

# CHAIRE EUROPEAN ELECTRICITY MARKETS

## ACTIVITY REPORT 2019

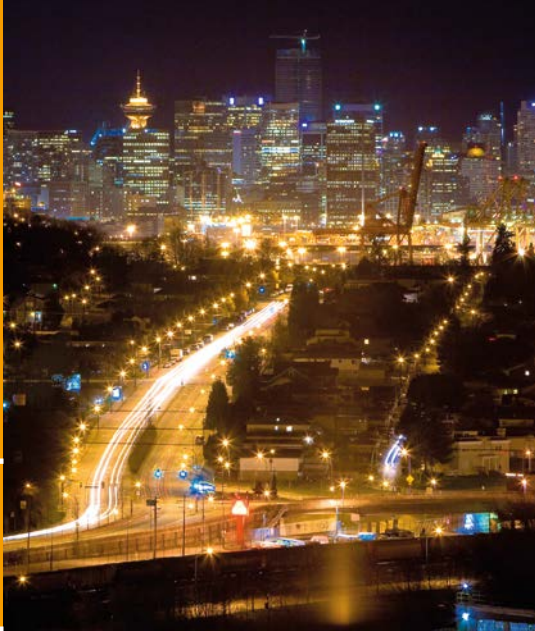
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CHAIRE EUROPEAN ELECTRICITY MARKETS



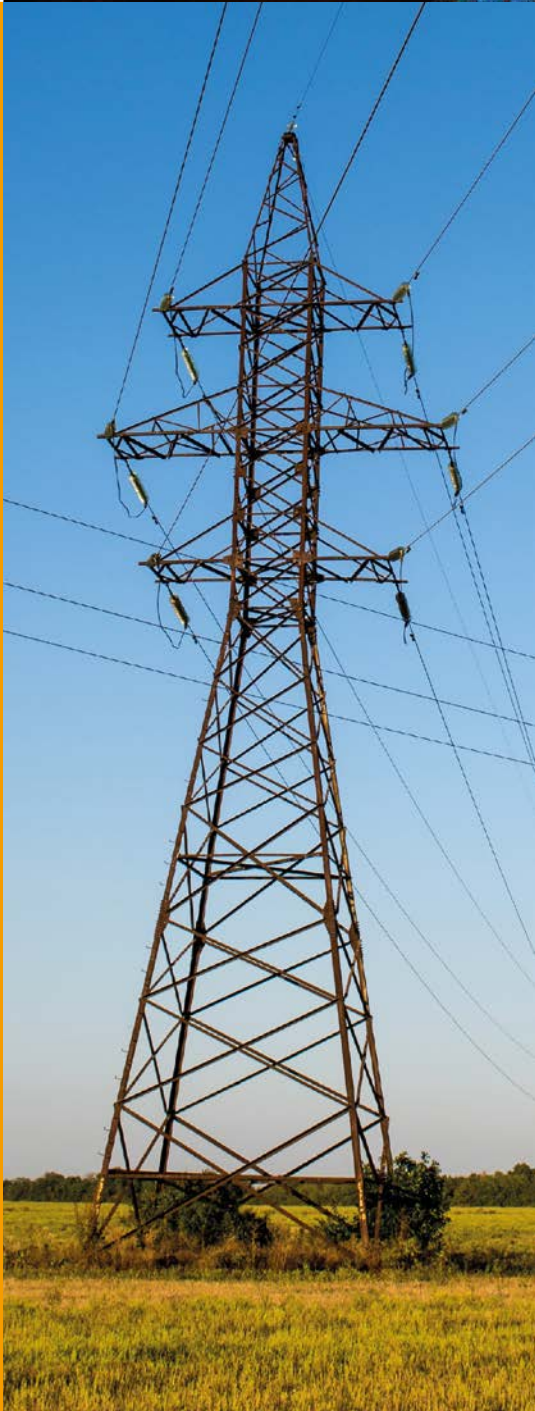
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## A WORD FROM THE CEEM SCIENTIFIC DIRECTOR



### Dear friends of the Chaire European Electricity Markets (CEEM),

What if 2020 was the year where we begin to re-think European electricity markets...? Even before the public health crisis of Covid-19, 2020 was a pivotal year for the CEEM. 2019 was indeed the last full year of the second period of the tripartite partnership agreement governing the CEEM, between Paris-Dauphine University - PSL, Paris-Dauphine Foundation, and its four partners which include Réseau de Transport d'Électricité (RTE), Électricité de France (EDF), EPEX Spot and, since January 2019, Total Direct Énergie (TDE). Discussions with partners on a second renewal of this Agreement are well underway and focus on the new CEEM 2020-25 Scientific Project.

It is clear that the year 2020 will have a profound impact on the energy sector in general and electricity industry in particular. Together with ensuring the supply of food and water as well as providing access to health care, it has become evident that maintaining a working electricity supply is vital not only for the economy but also for daily life and the cohesion of the country as a whole. There was consensus among partners in relation to the fact that the new Scientific Project must meet the academic requirements and the ambition to provide answers to the challenges of the European electricity markets as much as it is technically feasible, economically relevant and socially sustainable, in the same way as during the two previous partnership cycles. Ensuring the security of electricity supply and achieving an adequate level of investment has always been part of the key issues studied by the CEEM. In light of the events of Spring 2020, it is clear that the research carried out at the CEEM will even more strongly and more systematically focus its attention on this issue. The following remarks will need to be read in this perspective.

These developments show both continuity and change in relation to CEEM activities, which have continued throughout 2019 and are presented in this annual report. Decarbonisation, security of supply, economic efficiency and social sustainability: the demands by consumers and political decision-makers concerning the European electricity markets have hardly changed at the start of this new decade. However, the answers to be provided must strongly evolve within a context featuring five clearly identifiable challenges in conjunction:

- 1 Organising the financing of adequate investment in low-carbon electricity generation technologies, all of which come with, with no exception, high fixed costs;
- 2 Ensuring sufficient sources of flexibility (flexible production, excess demand response, storage, interconnections) in the presence of an increase in variable renewable capacities;
- 3 Answering to new consumer demands for electricity produced in a de-centralised or self-produced manner;
- 4 Liaising the electric sector with other sectors such as transports, hydrogen production or heating within a context of electrification of the economy;
- 5 Integrating new technologies for the generation, transport and consumption of electricity, but also those relating to data collection, processing and protection.

Actually, the understanding of these five challenges has progressed considerably in recent years, as shown by the works presented in the following pages; however, the effects of their articulation and the relative concrete technical and organisational measures remain a new frontier of research. In order to take part in this research effort in the most effective way, the CEEM 2020-25 Scientific Project is organised around three main axes.

*It is clear that the year 2020 will have a profound impact on the energy sector in general and electricity industry in particular.*

- A** The market designs which are best suitable for producing the appropriate incentives and ensure a sufficient level of carbon-free production capacities:

The decarbonisation involves the implementation of capital-intensive electricity production technologies, which can make their remuneration insufficient, based on energy only market prices (aligned with variable costs). In the past, the financing issue has often been approached from the angle of the capacity mechanisms, which provide a fundamental complement to the income generated by electricity markets. If capacity mechanisms will continue to be studied carefully, the new Scientific Project will advance in a direction which will thematise, more crucially, the tension which can exist between market operations in the short-term (production, dispatch, adjustment) and investments in capacity in the long-term. Such a research will also include an economic and financial risk analysis, all along the value chain. In particular, it is suggested to study market designs more in depth and systematically, implementing "hybrid markets". These market architectures see competitive and regulated elements coexist in a context of massive decarbonisation of the electricity sector. To mitigate any risk of involuntary load shedding, it will then be necessary to combine long-term investment financing with a dispatch and by triggering short-term flexibilities. Even if the principle is well understood, its translation onto the reality of the markets, for example, through the renewal of an ARENH mechanism currently under discussion, constitutes a rich background for much awaited research.

