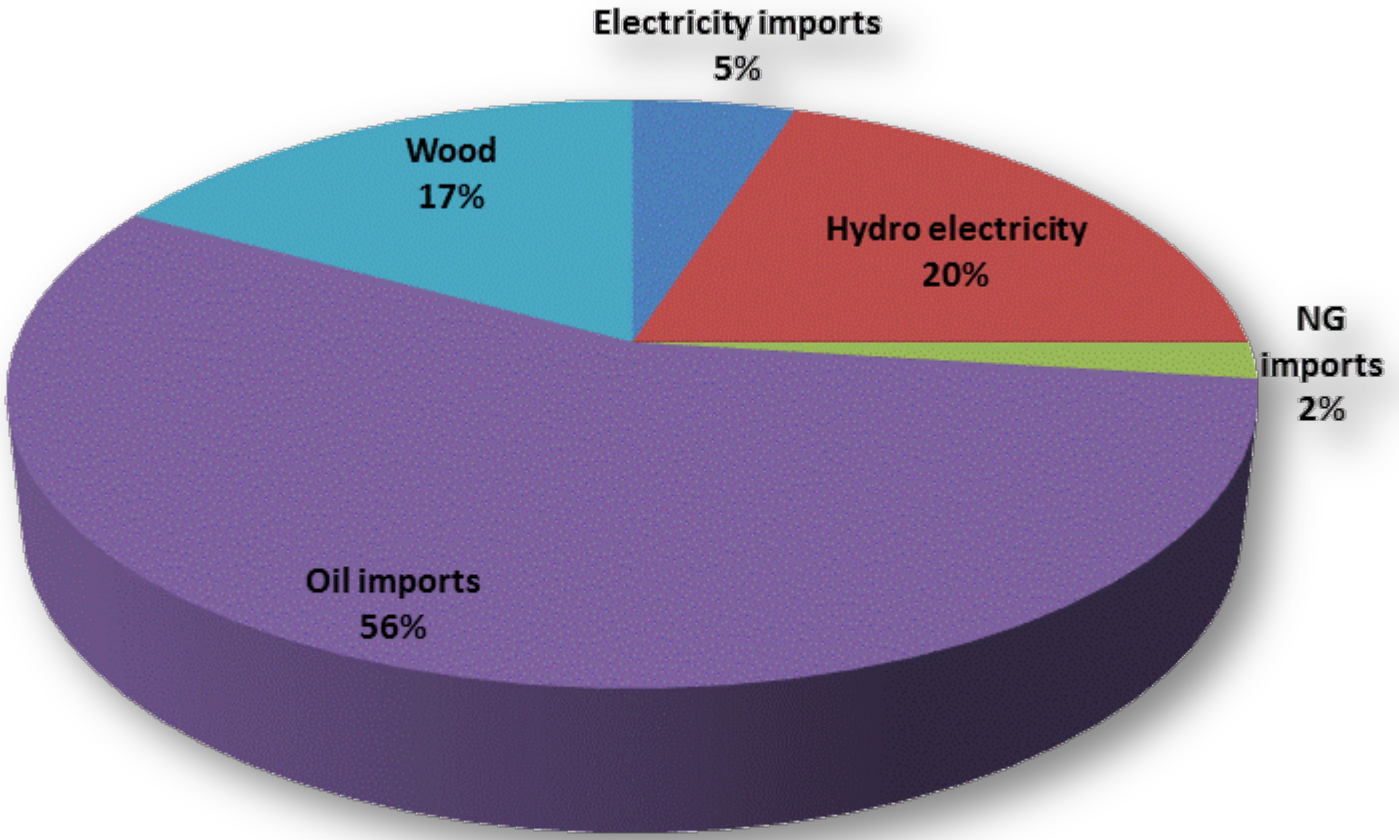
- High dependence on imported oil, representing up to **27% of total imports** of Uruguay

Historical background II - Electric mix source (GWh)



Source: DNE - MIEM

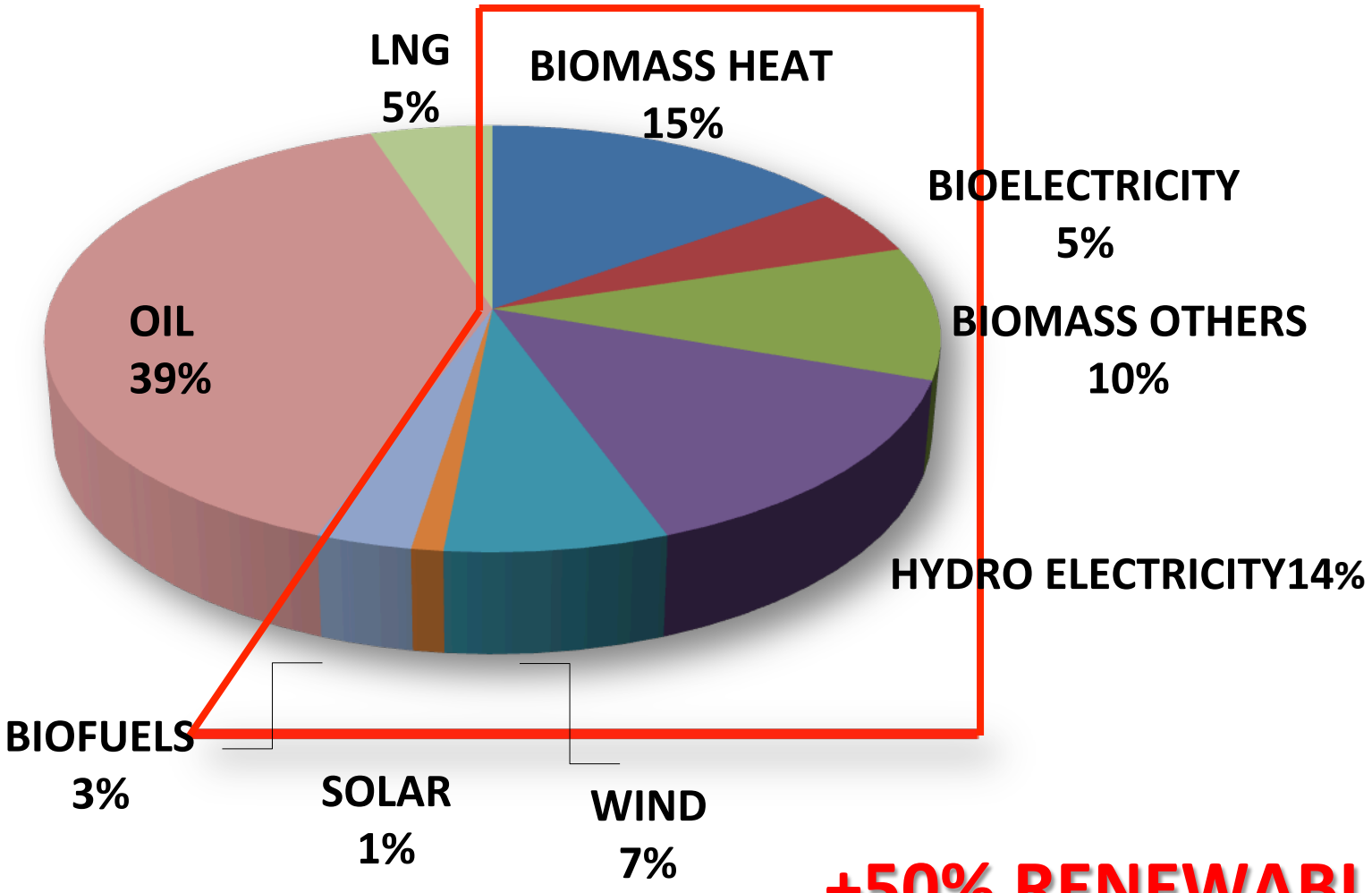
Primary global energy mix (2001-2006)



