



**RENEWABLE ANALYTICS<sup>LLC</sup>**

**Effects of PV Electricity Generation on Wholesale Power Prices  
Summary 2012 and January 2013**

# Summary

- Wholesale electricity costs in Germany decrease in 2012 vs. 2008 by a total of €6.145b driven by increased solar PV generation (conventional generation is displaced by renewable generation with lower marginal costs).
- As Solar electricity from decentralized systems replaces centrally produced electricity, centralized power producers experience lower levels of capacity utilization during summer month. As centralized power producers try to increase commercial and residential electricity rates this increases the attractiveness of decentralized solar systems: speeding up the process of solar adoption.

# Explanation

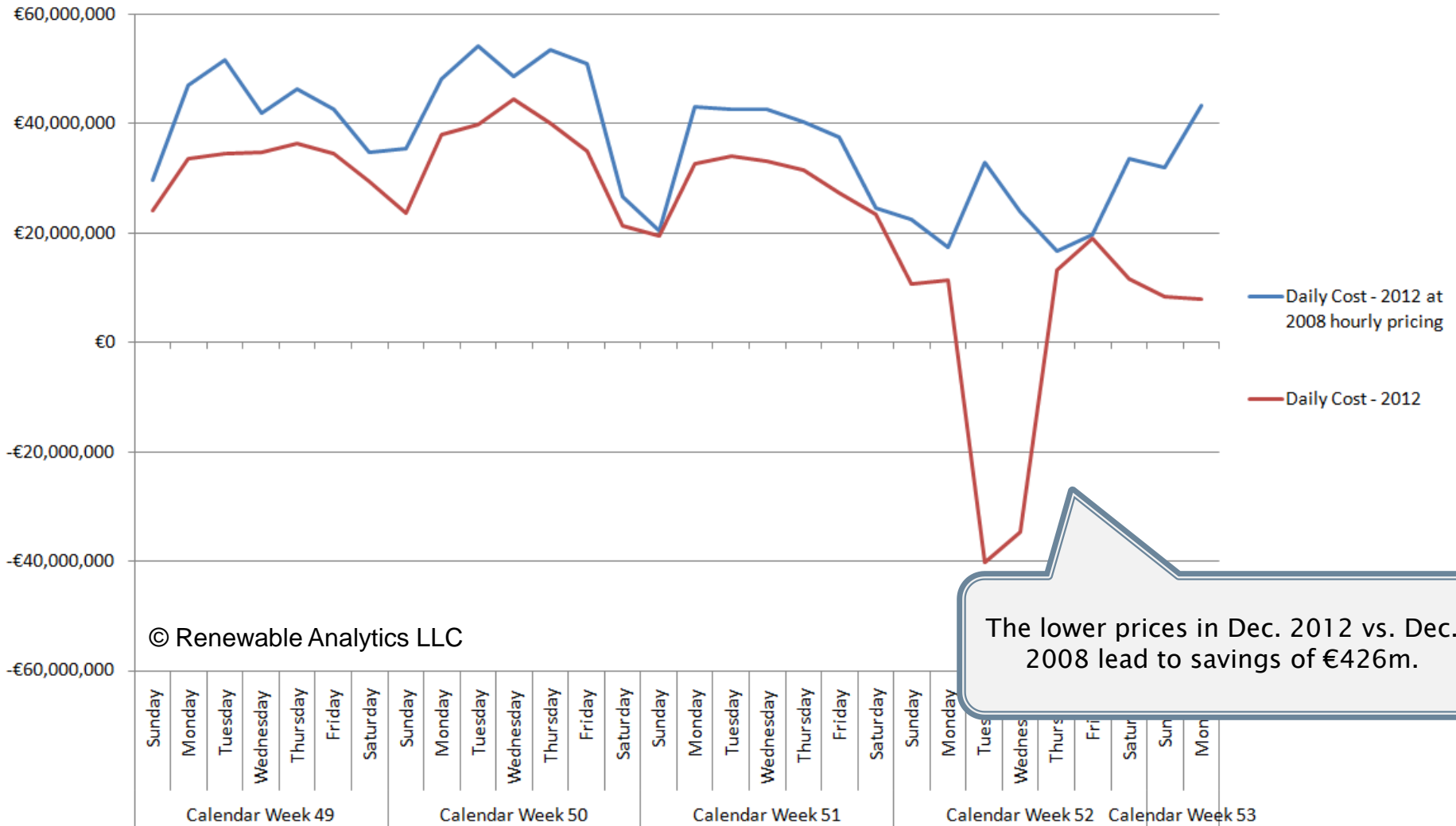
- In Germany, in December, €213m was saved during the day and €213m at night, for a total of €426m. Total difference 2012: €6.145b
- In December 2012 solar power generation had a share of 1.12% of total electricity generation (compared to 2.04% in November 2012)
- In January 2013 solar power contributed 0.83% to the total generation (compared to 1.36% in January 2012)
- Jan 2013 lower than Jan 2012 although 7.6 GW more installed due to very cold and cloudy first 3 weeks of January.
- During months of longer and more intense days, a much larger drop in pricing has occurred, and it takes place almost entirely due to the price difference during peak solar production hours.
- Impact on pricing will continue if current market framework remains in place. The discussion about the need for a new electricity market design has already started in Germany.

