

The impact of photovoltaic on power market in Italy



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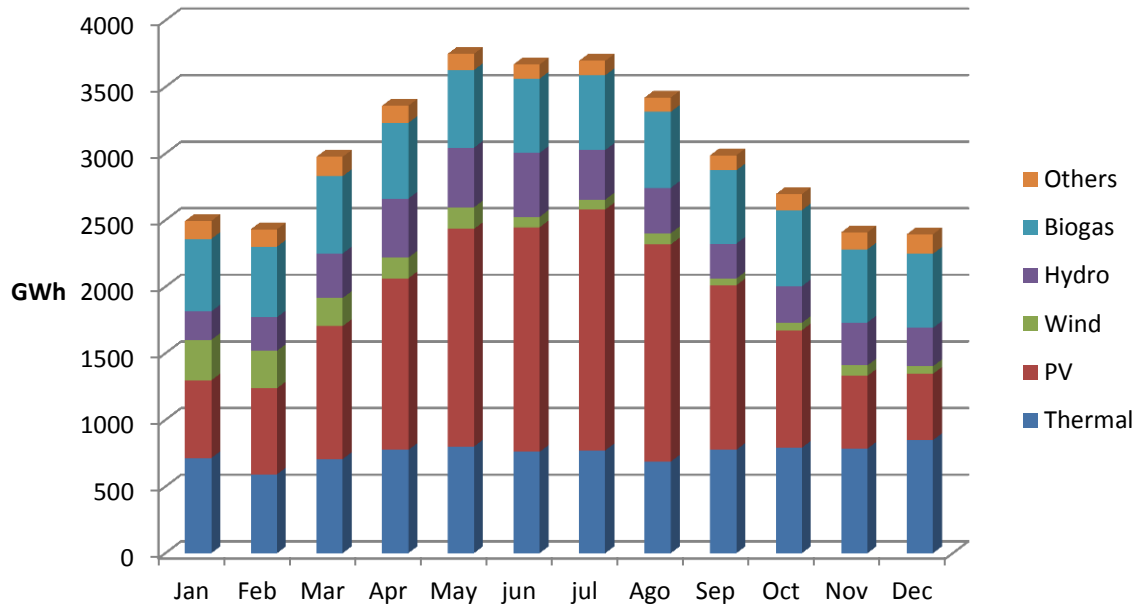
1 PV systems overview

1 Gse's energy sold and relevance in PV market

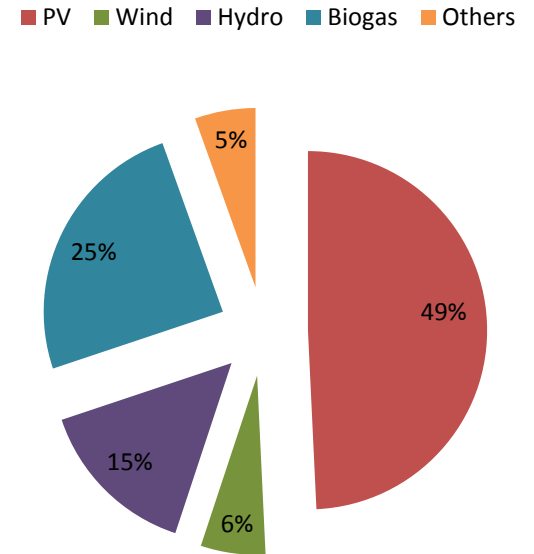
During 2016 GSE has sold in the Italian electricity market*, commonly called Italian Power Exchange (IPEX), around 27 TWh of electricity produced by RES power plants.

The share of solar energy is 49% (**13,4 TWh**) of total renewable energy sources sold on the market.

Energy sold in Day-Ahead Market 2016



%Share of RES 2016



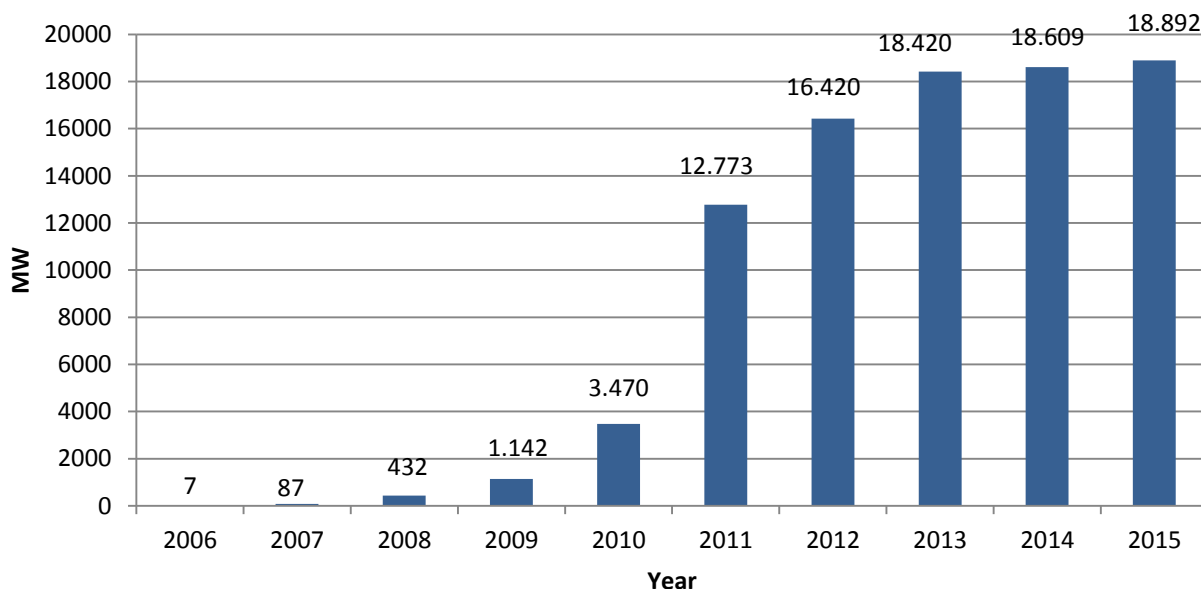
(*) Data are referred to Day Ahead Market's sales

1 PV systems overview

2 Installed capacity ,production

Photovoltaic systems had a quick development during the last decade in Italy (mainly in 2011) due to support scheme for RES generation.