*Ensuring the security of electricity supply and achieving an adequate level of investment has always been part of the key issues studied by the CEEM.*

- B** The management of electrical flows in conjunction with the development of local networks and flexibilities:

The need for flexibility over different time horizons (second, minute, hour, day, week, season and from one year to the next) obviously increases with the increasing share of variable renewable energies such as solar photovoltaic and wind power. However, they are also increasing, or, at least, changing in nature, along with the evolution of modes of production and consumption at the local level. Decentralisation, prosumers and smart grids are just formulas which summarise some of the developments underway. Therefore, the electricity system will have to ensure a "last resort supply", allocating precise responsibilities and providing pricing solutions which are still largely to be defined. A key point is the trade-off between, on the one hand, developing transport and distribution networks and, on the other, providing flexibility, for example through the distributed flexibilities of local energy markets. Such a trade-off is subject to tensions between centralised and decentralised solutions or, again, between the long-term with high fixed costs (CAPEX) and the short-term, with higher variable costs (OPEX). These issues inevitably are linked to the structure of pricing and to the institutional dimension. Is the traditional division of labour in the European electricity sector between the regulated management of networks and the decentralised supply of electricity, capacity and system services, the only one conceivable? Under what circumstances would it be possible to move from the current TSO model to an ISO model? The entire division of labour between network operators, power exchanges, producers and suppliers of flexibility at all levels then needs to be reviewed. In close consultation with its European partners, CEEM will actively take part in this reflection.

## C Analysis of scenarios at the 2050 horizon and medium-term transition paths:

In addition to its intrinsic intellectual interest, carrying out research consistent with university research and in collaboration with its partners, CEEM is essential to understand both the implications of the political frameworks formulated at national and European level, as well as the evolution of different energy sources' trajectories, notably of nuclear energy, renewable energies and natural gas. The European electricity sector will be at the centre of the efforts of the European Union countries in order to achieve carbon neutrality by 2050. Very recently, these efforts have known further momentum thanks to the Green Deal presented by the European Commission. Therefore, it is essential to analyse the consistency of the visions formulated at the 2050 horizon. At the same time, it is equally essential to question the trajectories toward carbon neutrality, over time, of a mix of electricity which currently still emits almost 300 gCO<sub>2</sub>/kWh. Despite the fact that we can anticipate the evolution of de-carbonated energies (renewable, nuclear and hydroelectricity) upwards and that of coal downwards with a certain confidence, the structural question arises about the role of natural gas in the mix, during the transition of the next decades. The "scenario analysis" activity is suitable to strengthen the collaboration between the CEEM and its partners, who are equipped with powerful modeling tools, as well as with European research centres working in this field.

*The current changes at the European and the global level will ensure that the security of electricity supply will remain at the centre of attention even when the current health crisis has been overcome. Yet the technical nature of the challenges facing the electricity sector will ensure that the new Scientific Programme 2020-25 of the CEEM outlined below will be fully relevant also in the context of the new economy and the new energy world that are about to emerge.*



In 2019, the activities of the CEEM team and researchers at Paris-Dauphine University - PSL once again laid a formidable basis for pursuing excellence work in three areas, i.e. the exploration of 'hybrid electricity', the supply of systemic and local flexibility as well as the analysis of scenarios for 2050. The new CEEM 2020-2025 Scientific Project thus opens up new and promising opportunities for continuing together with you and our partners to fulfil the CEEM's missions, including an ambitious research programme, the training of talented doctoral students and the participation in public debate through relevant seminars and conferences. The current changes at the European and the global level will ensure that the security of electricity supply will remain at the centre of attention even when the current health crisis has been overcome. Yet the technical nature of the challenges facing the electricity sector will ensure that the new Scientific Programme 2020-2025 of the CEEM outlined below will be fully relevant also in the context of the new economy and the new energy world that are about to emerge.

Jan Horst Keppler

CEEM Scientific Director

## THE LIFE OF THE CEEM

### Introduction

The Chaire European Electricity Markets (CEEM) is an economic research chair at Paris-Dauphine University - PSL supported by RTE, EDF, EPEX Spot and Total Direct Energie (TDE). Its main activity is the research on the de-carbonisation of electricity production and the sustainability of long-term investment in the context of energy transitions. In rapidly evolving electricity markets, this field of research involves the study of market designs, of the evolution of electricity prices, of transport and distribution infrastructures as well as of business models of tomorrow's electricity sector. A particular focus is the issue of the electricity system's flexibility and the coordination between decision-making at the local level and the supply-demand balance at the national and European level.

CEEM's scientific research is accompanied by a complementary program of scientific conferences and seminars aimed at the discussion and dissemination of its research results, as well as by the training for doctoral students and young researchers. In the three areas, i.e. research, dissemination and training, the CEEM is seeking to develop collaborations with other research centres. This way, synergies will be created, the quality and visibility of its research will be improved, whilst contributing to the emergence of a new generation of researchers in the economics of electricity systems.



## I. INTERNAL OPERATIONS

On a daily basis, CEEM's work is carried out in accordance with the strategic guidelines established in collaboration with the partners and the Scientific Director. Assisted by his Scientific Advisor, the latter is responsible for the organisation of CEEM's three areas of work, i.e. scientific research, the organisation of events for the dissemination of research as well as the supervision of doctoral students and the training of young researchers. The administrative aspects are managed by the CEEM Coordinator. About twenty researchers associated with the Chaire, in addition to research assistants, complete the Chaire's team (for more details, visit the Chaire's website <http://www.ceem-dauphine.org/home/fr/>, which centralises all the different information concerning the CEEM, including the presentations of scientific events).



## THE TEAM



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### Jan Horst KEPPLER

CEEM Scientific Director and Professor of Economics at Paris-Dauphine University - PSL, is responsible for the organisation of the Chaire as a whole, as well as of its research activities



### Fabien ROQUES

Associate Professor in Economics at Paris-Dauphine University - PSL, and Associate Researcher at Cambridge University's Electricity Policy Research Group, is Scientific Advisor to CEEM



### Patrice GEOFFRON

Professor of Economics at Paris-Dauphine University - PSL, is responsible for the field "Decentralisation and harmonisation of the links between local grid and the supply/demand balance at both the National and European level"



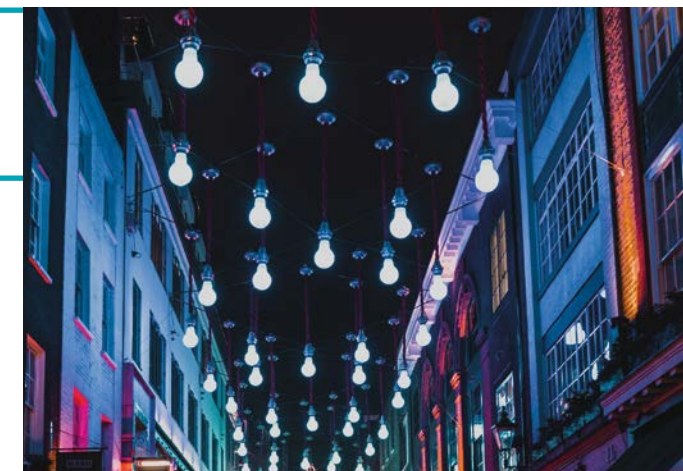
### Fatoumata DIALLO

CEEM Coordinator

## ASSOCIATE RESEARCHERS

Today, the CEEM has, altogether, around 30 researchers working on the European electricity markets at different levels. In particular, the involvement of a researcher implies a collaboration, to varying degrees, in terms of events organized by the CEEM and participation in the CEEM copyright repurchase program for the *Working Papers* as well as peer-reviewed publications in journals. This structure has a proven track record and will continue in the next period.

- ⊗ Clara BALARDY, Researcher
- ⊗ Amaury DE BALINCOURT, Researcher
- ⊗ Marie BESSEC, Researcher
- ⊗ Pierre BOUFFORT, Researcher
- ⊗ Régis BOURBONNAIS, Researcher
- ⊗ Mauricio CEPEDA, Researcher
- ⊗ Cédric CLASTRES, Researcher
- ⊗ Florent COGEN, Doctoral student
- ⊗ Alexandre COQUENTIN, Researcher
- ⊗ Anna CRET, Researcher
- ⊗ Michel CRUCIANI, Researcher
- ⊗ Guillaume DEZOBRY, Researcher
- ⊗ Théo DRONNE, Doctoral student
- ⊗ Lamine DUCARD DAKE, Researcher
- ⊗ Dominique FINON, Researcher
- ⊗ Patricia VAN HORN FLORIN, Researcher
- ⊗ Julien FOUQUAU, Researcher
- ⊗ Romain GATÉ, Researcher
- ⊗ Patrice GEOFFRON, CEEM Responsible for the "Decentralisation" field
- ⊗ Frédéric GONAND, Researcher
- ⊗ Stéphane GOUTTE, Researcher
- ⊗ Mamadou GUEYE, Post-Doctoral Researcher
- ⊗ Morwenna GUICHOUX, Researcher
- ⊗ Daniel HERRERA, Researcher