# 2008 vs. 2012 Summary

- 2012 prices were reliably below 2008 prices, and two main trends indicate that a large portion of these price drops were correlated with solar power production: 1) the largest pricing drops tended to occur during the months with the most sunlight, and 2) during months with little sunlight, prices decreased roughly equally during the day and night, whereas during the summer prices decreased much more during daylight than nighttime hours. These two macro trends serve to verify what seems clear when looking at the pricing during any specific day on the German spot market: 2012 prices dip when the sun comes up and stay suppressed until the sun sets; 2008 prices spike during the day instead, as demand peaks. The influx of solar power during 2012 has drastically reduced German spot market electricity pricing.
- **Euros spent during Dec:**

This graph shows that much less was spent on a day to day basis during 2012 than would have been spent at 2008 pricing. The anomalous low price spikes in Dec12 are very visible in the price differences at the end of this graph.

# Daily paid € (total traded volume on EPEX Spot) – Dec '12 Prices and Volumes compared to Dec '08 Prices and '12 volumes



# Explanation

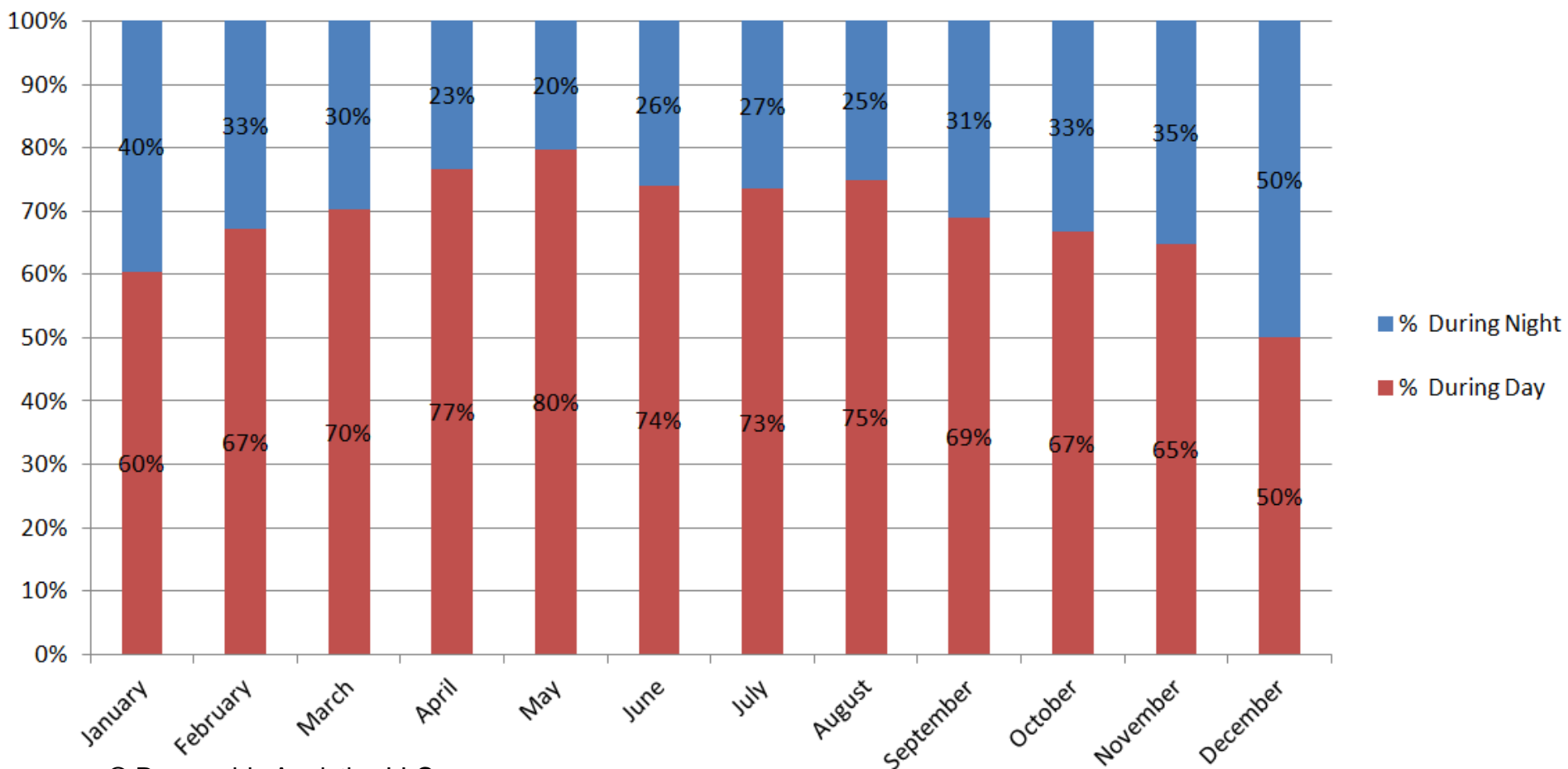
- **Euros saved day vs. night by month:**