PV italian capacity



Source:Terna

During 2015 GSE managed in 2015 **79% of total PV capacity installed** in Italy . GSE is in charge to support the italian trasmission operator **forecasting the total production of italian PV systems** .

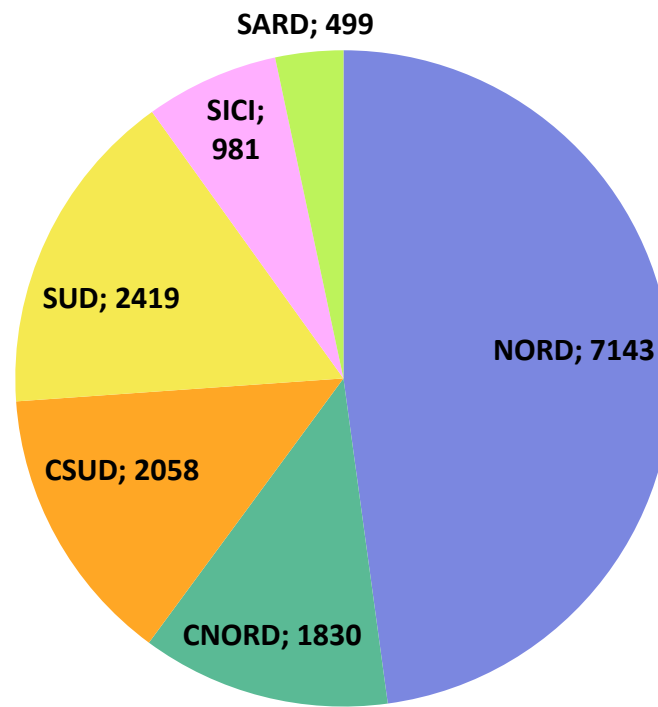
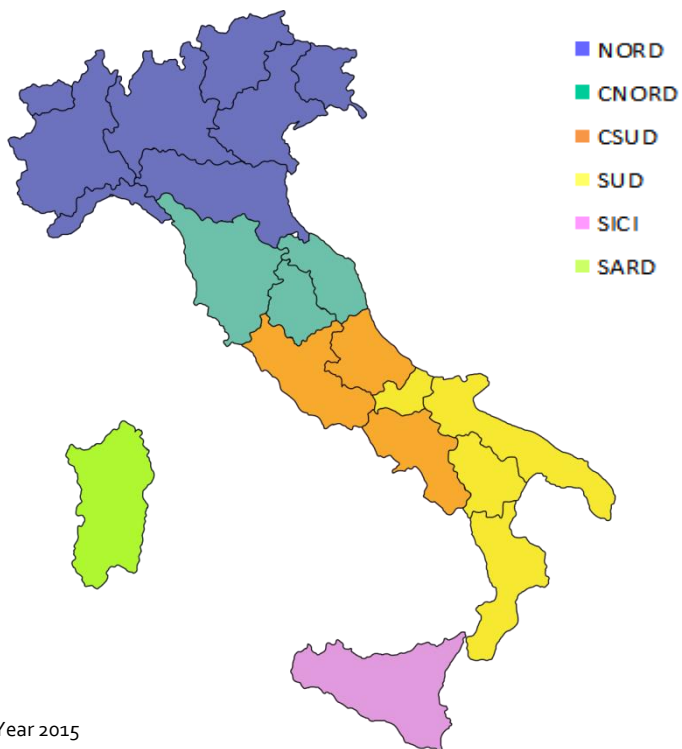
1 PV systems overview

3 Geographical Distribution of PV power

The Italian market is split into 6 market zones (NORD, CNORD, CSUD, SUD, SICI, SARD), each of these zones is considered by TSO as a delivery point of electrical energy.

The figure represents the GSE capacity of PV systems installed* for each zone.