Source: DNE - MIEM

63 % IMPORTS

Primary global energy mix 2015

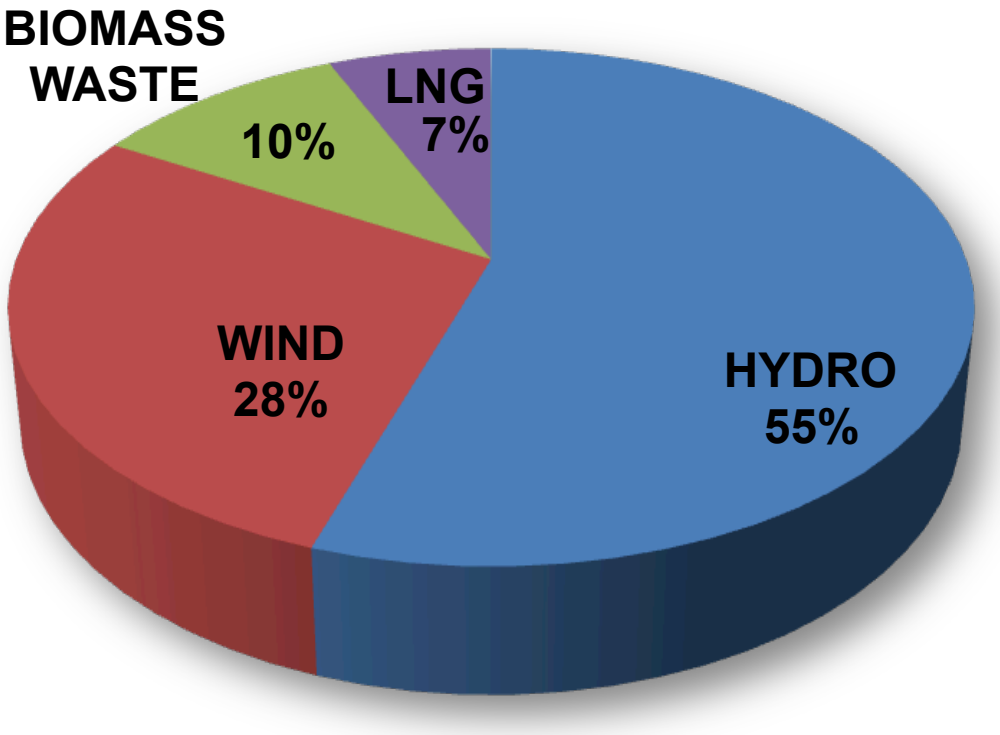


Source: DNE - MIEM

+50% RENEWABLE

2013: 49 % RENEWABLE

Electric mix - 2015



HYDRO: 1.538 MW

WIND: 1.300 MW

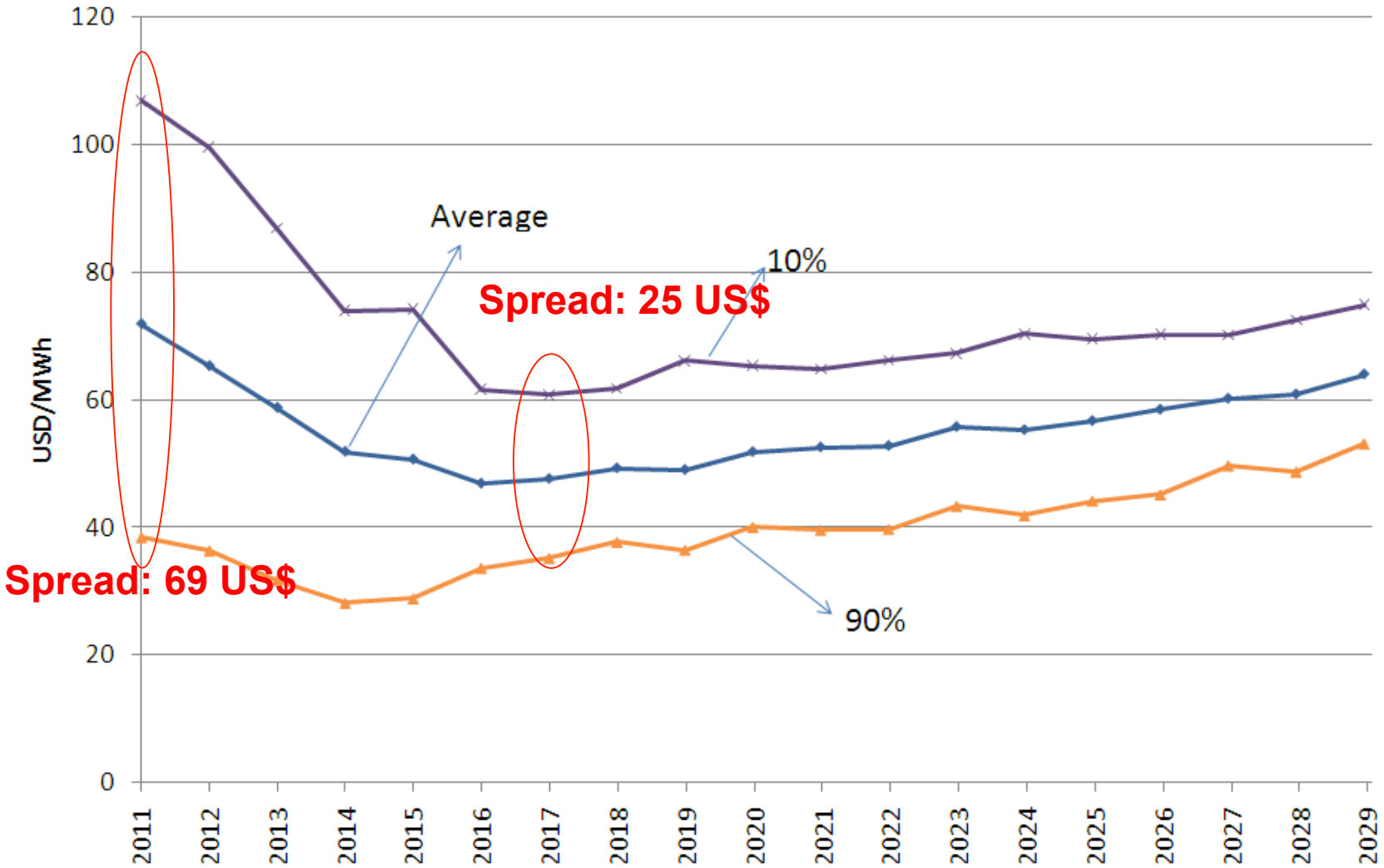
SOLAR PV: >200 MW

BIOMASS: >250 MW

+ 90% RENEWABLES

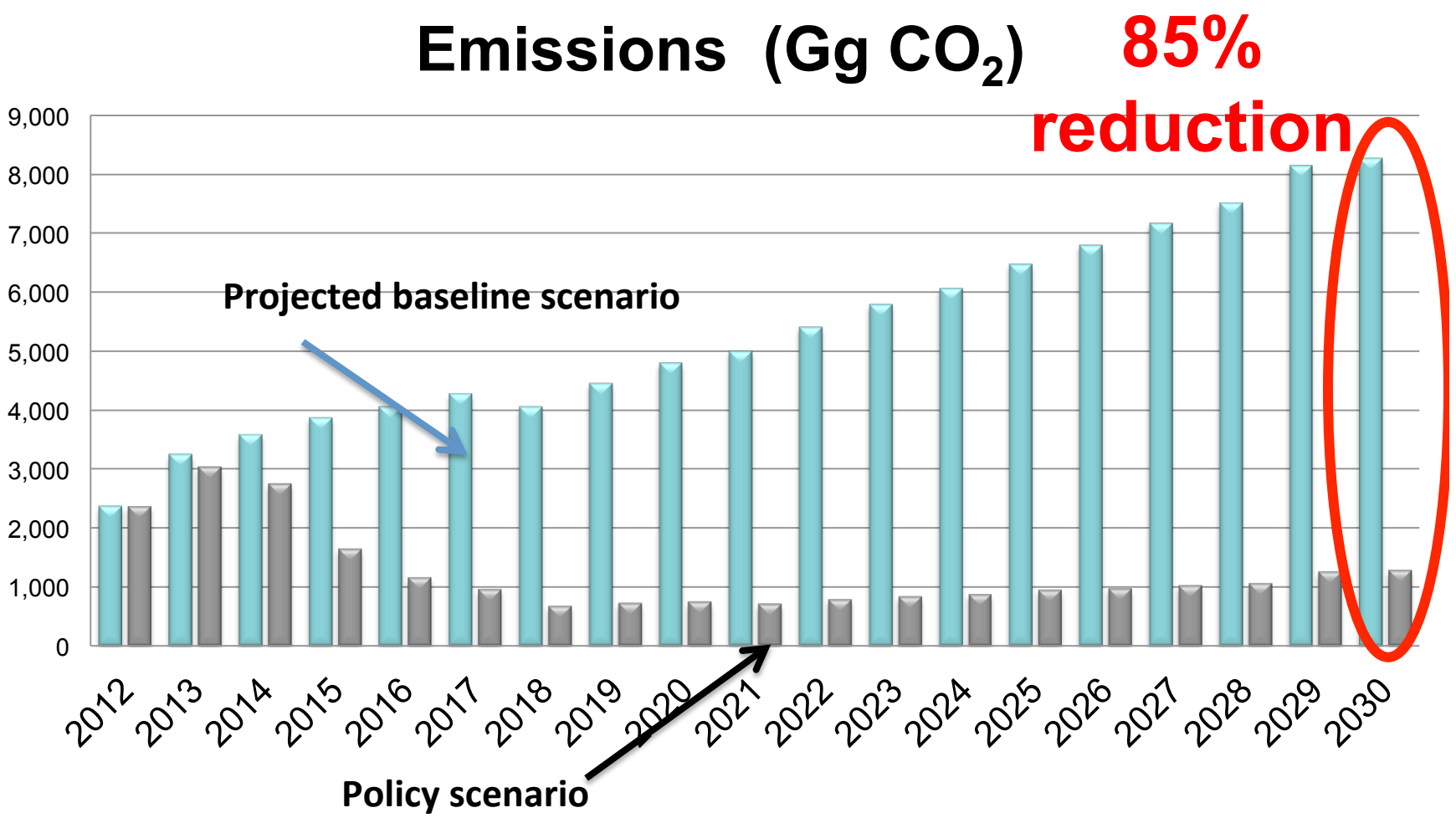
2013: 83 % RENEWABLES

Annual mean energy cost according to rain probabilities



Source: DNE - MIEM

GHG EMISSIONS REDUCTION (in the Power Sector)



Source: DNE - MIEM

How could we do this?...

Long term Energy Policy (2030)

2008: Council of Ministers

2010: **State Policy**

Special Committe including all Political Parties in the Congress.

Multidimensional and integrated vision, including technological, economic, geopolitical, environmental, ethical, cultural and social issues

Energy Policy – Strategic guidelines

Institutional

Government defines and coordinates energy policy, Public utility (UTE) and NOC (ANCAP) as the main tools, Enhanced participation of private companies, **Transparent and stable regulatory framework**

