

Belgian Solar Forecasting 2012-2013

Users' Group

28/03/2013

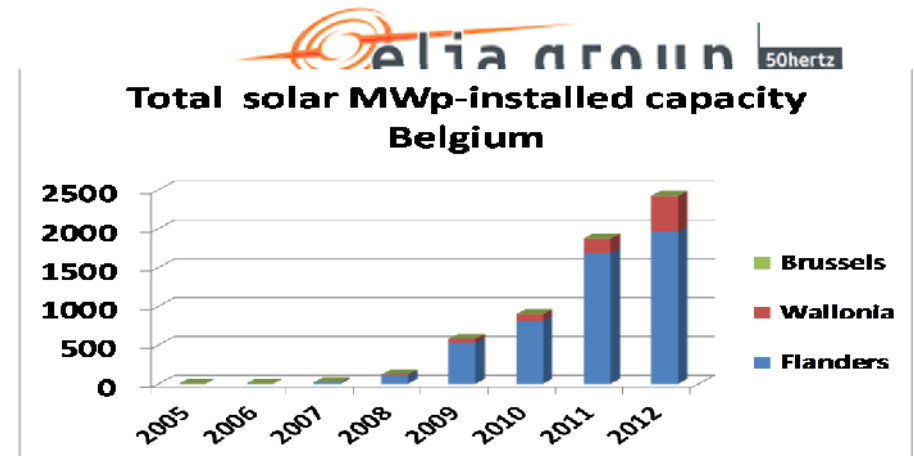
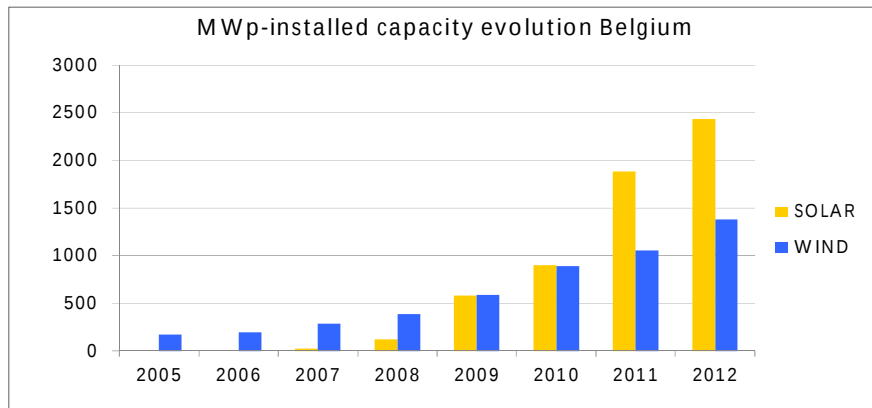
Pieter-Jan Marsboom
Energy Management

Summary

- Context & drivers
- Deliverables
- Forecast & Upscaling Service
- Quality
- Challenges
- Conclusion



Context & drivers



➤ Long term: *expected evolution of installed solar capacity [months,years]*

- Drivers:
 - Grid investment decisions
 - Operational reserve dimensioning – contract sourcing

➤ Short term: *forecasted solar power production [D,D+3]*

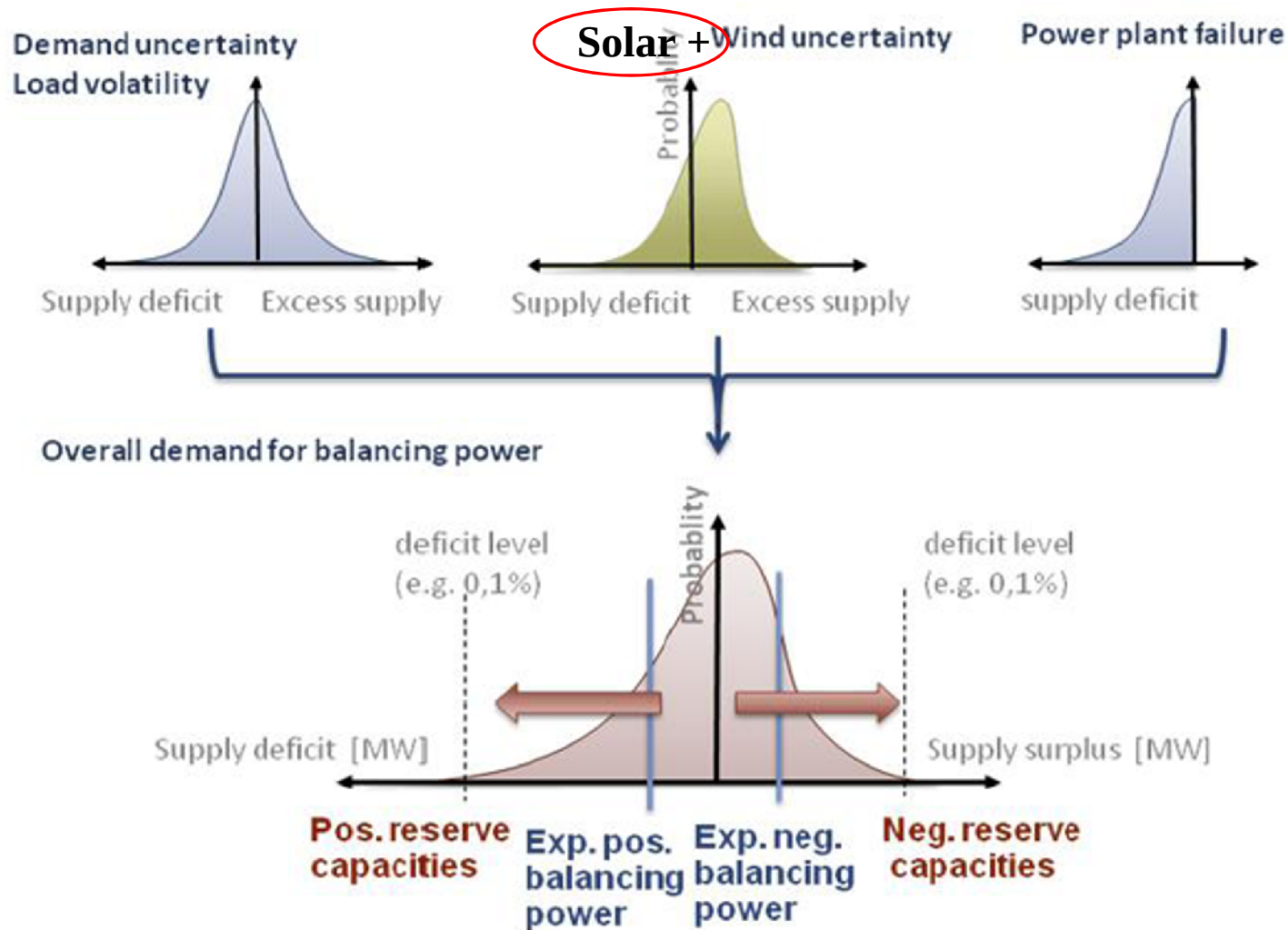
- Drivers:
 - **Operational security & economical grid management**
 - reserve-activations & reservations (balancing – NCC)
 - security calculations & loadflow analysis D-1 & RT (congestion & maintenance mgmt – NCC&RCC)
 - **Transparency requirements ERGEG (2014)**
 - aggregated publication of forecasted & RT-measured renewable production
 - **Stimulation of correct system functionality**
 - Improvement of load estimation for market players & ELIA