Zonal Capacity in MW



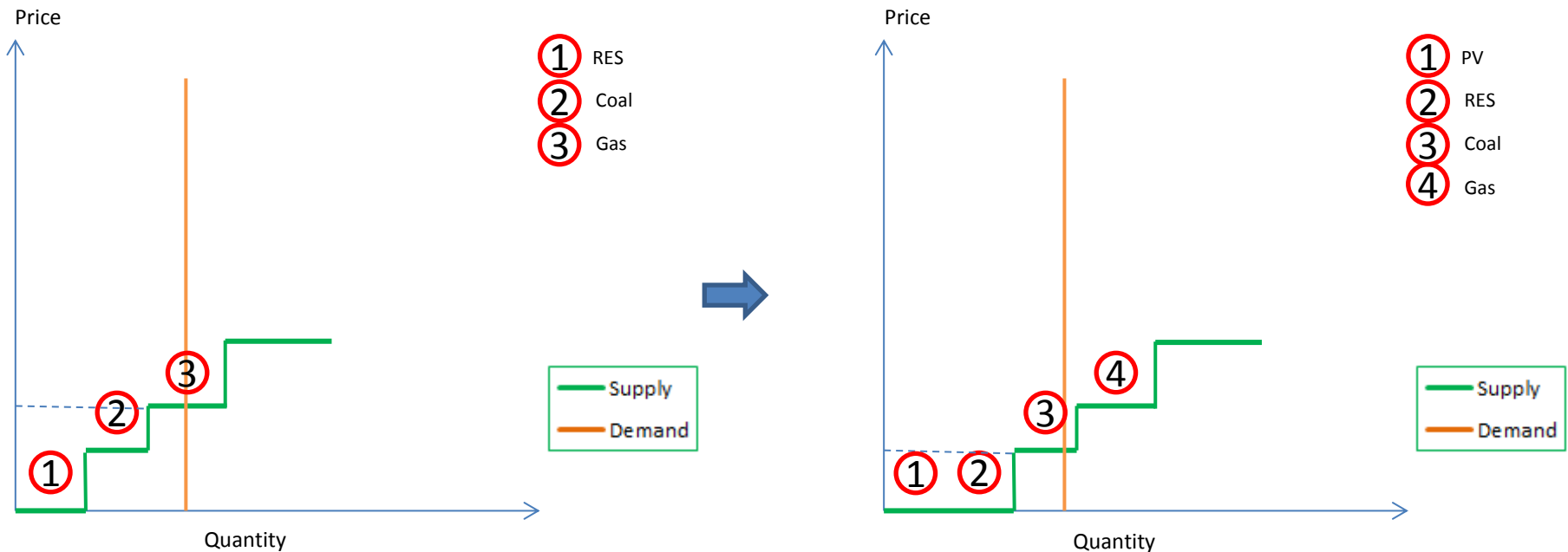
(*) Year 2015

2 Impact of PV systems on Day-Ahead Market

1 Marginal price system and main actors

The Day-Ahead market is based on **marginal price system**. In this kind of system offers and bids are collected and ordered by price. The clearing price (*marginal price*) is the highest price offered and accepted in the market session. Each power plant that offered a lower price is paid at the same price (marginal price).

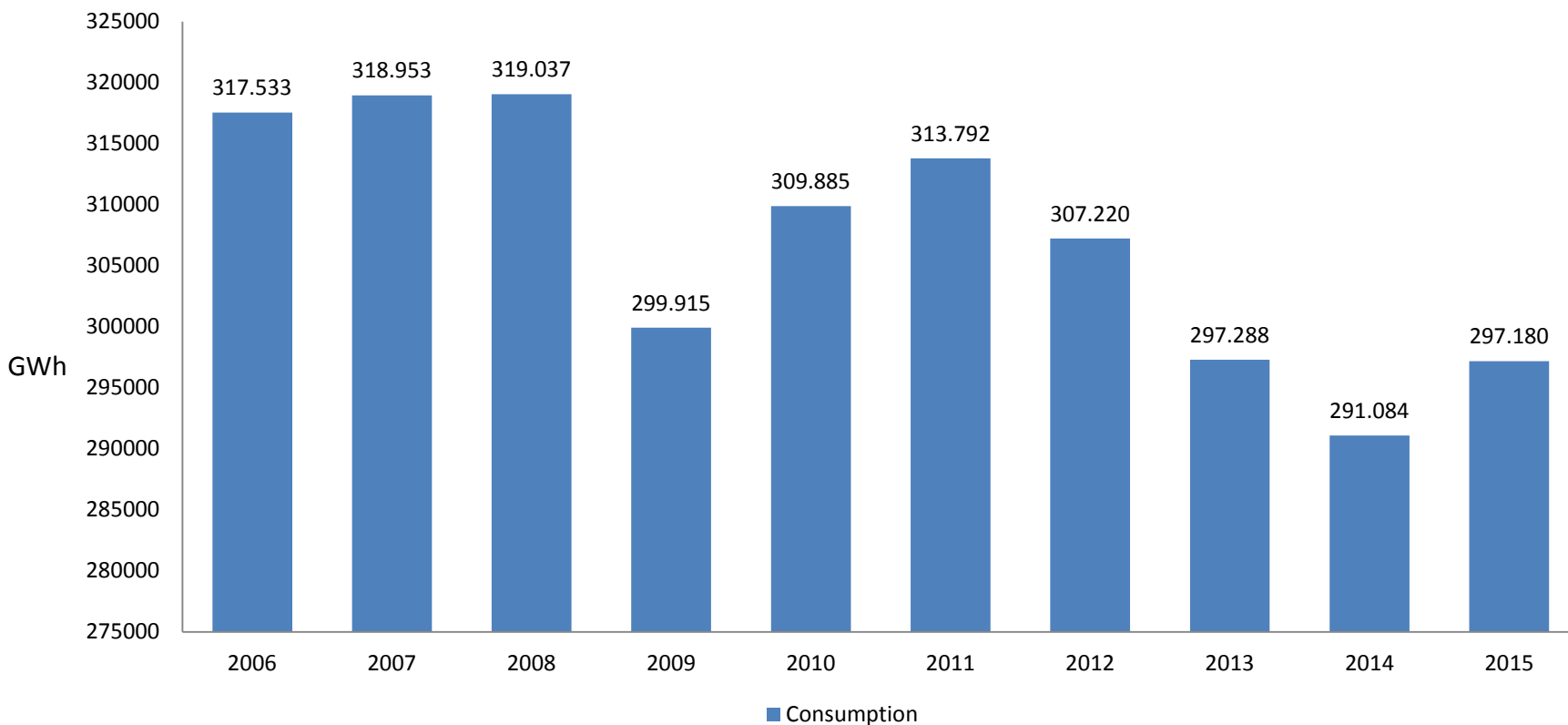
Accordingly the introduction of PV systems (with almost zero variable costs) affects the accepted offer, lowering the clearing price.