Savings per month between 2012 and 2008 continued to drop during the winter months, completing the rough trend for year of highest savings having occurred during the sunnier months. This points towards solar power as being a main factor in the savings between 2012 and 2008.

- **Euros saved %, day vs. night by month:**

The % of saving that occurred during the day vs. the night followed the seasons near perfectly throughout the year, with the largest % of saving during 6am to 6pm always occurring during the months with the most sunlight. This again strongly indicates the influx of solar power into the grid as one of the main factors for the savings between 2012 and 2008.

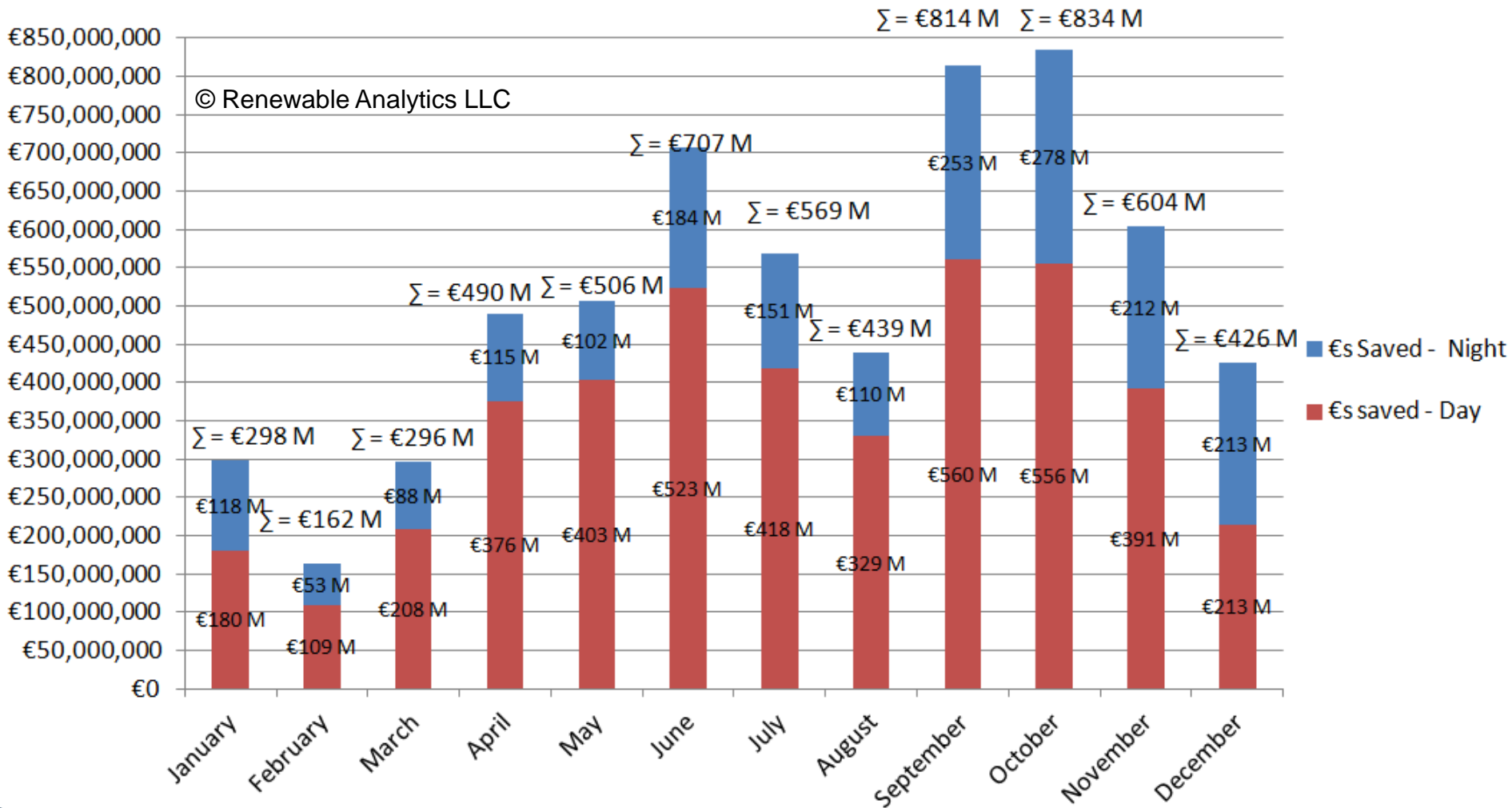
# % of savings per month split into Daytime and Nighttime (2012 Prices and Volumes vs. 2008 Prices and 2012 Volumes)



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Note: 6am to 6pm used for day and 6pm to 6am for night.

