



HAL
open science

Simulation of day-ahead electricity market prices using a statistically calibrated structural model

Valentin Mahler, Robin Girard, Sébastien Billeau, Georges Kariniotakis

► **To cite this version:**

Valentin Mahler, Robin Girard, Sébastien Billeau, Georges Kariniotakis. Simulation of day-ahead electricity market prices using a statistically calibrated structural model. DTU CEE Summer School 2019: Data-Driven Analytics and Optimization for Energy Systems, Jun 2019, Copenhagen, Denmark. hal-03445344

HAL Id: hal-03445344

<https://hal.science/hal-03445344>

Submitted on 23 Nov 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Valentin Mahler^{1,2}, Robin Girard¹, Sébastien Billeau², Georges Kariniotakis¹

¹ MINES ParisTech, PSL University, PERSEE – Centre for Processes, Renewable Energies and Energy Systems, France

² ADEME – Agence de l'Environnement et de la Maîtrise de l'Énergie, France

1. Introduction

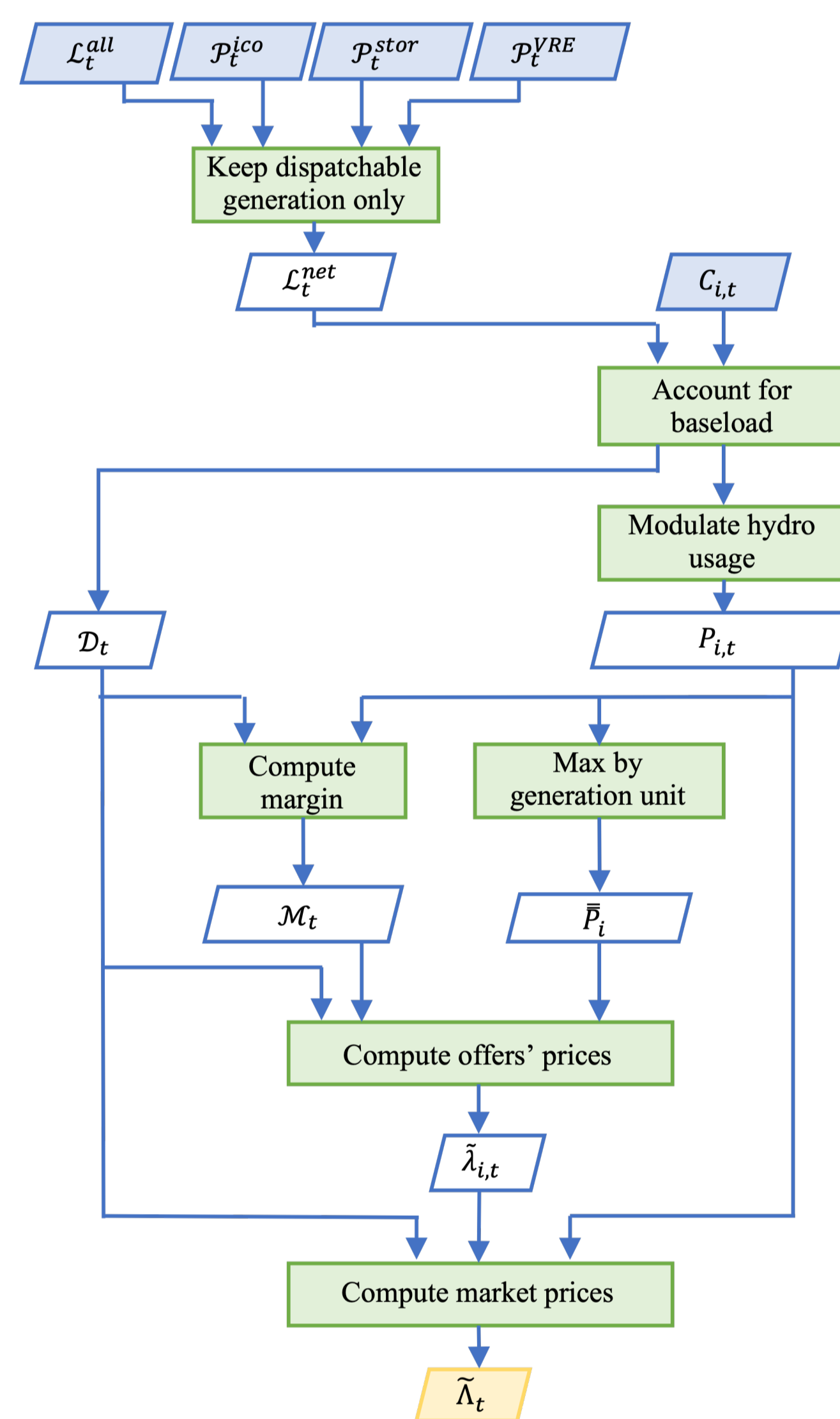
- Power exchanges are playing a central role in electricity trading.
- The number of transactions in Europe keeps growing.
- On day-ahead markets, bids are made one day before delivery.
- This allows to account for the latest consumption and production forecasts, while giving enough time to plan operations at the system level.
- Understanding price formation mechanisms is of key interest:
 - for companies willing to anticipate their costs or revenues
 - for policy makers and energy regulators, which shall design and enforce suitable regulations.