2 Demand

Impact of PV systems on Day-Ahead Market

The economic impact of PV production on Italian energy market is strictly linked to demand. In order to have a better understanding of price's development it is necessary to analyze evolution of energy demand in time and geographical distribution of local requirement of energy.

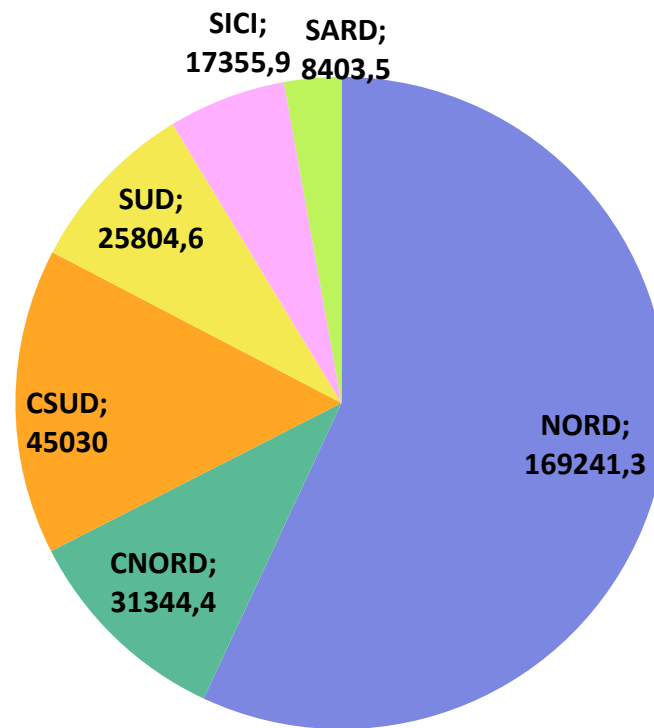
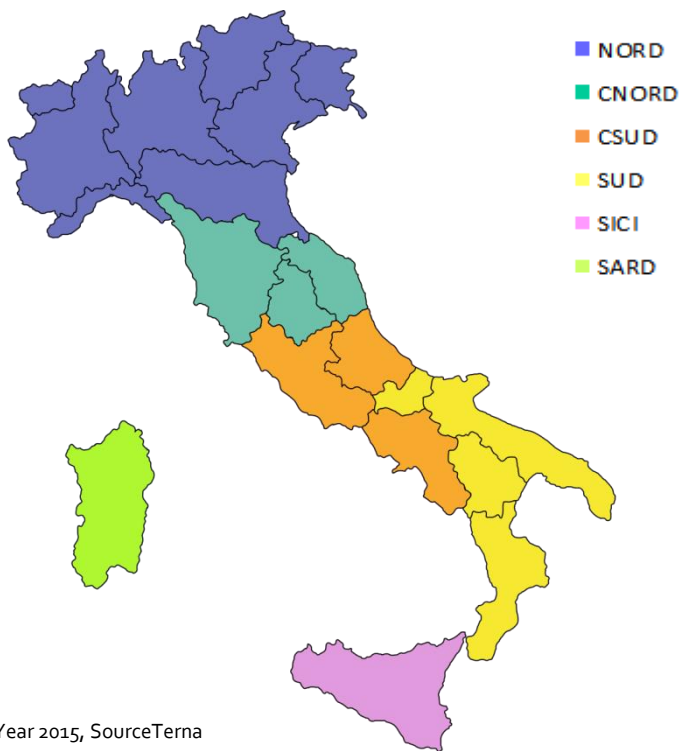


2 Demand

Impact of PV systems on Day-Ahead Market

The consumption of electrical energy is not homogeneously distributed over the grid. The NORD market zone consumption is 57% of the national consumption*.

Zonal Consumption in GWh

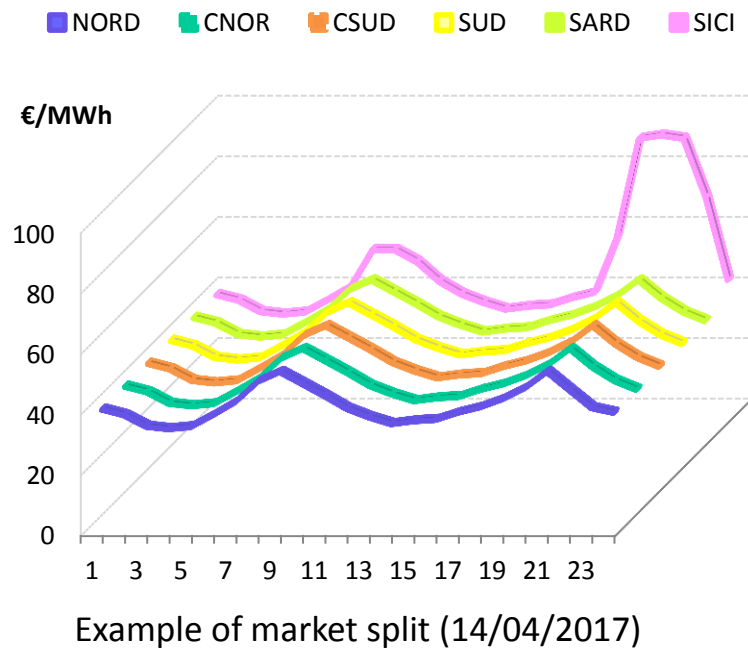


(*) Year 2015, SourceTerna

2 Impact of PV systems on Day-Ahead Market

3 Constraints

Terna (TSO) evaluates power flows limitations on the grid and provide this information before Day-Ahead market opening. The market's algorithm collects all national supply offers and demand bids (described in terms of quantity and price) and calculates the marginal price of accepted quantities. If equilibrium between supply and demand does not satisfy these constraints the market algorithm runs again splitting one or more market zones.

