IT Solutions for Renewables

Energy Forecasting Customers:
Analysing end users' requirements

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Carlos Alberto Castaño, PhD
Head of R&D
carlos.castano@gnarum.com

I. Who we are

II. Customers’ Profiles

III. Improving forecasts for trading

IV. Conclusions

I.
Who we are

- The name ***GNARUM*** is derived from the Latin word *gnarum* which means "**I knew it"**.
- **GNARUM** was born out of **Gnera Group's** desire to satisfy the **IT demands** of renewable energy companies operating in the **electricity market.**
- **GNARUM** is committed to exceptional customer service.
- **GNARUM's** foundation is formed through **Gnera Group's** vast experience. All the knowledge and **know-how possessed by Gnera Group** has been used and expanded upon for every project developed by **GNARUM**.

International Experience

- **Experienced** with multiple renewable technologies
- **Solid know-how** backed by 10 years of experience operating in **electricity markets** with a high concentration of renewable technologies.
- More than **400 plants** and **1,200 MW** currently managed
- More than **2.5 TWh** forecasted energy in 2012
- **24x7x365** Monitoring Center

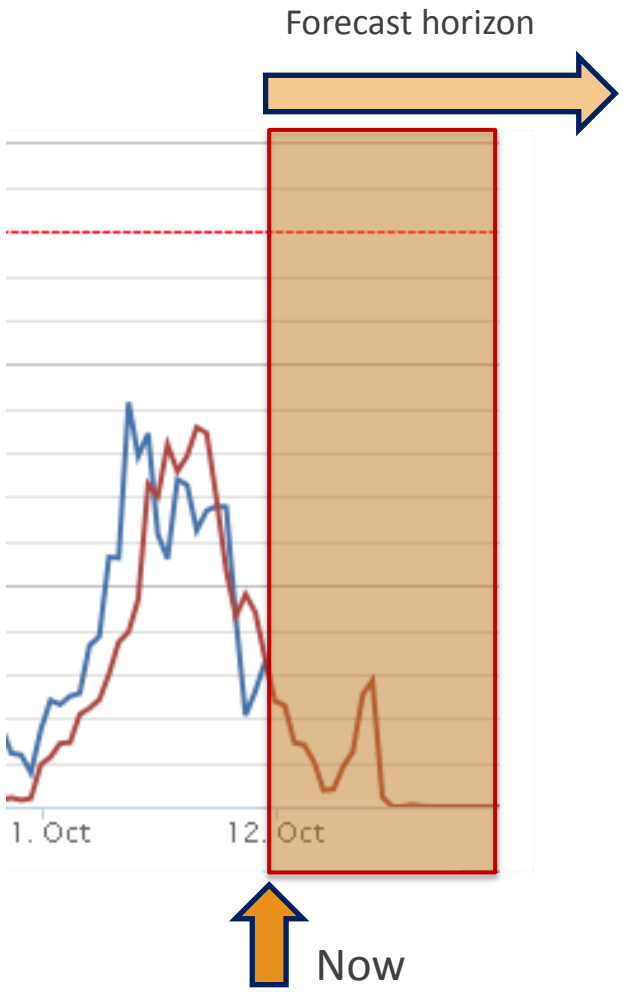
II. Customers' Profiles

Forecasting Horizon Time Scales:

- **Nowcasting**
  - Seconds to minutes ahead
- **Short-term prediction**
  - Up to 96-120 hours ahead
- **Medium-long term prediction**
  - Several days ahead up to 2 weeks

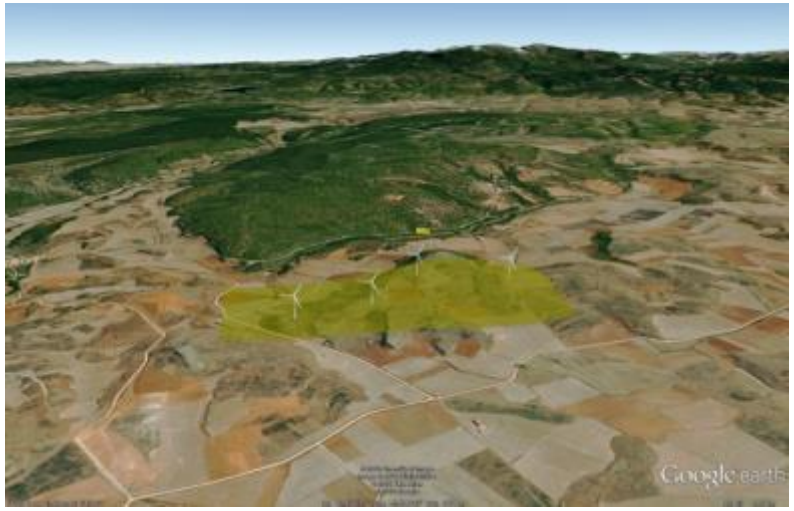
Forecasting Time Resolution:

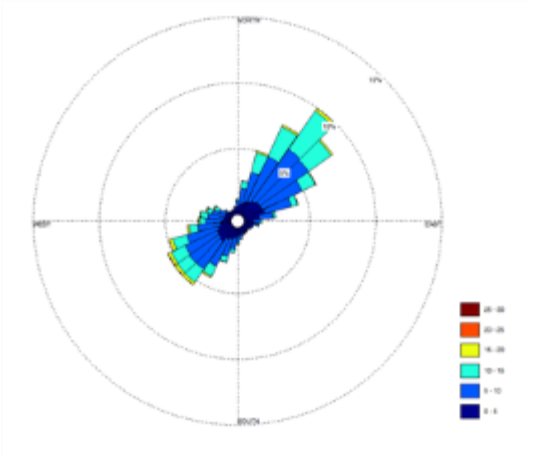
- **5 min, 15 min, hourly, daily, monthly**



Resource/Generation Analysis Customers:

- Required for **decision making**
- Long-term simulation
- Monthly/Yearly averages
- On-site Data availability: poor
- Predictability higher
- Statistical characterization
- Error tolerance higher
- High computation time consuming





Applications

- Wind farm siting
- Bilateral contracts evaluation

O&M Customers:

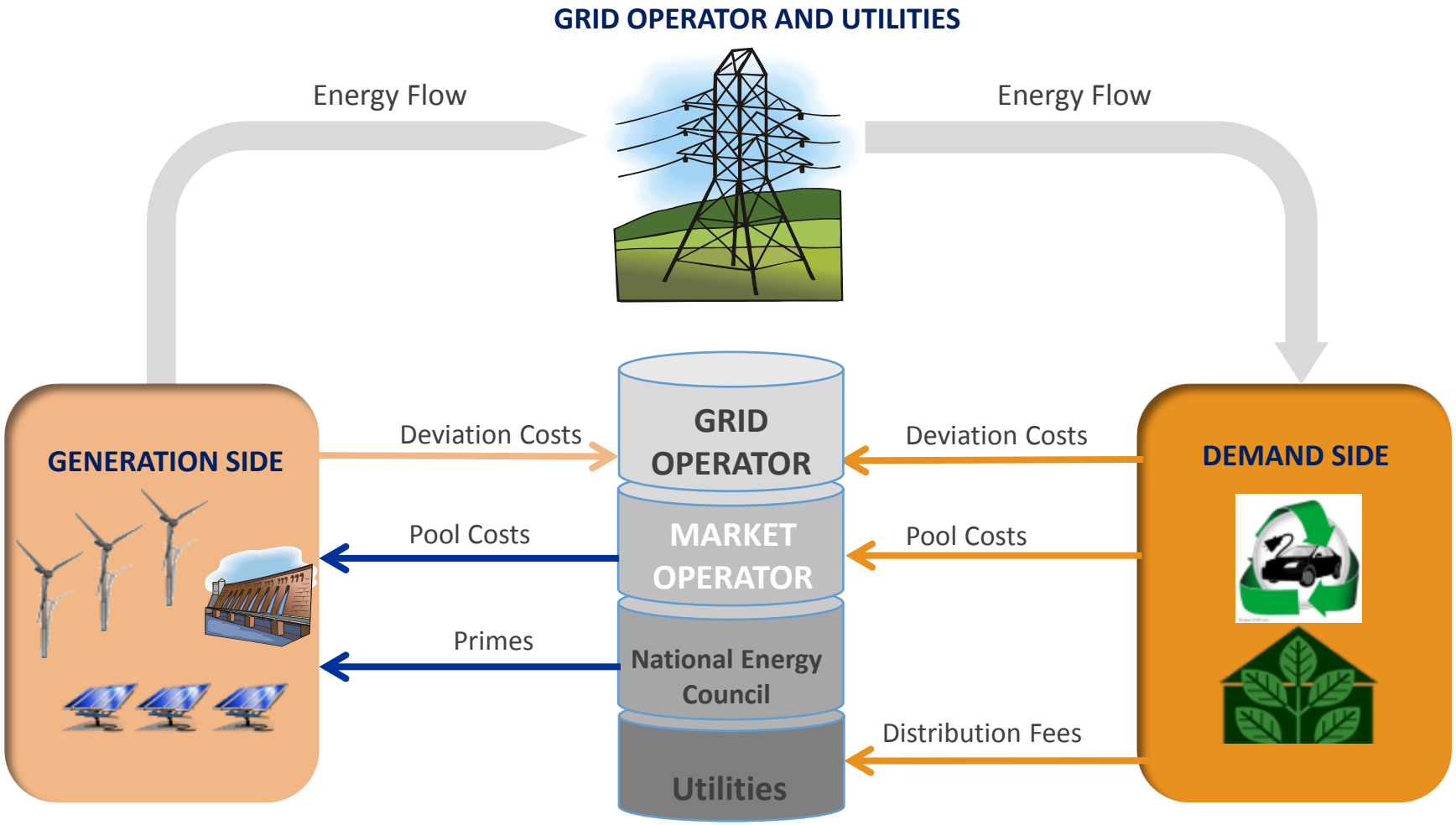
- **Short-term operation**
- Accuracy is important
- Up to 6-10 hours ahead
- 5 to 10 min time resolution
- Real-Time data availability
- Computation time limited to minutes
- Update cycle: high
- Ramp events forecasts