# Savings per month – (2012 Prices and Volumes vs. 2008 Prices and 2012 Volumes)



Note: 6am to 6pm used for day and 6pm to 6am for night.

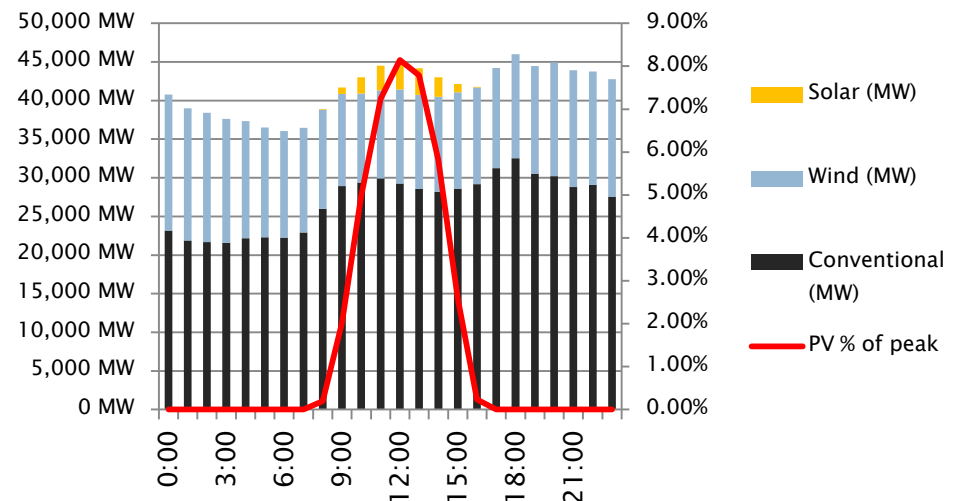


# December 2012 hourly pricing

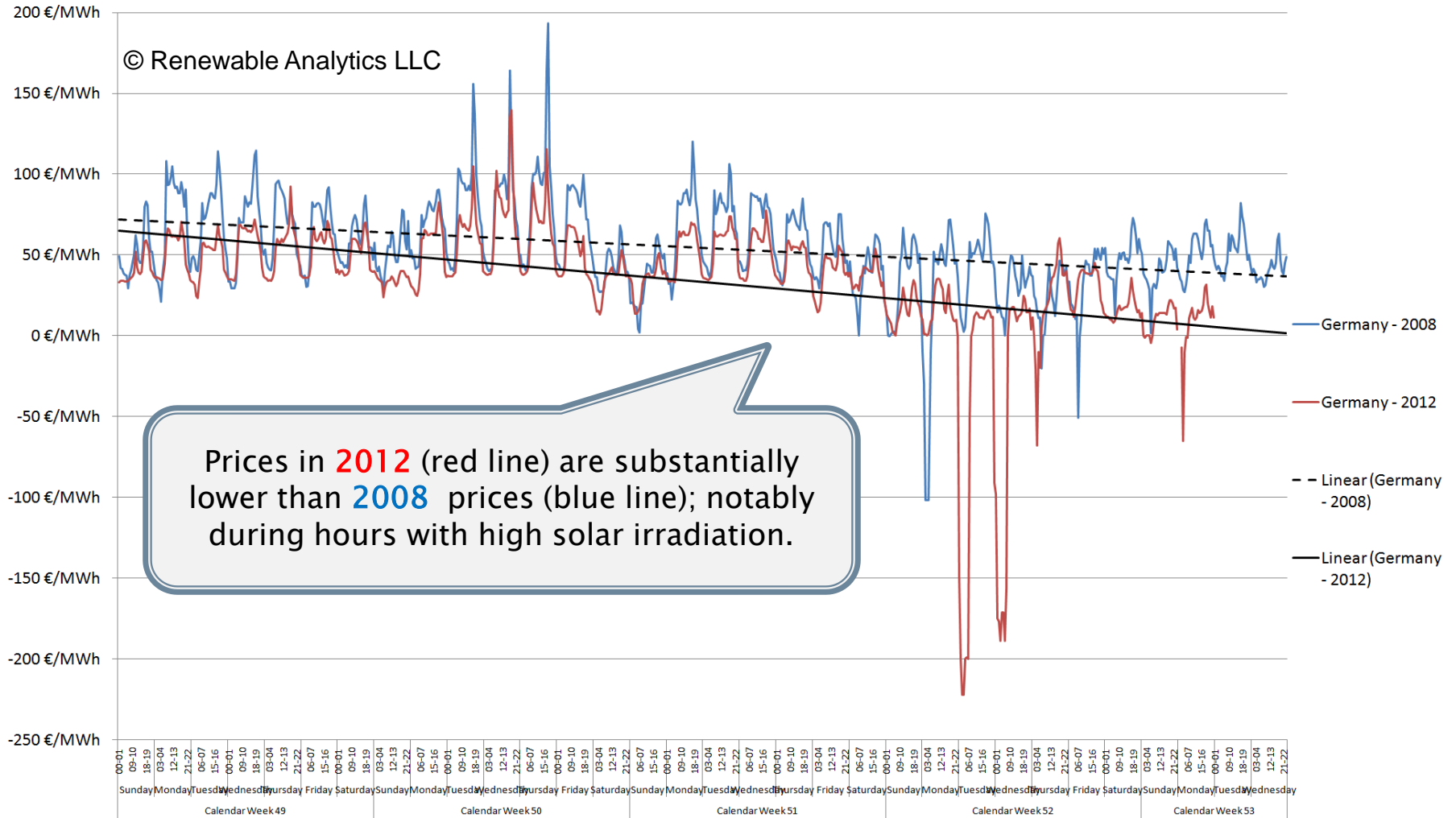
- For the most part, 2012 pricing was below 2008 pricing and followed the general trend of much larger pricing differences during peak solar production hours.
- However, year week 52 (in particular 26<sup>th</sup> December 2012) had some very anomalous 2012 pricing data points during which prices went extremely negative from midnight to 7am Tuesday and Wednesday morning.
- 26<sup>th</sup> December 2012 pricing was negative between midnight and 8am due to low demand and strong wind power input (33% of total generation on that day)