Energy Supply

Energy mix diversification, Reduce share of imported oil, Increase share of domestic sources, **Strong support to renewables**, with **no subsidies**, Building local capacities, Keeping low carbon footprint.

Energy Demand

Strong support to energy efficiency in all energy sectors and all activities (transport, building, industry). The State as a paradigmatic example. Promoting a **cultural change**.

Social

Adequate energy access to all citizens as a human right
Energy policy embedded in national social policies to face vulnerability.

Energy Policy – Short term goals (2015)

Short term goals - medium term goals - long term goals

Supply

50% renewables in primary energy mix

25% ERNC in power sector

Demand

6% reduction of global energy consumption*

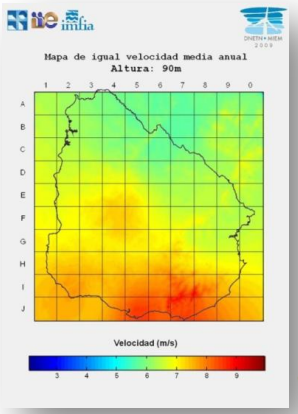
15% reduction of oil in transport *

*Based on BAUS

Social

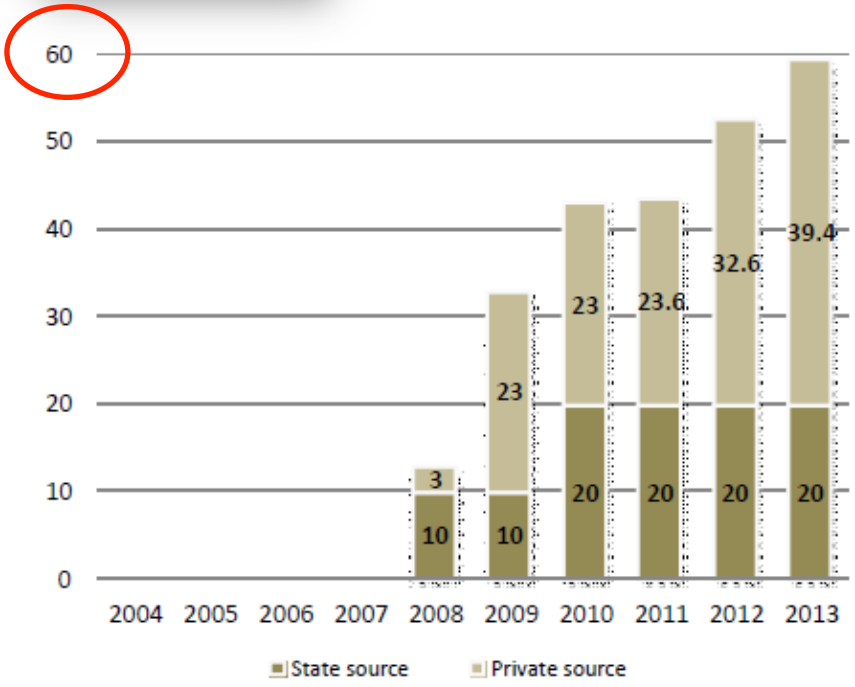
100% electrification

Evolution Wind Power

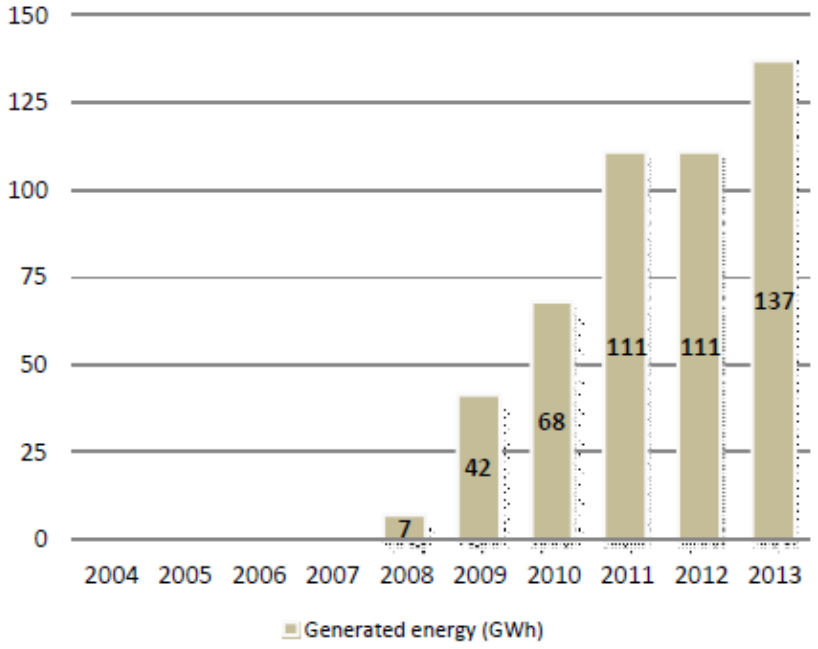


+ 450 MW this year

Wind Installed Power (MW)

