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Imbalance costs of small scale renewable not dispatchable power plant in the Italian electricity market

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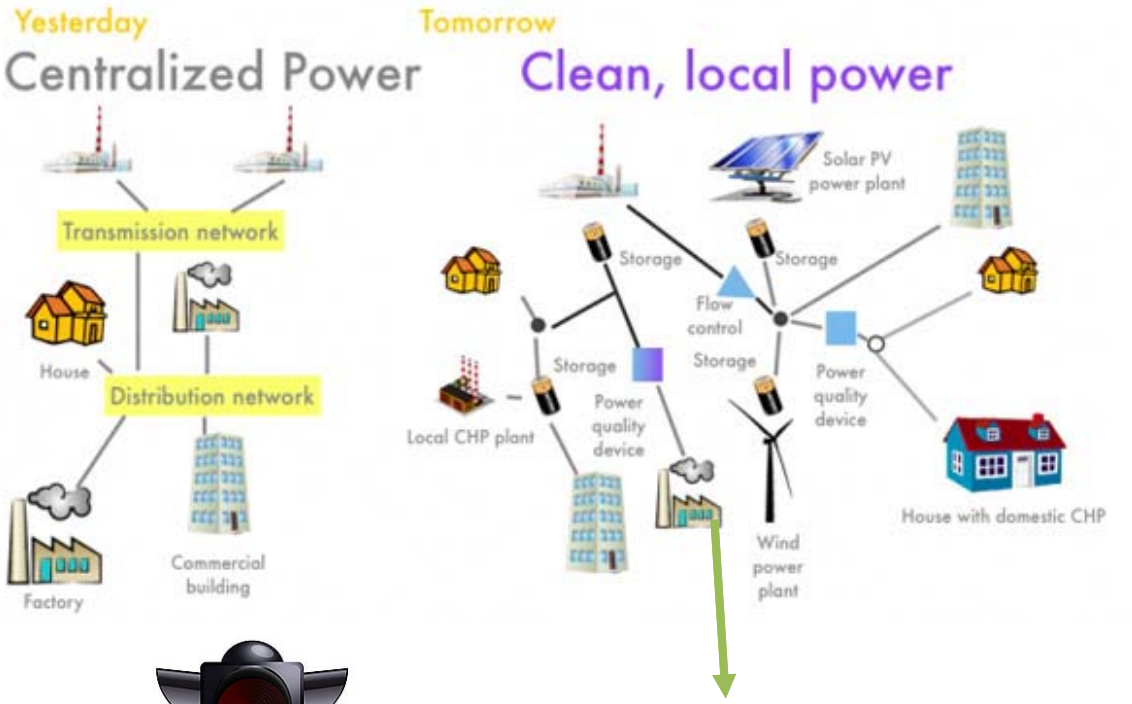
Discussion overview

- Introduction to the problem of imbalances fee for distributed generation
- Aim of the paper
- Real case presentation
- Conclusion

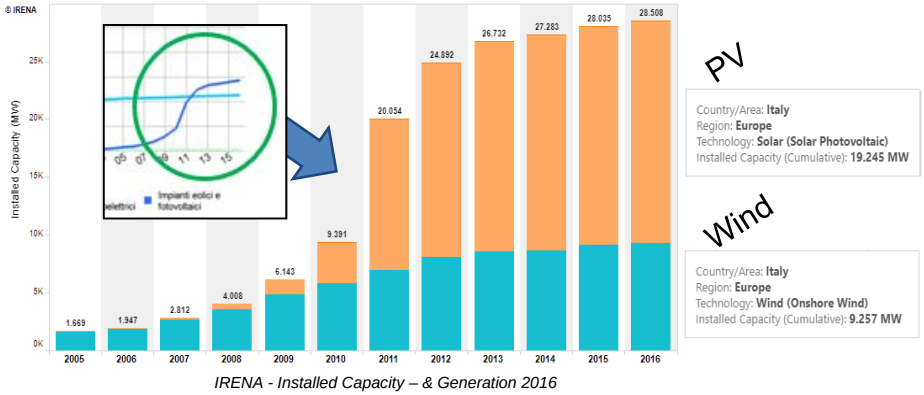
Introduction



- Distributed generation from small-size power plants<10MVA (DG)
- Better and strong use of RES
- More sustainability
- Engagement of final user