Hourly Price (€/MWh)    Hourly Volume (MWh)

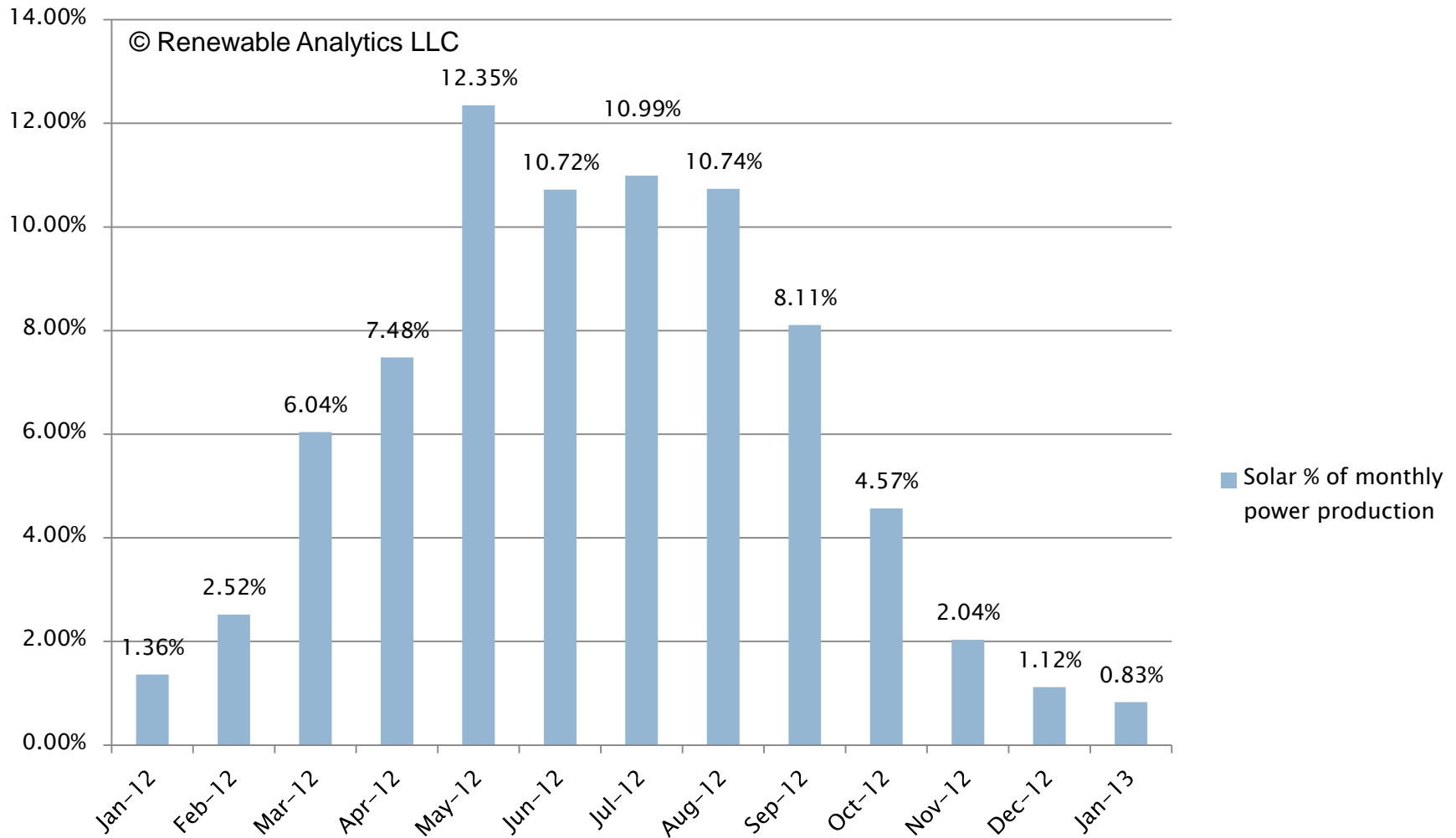
Hour	Hourly Price (€/MWh)	Hourly Volume (MWh)
00-01	-97.82	32085.40
01-02	-174.99	32035.70
02-03	-176.92	32981.00
03-04	-188.91	32536.50
04-05	-170.92	32520.50
05-06	-170.92	31555.90
06-07	-188.95	30504.80
07-08	-156.92	30868.80