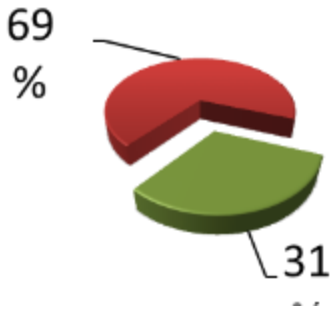
Market Operations:

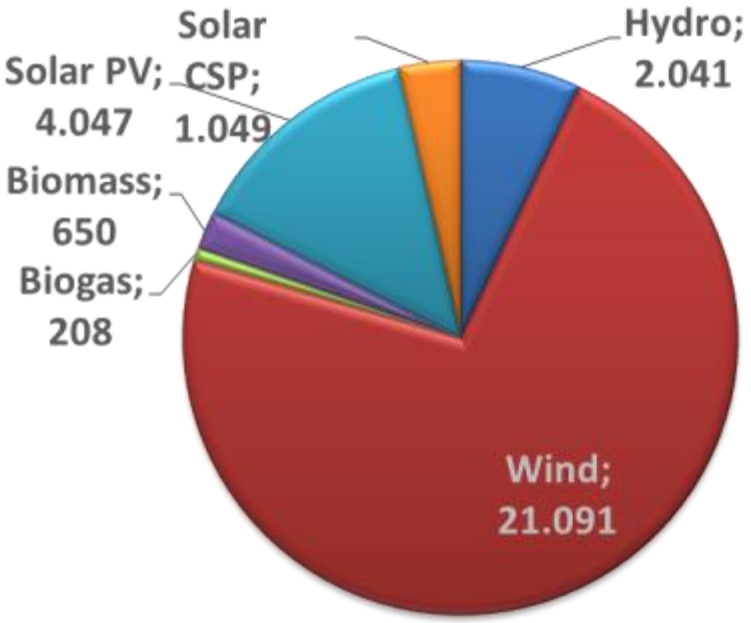
- **Day-Ahead management**
- Revenues and penalties depend on accuracy
- From 6 to 48 hours ahead
- 15-min or Hourly time resolution
- Update cycle: several times/day
- Forecast driven by NWP
- Managing uncertainties