Significant incentive policy to encourage the use of DG

Not programmable RES plant
Trend in Italy



IRENA - Installed Capacity – & Generation 2016

Trend of installation of RES (photovoltaic and wind) plant from 2005 to 2016

Trend of demand from 2005 to 2017

Trend of demand supplied by RES (photovoltaic and wind) from 2014 to 2016

Problem

Electric system unchanged over the years + **Not Programmability of most common RES** + **Increase of n. of connection requests from RES** =

- High degree of variability;
- Difficulties in planning operations and management the system;
- Problems on security;
- Economic engagement to face instability.

→ ***Increase of TSO dispatching costs***

Problem

Increase of TSO dispatching costs + **Operators arbitrage using imbalances rules** =

- Introducing imbalances penalties for DG
- New rules for imbalances penalties

→ ***Increase of imbalances costs for DG***

Aim of the paper

To analyze the actual Italian imbalance policy for DG

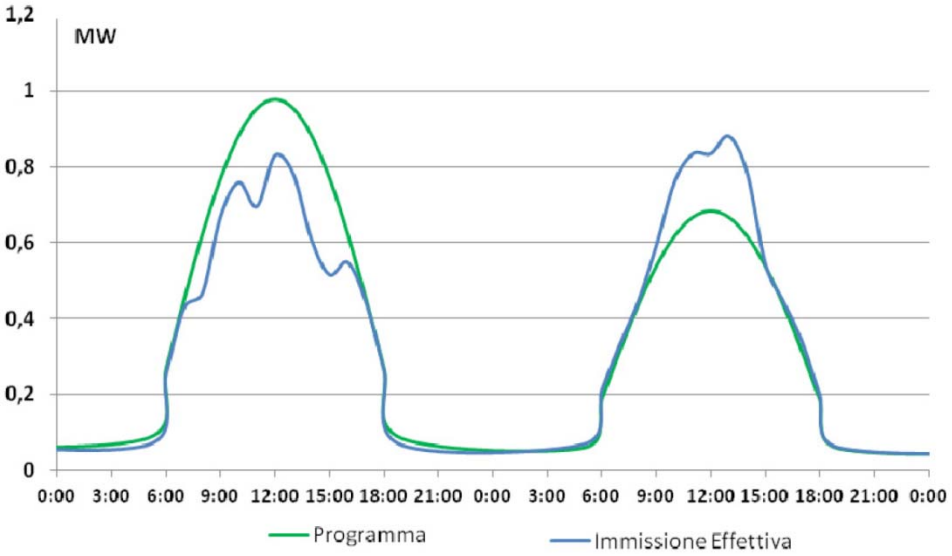
+

Evaluate its impact on the economic point of view for DG

Input for economic evaluation of countermeasures

DG Imbalances:
Premises

The sources cannot be programmed only forecasted ✚ **Forecast depend on local weather forecast** ✚ **DG cannot operate in intraday and balancing market**



Imbalances cannot be avoided by DG operator

Brief history of Dispatching Regulation in Italy by AEEGSI

- In a first time, RES do not pays penalties for imbalances.
- Deliberation 281/2012/R/efr introduces imbalances fees for DG
- Deliberation 522/2014/R/eel reviews the deliberation in consequence of legal engagement with RES company
- Deliberation 444/2016/R/eel establish new imbalances fees also for DG
- Deliberations 800/2016/R/eel and 419/2017/R/eel extend till March 2018 the use of imbalances fees introduced by deliberation 522/2014/R/eel

Imbalance fees for DG actual and future

Actual (case A): Deliberation 522/2014 penalties:
Within the range error (8% for PV): zonal price +equalization price
Out of the range error: Single price based on MSD price

From March 2018 two options:

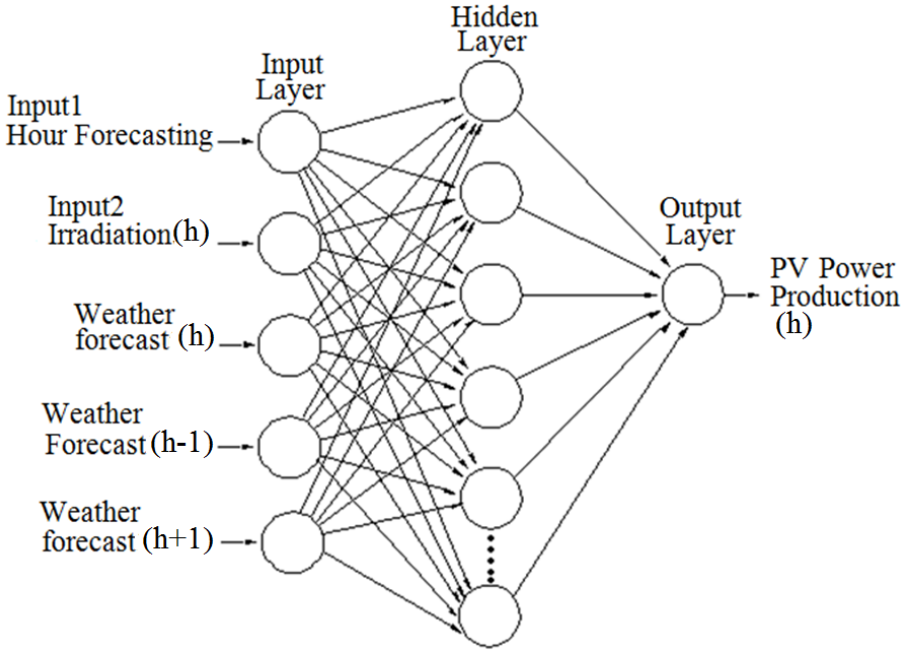
Case B Deliberation 800/2016
Within the range error (8% for PV): zonal price +equalization price
Out of the range error: Dual price

Case C Deliberation 444/2016
Within the range error (7,5% for PV): single price based on MB prices+equ. price
Out of the range error: Dual price

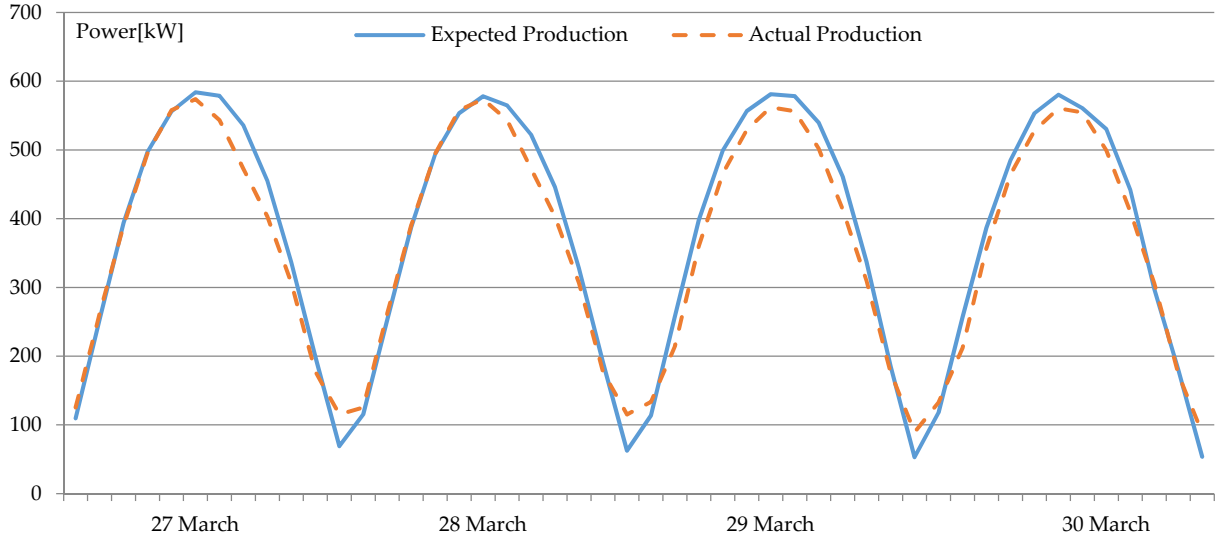
Quantifying imbalances costs: PV Forecast method

The used Artificial Neural Network (ANN) and consists in:

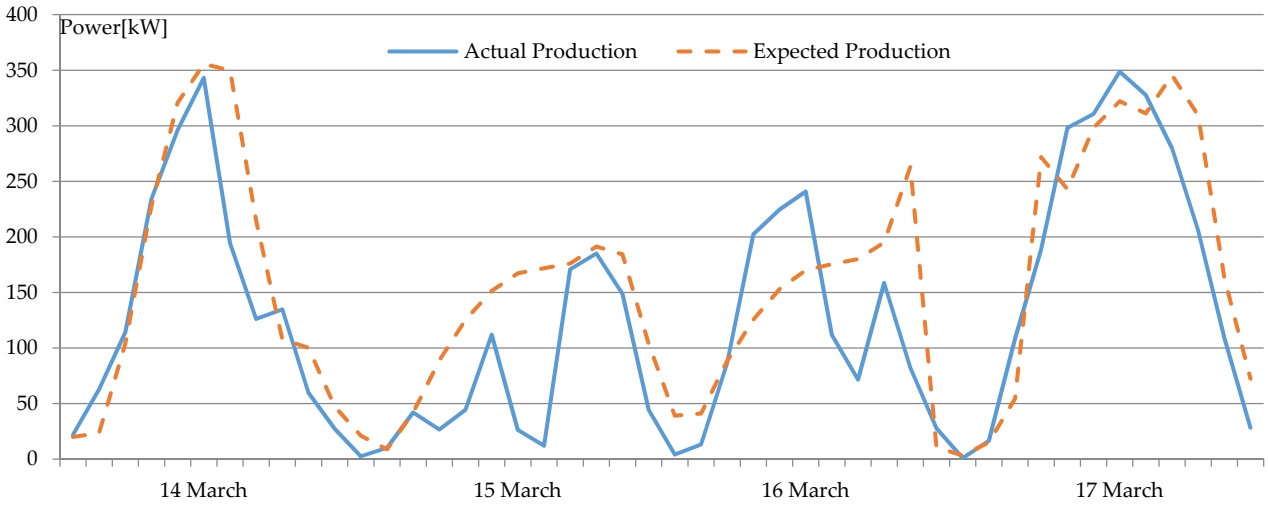
- 5 input neurons (meteorological condition of the considered hour h, meteorological condition of the hour h+1, meteorological condition of the hour h-1, the hourly irradiance, the considered hour);
- 30 hidden layer neurons;
- 1 output neuron (hourly forecasted power production).