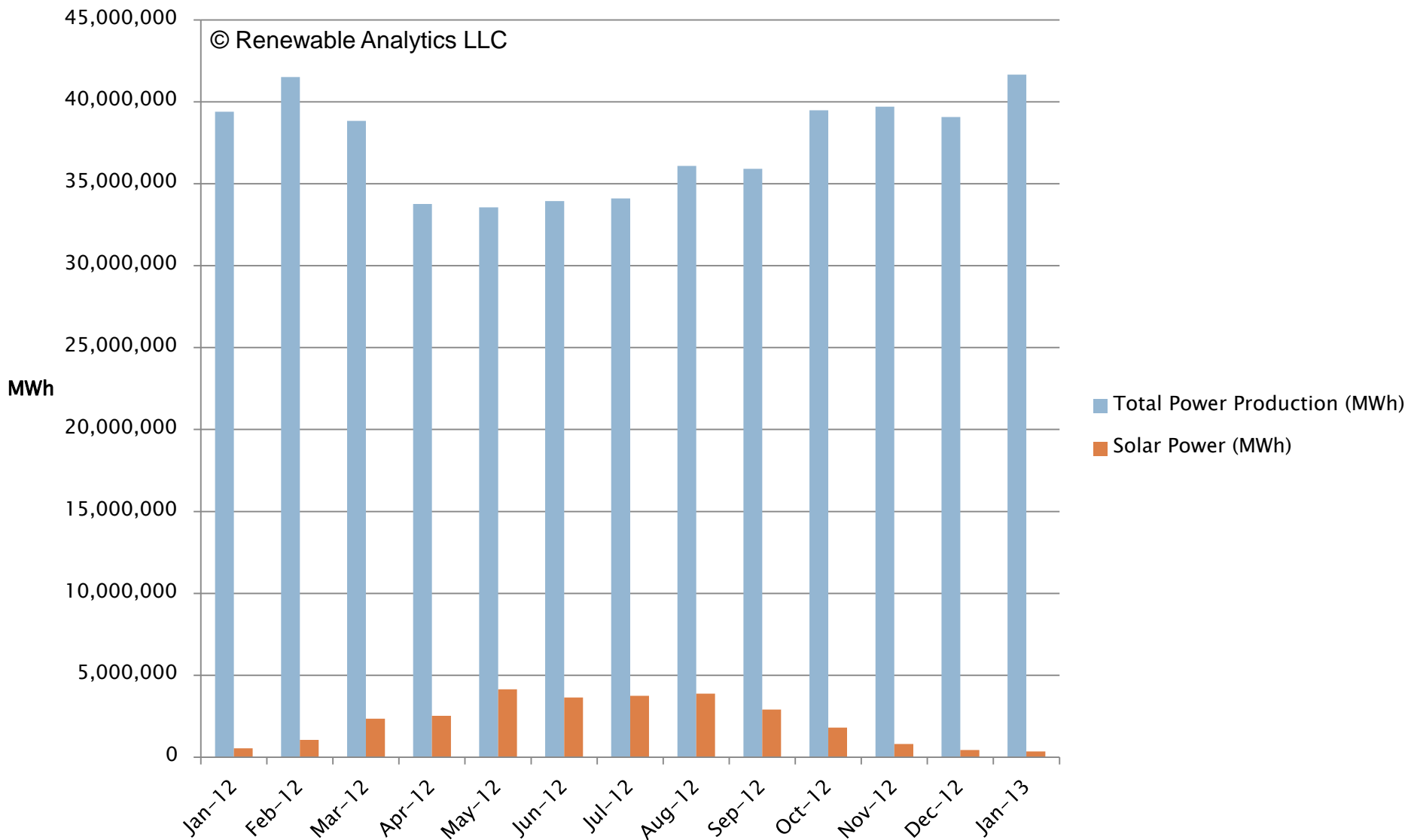
# German Wholesale Power Prices - December 2012 - €/MWh