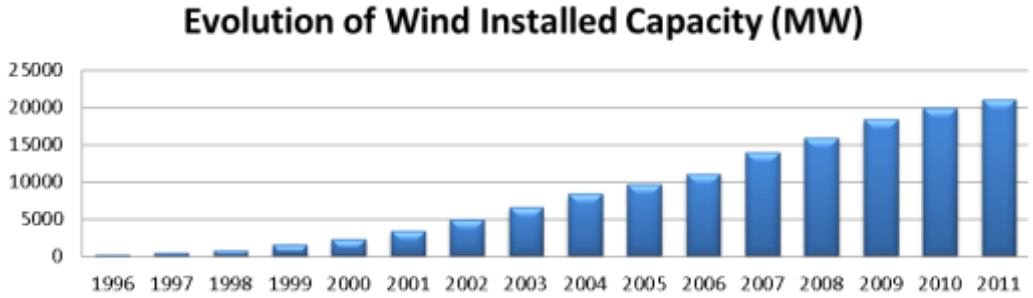
III.
Improving forecasts for trading

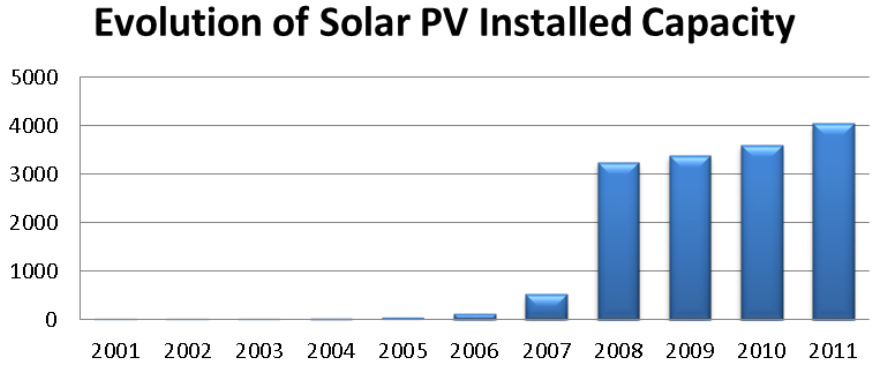
Spanish FIT System

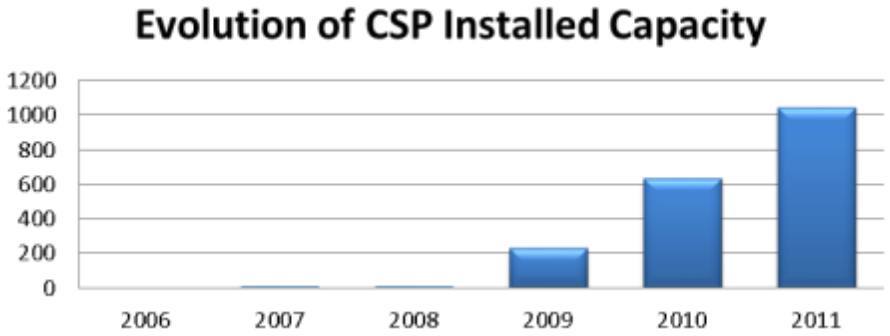



69
%
31


Solar PV; 4.047
Solar CSP; 1.049
Hydro; 2.041
Biomass; 650
Biogas; 208
Wind; 21.091


Evolution of Wind Installed Capacity (MW)
25000
20000
15000
10000
5000
0
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

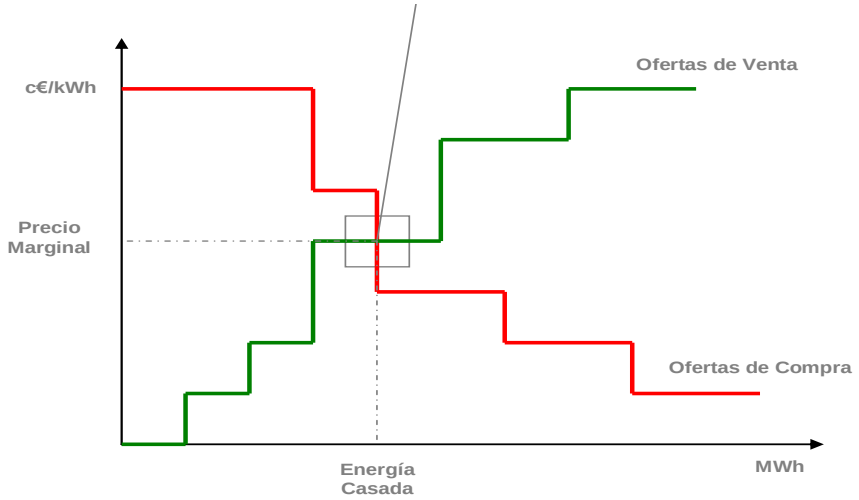

Evolution of Solar PV Installed Capacity
5000
4000
3000
2000
1000
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011