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- ⊗ Jan Horst KEPPLER, CEEM Scientific Director
- ⊗ Cyril Martin DE LAGARDE, Researcher
- ⊗ Seungman LEE, Researcher
- ⊗ Arnaud LEMANT, Executive Doctorate in preparation, employee at EDF Renewables
- ⊗ Yannick LE PEN, Researcher
- ⊗ Yuanjing LI, Researcher
- ⊗ Olivier MASSOL, Researcher
- ⊗ William MEUNIER, Researcher
- ⊗ Léopold MONJOIE, Doctoral student
- ⊗ Alexis PASKOFF, Researcher
- ⊗ Marie PETITET, Researcher
- ⊗ Thao PHAM, Researcher
- ⊗ Sébastien PHAN, Researcher
- ⊗ Marion PICHOU, Doctoral student
- ⊗ Fabien ROQUES, Scientific Advisor
- ⊗ Maria-Eugenia SANIN, Researcher
- ⊗ Charlotte SCOURLAIRE, Post-Doctoral Researcher
- ⊗ Maria-Juliana SUAREZ FORERO, Doctoral student
- ⊗ Ángela TORRES CORONA, Doctoral student
- ⊗ Pierre UGINET, Researcher
- ⊗ Antoine VERRIER, Researcher
- ⊗ Manuel VILLAVICENCIO, Researcher
- ⊗ Julie Hyun Jin YU, Researcher

## II. GOVERNANCE

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### Steering Committee

The Steering Committee is CEEM's governing body. It sets CEEM's strategic guidelines, validates its prospective budget and controls expenditure. Fixed by the Partnership Agreement, its composition includes partners representatives, the CEEM's Scientific Director, a second Paris-Dauphine University – PSL teacher-researcher, a Paris-Dauphine Foundation representative, CEEM's Scientific Advisor and two qualified external persons. The Steering Committee meets twice a year. In 2019, two meetings were held on 26 June and 10 December.

#### The members of the Steering Committee for the 2017–20 period are:

- ⊗ **Jan Horst KEPPLER**, CEEM Scientific Director and President of the Steering Committee
- ⊗ **Yannick JACQUEMART**, Director, Department of Power System Economics (DiESE), RTE
- ⊗ **Vincent RIOUS**, Head of the Centre of Economic Studies of the Power System Economics Department, RTE
- ⊗ **Jérôme PIGAT**, Head of the Centre of Short-Term Supply-Demand Balance, R&D Department, RTE
- ⊗ **Patrice BRUEL**, Regulatory Director, EDF
- ⊗ **Fabienne SALAÛN**, Project Manager, Regulations Department, EDF
- ⊗ **Philippe VASSILOPOULOS**, Director of Product Design, EPEX Spot
- ⊗ **Aurore LANTRAIN**, Senior Business Developer, EPEX Spot
- ⊗ **Vianney LECONTE**, Director of Business Development, Total Direct Energie, Power & Gas Europe
- ⊗ **Patrice GEOFFRON**, Professor of Economics, Paris-Dauphine University – PSL
- ⊗ **Sandra BOUSCAL**, Director of the Paris-Dauphine Foundation
- ⊗ **Fabien ROQUES**, CEEM Scientific Advisor and Compass Lexecon (Observer)
- ⊗ **David NEWBERY**, Director Cambridge Energy Policy Research Group, Faculty of Economics (non-voting)
- ⊗ **Graham WEALE**, Honorary Professor for Energy Economics and Politics, Faculty of Management and Economics, Ruhr Uni Bochum (non-voting)



### Validation Committee

The Validation Committee decides on the acceptance of the *Working Papers*, as well as of scientific articles which have not previously been the subject of a *Working Paper*, prepared by CEEM researchers within the CEEM's research incentive program. Each "candidate paper" is sent to the members of the Validation Committee, a first time for comments, and, after the integration of any comments, a second time for validation. The Validation Committee is notified electronically each time a new scientific production is submitted for the application to the research incentive program. Each of the CEEM partners appoints a representative to take part in the work of the Validation Committee. In 2019, the Committee validated 6 *Working Papers* and 1 publication in the journal *Energy Policy*.

#### Members of the Validation Committee:

- ⊗ **Jan Horst KEPPLER**, CEEM Scientific Director
- ⊗ **Fabien ROQUES**, CEEM Scientific Advisor and Compass Lexecon
- ⊗ **Yannick JACQUEMART**, Director, Department of Power System Economics (DiESE), RTE
- ⊗ **Vincent RIOUS**, Head of the Centre of Economic Studies of the Power System Economics Department, RTE
- ⊗ **Jérôme PIGAT**, Head of the Centre of Short-Term Supply-Demand Balance of R&D Department, RTE
- ⊗ **Patrice BRUEL**, Regulatory Director, EDF
- ⊗ **Fabienne SALAÛN**, Project Manager, Regulations Department, EDF
- ⊗ **Philippe VASSILOPOULOS**, Director of Product Design, EPEX Spot
- ⊗ **Vianney LECONTE**, Director of Business Development, Total Direct Energie, Power & Gas Europe
- ⊗ **Patrice GEOFFRON**, Professor of Economics, Paris-Dauphine University – PSL
- ⊗ **Yannick LE PEN**, Associate Professor, Paris-Dauphine University – PSL



### Paris-Dauphine Foundation

The Paris-Dauphine Foundation manages all CEEM's legal and financial aspects. It is the third partner of the tripartite agreement between CEEM's partners and Paris-Dauphine University – PSL, which includes the Paris-Dauphine Foundation. Apart from the teacher-researchers of Paris-Dauphine University – PSL's, CEEM employees (coordinator, research assistants), from a legal point of view, are employees of the Paris-Dauphine Foundation. The CEEM, as such, has no legal existence as an employer.

### III. BRIEF OVERVIEW OF THE 2017-2020 PERIOD

The three years of the second Partnership Agreement between Paris-Dauphine University - PSL, Dauphine Foundation and the Partners governing the activities of the CEEM, once again, managed to achieve significant results in terms of scientific publications, of different types of events and training for young researchers. In terms of scientific publications, CEEM has published 21 *Working Papers* during the past three years, 2 of which were put forward to be published in *Energy Journal*, 8 have been published in *Energy Policy* and 1 has been published in *Revue de l'Energie*. Each work published in collaboration with CEEM features a mention of support by the Dauphine Foundation and CEEM's four partners, which are RTE, EDF, EPEX Spot and Total Direct Energie. The second period saw, in particular, an enhanced collaboration with the partners' research departments. Several publications have also benefited from the access to spot market data that EPEX Spot has been able to provide CEEM researchers with.

As regards the events, the CEEM has organised, whether alone or in collaboration with its partners, 16 scientific conferences, 3 internal research seminars and 13 sessions of the Paris-Sciences-Lettres (PSL) Energy Economics Research Seminar. Two research seminars were reserved for partners and saw academics and industry experts tackle key issues related to the electricity markets, the restriction session allowing great freedom of speech. Today, the CEEM has established a solid network of experts, academics and industrialists dealing with the challenges of electricity markets as well as a second circle of "multipliers" with deep ties in civil society.



SECTION II

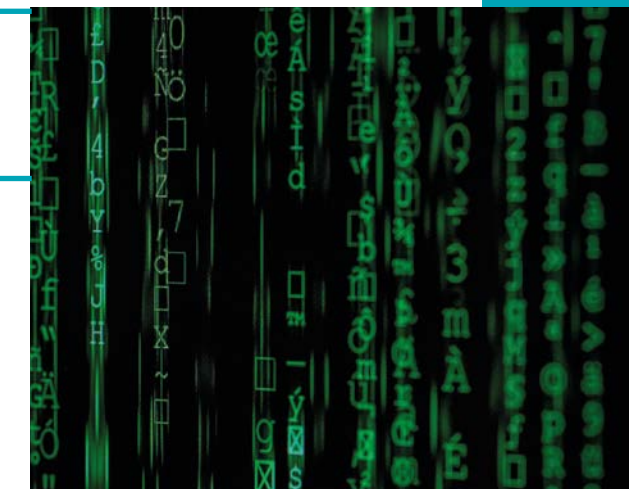
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## CEEM NEWS - 2019

### # 2019 Key Figures

- 3 Doctoral theses defended
- 7 Doctoral theses in progress
- 2 Collaborative European research projects
- 2 Scientific and academic awards and distinctions of PSL researchers, members of CEEM
- 1 Research assistant through collaboration with the Master in Energy Carbon Finance
- 6 *Working Papers*
- 1 Publication in the *Energy Policy* journal
- 7 Scientific conferences
- 1 Internal research seminar
- 5 Sessions of the Paris-Sciences-Lettres Energy Economics Research Seminar



## I. SCIENTIFIC PUBLICATIONS

As part of its scientific production, the CEEM allows all its researchers, including doctoral students, to present academic papers for the Dauphine Foundation's copyright repurchase program. At the same time, a researcher working within a CEEM partner company may also be, in their personal capacity, a CEEM researcher. The CEEM Scientific Director is responsible for deciding on such membership on the basis of joint research collaboration projects. However, each paper must be part of a research on European electricity markets and follow the procedure put in place for this purpose. The CEEM Scientific Director and the CEEM Scientific Advisor must accept beforehand the paper presented and decide whether to refer it to the CEEM Validation Committee. Once referred to them, the above Committee, which is a small group, mainly composed of representatives of CEEM partners, is responsible for analysing the papers submitted according to the spirit and objectives of the CEEM in order to determine if they are eligible to be integrated into the CEEM scientific production. All intellectual work validated by the Validation Committee entails the establishment of a copyright repurchase contract by the Foundation.