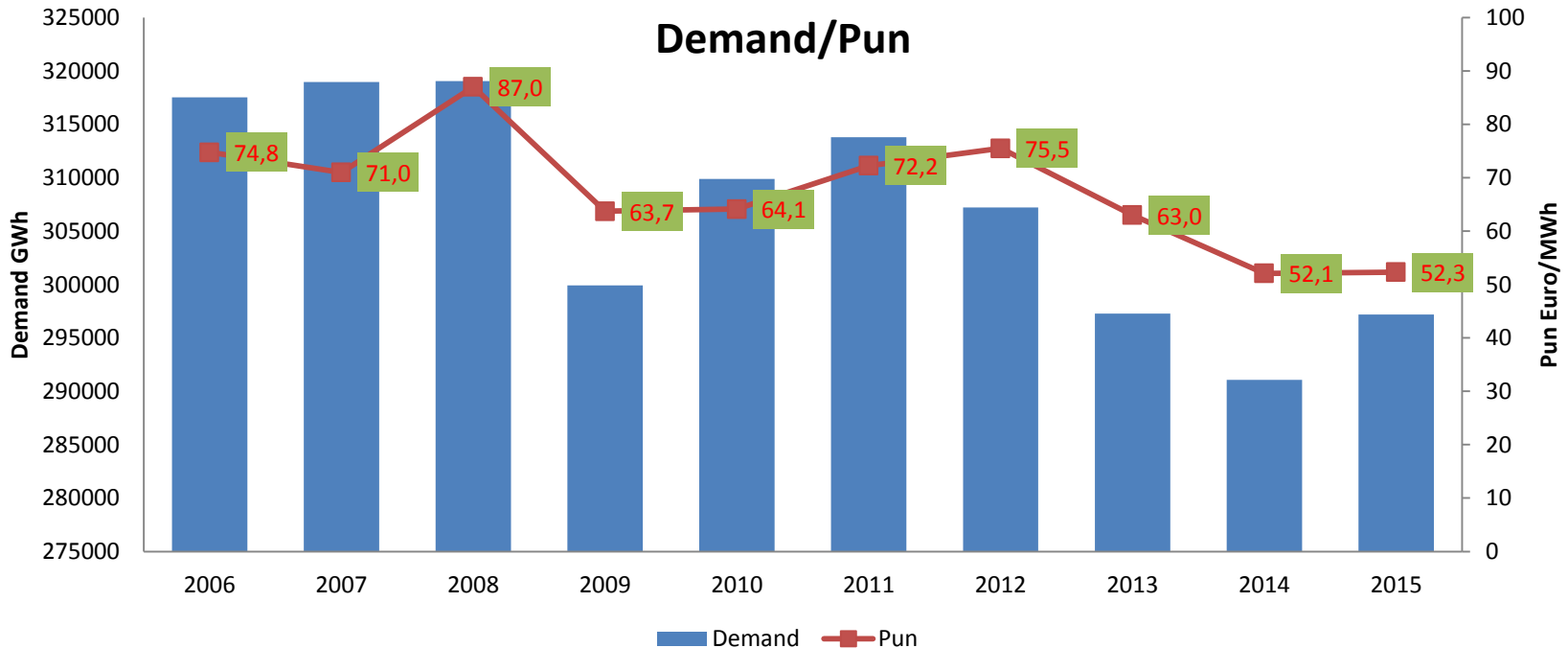


2 Impact of PV systems on Day-Ahead Market

4 Wholesale energy price (PUN)

The *single national price* (PUN) is the wholesale price of weighted average of zonal prices formed in each market zone.

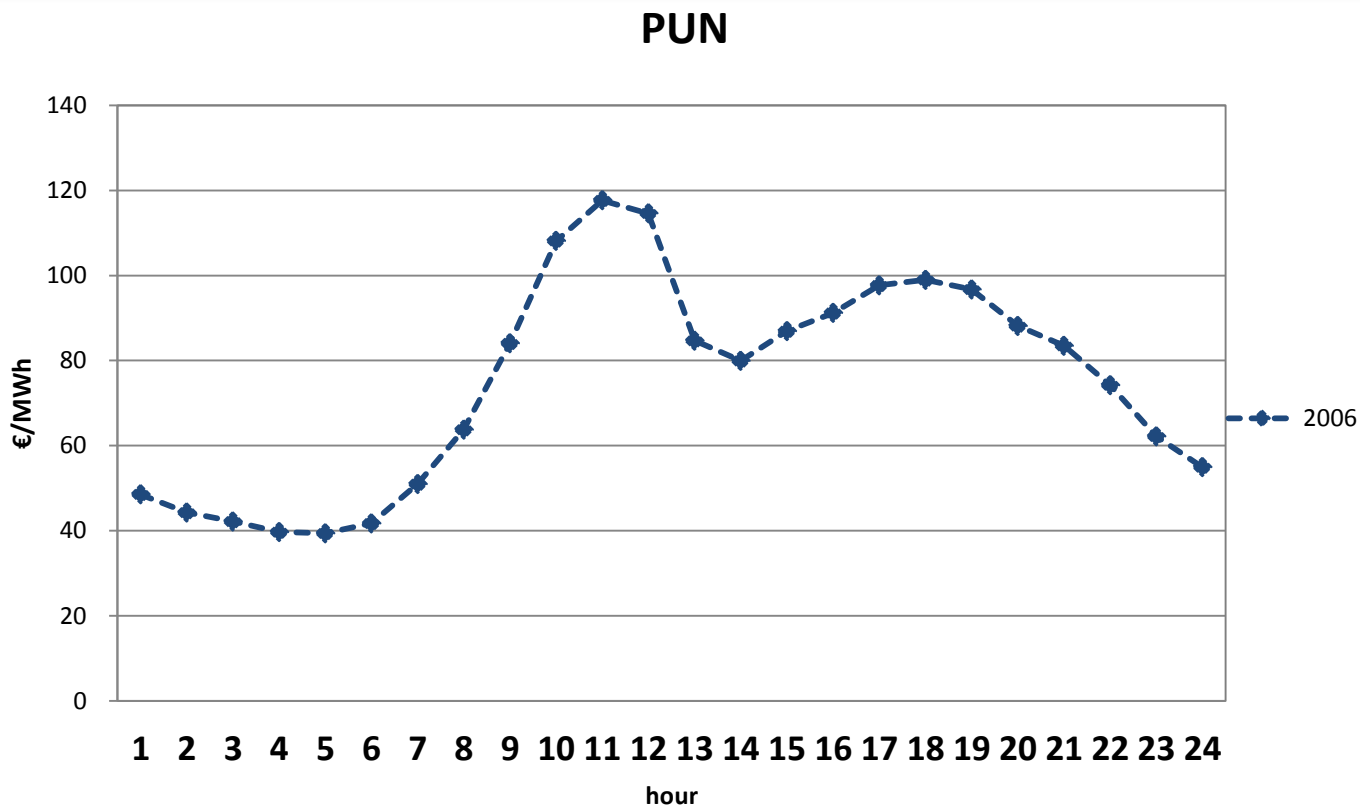
Contraction of demand, development of fuel's cost, increase of PV installations and evolution of imports are the main factors that affect PUN's evolution in time.