Project Belgian Solar Forecasting 2012-2013

Context & drivers

Balancing needs for the TSO – reserve dimensioning



Source = Universität von Köln "Market Design : options for wind integration" 2011

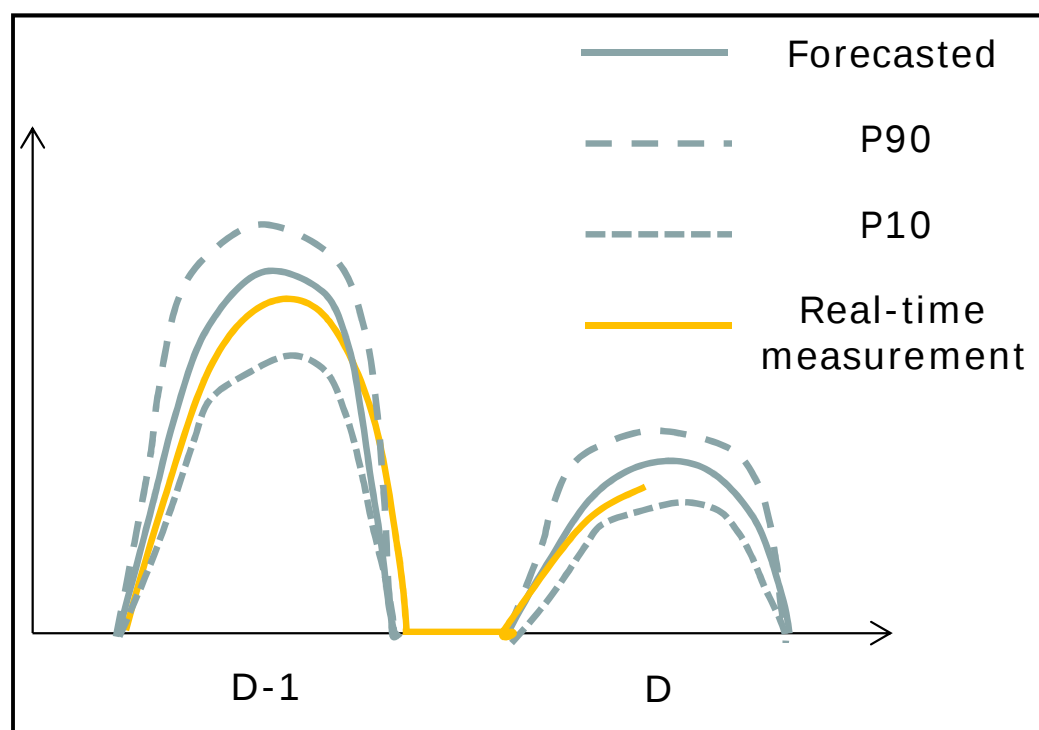
Key Deliverables (1/2)

- Buy aggregated day-ahead **forecasts** [D+1;D+3] from Forecast Supplier
 - Intraday-forecast @11A.M => [D;D+3]
 - Aggregate + zip-code level forecasts
 - P10, P90 uncertainty indicators
 - Snow-indicator
- Buy aggregated real-time **measurements** [per quarter] from Forecast Supplier
 - Aggregate + zip-code level estimations
 - Data-quality indicator
 - Ex-post (12 hours) corrections
- Buy ex-post **metered values**
 - Calibration + 2012 FC-quality analysis
 - One-shot acquisition of aggregated zip-code estimations for Belgium 2012
 - Future = through metering departement

Forecasting service

ELIA's forecast service summary:

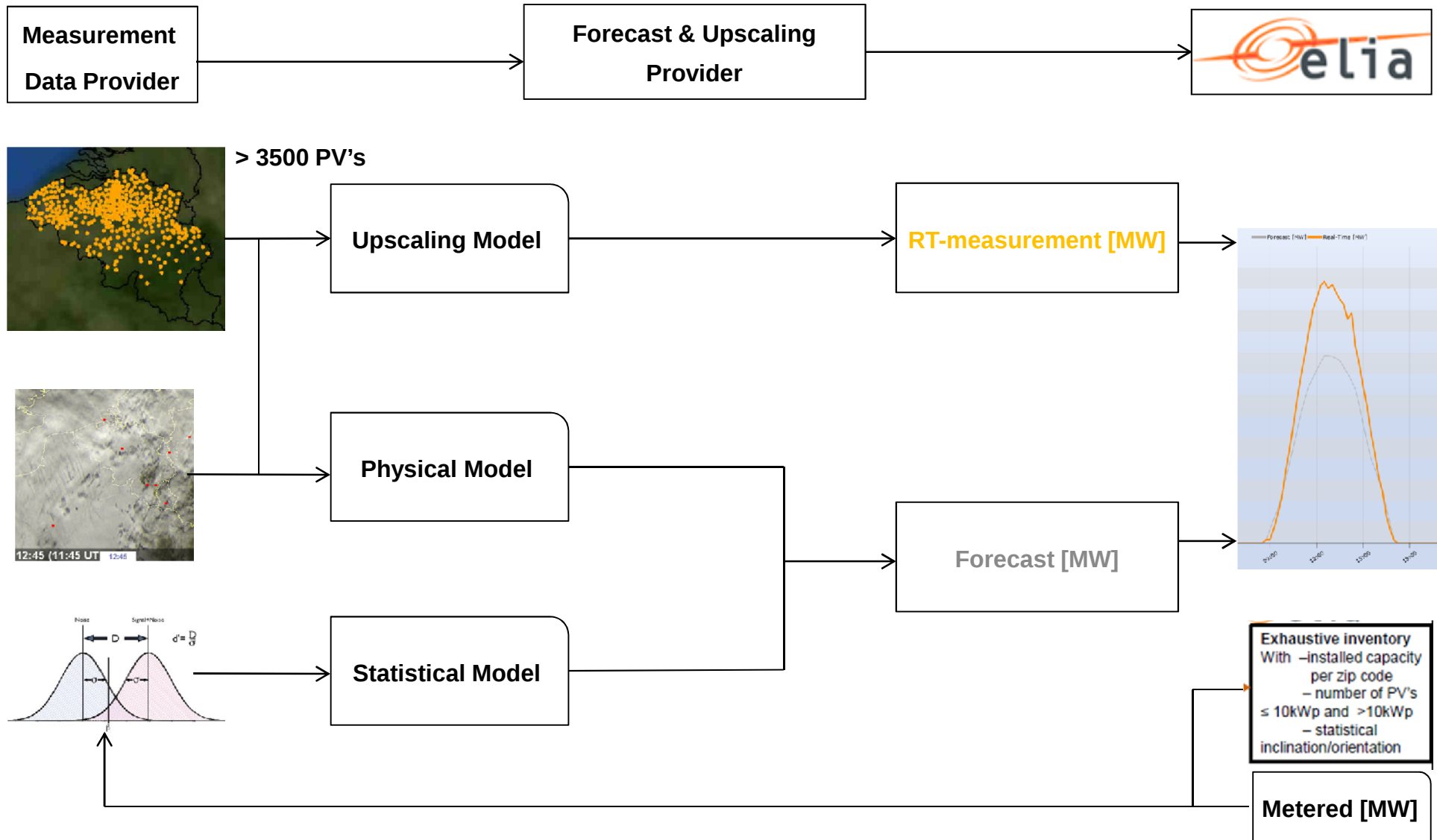
- Hybrid model (physical (5 weather models) + statistical model)
- Update frequency = 1x per day @ 11 A.M.
- [D, D+3] intraday + day-ahead [MW]-forecasts per quarter hour per zip code & aggregates
 - Forecast-value [MW]
 - Uncertainty band P10 and P90 [MW]
 - Snow indicator ☁️❄️ [0/1]