RAPPORT D'ACTIVITÉS  
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### "Effects in Terms of Excess Demand Response in Intelligent Electrical Networks"

*The valuation of Demand Response (DR) has been the subject of many works, both on its introduction and its valuation on the electricity market, as well as on the induced effects in terms of surplus for the community. Based on the industrial structure developed by Chao (2011) as well as on the day-ahead market data provided by EPEX, we develop a model simulating the introduction of DR on the French electricity market. We show that, in order for the DR to improve collective well-being and create value for all categories of players, different conditions are necessary, in particular limited implementation costs. Through supply and*

### "Comparing Methods for Customer Baseline Load Estimation for Residential Demand Response in South Korea and France: Predictive Power and Policy Implications"

*Worldwide concern on climate change and paradigm shifts in the electricity sector towards more flexibility contribute to making Demand-side management (DSM) an increasingly important element for establishing the demand and supply balance. In particular, Demand Response (DR) is expected to improve the security of electricity supply by reducing peak demand, reduce CO2 emissions, contribute to the integration of variable renewable energy (VRE) and minimize overall costs. DR activities are complex and depend on a number of technical, meteorological and behavioral parameters. It is thus instructive to compare the DR pilot programs launched in different countries, such as the Notification d'Échange de Blocs d'Effacement (NEBEF) mechanism in France in 2013 or the market-based DR programs in South Korea in 2014. Among the different economic issues at stake, the estimation of the Customer Baseline Load (CBL) emerges as a key component for defining the nature, performance, and costs of different DR*

**Keywords :** Demand Response (DR), Customer Baseline Load (CBL), Korean Demand Resource Trading Market (DRTM), NEBEF, Load Aggregator (LA).

WP  
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Cédric CLASTRES

University of Grenoble-Alpes, CNRS, INRA, Grenoble INP, GAEL (UMR 5313) and Chaire EEM and Patrice GEOFFRON  
Paris-Dauphine University - PSL, LEDa, UMR CNRS-IRD) and Chaire EEM

*demand curves obtained from these same data, we confirm these first simulated results. We also analyse the effects, in terms of excess, for both consumers and suppliers as well as the scope of compensation paid by excess demand response operators.*

WP  
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Seungman LEE

PhD Student, Paris-Dauphine University - PSL, LEDa [CGEMP] and Chaire EEM

*programs. Based on the re-scaled load profile for an average household, this research thoroughly examines the performance of several CBL estimation methods in the context of the South Korean and French DR mechanisms. In particular, it is shown how optimizing the methodologies for CBL estimation allows improving the incentives for DR participation. For instance, the more accurate CBL estimation methods currently in use in South Korea could significantly enhance the potential for DR also in the context of the French electricity market. To assess this potential quantitatively, different CBL methodologies are integrated into a Cost-Benefit Analysis (CBA), which allows determining both overall changes in consumer surplus and the profits of private operators. The results of this research on CBL estimation methods are indeed relevant for public policy-making as well as for the design of industrial and commercial DR programs.*

### "Counting on the Neighbours: Challenges and Practical Approaches for Cross Border Participation in Capacity Mechanisms"

*Capacity mechanisms have been implemented in an uncoordinated way by many countries in Europe in recent years to ensure security of supply. The European Commission has defined via the state aid guidelines principles to minimize their impact on trade and competition in European electricity markets. The paper identifies the different drivers of these national reforms,*

**Keywords :** Capacity Mechanisms, Generation Adequacy, Security of Supply, Cross Border Participation.

WP  
40

Fabien ROQUES

Associate Professor, Paris-Dauphine University - PSL, LEDa [CGEMP], and Chaire EEM

*maps the key issues associated with the coordination of capacity mechanisms across countries, and explores alternative approaches to allow for explicit cross border participation in capacity mechanisms.*

### "Market Design and the Cost of Capital for Generation Capacity Investment"

*We study the impact of market design on the required rate of return asked by investors (the cost of capital) for generation capacity investments. We find that, if the Capital Asset Pricing Model applies and there is a positive correlation between electricity demand and the market return, then different generation technologies have different costs of capital at equilibrium in an Energy-Only setting. We show that peak capacity underinvestment can be explained by financial risk, even in the absence of the so-called "missing-money" problem. Analytic expressions of the equilibrium cost of capital are obtained in a simplified generation capacity expansion model. In order to respect generation adequacy standards, fixed-price contracts or capacity markets should be introduced, as was done in the UK with the Electricity Market Reform. We find that*

**Keywords :** Generation Adequacy ; Capacity Remuneration Schemes ; Electricity Market Design ; Cost of Capital.

WP  
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Benoît PELUCHON

EDF R&D EFSE Department, EDF Lab Paris-Saclay

*Contracts for Difference (CfDs) or capacity markets lower the equilibrium cost of capital, and thus lead to more capacity investment when perfect competition applies, as well as to lower expected costs for consumers. As a consequence, these mechanisms should not be seen as subsidies, but as welfare improving market-design reforms. By opposition, strategic reserves are not an efficient capacity mechanism: they have not cost of capital reduction properties and only add costs to an EO design.*



**"Evaluate the Cost of Renewable-Based Electricity Transitions: Good Use of Sector Optimisation Models"**

Many countries have adopted a low-carbon transition policy in the electricity sector, however this is inefficient as it's mainly based on the promotion of large-scale renewable energies, alongside carbon pricing, the role of which remains minor. In this paper, firstly, we identify the results of first-best low carbon policies based on carbon pricing alone, placing all low carbon technologies on the same level in order to identify the optimal electric mix. Then, the aim is to assess the loss of social efficiency associated with policies aimed at developing renewable energies in an "indefinite" manner, which can no longer even be considered as a second-best perspective. The complexity of the electricity sector, increased by the development of intermittent renewable energies, requires the use of electricity system detailed models in order to assess transition policies. Three exercises show that the

**"Modelling Participation in Residential Demand Response Mechanisms in South Korea and France: The Impacts of Inconvenience, Customer Baseline Estimation and Marginal Pricing"**

In this study, the Cost-Benefit Analyses (CBAs) and the Decision-making Analyses are conducted in order to provide a framework that allows the Demand Response (DR) system operators in South Korea and France to assess the expected level of residential customers' participation according to the loss of consumer surplus based on different Customer Baseline Loads (CBLs). With the economic assumption of rationality, it is found that DR participants shift their loads to just before or after the DR event period as a result of the optimization of the costs considering their stochastic conditions. The degree of the additional inconvenience and its functional form of the DR program participants have significant impacts on their decision-making of the DR participation.

**Keywords :** Demand Response (DR), Cost-Benefit Analysis (CBA), Decision-making Analysis, Optimization (Linear Programming), Monte Carlo Simulation, Sensitivity Analysis (SA).

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**Dominique FINON**

CNRS Emeritus Research Director,  
associate researcher at CEEM

optimal renewable energy shares are low (at most 15%), regardless of the price of carbon. However, the need for a very detailed representation of the electricity system paves the way for an over-representation of the sources of flexibility (storage, demand management, integration between systems, inter-sector uses) which enhance the value of the use of intermittent renewable energies, resulting very favourable to them. We can see it by comparing the results of the three exercises with those of a very complete exercise by Ademe which seems to prove that the electricity system can economically rely on renewable energies alone, by eliminating all the other low carbon technologies, including nuclear.