Evolution of CSP Installed Capacity
1200
1000
800
600
400
200
0
2006 2007 2008 2009 2010 2011

Day ahead Market:

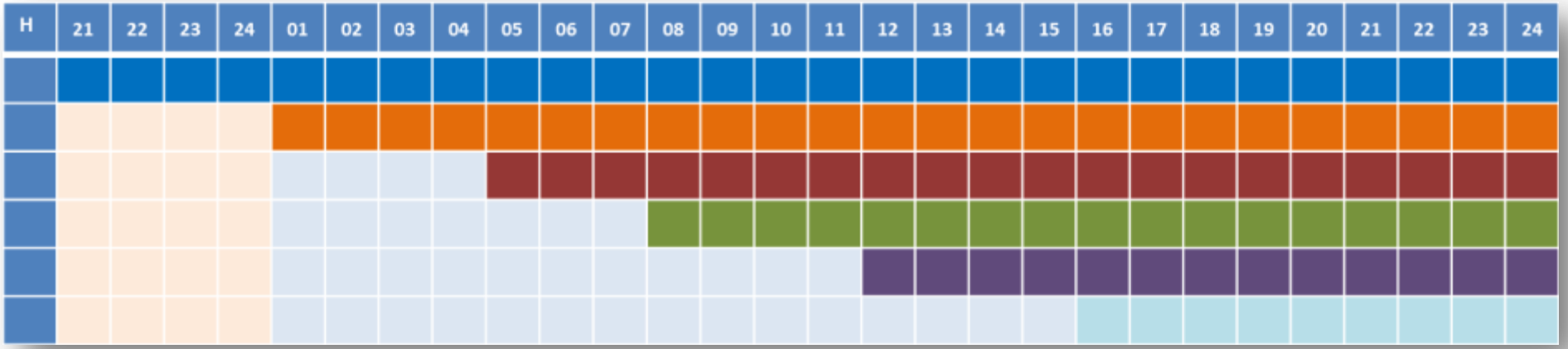
Daily session with forecasted energy for the next day.

H	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

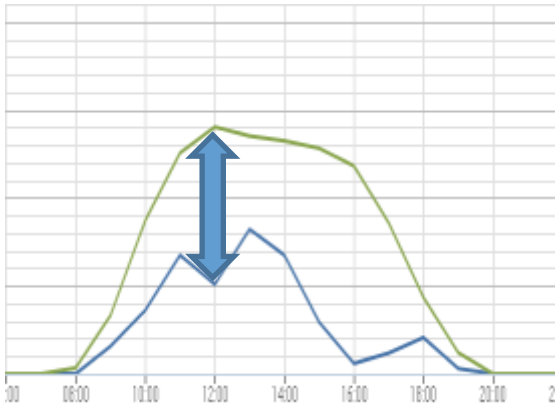


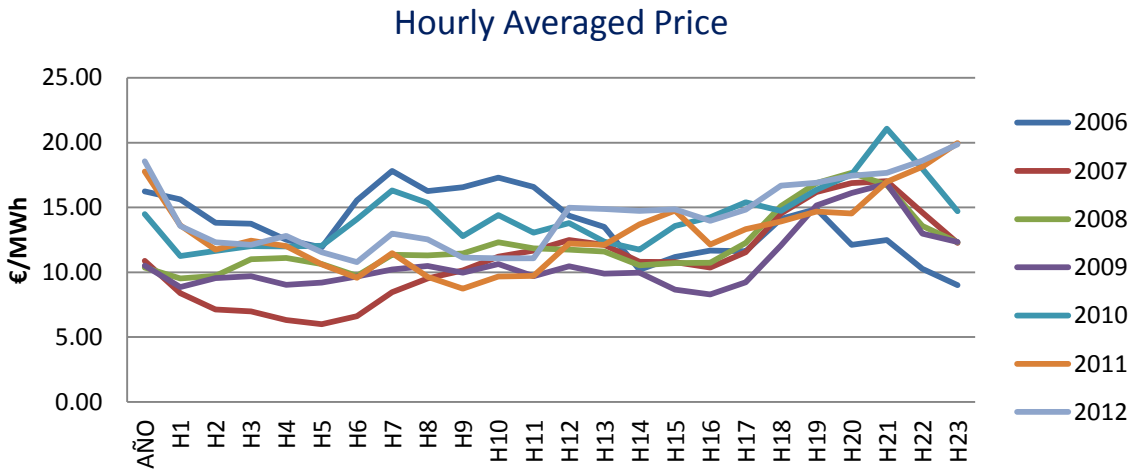
Intra-day Market:

Several sessions a day to adjust the energy sales



Imbalancing penalties





Costs = P x D

P = Imbalancing price

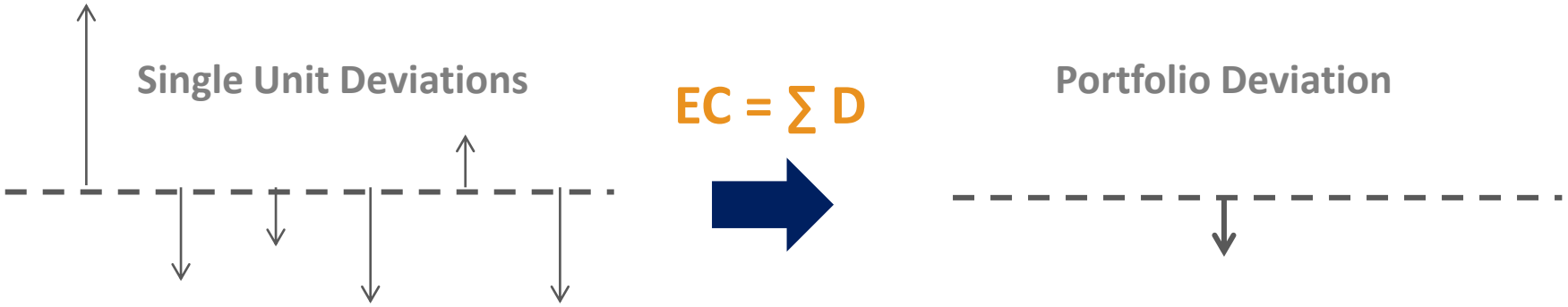
D = Deviation

Average cost 15 €/MWh

Imbalancing penalties are directly proportional to the inaccuracy or deviation.

Reduction of Imbalancing Penalties

- The **Portfolio Effect (EC)** is the result of damping. It is the net deviation of a set of renewable plants.



- **Cost Asymmetry** only penalizes deviations in one direction, relative to the needs of the electric system.