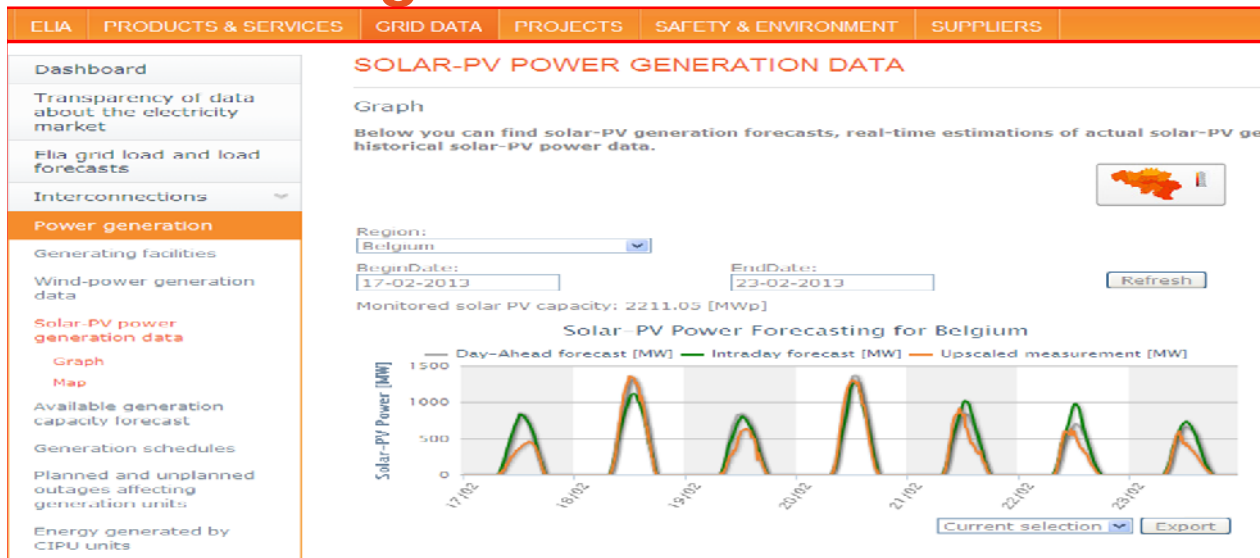
Key Deliverables (2/2)

- Acquire **inventory information** per community
 - Geographic info from VREG/CWAPE/BRUGEL (kWp, # for $<$ & $\geq$ 10kWp PV-systems)
 - Wind & solar automatic inventory updates => through PISA (on-going)
 - **Internal mapping to grid operator level & PISA PU's:**
 - ☐ IT-architecture foreseen & integrated into application
 - ☐ best-effort base data provided => to improve
 - ☐ improved balancing (ARPs), congestion mgmt (DSO's, NCC, RCC)
- Create **GUI's / maps / databases** (= internal tool)
 - GUI1 = 'graphs' for statistical analysis (ENMAN, NCC, GD, ...), energy-deals (traders, ARP's), balancing D-1 & RT (ARPs, NCC)
 - GUI2 = 'map' = visualisation of locational info for congestion mgmt & maintenance planning (NCC/RCC)
 - GUI3 = 'Tabel' = 'data-dump' for detailed statistical analysis & loadflow calculations
 - Databases = to be merged with EDW to allow access to wind/solar-data for all Elia-employees (2013)
- **Online publications** (intranet & internet)
 - Internal short-term solution since feb 2012 & online since summer 2012 ~ incompressibility risk
 - Go-live of final solution since 25th of March 2013

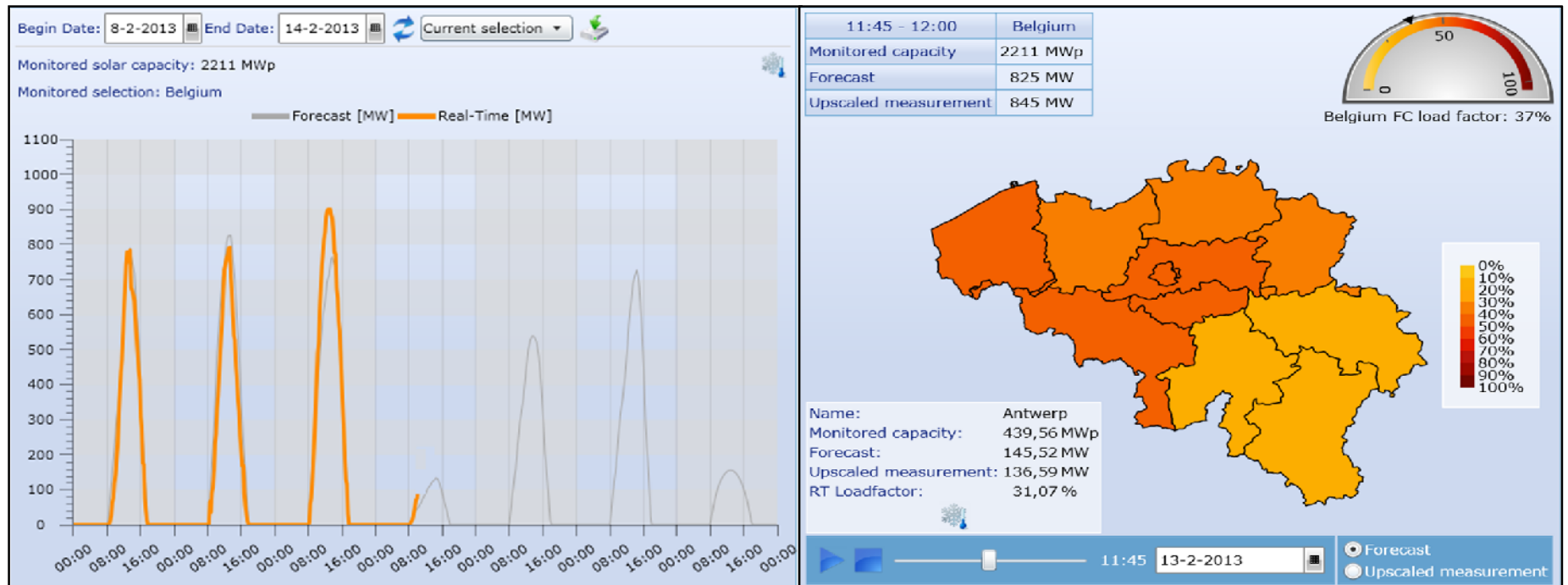
Solar Process Flow



Forecasting tool : illustrations



<http://www.elia.be/en/grid-data/power-generation/solar-power-generation-data/graph>