Quantifying imbalances costs: PV Forecast method

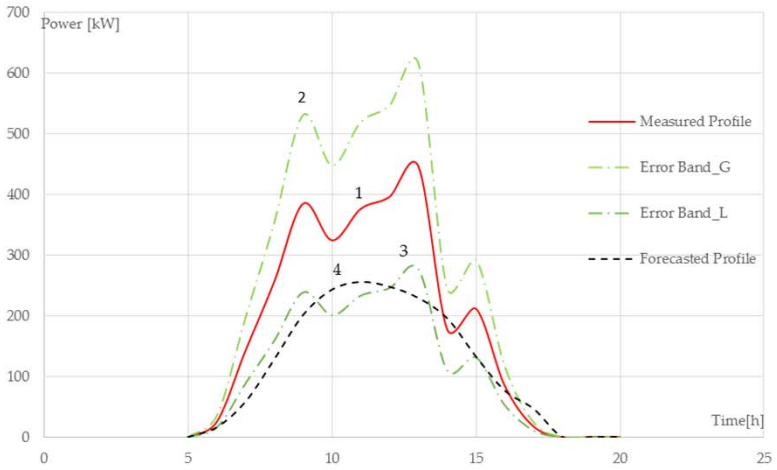


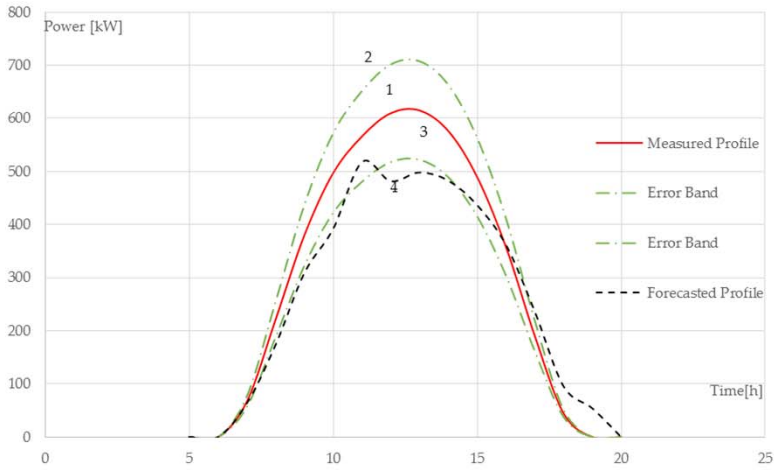
Clear sky



Not clear sky

Quantifying imbalances costs: PV Forecast method





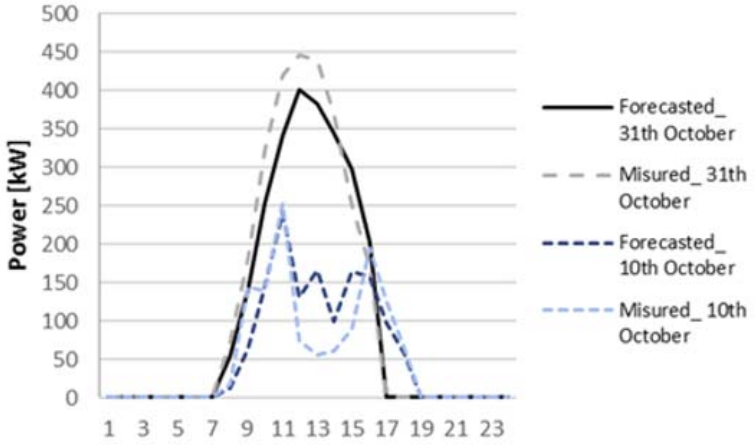
Line 1 (red) indicates the actual PV production
Line2 and Line3 are obtained utilizing the MAPE of the method [1], respectively greater and lower than the actual profile, obtaining an error band.
Line4 indicates the forecast production obtained using the implemented forecasting method

[1] Chen, C.; Duan, S.; Cai, T.; Liu, B. Online 24-h solar power forecasting based on weather type classification using artificial neural network. Sol. Energy 2011, 85, 2856–2870, doi:10.1016/j.solener.2011.08.027.

Quantifying imbalances costs: A real case

Test Case: a unit of production, not relevant, non-eligible, from NPRS. This unit is a 975.5 kW photovoltaic plant, located Cirò Marina - Crotone, Italy. Tests are reported for October 2016.

To send the binding modified and correct program - the prediction of the energy generated by the plant in a certain time interval - to Terna, we use a PV forecasting model, using available input data, that is weather forecast download by internet, and an Artificial Neural Network.