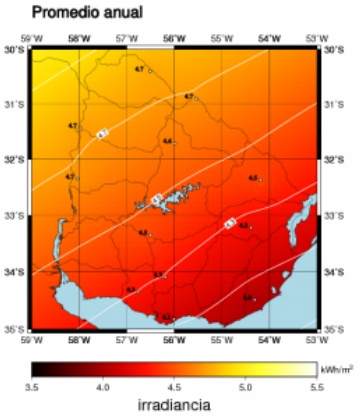


Generated Wind Energy (GWh)

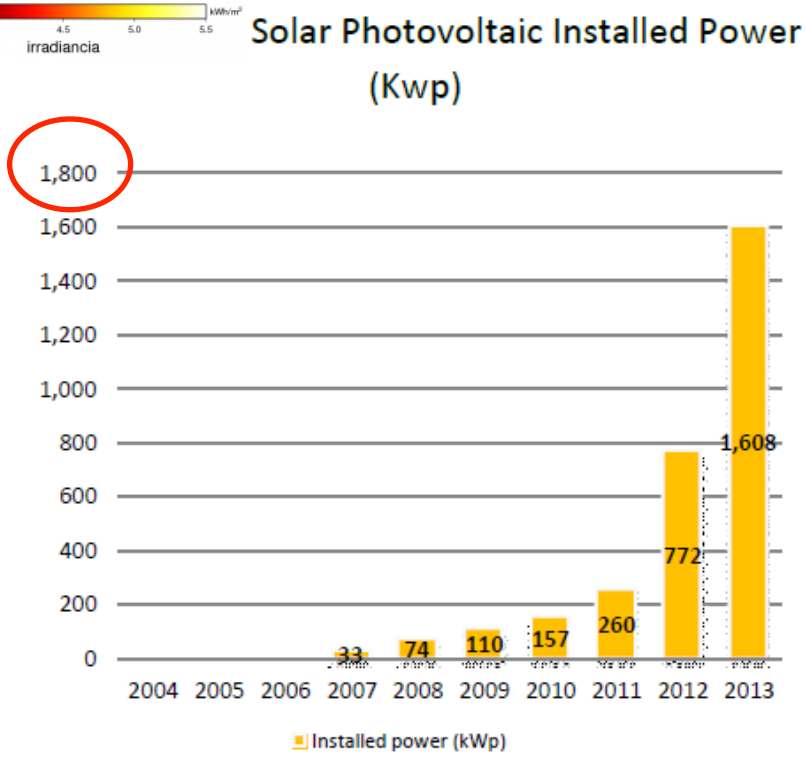


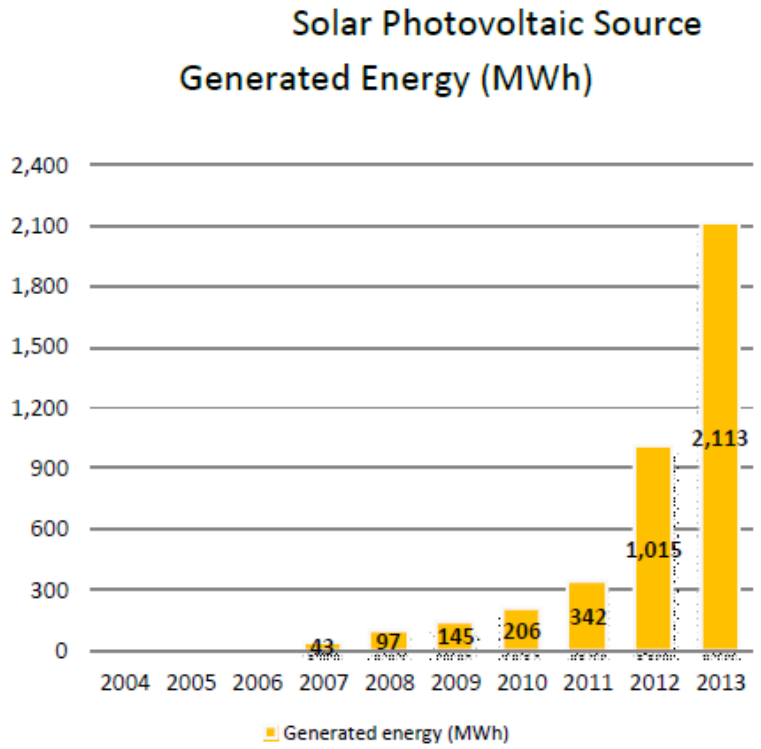
Source: DNE - MIEM

Evolution Solar PV



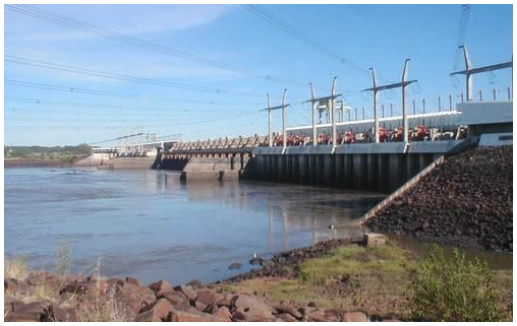
+ 200 MW in 2015



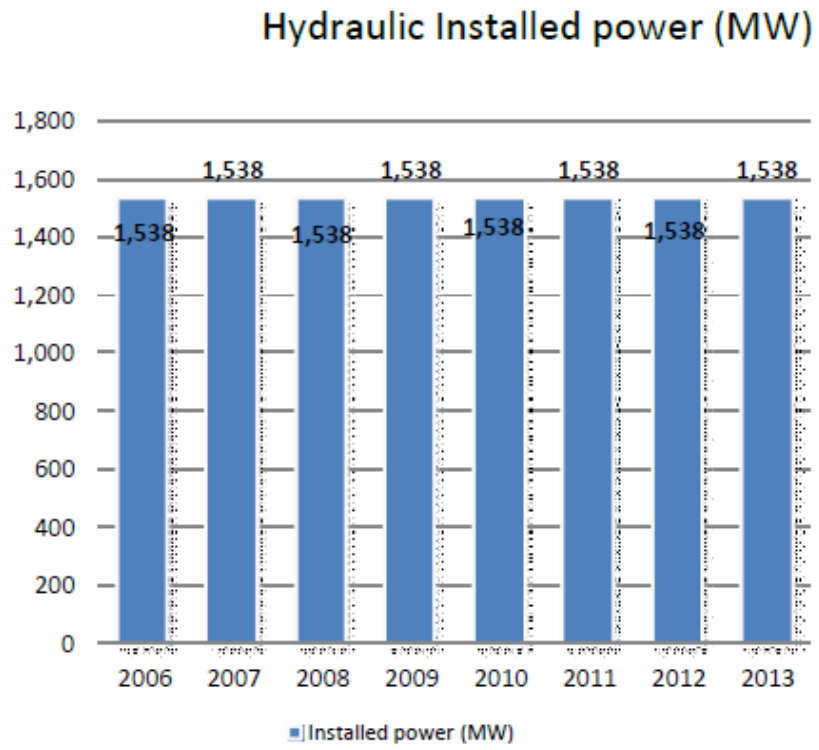


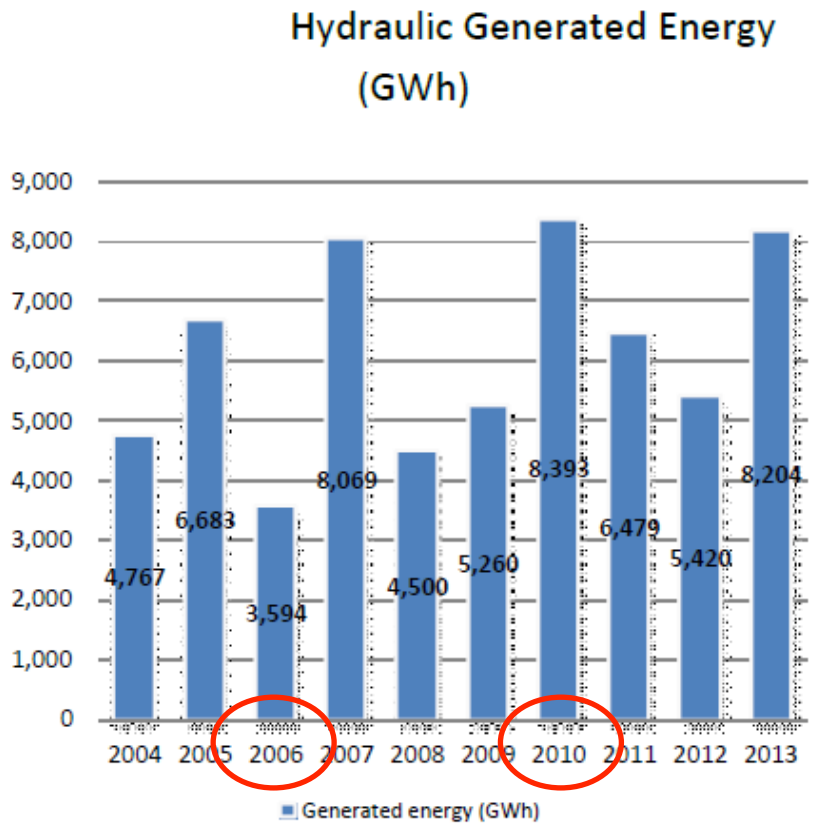
Source: DNE - MIEM

Evolution Hydro



2010 = 2006 x 2,3





Source: DNE - MIEM

The new challenge…

How to manage a system with a huge amount of non manageable energy?