Forecasting tool : illustrations

25/03 – 30/03

Dashboard
Transparency of data about the electricity market
Elia grid load and load forecasts
Interconnections
Power generation
Generating facilities
Wind-power generation data
Solar-PV power generation data
Graph
Map
Available generation capacity forecast
Generation schedules
Planned and unplanned outages affecting generation units

SOLAR-PV POWER GENERATION DATA

Graph

Below you can find solar-PV generation forecasts, real-time estimations of actual solar-PV generation and historical solar-PV power data.



Region:

Belgium

BeginDate:

25-03-2013

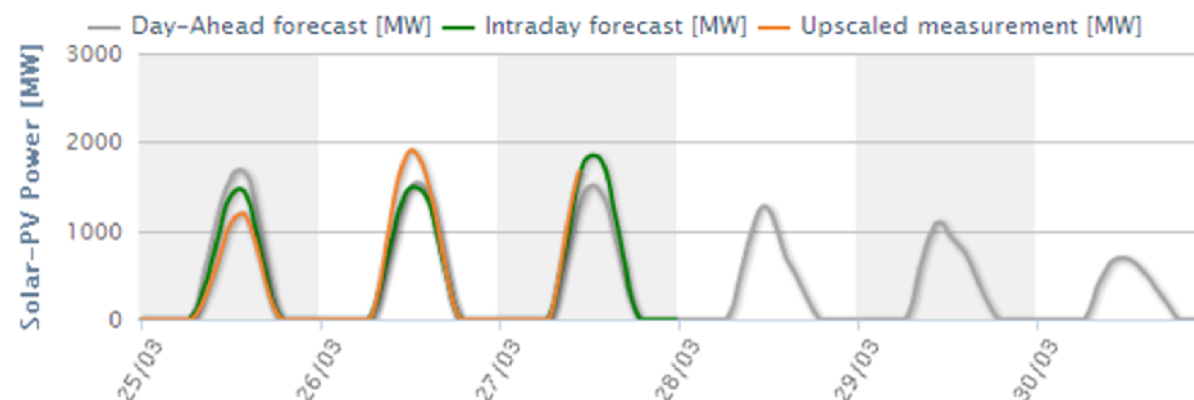
EndDate:

30-03-2013

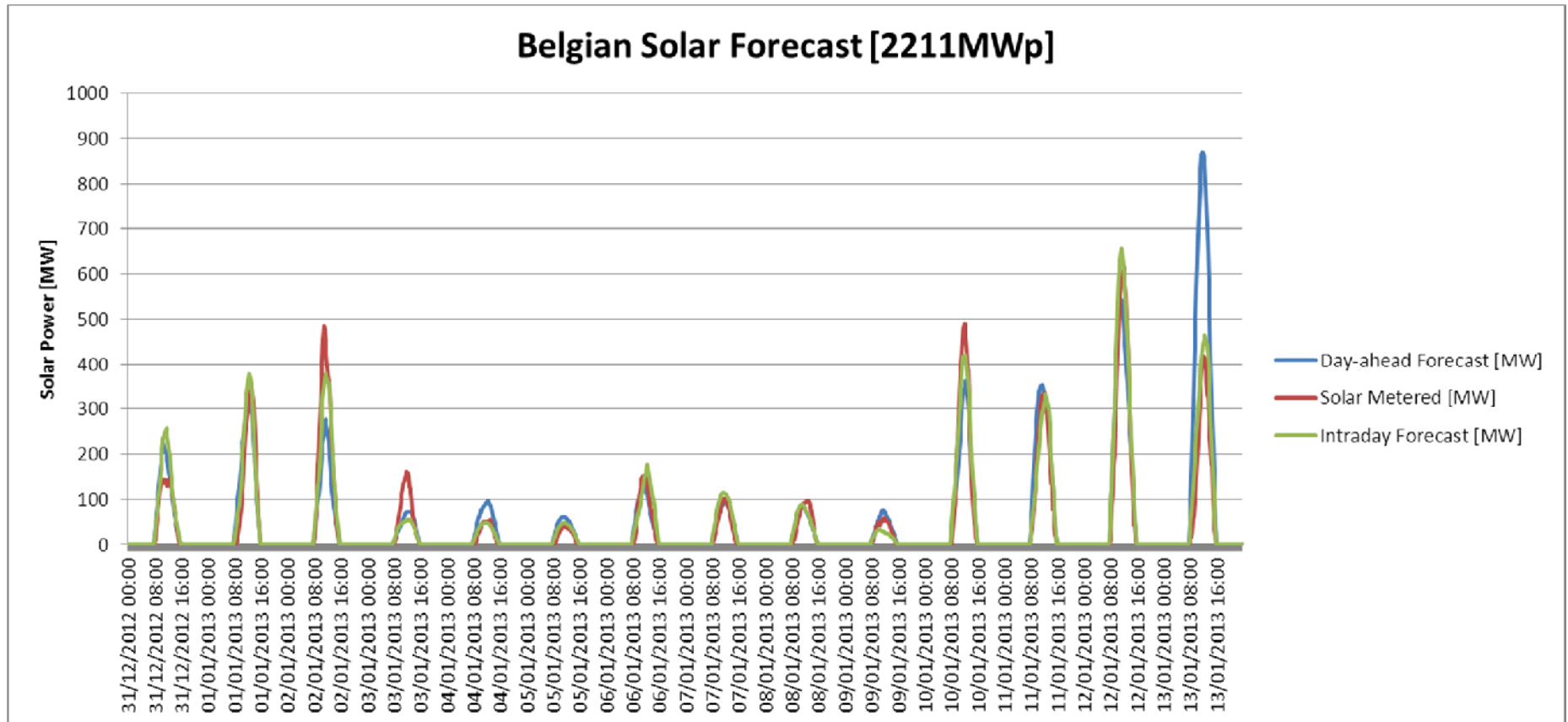
Refresh

Monitored solar PV capacity: 2501.53 [MWp]