2. Objectives

- Mathematical models are developed to reveal the link between the state of the power system and day-ahead prices.
- Such model are used to generate price forecasts that support decision processes.
- Our model generates time series for long time scale (i.e at least a year) with hourly resolution.
- This time horizon and resolution is useful for strategic planning.
- A parametrized supply curves, calibrated on real observations, is used to simulate the market clearing prices.
- This model belongs to the category of « structural models ».

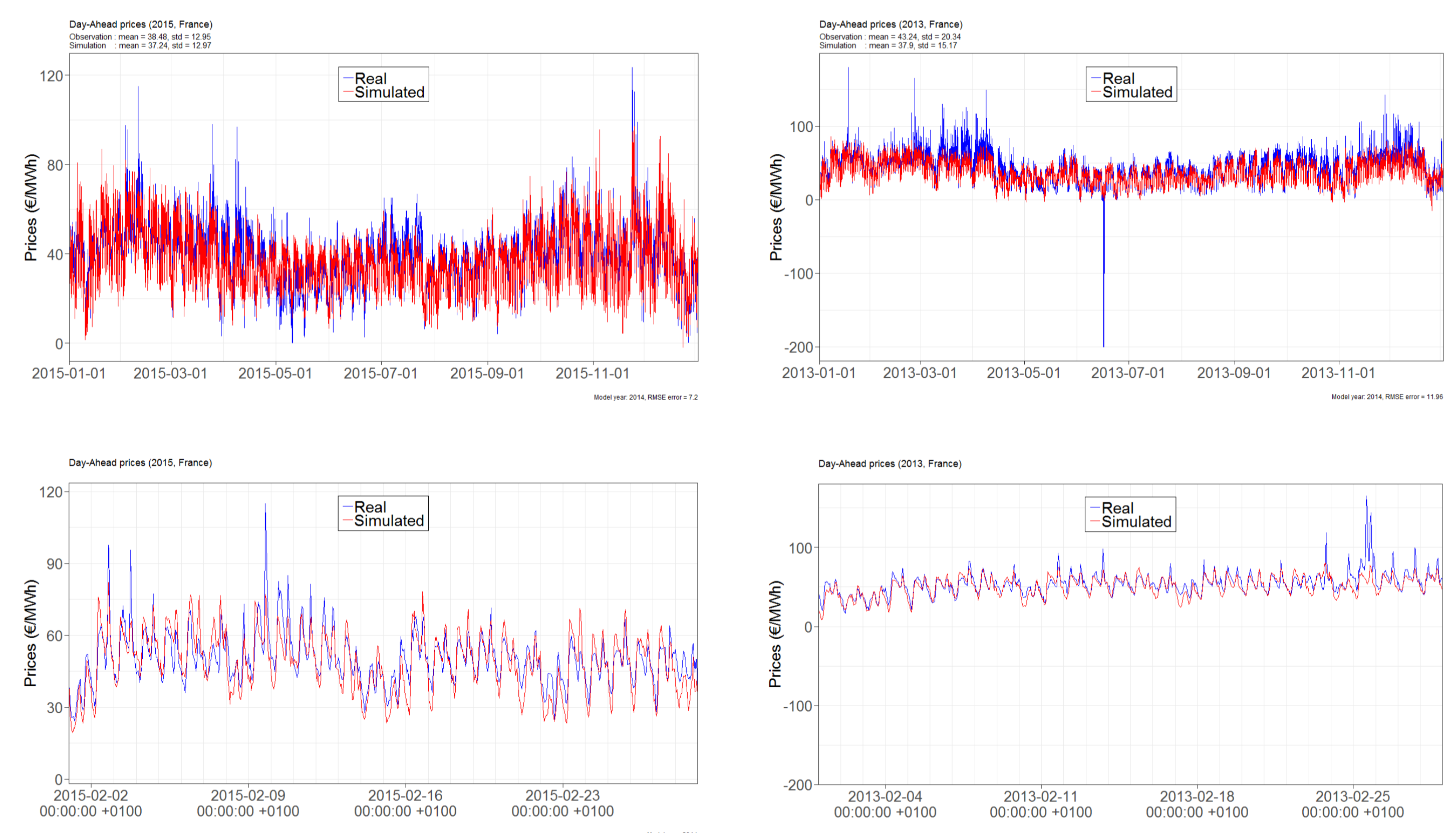
3. Methodology

- We consider an inelastic demand corresponding to the national power consumption covered by the dispatchable generation units, to which we subtract a baseload assumed to not go through the day-ahead market.
- Each offer of the supply curve corresponds to a generation unit with a nominal capacity over 100 MW.
- The offers' volume depends the effective availability of units ; the price depends on the reserve margin (i.e. the difference between the load and the generation capacity).
- The strategic use of water resources, as well as the effect of hours and weekdays on prices, are taken into account.



4. Case study

- A study about the French bidding zone for the period 2013-2015 has been conducted using market data provided by EPEX SPOT and power system data provided by RTE.
- The time series relative to the best and worst performances are presented below (RMSE of 7.2 €/MWh and 12.0 €/MWh).
- For both, it corresponds to the training year 2014, and respectively to 2015 and 2013 for the test years.



5. Conclusion and perspectives

- The model captures the typical price patterns but shows limitations in properly rendering price spikes.
- Other factors, such as the influence of fuel and emission costs, should be taken into account for prospective applications.