Dramatic redefinition of dispatch rules and grid expansion criteria, **Flexible Dispatch**.

How can we do that?

Based on the best information available…

R&D

ANII
Agencia Nacional de Investigación e Innovación

ANCAP

UTE

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The new challenge…

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Capacity building in:

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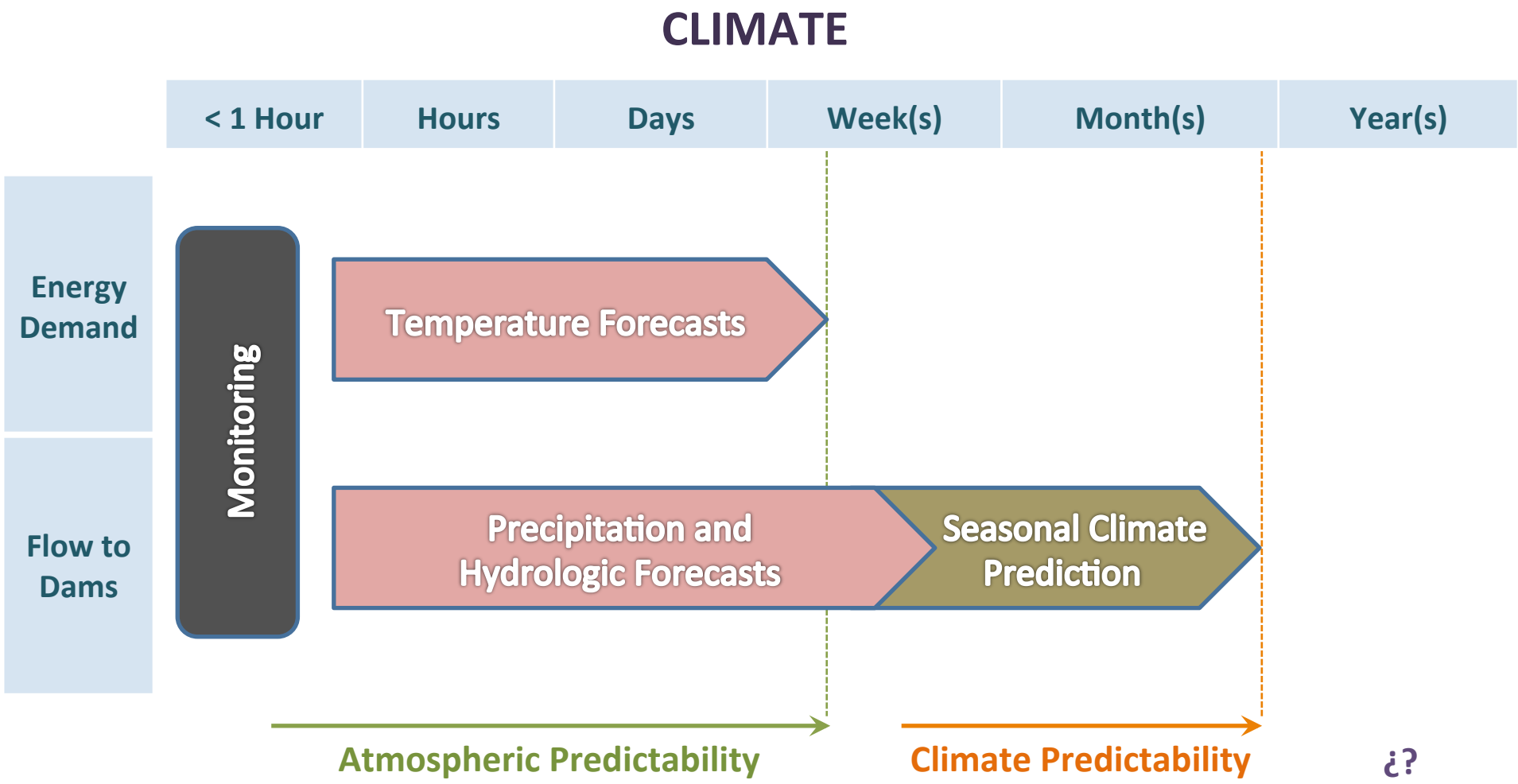
Before the renewable energy "revolution"