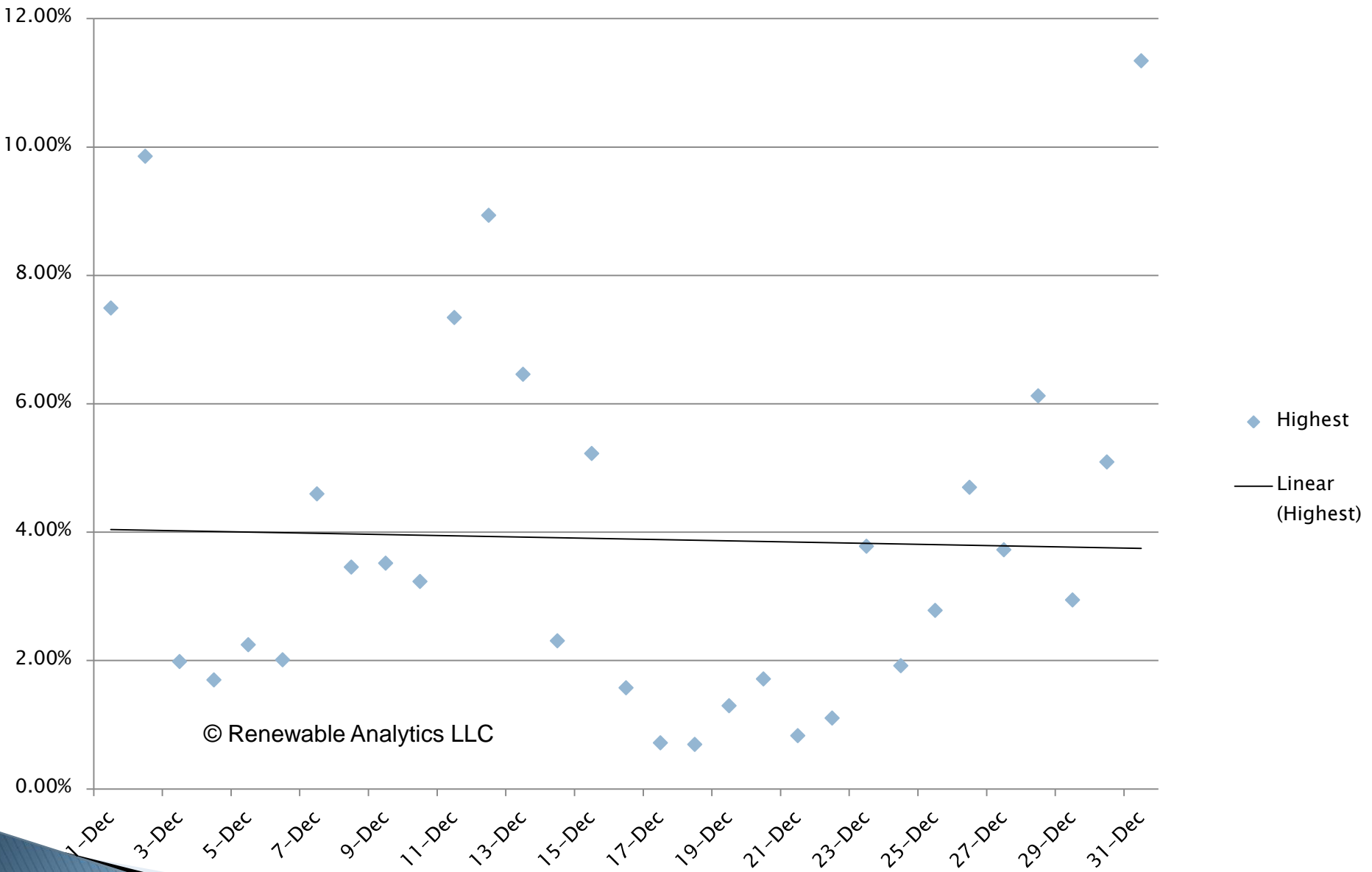
# Solar % of monthly power production (Jan 2012 – Jan 2013)