2 Impact of PV systems on Day-Ahead Market

4 Wholesale energy price (PUN)

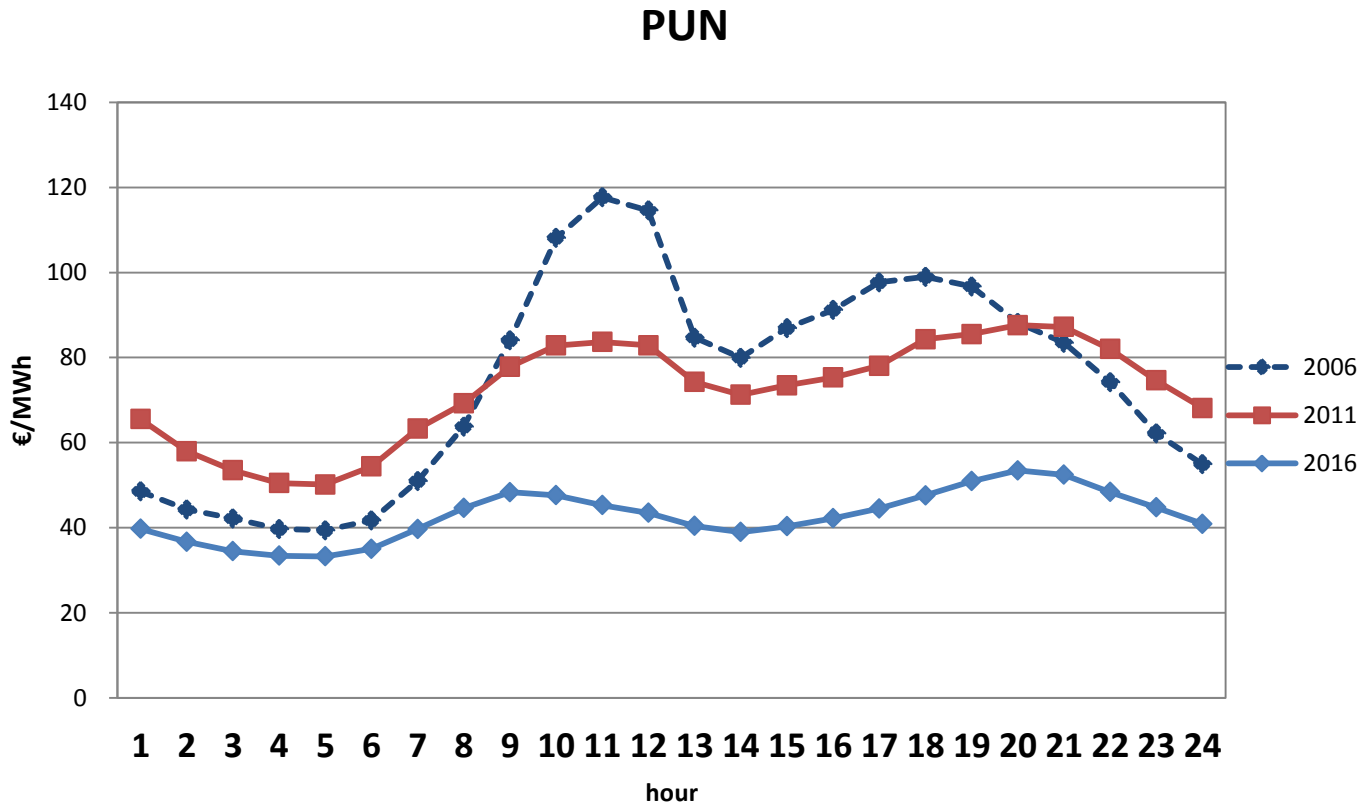
PV production has a direct impact on hourly national price evolution over a day. This phenomenon is not evident in annual average PUN's trend. The figure below shows the average value of hourly price.