BUT

Climate Services

ARE

Decision - Oriented

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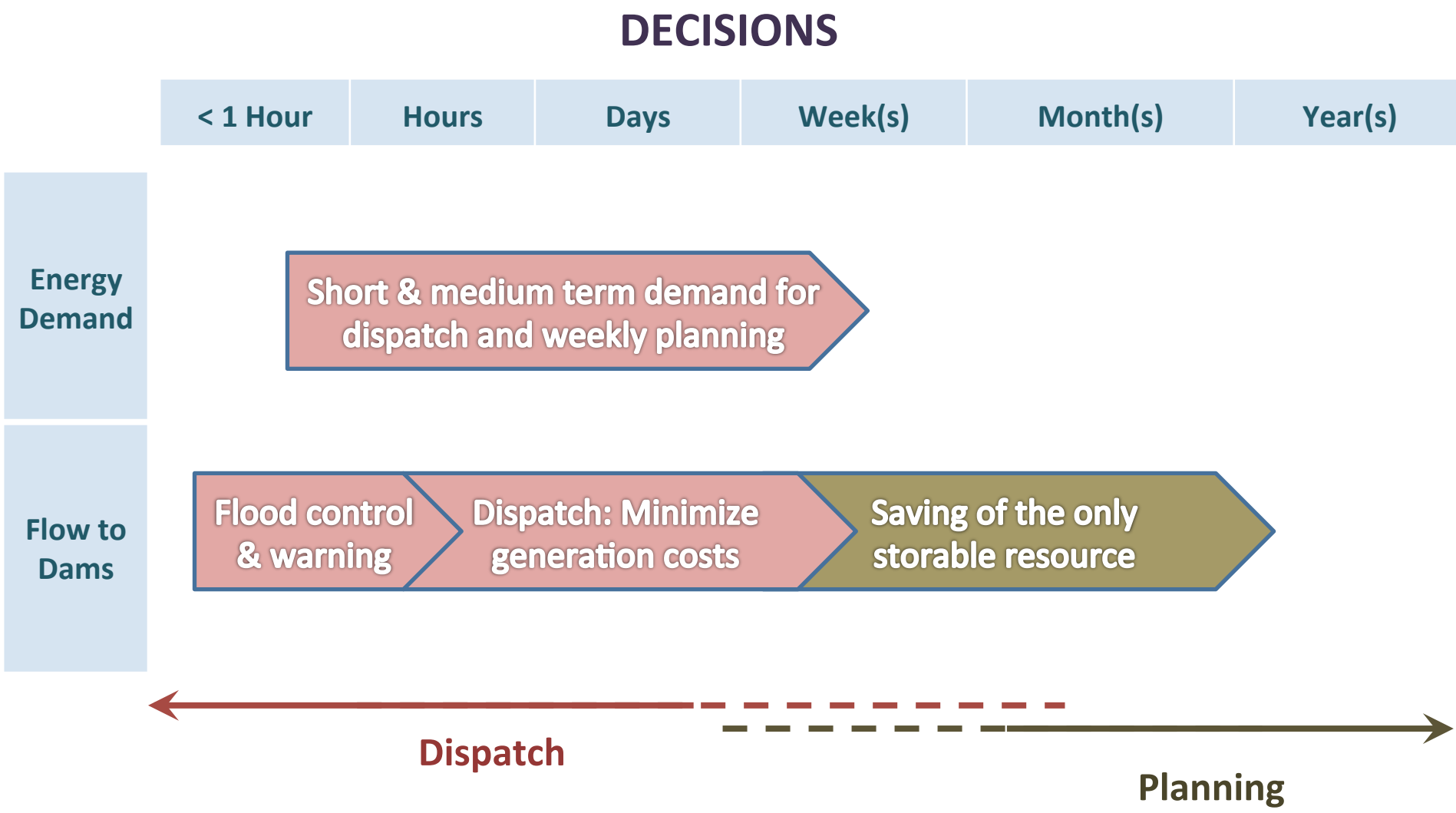
Before the renewable energy "revolution"



Example: Do I use the water in the reservoir now or do I save it for later?

The Direct Cost of generation with the most economic available unit (known) is compared with the incremental Future Cost (unkonwn) associated with the use of water now.

It depends on expected inflow (few months timescale)

HOW

Is Climate Information

Incorporated into the

DECISION-MAKING PROCESS?

Integrated Electric System Simulator
SimSEE

SimSEE

1) Stochastic programming optimization

Operation Policy (OP)