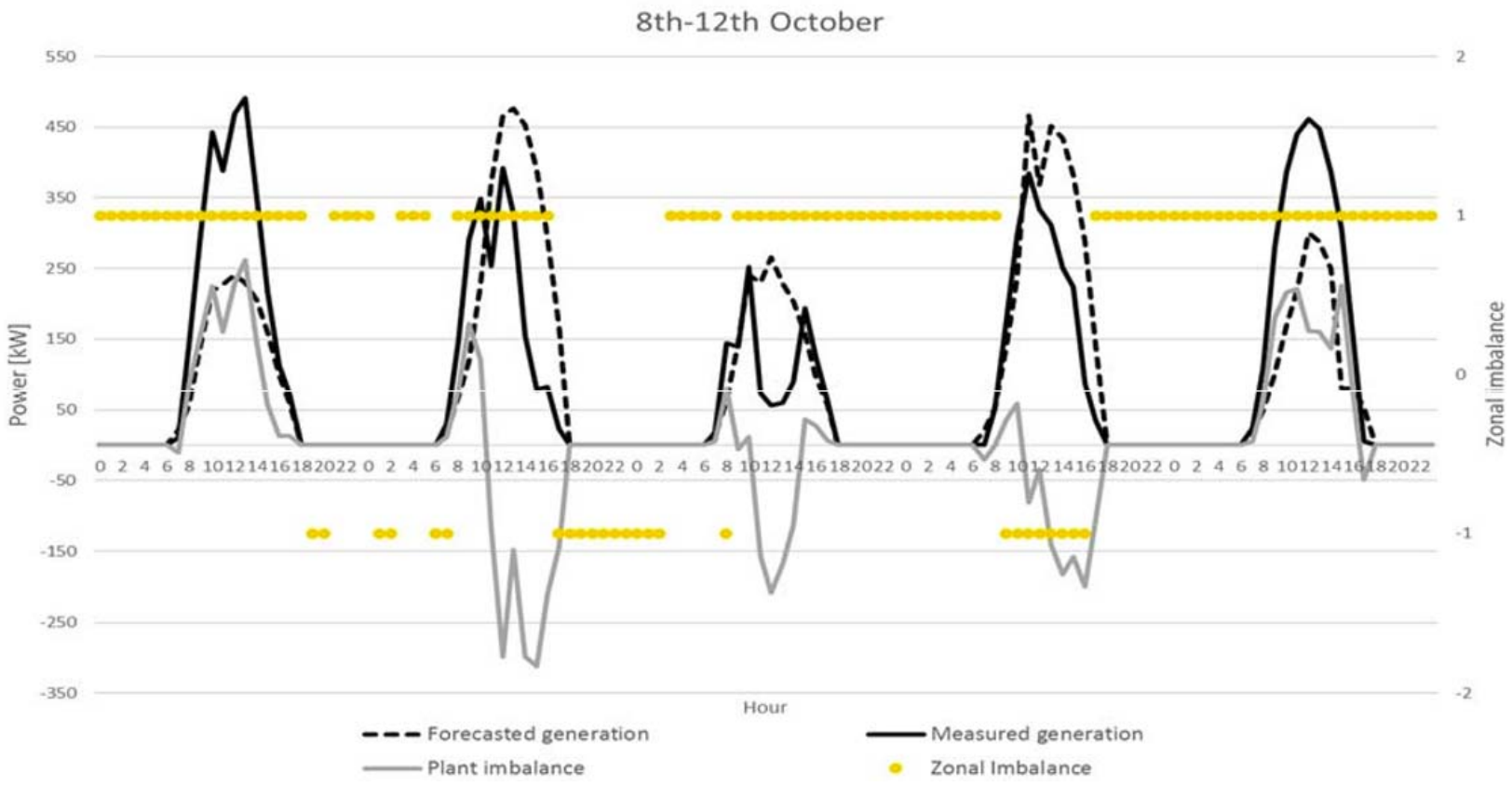
Aggregated Zonal Imbalance

- 167 h of negative imbalance
- 349 h of positive imbalance

Respect to these values, the imbalance of the plant was:

- 49,3% in agreement of sign
- 51,7% in opposite sign

Quantifying imbalances costs: A real case



1: positive aggregated zonal imbalance
-1: negative aggregated zonal imbalance

Quantifying imbalances costs: A real case

Economic values of imbalances for 5 days calculated with diffenet alternatives [€]

Day	Case A	Case B	Case C
8/10	22,56	19,54	22,26
9/10	-31,98	-56,06	-57,12
10/10	2,51	-17,82	-19,06
11/10	-19,16	-30,59	-32,99
12/10	31,24	28,77	30,30

Monthly economic values of imbalances

Month	Case A	Case B	Case C
February	-484,20	-737,09	-781,42
March	92,733	-396,11	-435,51
April	163,982	-305,71	-326,96
May	-836,183	-1636,67	-1690,91
June	342,824	-777,23	-735,13
July	-10,132	-281,53	-304,32
August	-157,45	-487,60	-452,32
September	-277,40	-611,36	-629,81
October	50,05	-391,57	-395,16
November	-218,39	-468,89	-494,21
TOT	**-1334,17**	**-6093,80**	**-6245,79**

Conclusions

- New rules have negative impact on DG economics, damaging the grid parity goal for DG
- Better and 'cheaper' forecasting methods are necessary
- Before introducing the new rules, DG has to be able to partecipate to intraday market and balancing market in aggregated mode, so deliberation 440 has to be postponed when the full implementation of deliberation 393/2015/R/eel reforming dispatching market will take place

Thanks for your attention!