2 Impact of PV systems on Day-Ahead Market

4 Wholesale energy price (PUN)

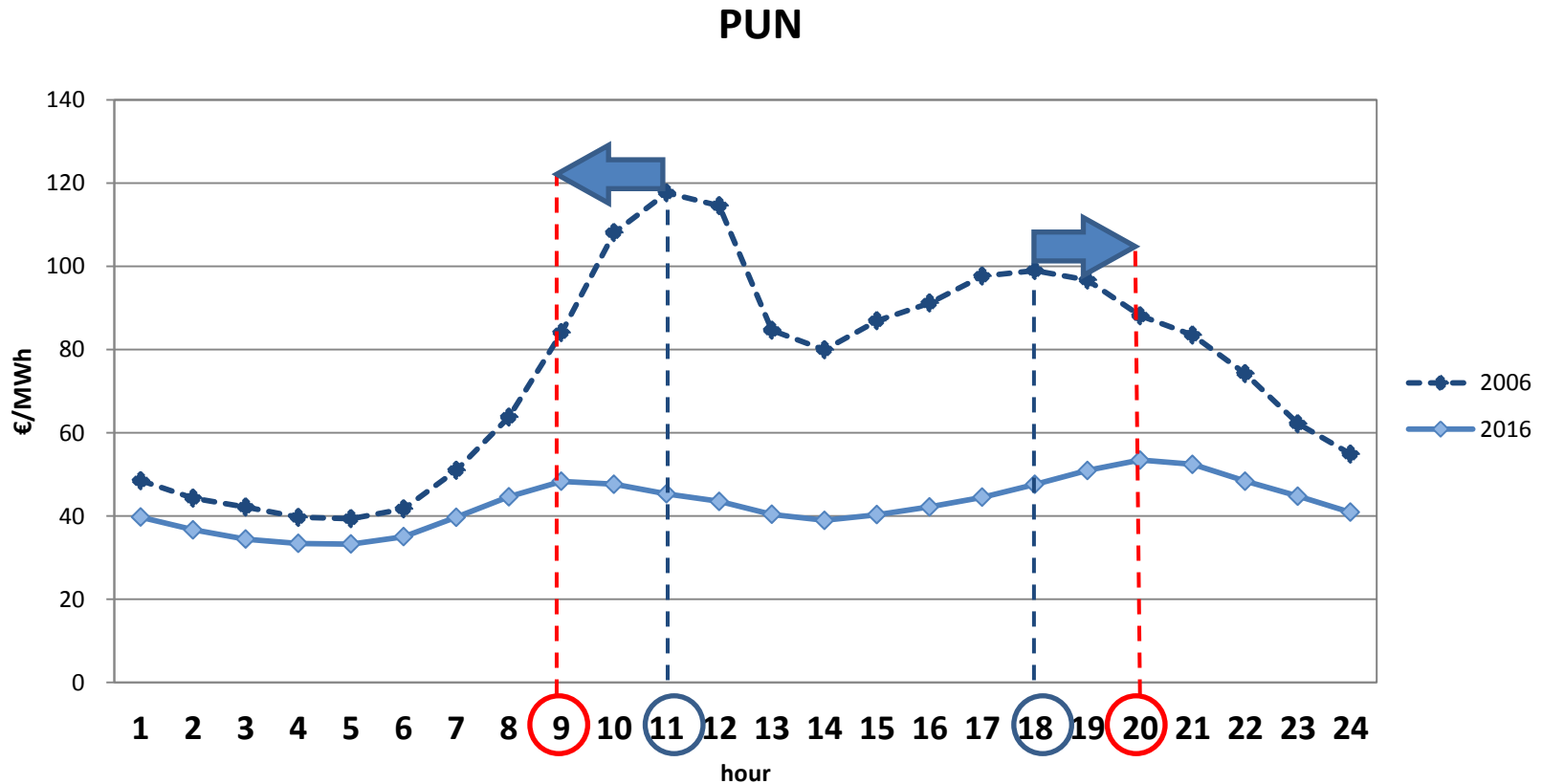
PUN's daily profile has been shaped by PV production during daylight hours. The absolute value is mostly affected by fuel's cost because the clearing price of the market is fixed by marginal power plants.