Value of water as a function of state of the system

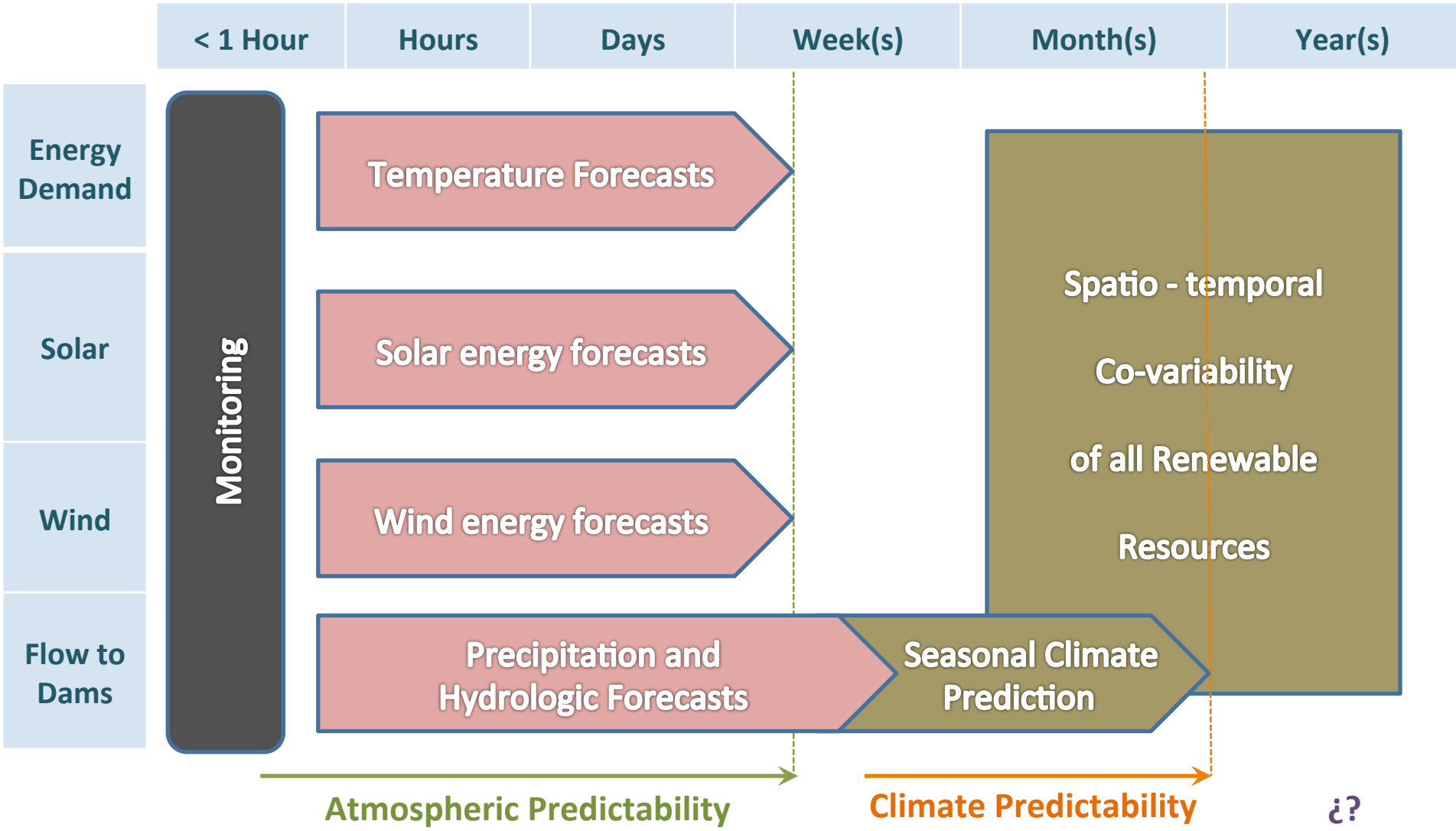
&

2) Simulation with such OP

Climate services in support of the electric sector in Uruguay

Ahead

CLIMATE



Climate services in support of the electric sector in Uruguay

Ahead

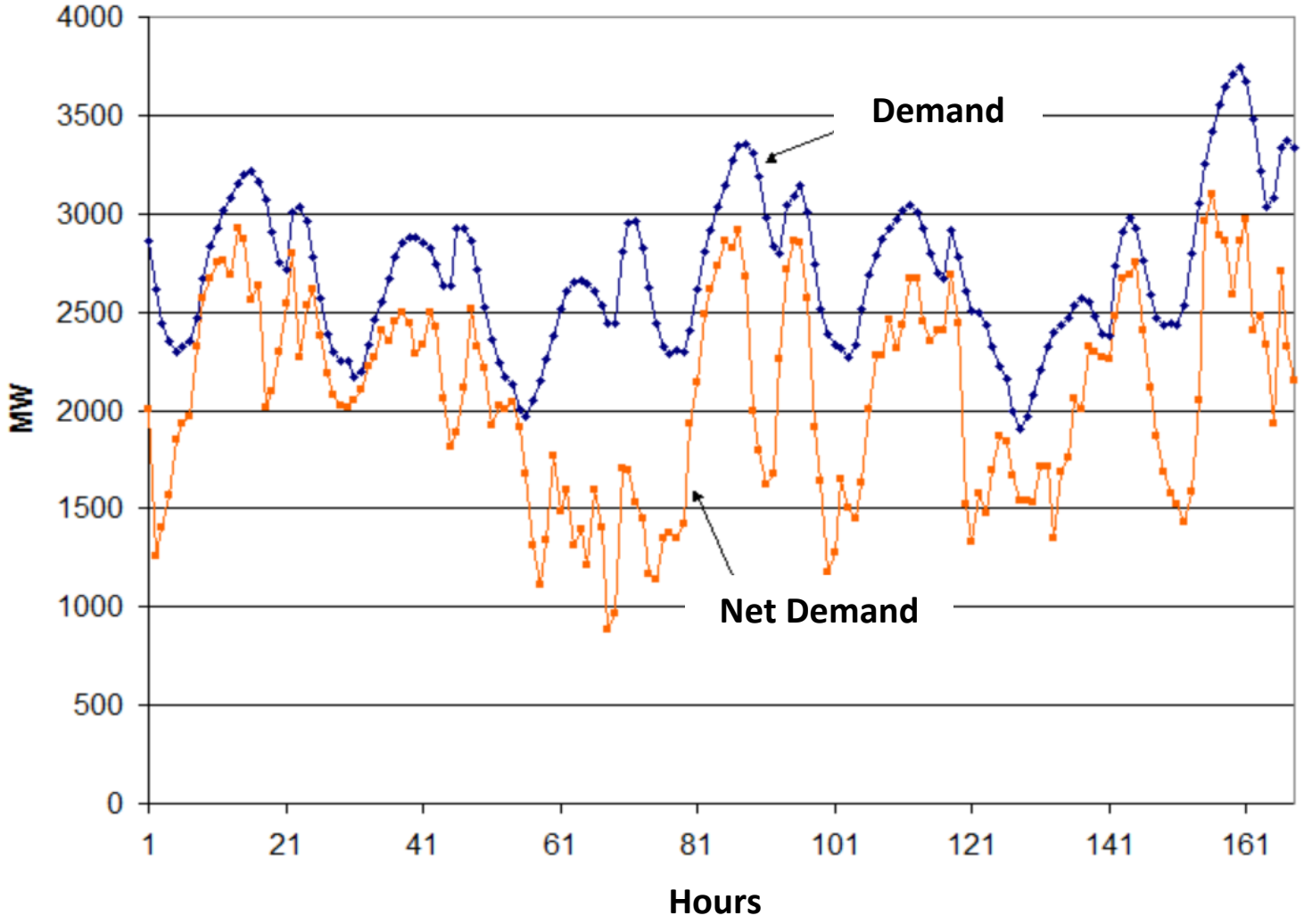
DECISIONS

	< 1 Hour	Hours	Days	Week(s)	Month(s)	Year(s)
Energy Demand	Short & medium term NET demand				Define optimal expansion (mix of GNL, solar & wind)	
Solar	Dispatch: Minimize generation costs				Requirements to filter Solar + Wind	
Wind	Real –time price signal (¿Smart Grid?)				Local complementation of solar and wind to optimize transmission	
Flow to Dams	Flood control & warning			Manage storable resources: Water in Dams & LNG		