WP  
43

**Seungman LEE**

PhD Student, Paris-Dauphine University – PSL,  
LEDa [CGEMP] and Chaire EEM

The importance of the accurate CBL estimation methods is mathematically and systematically reconfirmed with the CBA model and the Sensitivity Analysis (SA). In terms of the marginal pricing, there should be as stark pricing differentiation between the peak and off-peak periods to provide more incentives. As a higher SMP (System Marginal Price) provides larger remuneration for participants, DR can make a bridge between the wholesale market and the consumers of electricity by sending a wholesale market price signal. With these key results, it is expected that this study can provide the DR system operators in two countries with meaningful policy implications for a better and well-functioning DR market design.

**B Publications in peer-reviewed journals**

**"Impact of Gate Closure Time on the Efficiency of Power Systems Balancing"**  
*Energy Policy – Volume 129 (2019), pp. 562–573, Petit et al.*

This paper focuses on market design options for operational balancing management in self-dispatch electric power systems. In particular, it investigates the most relevant timing for the balancing gate closure, when competitors' decisions on the setting of controllable assets are neutralized and this responsibility is simultaneously transferred to the system operator. This discussion is central in the development and implementation of the European Electricity Balancing Guideline. Based on a multi-level simulation tool with a realistic modelling of short-term power system operations, this paper proposes the first quantitative assessment of postponing the

**Keywords :** Electricity Markets, Balancing Markets, Balancing Gate Closure Time, Simulation Mode.

EP  
129

This research paper was co-written with **Marie PETITET** EDF R&D and CEEM researcher, **Marie PERROT** and **Yannick PHULPIN** all from EDF R&D (France), and **Sébastien MATHIEU** and **Damien ERNST** from the University of Liège (Belgium)

balancing gate closure time from 1 h to 15 min ahead of the imbalance settlement period. For different environments (energy mix, power plant capabilities, outages, etc), the results highlight that postponing the balancing gate closure time from 1 h to 15 min increases the operational cost of the system. Based on robust and scalable results, we show that this difference is mainly due to a better coordination of the available resources by the central decision maker.



# II. SCIENTIFIC RESEARCH

## A Doctoral theses defended

- 1 "Optimization and Simulation Based Cost-Benefit Analysis on a Residential Demand Response: Applications to the French and South Korean Demand Response Mechanisms"

Seungman LEE

Thesis defended on 3 December 2019,  
at Paris-Dauphine University - PSL  
Supervision : Jan Horst KEPPLER

- 2 "Capacity Remuneration Mechanisms: An Assessment of their Performance and Implications for Market Design"

Charlotte SCOUFLAIRE

Thesis defended on 4 December 2019,  
at Paris-Dauphine University - PSL  
Supervision : Jan Horst KEPPLER

- 3 "Auction and Continuous Market for Power: Organization and Microstructure"

Clara BALARDY

Thesis defended on 10 December 2019,  
at Paris-Dauphine University - PSL  
Supervision : Bertrand VILLENEUVE  
and David ETTINGER



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## B PhD theses in progress

- 1 "The Efficiency of Short-Term Electricity Markets with Variable Renewables and their Impact on Forward Prices and Hedging Strategies"

The first year of this thesis has been devoted to study the main composition of the electricity risk premium and how the existence of negative spot prices could impact the industry's participants hedging decisions. Here some of the main findings and the methodology applied.

The two current puzzles that electricity markets should aim at solving to avoid their high spot price volatility have to do with a) the increasing production of Intermittent Renewable Energy Sources (RES) that usually arise during low demand periods; and b) the impossibility to store electricity at a large scale and at a reasonable cost.

It has been found that the first puzzle has produced the existence of negative spot prices. According to EPEX Spot, this phenomenon appeared for the first time in 2008 on the German/Austrian Day-Ahead Market and in 2010 on the French Day-Ahead and Intraday Markets. Ever since, the frequency of negative prices has rapidly increased.

As for the second puzzle, it conveys the impossibility to price electricity futures through standard arbitrage techniques. Instead, its value depends on the willingness of industry participants (producers, retailers and speculators) to hedge for the price risk. Here, hedgers (producers and retailers) want to participate in the future market to reduce their natural exposure to the spot price volatility while speculators want to earn an expected risk premium and diversifying their portfolio. In general, the behavior of these industry participants will influence the magnitude and sign of

- TD Ángela TORRES CORONA  
Thesis funded exclusively by Chaire EEM  
Supervision : Jan Horst KEPPLER

the risk premium, which should be understood as the difference between future price and the expected spot price of electricity at the delivery period.

The first step was to extend a theoretical framework to price an electricity future developed by BESSEMBINDER, Hendrik and LEMMON<sup>1</sup> which only accounts for positive price spikes and assumes a fixed risk averse retailer position. Secondly, by testing empirically its validity for the French and German Electricity Markets. Both markets of great interest due to their differences on generation mix, its high level of interconnection and the high EU ambitious targets for renewables by 2030. An inverse S merit order curve that accounts for the increasing production of RES change the main theoretical results and show that during spring and summer electricity risk premium is positively related with the variance and skewness of spot prices at the delivery period while during winter is negative related with variance but still positive related with skewness. These results are of paramount importance to assist market participants to make accurate investment decisions.

1. BESSEMBINDER, Hendrik, and Michael L. LEMMON. "Equilibrium Pricing and Optimal Hedging in Electricity Forward Markets." *The Journal of Finance* 57, no. 3 (2002): 1347-82. <https://doi.org/10.1111/1540-6261.00463>



2 "Activation and Remuneration of Flexible Distributed Resources: What Incentive Mechanisms for a Global Economic Optimisation in the Context of Emerging Community Markets?"

Coordination for the activation of distributed flexibilities

Distribution networks are undergoing profound changes. The emergence of new electrical uses, such as the charging of electric vehicles, which takes place on the distribution network, increases the need for electricity withdrawal at source sub-stations. New wind and photovoltaic connections, in turn, cause further need for injection. At the same time, managing tools for certain electrical uses are being developed, enabling the activation of distributed flexibilities, corresponding to the volume of controllable electrical uses connected to the distribution network. Such tools can be used, on the one hand, to avoid DSO network reinforcements by shifting usage to times when the network is less strained, and on the other hand, to reduce production costs, by shifting usage to times when the marginal cost of production is lowest. This study features an analysis, from the point of view of social well-being, of the different modalities of coordination between market players, the TSO and the DSO, for the activation of distributed flexibilities.

The comparison of such coordination modalities is done in terms of reinforcement costs on approximately 2000 sub-stations for the "VOLT" scenario from French TSO RTE's "Bilan Prévisionnel", for the year 2030. Several types of flexibility management will be compared: with reference to a situation where no flexibility is activated, a "managed" type, where 100% of available flexibility is activated with deterministic knowledge of consumption and average production costs in  $D - 1$ , as well as a tariff-based type which simulates a peak-/off peak-hours type signal, resulting from observations of flexibility placement by the "managed" type. So far, the modalities of coordination to be compared have been defined. Priority is given either to the European markets, the cost of which is optimized through flexibility management, or to the network, whose reinforcement costs are minimized through flexibility management:

TD Marion PICHOU  
CIFRE thesis with RTE  
Supervision : Jan Horst KEPPLER

- The placement of distributed flexibility takes place only to minimise costs of the electricity provision on the European market;
- The placement of distributed flexibility takes place to minimise costs of the electricity provision on the European market, with filtering of the activated offer creating constraints on the network;
- The placement of distributed flexibility takes place to minimise costs of the electricity provision on the European market based on an activation bonus/malus for the activated offer creating constraints on the network;
- The placement of distributed flexibility takes place only to minimise network costs;
- The placement of distributed flexibility takes place to minimise network costs through the filtering of the activated offer creating additional costs for the electricity provision on the European market;
- The placement of distributed flexibility takes place to minimise network costs based on an activation bonus/malus for the activated offer creating constraints to the additional costs for the electricity provision on the European market;
- The placement of distributed flexibility takes place to minimise the sum of costs of the electricity provision on the European market and of network constraints costs.

For each source sub-station, a "maximum consumption power" is calculated, according to network sizing breakdown criteria. Such consumption power is calculated from historical data for each source sub-station studied and from results given by the different modalities, according to the distribution of the national load curve obtained for each modality for each of the source sub-stations. Thanks to the comparison for each source sub-station of the historic maximum consumption power and that for 2030 the necessary reinforcement costs for the substation and for each modality considered can be determined.