2 Impact of PV systems on Day-Ahead Market

4 Wholesale energy price (PUN)

Peak price hours shift and increased stability of mean hourly price over the day

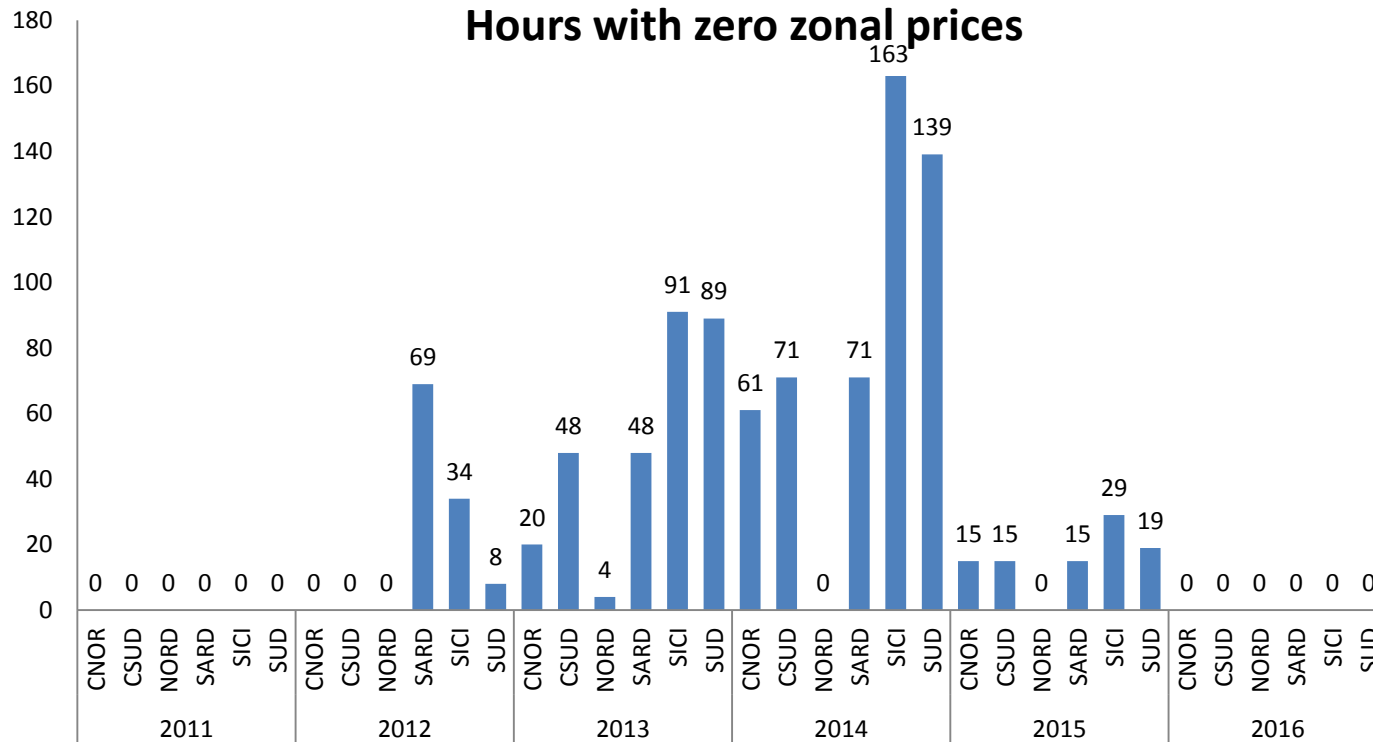


2 Impact of PV systems on Day-Ahead Market

4 Zero Prices

PUN is an averaged macro parameter which is not suitable to describe sporadic events that are nevertheless emblematic for the market.

Italian market doesn't allow dispatching users to offer negative prices. The *floor* is equal to zero. In the figure is shown the number of hours in which the marginal price of the power market have been equal to zero.

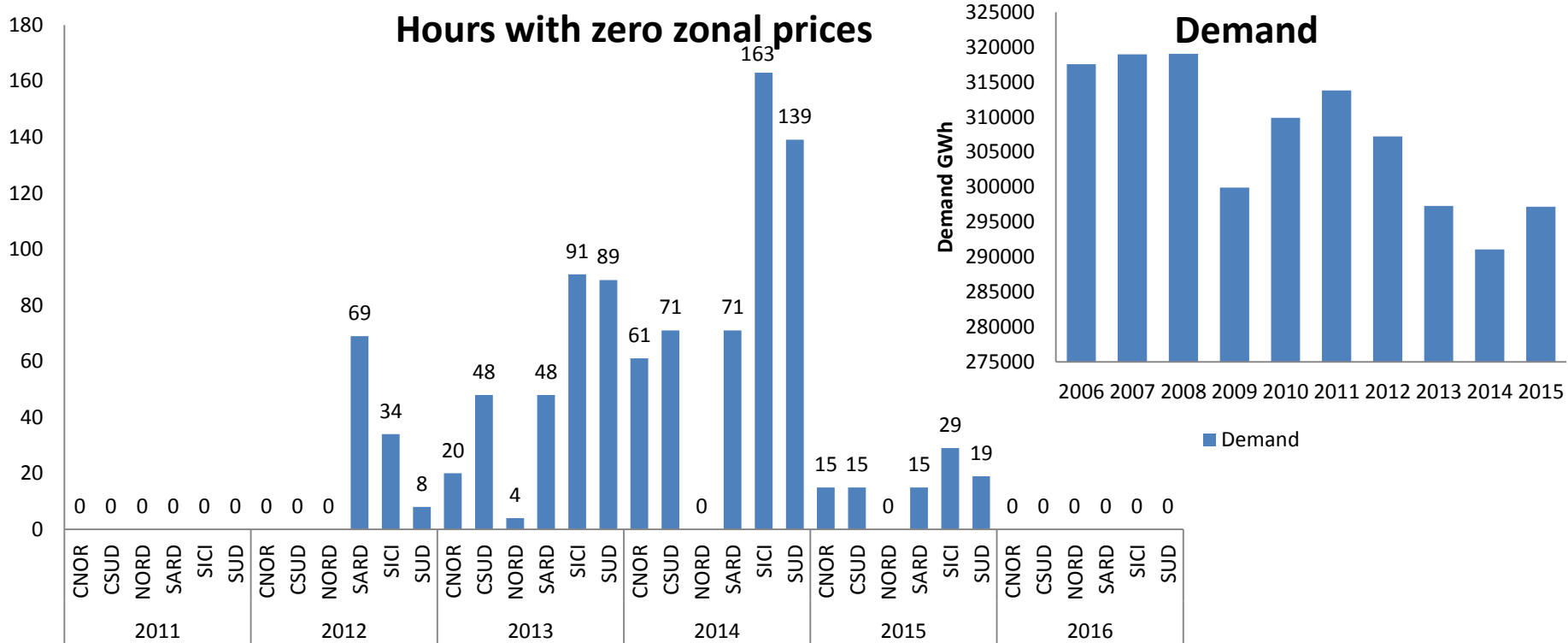


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3 Next steps

The anomalies underlined require investments in grid development and improvement of market rules and structure

The main issues authorities and stakeholders are working on are:

- Capacity Market
- Dispatching services in MT/BT (DSO)
- Ancillary services provided by FER

Thanks for your attention