Solar-PV Power Forecasting for Belgium

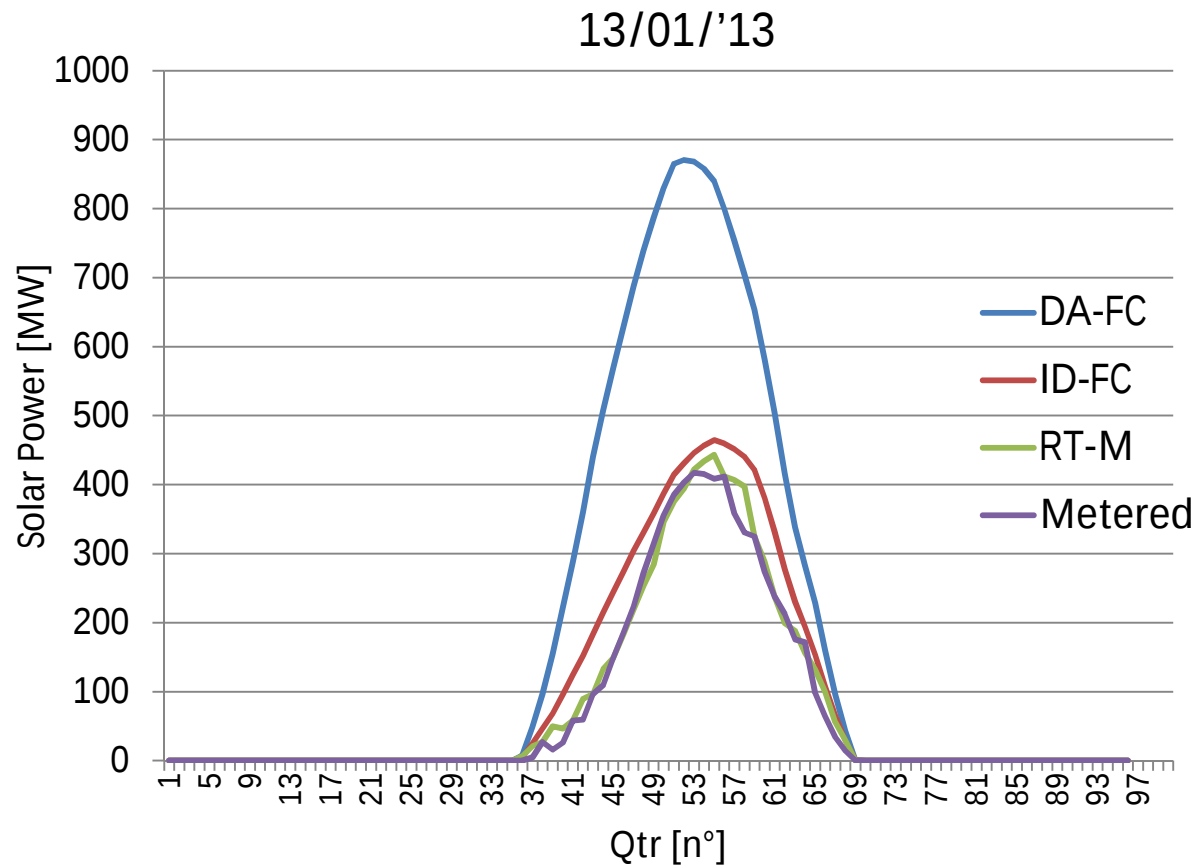


Solar Forecasting Quality



- ⇒ Preliminary indications show good aggregate solar forecasting quality (even with snow)
- ⇒ Quality remains good for province-level & even zip-code level (further analysis needed)

Solar Forecasting Quality

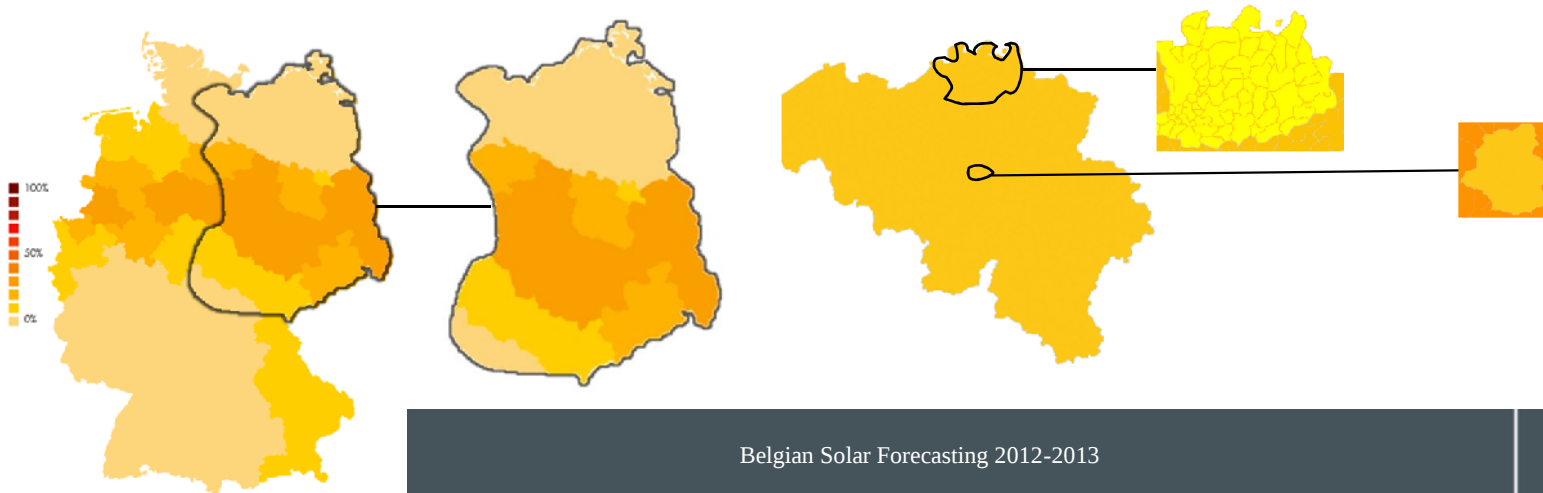
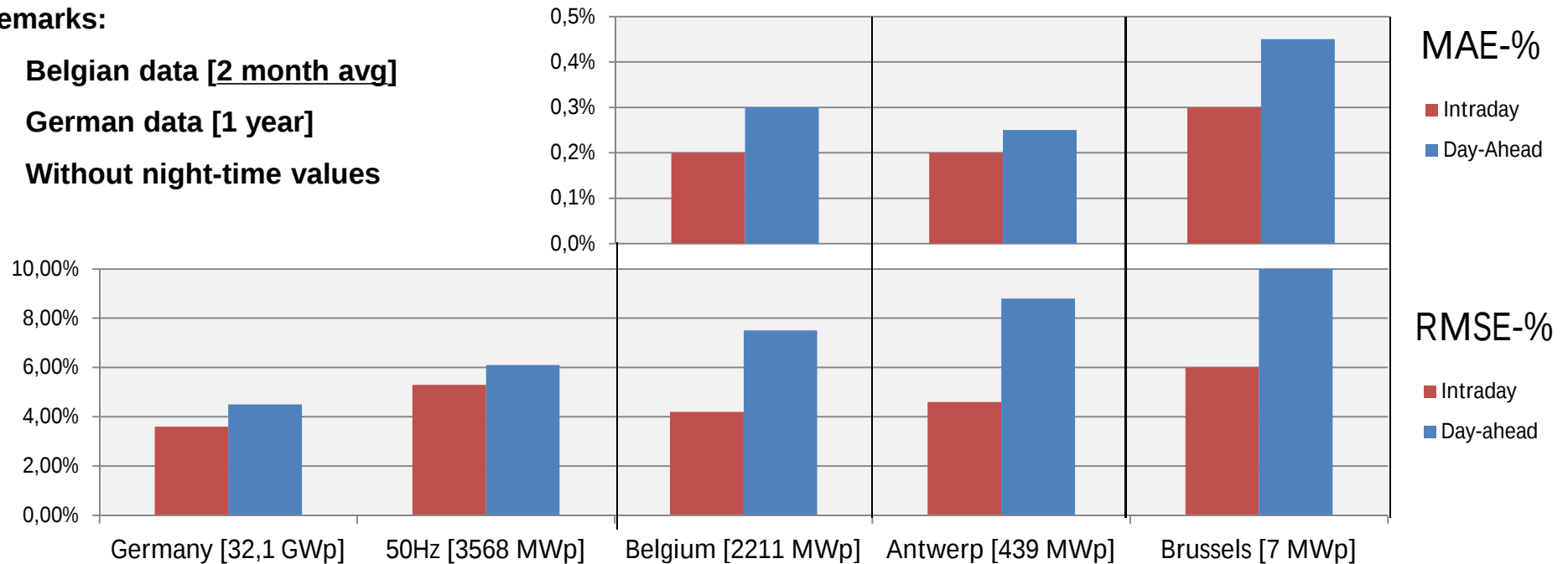