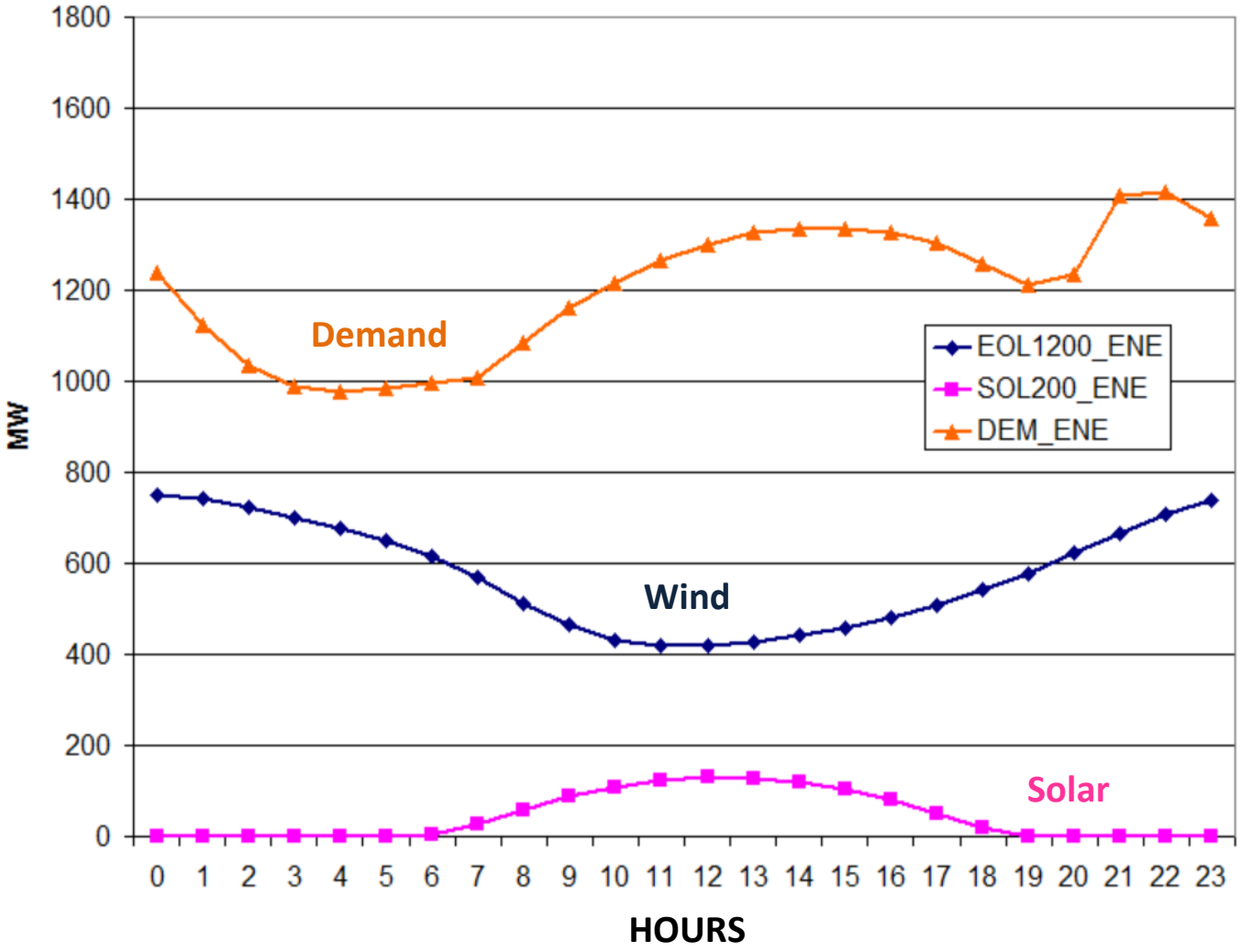
Dispatch

Planning

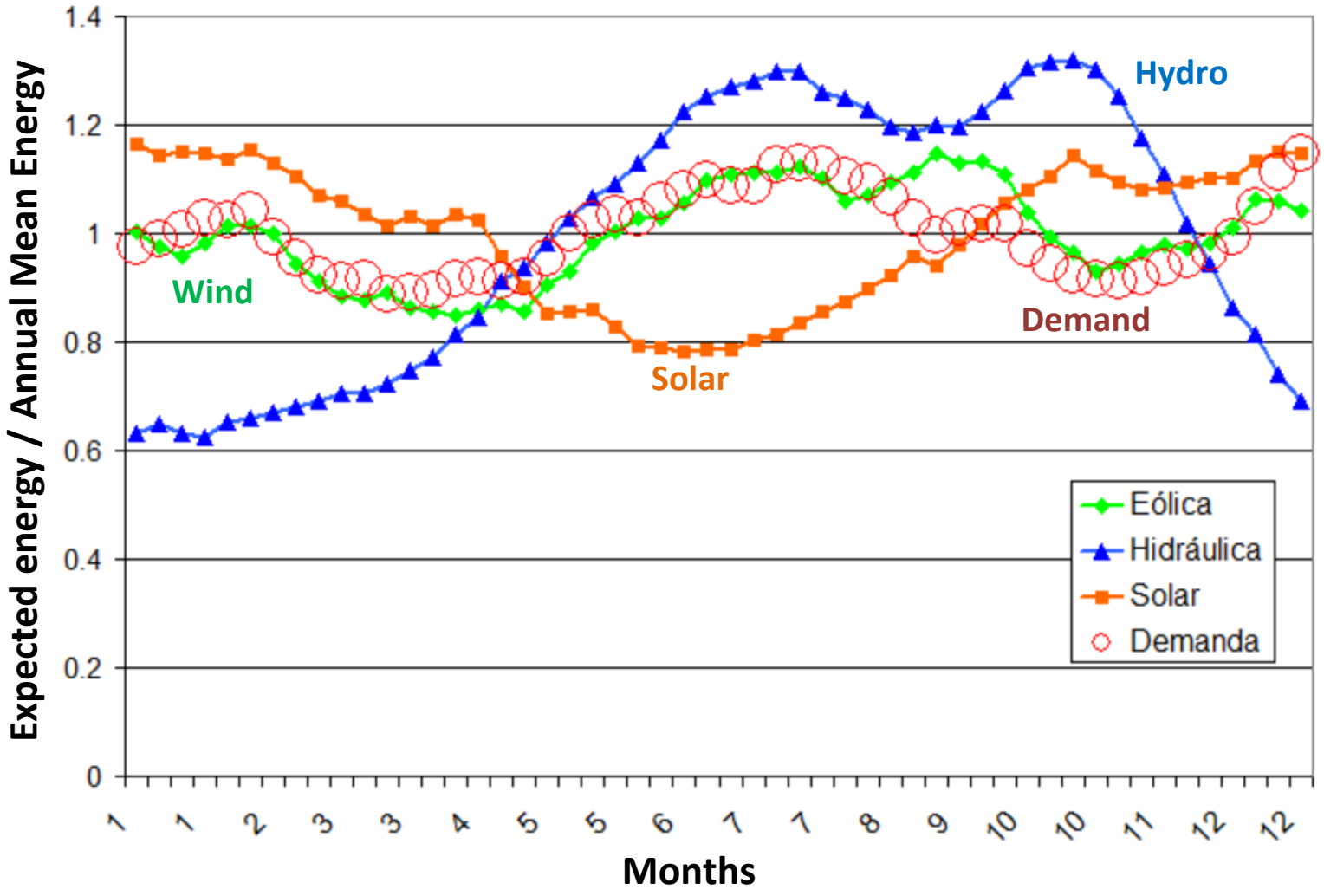
Example: Demand & Net Demand



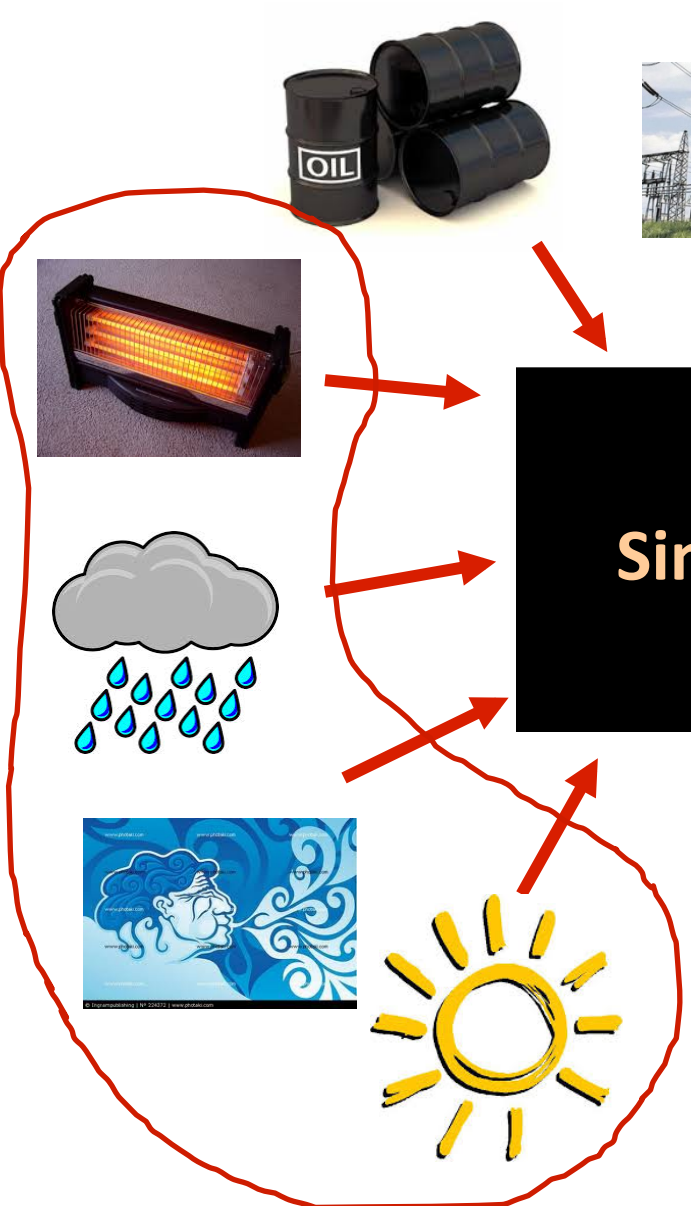
Example (2): Diurnal Cycle - Summer



Example (3): Annual Cycle



Integrated Electric System Simulator
SimSEE



1) Stochastic programming optimization

<u>Operation Policy (OP)</u>

Value of water as a function of **state** of the system

&

2) Simulation with such OP

Both predictive and climatological information is needed

Number of relevant variables
and time scales has expanded greatly

Co-variability within variables also matters.
(For dispatch –within the predictability threshold-
and climatologically to define optimal expansion)

It is NOT enough to have predictions and climate information, they need to be "digestable" by the decision making process.

The complexity of the decisions require that all climate services be integrated to the Electric System Simulator

¡ Challenges and opportunities for climate services
In the energy sector change fast !

Successful developments and implementations
have one key aspect in common:
Join work between climate scientists and technical staff
involved in the decisions within an environment of TRUST.

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