- The model will also be extended to offer a more accurate representation of the impact of international interconnections.
- Thanks to the regulation regarding transparency, this methodology can also be applied to other European markets.

Bibliography

- F. Ziel and R. Steinert, "Probabilistic mid- and long-term electricity price forecasting," *Renew. Sustain. Energy Rev.*, vol. 94, pp. 251–266, Oct. 2018.
- R. Carmona, M. Coulon, and D. Schwarz, "Electricity price modeling and asset valuation: a multi-fuel structural approach," *Math. Financ. Econ.*, vol. 7, no. 2, pp. 167–202, Mar. 2013.
- C. Ruiz, A. J. Conejo, and D. J. Bertsimas, "Revealing Rival Marginal Offer Prices Via Inverse Optimization," *IEEE Trans. Power Syst.*, vol. 28, no. 3, pp. 3056–3064, Aug. 2013.
- R. Aid, L. Campi, and N. Langrené, "A Structural Risk-Neutral Model for Pricing and Hedging Power Derivatives," *Math. Finance*, vol. 23, no. 3, pp. 387–438, 2013.
- L. Mitridati and P. Pinson, "A Bayesian Inference Approach to Unveil Supply Curves in Electricity Markets," *IEEE Trans. Power Syst.*, vol. 33, no. 3, pp. 2610–2620, May 2018.
- R. Chen, I. C. Paschalidis, M. C. Caramanis, and P. Andrianesis, "Learning from Past Bids to Participate Strategically in Day-Ahead Electricity Markets," *IEEE Trans. Smart Grid*, pp. 1–1, 2019.

About the author



Valentin Mahler

- M.Sc. in Electrical Engineering from Centrale de Lille (2014)
- Undergraduate degree in Psychology from Université Paris 8 (2014)
- Worked as a project engineer and a software developer in Germany
- 1st year PhD student at the PERSEE Center, MINES ParisTech (FR)

PhD Director : Georges Kariniotakis

PhD Supervisor : Robin Girard

contact : valentin.mahler@mines-paristech.fr

Acknowledgment

Financing



Affiliation



Data and tools