- ⇒ Added value from intraday forecast can be large and is better on average than day-ahead
- ⇒ Real-time estimation should be very qualitative (~ 50Hz & German upscaling quality)

Solar Forecasting Quality

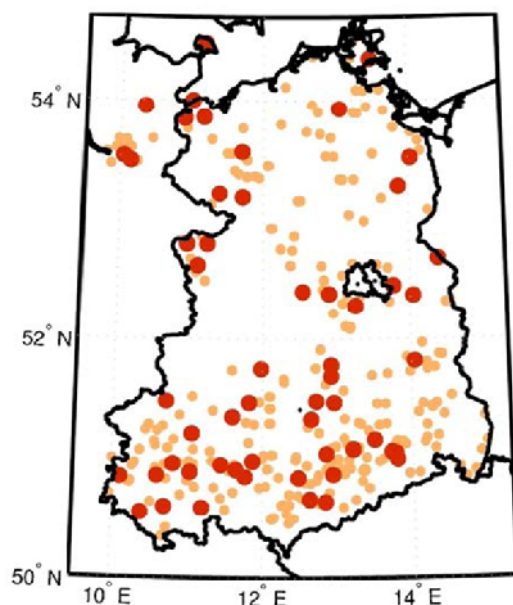
Remarks:

- Belgian data [2 month avg]
- German data [1 year]
- Without night-time values



Solar Forecasting Quality

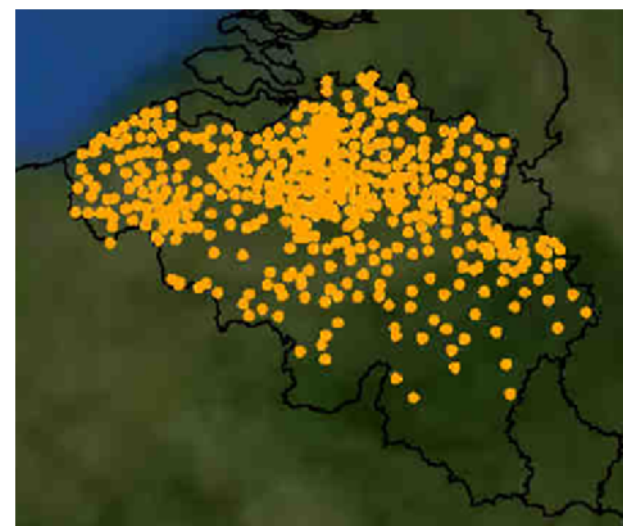
50Hz comparison



- Comparable control size regions
- Better PV-distribution at 50Hz
- More experience at 50Hz

However :

Forecast quality [RMSE%]	Belgium [2 month avg]	50Hz-zone [1 year]
Day-ahead	7,5%	6,1 %
Intraday	4,2%	5,3%



daylight hours only

$$rmse = \sqrt{\frac{1}{N} \left(\sum_{t=1}^N \frac{P_{pred} - P_{meas}}{P_{nom}} \right)^2}$$

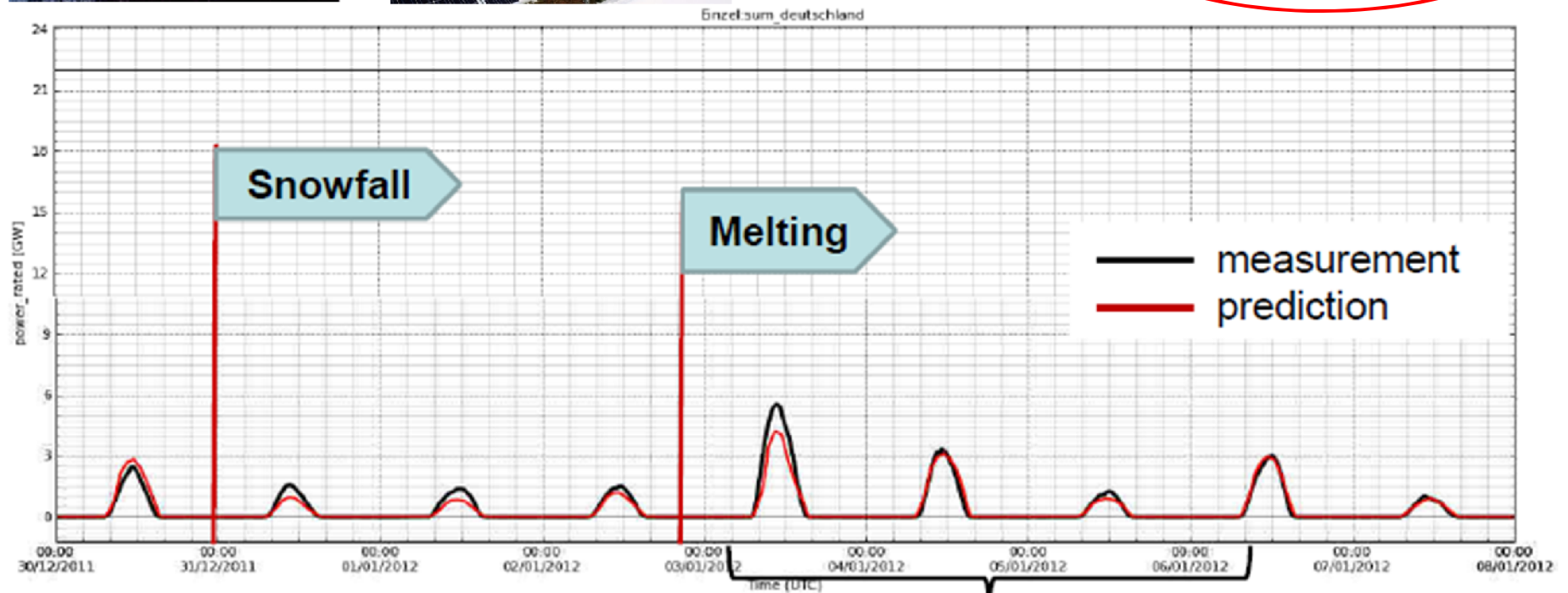
Explanation:

- Data not yet statistically representative (2 month avg <-> 1 year)
- Different physical weather backgrounds ? (snowy months <-> all seasons)
- Currently no firm conclusion possible, but first 2 months shows best industry practice performance

Solar power forecast: Snow model

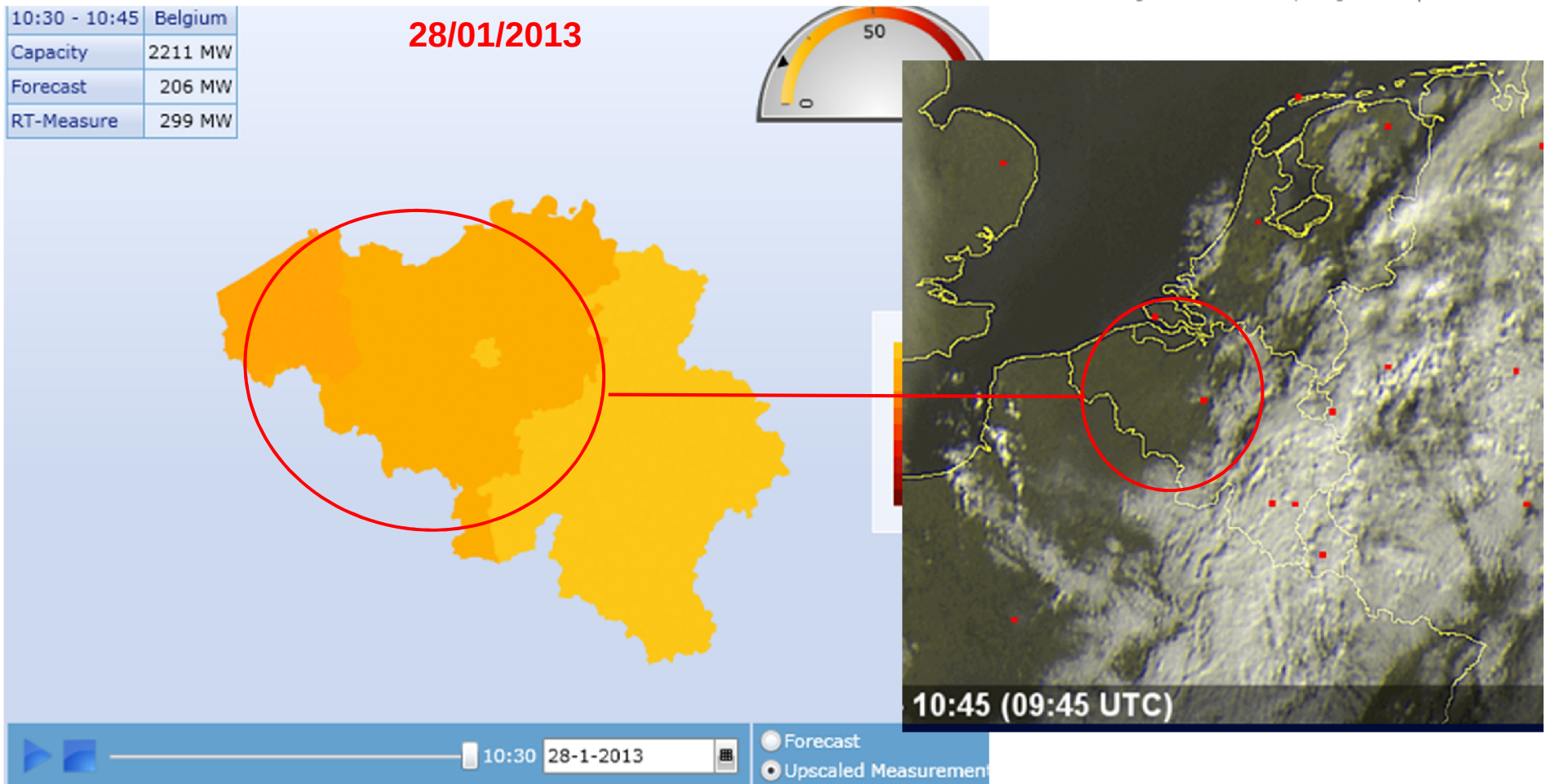


	50Hertz	
	intra-day	day-ahead
rmse	5.7%	6.4%
rmse _{new}	5.3%	6.1%



Temperatures higher than 0 °C
➤ Snow is melting
➤ Models recognizes

Solar Measurement Quality



- ⇒ Consistency checks appear coherent
- ⇒ SI-impact analysis appears to confirm aggregate measurement validity
- ⇒ More quantitative analysis needed on acquired dataset (very detailed) – first results = satisfactory

Challenges – impact on SI (1/2)

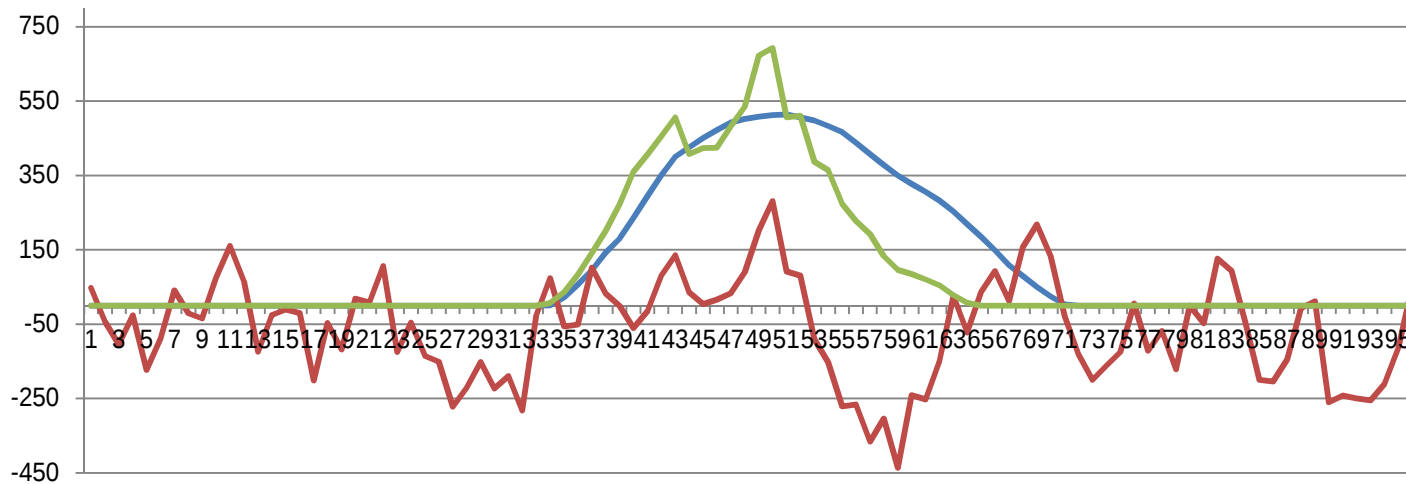
Limited DA-predictability of production of PV units impacts the energy balance of the system