3 "Challenges and Impact on the Design of Electricity Markets due to Emerging Local"

TD Théo DRONNE  
CIFRE EDF thesis  
Supervision : Fabien ROQUES

During the first year of preparing his thesis between Paris-Dauphine University - PSL and EDF R&D, Théo Dronne focused on the study of the development of local flexibility markets for distribution network operators in order to resolve congestion appearing on their networks. In a first article entitled "Local Flexibility Markets: Which Design for Which Needs?", written together with Fabien Roques and Marcelo Saguan, he highlighted the correlation between specific circumstances observed in 4 European countries (Germany, Netherlands, United Kingdom and France), and the design of emerging local

flexibility markets (ENERA, GOPACS, UKPN & ENEDIS) within these countries. This article, presented during the doctoral session of energy economists, was accepted for the European workshop of the International Centre for Research on Environment and Development (Berlin, June 2020) and for the conference of the International Association for Energy Economics (IAEE).



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4 "How Market Design Affects Actors' Behaviors and Price Formation in an Imperfect Environment: The Case of Capacity Markets"

In recent years, the electricity sector has been characterized by the introduction of competition-based mechanisms aimed at solving the problems of adequacy between supply and demand. One of the solutions consists in the implementation of capacity markets, in which the actors owning capacities are remunerated for their availability during critical periods for the system. This remuneration takes the form of a price, which is the result of a confrontation between, on the one hand, the availability of the actors owning capacities and, on the other hand, the demand seeking to cover peaks of consumption during critical periods. Therefore, the effectiveness of such a mechanism is conditioned by price formation, itself being the result of actors' behaviors and strategies in this mechanism. In this context where any deviation of the price from the true value of additional capacity for the system can cause adverse effects, and where policy-makers seem to lack both theoretical and empirical arguments to reach a consensus on the correct market design for capacity markets, the thesis "How Market Design Affects Actors' Behaviors and Price Formation in an Imperfect Environment: The Case of Capacity Markets?" seeks to provide some answers.

In an introductory work, I present approaches and models used by the research community to represent behaviors and strategies in capacity markets. As a first step, it proposes a grid of analysis of the different actors' motivations for participating in capacity markets, as well as drivers impacting their behaviors. Based on the previous analysis, this work presents a survey of the most relevant publications which model capacity markets. Finally, it identifies the main topics that have not been yet addressed by the literature and which will form the basis of a certain number of analyses carried out as part of this thesis. More precisely, I highlight that there is a lack of representation of capacity market specificities associated with issues on how market design can affect price formation, especially in the context of risk and imperfect information.

TD Léopold MONJOIE  
CIFRE RTE thesis  
Supervision : Fabien ROQUES

The second work in progress aims to study three dimensions which are essential if we want to soundly understand how actors estimate their bid in capacity market: how we can forecast the opportunity cost associated with the participation in capacity markets, which forms a part of the potential bids? what is the effect of risk aversion on those forecast and how it can impact bids?; and the implication of different temporal characteristics of capacity products on those two previous dimensions. The model developed in this work relies on a single-project approach based on empirical data and represents the uncertain evolution of a power plant value. I allow the addition of losses that account for the opportunity cost associated with the obligation of being available, as well as a module representing an additional remuneration of capacity. Second, I provide three different approaches based on risk theory which allow considering risk in the value of an asset: utility functions - the capital asset price model - the conditional value-at-risk approach.

In parallel, I also work on adapting multiunit auction models to capacity markets. Indeed, the literature review shows such models present multiples advantages if we want to understand the specificities of actors' behaviors in capacity markets: they have proven both their theoretical and empirical robustness in analyzing strategic behaviors in energy markets; they can account for multiple extensions such as allocation externalities, uncertainty, and imperfect information; and they can be used to compare effectiveness of different market design.

5 "The Short-Term Supply-Demand Balance of the Electricity System in 2025-2050: Impacts of Decarbonisation on the Architecture and Economic Fundamentals of European Balancing Markets"

On an electricity network, it is necessary, at all times, to maintain a balance between production and consumption of electricity: this is called the Supply-Demand Balance (SDB). The SDB is partly provided by the electricity markets, running from the long-term (several months in advance) to the short-term (a few hours before schedule). Approaching real time, it is no longer technically possible to maintain the SDB through these markets, and Transmission System Operators (TSOs) take over in a process called balancing. To guarantee the SDB in their area, TSOs activate different reserves, corresponding to groups whose production can be varied upward or downward. Two main changes will impact the SDB in the long-term: the establishment of European balancing markets, and energy transition. Indeed, the European will to harmonise and seek economic optimum leads to the imminent creation of several balancing markets bringing together various European countries, which will replace the current balancing process. As regards energy transition, it changes the technical features of the electricity production mix, and therefore, of SDB control, and can consequently impact on the performance of the balancing markets. Therefore, the thesis' central topic integrates these challenges: we will present a vision of the evolution of balancing management and cost in 2025-2050, taking into account the harmonisation of European balancing mechanisms through several markets, as well as of energy transition. Thus, firstly, the thesis compares the performance of the potential architectures of these markets by modeling them on PROMETHEUS, a market simulation platform developed by RTE, through a cost-benefit assessment, in addition to other energy and environmental indicators. The second study models energy transition through variants of the energy mix, and new simulations conducted on the platform allow to highlight the impact of de-carbonisation on the sizing of the necessary reserves and on balancing markets performance. Particular attention is paid to how the methods used by the TSOs to carry out this design react to the new features of the production mix,

TD Florent COGEN  
CIFRE RTE thesis  
Supervision : Fabien ROQUES

such as the uncertainty brought by intermittent productions like renewable energies. Finally, the last step of this thesis consists in the fine modeling of frequency behaviour, which reflects real-time SDB on the network, in order to verify the impacts of the two aforementioned evolutions on the dynamic behaviour of the network, and study the feedback loop with balancing markets.

Works to date

I have just started to work on this thesis, and I am currently focusing on two main areas:

- Bibliographic research in relation to European balancing markets and their modeling. This way, I can study the identification of possible market architectures and the modeling methods for the players and their behavior (agent-based modeling, game theory, etc.).
- The implementation of the modeling of these markets on PROMETHEUS.

Work Plan for 2020

Firstly, I will continue the work on the 2 aforementioned research axes. The aim is to achieve a balancing market modeling on PROMETHEUS operational by mid-2020. Once reached this stage, and after having defined the market architectures to compare, I will carry out the different market simulations and analyse the results obtained in order to highlight the performance of these architectures using cost-benefit evaluations. The drafting of an article illustrating this work should then conclude 2020, as well as the thesis' first part.

**6** "Analysis of the Economic Challenges Associated with the Integration of Electric Vehicles into the Electricity Network"

The first months working on the "Analysis of the Economic Challenges Associated with the Integration of Electric Vehicles into the Electricity Network" thesis topic allowed me to establish a state-of-the-art reference and to formulate, more concretely, the results expected at the end of the doctorate. On the one hand, a conceptualisation using documents written by institutions concerned with energy transition (such as the RTE report on the development of electromobility, "Global EV Outlook 2019" by IEA and Programmation Pluriannuelle de l'Énergie) allowed me to visualise the different forecast scenarios to which the thesis refers, providing me with a general overview of the issue. On the other hand, the academic articles allowed me to understand the magnitude of the subject and the possible impacts of different points of view. It has appeared that the subject has been discussed since the 90's, when a professor in the US noticed the potential of using the storage capacities of electric vehicles to serve electricity networks. Since then, researchers have been trying to exploit and to calculate the value of such energy capacity. Then, a first economic optimisation model was created for the particular case of a remote island (with no interconnections) seeking

**7** "Energy Transition and Translation : How Electricity Companies Gain, Maintain and Repair their Legitimacy? Observation in Corporate Discourse"

This ongoing research is at crossroads of management and energy transition. The point of view taken is an observation and explanation of the strategies pursued by electricity companies in relation to energy transition. Whether it is labelled energy transition in Europe, or affordable clean power in the USA, climate related issues challenge electricity companies like no others. Will building renewable capacities be enough to maintain legitimacy? How to repair legitimacy when citizens, shareholders, NGO claim companies for insufficient action taken? Methodologies from rhetoric and discourse analysis, with statistical text analysis,

**TD** **Maria-Juliana SUAREZ FORERO**  
CIFRE thesis with Renault  
(in collaboration with IFPEN)  
Supervision : **Patrice GEOFFRON**

energy independence whilst minimizing CO2 emissions. To this end, a project seeks the integration of electric vehicles capable of charging when there is an excess of renewable energies and of returning this energy during periods of peak demand, where power production is the most emitting. The aim is to obtain a merit order model of the means of production on the island, which should include the optimal mix between photovoltaics, wind and EV storage. An approach through simulation with real data has highlighted the strong relationship between installed capacity (MW) by type of renewable energy and storage capacity required (MWh), due to the probabilities specific to intermittency.