	System Need	Deviation	Cost
1	↑	↑	0
2	↑	↓	Full Cost
3	↓	↑	Full Cost
4	↓	↓	0

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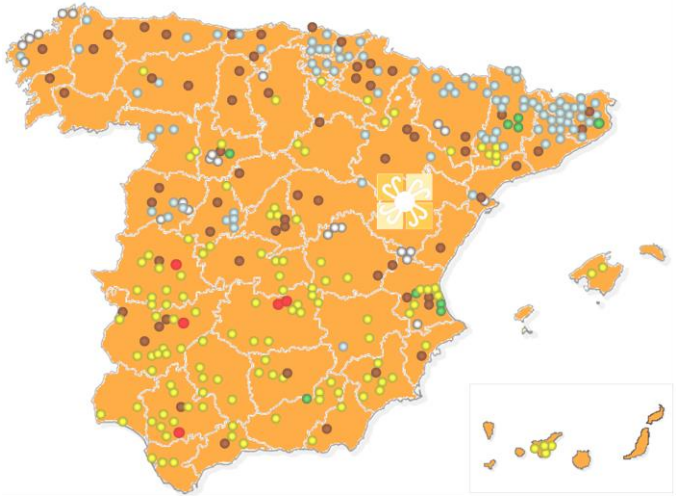
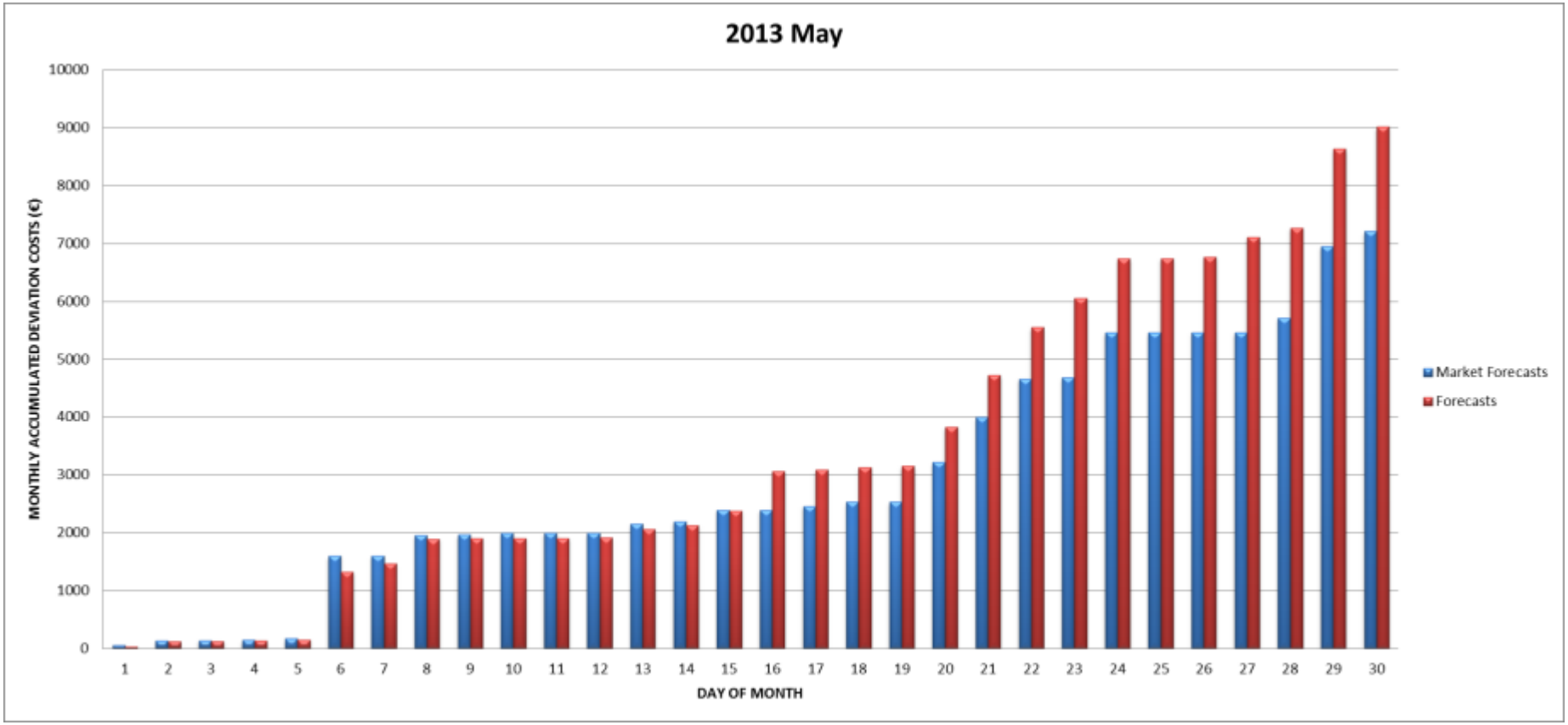
Weather Intelligence System for Energy



April to September 2012:

	Nameplate Capacity	Costs w/o Forecasting	Costs w/ Forecasting & Portfolio	Costs Managing Uncertainties	Savings
Wind	140 MW	0.86 M€	0.26 M€	0.20 M€	0.66 M€
PV	513 MW	4.05 M€	0.48 M€	0.40 M€	3.65 M€
Hydro	125 MW	0.6 M€	0.05 M€	0.04 M€	0.56 M€
TOTAL	**778 MW**	**5.51 M€**	**0.79 M€**	**0.64 M€**	**4.87 M€**


2013 May
MONTHLY ACCUMULATED DEVIATION COSTS (€)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
DAY OF MONTH
Market Forecasts
Forecasts

IV. Conclusions

- **Forecasting is a valuable source of information**
  - Different applications and problems
  - Different strategies to compute the forecast
  - Different customers for each solution

- **Forecasts adapted to your problem**
  - Extra information can be used to improve the forecasts
  - IT systems are helpful

- **Managing uncertainties, interesting profit for trading**

www.gnarum.com
carlos.castano@gnarum.com