Snowy Friday

03/02/2012

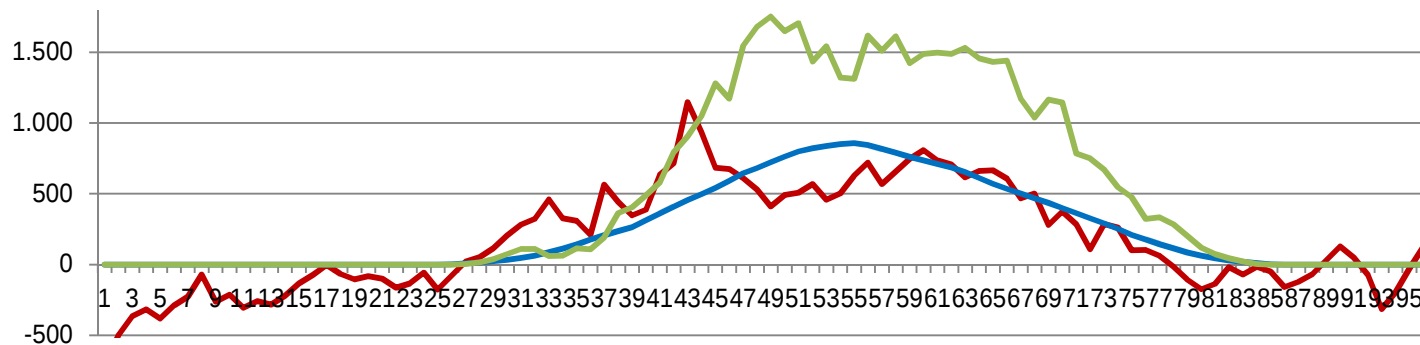
Correlation > 70%



Sunny Tuesday

01/05/2012

Correlation > 65%



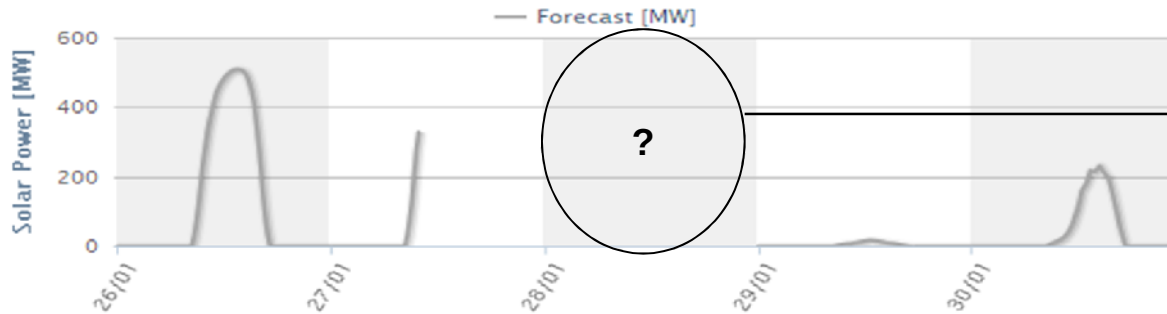
— System Imbalance [MW] — DA- Forecast [MW] — Upscaled measurement [MW]

Challenges – impact on SI (2/2)

Publishing DA, ID & RT- estimations of PV production should improve system energy balance

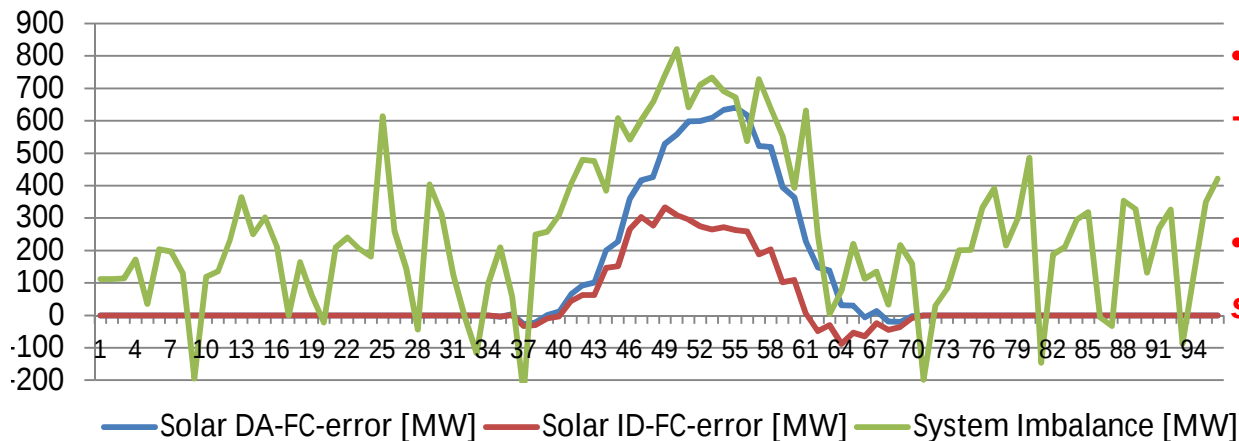
Monitored capacity: 1600 [MWp]

Belgian Solar-Power Forecasting



simple DA-forecast was missing

Monday 28/01/2013



- **Solar DA- FC-error =**
+/- overall SI during day-time hours
- **ARPs using solar ID-FC & RT-signal**
should on average cause SI-decrease

Conclusion – key messages

- **Overall preliminary forecast & upscaling quality are satisfactory**
 - Should systematically be monitored
 - Can further improve through: more weather models, better fog/snow/icing-models, measurement calibration, better inventory information, better Belgian PV-distribution, ...
 - Snow-model in place already contributing to better quality
- **Large added value for Elia & ARPs through:**
 - Integration & publication of ID-forecast & RT-measurement estimation
 - Aggregate & regional (province/DGO-level) information for balancing & congestion mgmt purposes
 - => Residual forecast errors should decrease
- **End-results will be used to improve:**
 - Grid load forecasting & estimation
 - RT- grid mgmt (balancing, congestions, maintenance) at NCC, RCC (DGO,ARP)
 - DGO-infeed publication
 - Reserves dimensioning
 - Grid studies & connection criteria