For the remainder, we will work on the understanding and execution of a V2G algorithm which tracks weather conditions without need to implement new and costly car technologies, as well as on a simulation of France EV fleet taking into account the charging and traveling habits of drivers.

**TD** **Arnaud LEMANT**  
Executive Doctorate in preparation,  
employee at EDF Renewables  
Supervision : **Patrice GEOFFRON**

are used to explore how legitimacy evolves. With a selection of 12 large utilities in Europe and USA, over a 10 years period, a back and forth analysis between text and statistics is performed with a textometry software. Outcome shows pattern across time and selection on how companies adapt. Some adopt energy transition as a new model, where others merely react. Vocabulary used emerges, sometimes converges for most companies, but not always, as does energy mix in many places.

**C** Scientific and academic awards and distinctions by CEEM/PSL researchers

**1** AEE SPECIAL PRIZE

**Anna CRETI**, professor of Economics at Paris-Dauphine University – PSL, member of LEDA and director of the Climate Economics Chair, as well as Fulvio FONTINI, for their work "Economics of Electricity: Markets, Competition and Regulations", published in 2019 by Cambridge University Press. On Monday 25 November 2019, the Association of Energy Economists (AEE) awarded prizes rewarding three books, by French authors, which are remarkable due to their contribution to the economics of energy. AEE's mission is to reveal the best work currently in this field, whilst giving the floor to the most competent experts on current affairs subjects which dominated the year.

**2** PRIZE FOR THE BEST STUDENT RESEARCH ARTICLE IN ENERGY ECONOMICS

**Clara BALARDY**, Paris-Dauphine University – PSL. The Association of Energy Economists awarded, on 25 November 2019, the prize for best student research article in energy economics to Clara BALARDY, doctoral student at LEDA, the Paris-Dauphine economics laboratory. This prize, endowed with 1000 Euros, rewards Clara BALARDY for her article "Vertical Integration, Real-Time Pricing and Market Power".

**D** Research assistance – Collaboration with the Master in Energy Carbon Finance Paris-Dauphine University – PSL

**Lamine DUCARD DAKE**

Master student in Energy Carbon Finance at Paris-Dauphine University – PSL

**CDD commitment** : from 01/04/19 to 30/09/19, full time

**Research mission** : Assistance in a research project on the green funding opportunities in the electricity sector.

- Inventory of existing funding, analysis of the needs of the sector and identification of gaps, as well as the development of proposals to facilitate green funding, in particular through the development of rating criteria at European level.

- In particular, the research project included the assistance in the preparation of a major European conference on "Sustainable Finance for Investing in a Low-Carbon European Electricity Sector: Optimising Market Designs, Risk Allocation, Reporting and Instruments", on 23 September 2019.



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### III. EUROPEAN COLLABORATIVE RESEARCH PROJECTS



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#### A The OSMOSE Project: Description, Objectives and Status

The OSMOSE<sup>2</sup> project is a [H2020 EU project](#) (2018-2021) led by RTE with 31 partners. Among them is the Paris-Dauphine University - PSL OSMOSE belongs to the call for tender for "Demonstration of system integration with smart transmission grid and storage technologies with increasing shares of renewables" of 2017. The aim of the project is to contribute on the development of advanced flexibility solutions and to assess their effective market integration.

Catalysed by the rapid uptake of renewable energies, evolving flexibility technologies require innovative market designs insuring temporal and spatial coordination for balancing capacity, energy and system services, as well as evolving regulatory frameworks to provide a non-discriminatory set of rules for the development of emerging business models capable to foster economic efficiency.

Under the responsibility of the Scientific Director of the Chaire European Electricity Markets (CEEM), a group of researchers of the CEEM are ensuring the contribution of the Paris-Dauphine University - PSL (UPD) to OSMOSE. In particular, they are leading the task on "Regulation and market design" with two key objectives:

- 1 building a comprehensive analysis of the existing regulatory issues and market barriers related with market participation of distributed assets (e.g. VRE, batteries, DSM), the more active role of consumers and the digitalisation of the grid, and

- 2 proposing evolutionary solutions to overcome them in the scope of the possible evolutions of the power sector by 2030 and 2050. The adopted methodology follows a "silo-breaking" approach towards new flexibility technologies, in particular, those being developed and tested on the demonstrators working packages of OSMOSE.

Specifically, the endeavors of the OSMOSE's working group on "Regulation and market design" are articulated around the following disruptive issues: what kind of market coordination mechanism would exist on a near-zero marginal cost world? Would the "Electricity Target Model" still be capable of leading to productive and allocative efficiencies? Would price volatility and risk perception hinder any investment signal in a low-carbon future? Would existing price zones still be capable of handling congestions efficiently? To what extent distributed generation will shift grid management issues to the local level? What kind of local signals or markets constructs would be required to coordinate DER resources on the interface between local and global services? How flexibility can contribute on alleviating such issues? How much and what kind of flexibility would prove valuable to the system in every case? How would the evolving structure of the industry impact scope and scale economies, and network benefits? Would consumers, provided with full active participation in the market,

receive incentives for pooling user-level and bulk resources? Or will consumers value other attributes than cost on their procurement choices (i.e. fuel and/or geographic origins, autarky capabilities, reliability, etc.)? How socially "optimal" would self-provisioning schemes, or even grid defection, result on a fully decarbonized future? Among other questions.

The UPD team is responsible for delivering four reports during the first year of the project: Three internal reports containing mainly the background on evolving system needs and the challenges for market design of the future, the description of flexibility technologies being tested in OSMOSE with a gap analysis with respect to current market design, and a report proposing quantitative and qualitative performance indicators for assessing different market architectures; and one external report containing the market design proposals to be assessed on the scenarios considered for simulations.

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#### B The Magical Project: Market and Grid-Oriented Integration of Central and Local Energy Markets

##### Consortium:

- The Institute for High Voltage Technology (IFHT) is part of the Faculty of Electrical Engineering and Information Technology of RWTH Aachen University.
- Paris-Dauphine University - PSL (UPD).
- The European Power Exchange EPEX SPOT SE.
- EWE AG headquartered in Oldenburg is one of the largest utilities in Germany supplying mainly the Elbe-Weser-Ems regions.

**Context and objectives:** Both the increasing penetration of distributed energy resources (DER) in power supply and the increasing electrification of energy consumption, e.g. in heat and mobility sectors, are reshaping the conventional power system. Innovative incentive-based mechanisms such as local energy markets (LEM) are being explored as a solution to efficiently allocate demand and supply and especially flexibilities at distribution grid level to reduce congestions at distribution and/or transmission grid level.

Increasing the local self-consumption can however have disruptive consequences for current market actors, in particular affecting market operators (e.g. EPEX) and market aggregators (e.g. VPPs). One option to overcome the disadvantages resulting from potentially reduced trading and market volumes





may be to explore new coordinative tasks at the interface between local and central energy markets. Complementing this paradigm shift, transmission system operators (TSOs) could explore the possibilities provided by these new interfaces between local and central market structures for grid-oriented purposes (e.g. reduction of congestions). Thereby, determining nodal incentives at the interfaces between the local and the central energy markets may prove to be an efficient grid-oriented integration approach for LEM.

Against this background, the objectives of the proposed research project magical are :

- Identification and discussion of the LEM's scope (operational premises, size, products proposed ...)
- Conceptualization of market- and grid-oriented integration approaches for LEM in central markets and transmission systems
- Development of a simulation framework for energy systems comprising LEM and application to the Franco-German context
- Evaluation of the developed integration approaches from an economic, technical and legal-regulatory perspective

To test the described hypotheses and the corresponding simulation tool, the Franco-German context offers an ideal test case. Being at the center of the European Energy system and representing a significant share of the trading and grid operation activities, the two countries bear the potential to provide meaningful and scalable results. Supported by substantiated evidence, national actors from both countries can continue their pioneering work in the context of the energy transition steering future developments in the European Energy Union in the right direction. In the case of the proposed project magical, significant contributions can be provided for the discussions regarding future market structures, the role of prosumers, market operators and aggregators as well as the interactions and synergies with transmission systems. Given the fundamental nature of the proposed research topics, corresponding developments will affect sustainable energy systems for many years to come.

## IV. SCIENTIFIC CONFERENCES AND SEMINARS

### A Scientific conferences

21-01-2019

CONFERENCE

**"The Regulatory Framework of Electricity Networks: What Are the Evolutions Necessary for Efficient Investment and to Stimulate Innovation Aimed at Energy Transition?"**

Energy transition involves many challenges for electricity networks, both in terms of transport and distribution. Uncertainties about the evolution of electricity demand, the development of self-consumption, as well as on technological developments such as storage and digitalisation, create a new context for the evolution electricity networks regulation.