# Total Power Production and PV (Jan 2012 - Jan 2013)



# Highest solar PV % per day - January 2013

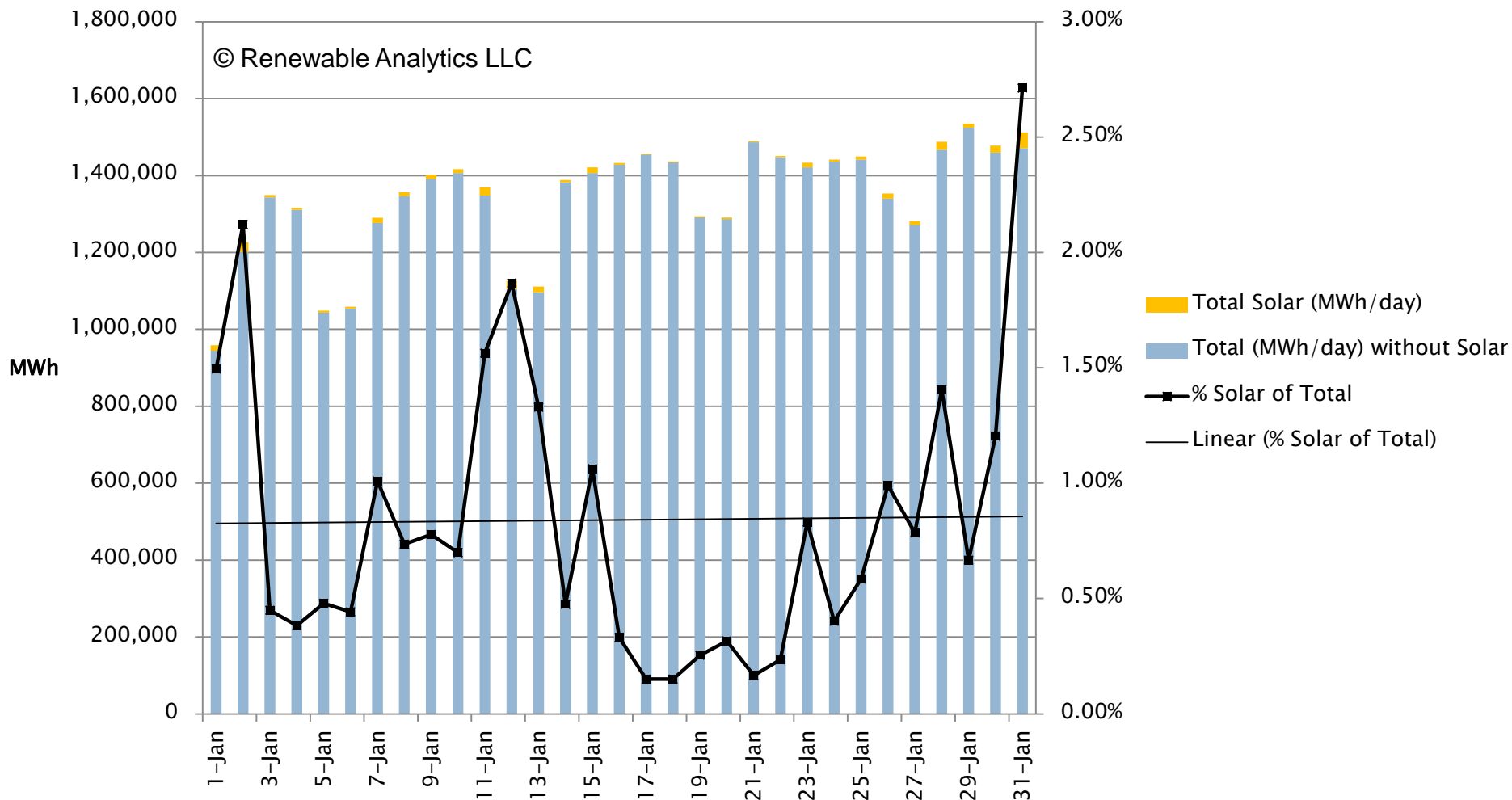


Source: European Energy Exchange

<http://www.transparency.eex.com/en/Statutory%20Publication%20Requirements%20of%20the%20Transmission%20System%20Operators/Power%20generation>



# Solar as % of total electric generation per day – Jan 2013



Source: European Energy Exchange

<http://www.transparency.eex.com/en/Statutory%20Publication%20Requirements%20of%20the%20Transmission%20System%20Operators/Power%20generation>



# Conclusions

- Increasing generation from Solar PV leads to decreasing wholesale power prices.
- Decreasing costs of installing PV in Germany are leading to negative effects on margins and sold electricity volumes of the large central generators.
- The conventional power generators have realized this threat to their business models but have not found means to react and try to delay the developments and are heavily lobbying against decentralized renewable generation in Germany.
- Currently Germany sees large overcapacities in the conventional power market.
- The current mechanism of calculating the EEG reallocation charge does not take into account the effects of renewable power generation.

# Renewable Analytics

Renewable Analytics LLC is an independent market research and consulting firm based in San Francisco and Berlin, Germany.

Renewable Analytics analyzes the impact of renewable power generation on wholesale power prices in different markets and the “traditional” central power generators like coal, gas and nuclear.

The firm’s analysts take a broad view of industry dynamics. Qualitative and quantitative analysis, combined with ongoing surveys and meetings with industry leaders, help our clients to maintain an accurate understanding of the direction of the industry.

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