In particular, the conference explored two challenges in the evolution of the regulatory framework for regulators and network managers:

- What are the needs in relation to investment in networks in the context of an energy transition characterised by an increasing share of variable and spatially dispersed energies?
- What is the regulatory framework which would allow effective investments and avoid a risk of overdue costs, given the uncertainties? How to switch from a cost plus logic to an approach where operators are responsible for their investment choices? What changes to the regulatory framework would allow to experiment with new funding models?

The conference gathered the representatives of the Commission de Régulation de l'Énergie (Energy Regulatory Commission, CRE), of network operators (Enedis and Réseau de Transport d'Électricité, RTE), and of the academic world in order to identify potential development path for the current regulatory framework, in particular drawing from experiences abroad.

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15-02-2019

CONFERENCE

### "Law and Economics at the crossroads of Energy Transition"

The commitment of Europe and its member states to the fight against climate change has a deep impact on energy policies, as they are meant to support energy transitions capable of achieving the objectives of reducing greenhouse gas emissions.

The electricity sector is one of the pillars of these transitions, with the aim of decarbonising electricity mixes. This results in a significant increase in the electricity system's capital-intensity, in a context of sustained technological evolution: highly pressing challenges are at stake for a competitive decarbonisation ensuring reliability of supply. The need for the implementation of good economic incentives is more and more clear, so that players facing a competitive and evolving environment can take the decisions which will deliver the right level of investment, in a context where it is necessary to articulate, more than in the past, the different geographic meshes and correctly allocate responsibilities and risks between players.



Thus, energy transition calls for a cross-reflection between the economy and the law, in order to articulate the different levels of regulation with the different levels of public policies decision-making, ensuring that market players will be effectively encouraged to support the fight against climate change.

16-04-2019

CONFERENCE

### "The Market Architecture for Enhancing Flexibility Provision in the EU Target Model"

The decarbonisation of the European power sector, to the extent that it is pursued primarily by introducing variable renewables, requires increasing amounts of flexibility over different geographic areas and different timeframes to match supply with demand. New technologies and behavioral changes offer some potential to respond to that need. There is, however, an open question whether this flexibility potential is best leveraged through decentralised competition in homogenous European markets, centralised competition for certain markets, e.g. auctions, or local energy markets with yet to be developed coordination mechanisms. This conference organised by the Chaire European Electricity Markets (CEEM) brings together leading experts to discuss how the first of these three options, European-wide markets with marginal cost pricing, can best respond to the flexibility challenge.



29-05-2019

CONFERENCE

### "Local Flexibility Platforms: Which Design and Governance to Support an Efficient Interface with National and European Markets?"

The energy transition will require the coordination of all available flexibility resources. While national and European-wide flexibility markets, based either on short-term marginal cost pricing or longer-term average cost pricing (auctions), will continue to play a role, much interest is currently focused on decentralised resources and consumption at the local level. Some form of local price signals for flexibility services will need to emerge in order to facilitate the integration of large quantities of variable renewable generation. This area of work represents a major challenge in Europe, where, unlike in the US, markets are largely providing signals at the level of wide geographic areas corresponding largely to national price zones.

The introduction of local flexibility markets could contribute to improve economic signals to activate flexibility to reduce congestion at the distribution grid level. Transmission system operators could also benefit from the flexibility resource coordination service provided by these new local markets which however raises the question of the articulation of local and national flexibility markets.

These new local flexibility platforms raise a number of theoretical and practical questions that will be discussed during the conference, such as:

- What are the products traded on these local flexibility platforms and what is the value added compared to the flexibility provided by the national reserve and balancing services?
- What are the alternative possible designs for such flexibility platforms? What are the emerging approaches in Europe and what do they have in common / how do they differ?
- How to ensure an efficient interface for the activation of offer with national reserve and balancing mechanisms?
- What are the governance issues raised by these new local flexibility platforms and the way they interface with the DSOs and TSOs operations?

The conference brought together a set of experts and academics to discuss these issues in the format of two sessions and a concluding roundtable as presented below.





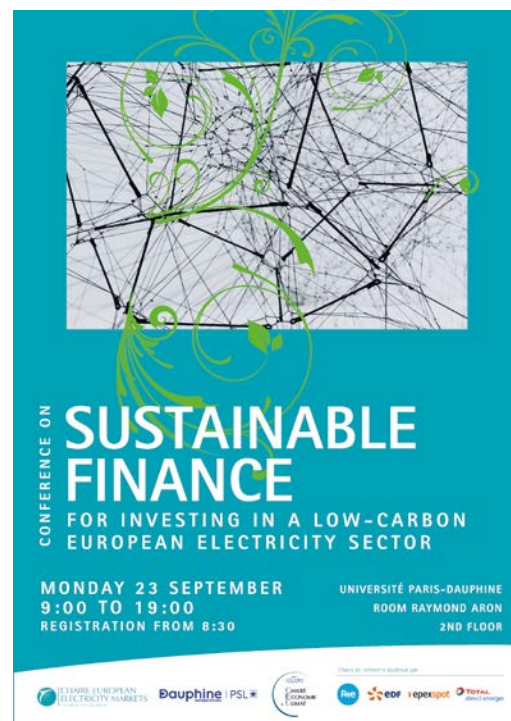
23-09-2019

CONFERENCE

**"Sustainable Finance for Investing in a Low-Carbon European Electricity Sector: Optimising Market Designs, Risk Allocation, Reporting and Instruments"**

The decarbonisation of electricity generation as part of the European energy transition requires large and increasing amounts of low-carbon power generation. With their high capital-intensity low carbon technologies such as wind, solar PV, hydroelectricity or nuclear energy require even greater amounts of investment than would ordinarily be the case. This constitutes one of the defining challenges of the European power sector in the next decade. At the same time, an increasing number of investors and financial institutions are specifically seeking investment opportunities that satisfy a number of strict environmental and, to a lesser extent, social criteria. Carbon-free or low carbon power generation offers likely the most mature market for such investments. Due to the complexity and the rapidity of its transition, it remains, alas, also still a very risky market.

The objective of this conference is to bring together experts from both the electricity and the financial industries to explore avenues for improving opportunities for sustainable finance in the European electricity sector. This implies working both sides of the equation. In the electricity sector the task is to reduce financial risks through market designs that are appropriate for low-carbon generation. In the financial industry, the task is to develop metrics and products that create the necessary confidence in environmental integrity for both project and portfolio investors. On the basis of evidence from recent academic work and industrial experiences, this conference will offer the opportunity to take stock of the state of sustainable finance in the electricity sector and to identify the levers for maximizing its future potential.



20-11-2019

CONFERENCE

**"Nodal versus Zonal Prices Revisited: Lessons from the US Experience and Applicability to Europe?"**

The decarbonisation of the power sector raises new challenges for the organisation of power markets and the interplay with the transmission and distribution networks. The rise of decentralised resources and the development of renewable resources in places with favourable conditions indeed require already create in some countries such as the UK and Germany unscheduled flows and local or regional congestions with significant costs. Even in countries where congestion remains limited today, the anticipated changes in the resources mix and location sheds a new light on the perennial problem of co-optimising the investments and the operation of the network and production resources.

There has been a continuous debate over the past decades on the pros and cons of the two main relevant approaches for power market design, namely zonal versus nodal prices. The theoretical 'first best' approach is to implement nodal prices which reflect the grids operational constraints into power prices. However, implementing such approach is in practice challenging, both in terms of computational issues associated with the sheer complexity of such approaches, but also institutionally. The alternative approach, using a zonal approach and leaving system operators to organise the internal redispatch is easier to implement in practice but the less granular price signals are believed to be less efficient in driving operational and investment decisions.

Whilst the US and some other countries such as Australia and New Zealand have chosen a nodal pricing approach, European electricity markets are based on a zonal approach. More than two decades after liberalisation, both models are facing challenges with the development of variable renewables and decentralised resources. The objective of this conference will be to revisit the old debate on the pros and cons of "Nodal versus Zonal prices" in the context of the ongoing evolution of EU power markets and the associated challenges. These new challenges include :

- The need for price signals that are robust enough to support both efficient operational decisions and investment decisions.

- The need for close to real time and granular price signals in order to reflect scarcity conditions in power prices.
- The issue of liquidity and potential exercise of market power / gaming strategies.
- The ongoing process of integrating further and coupling European power markets intraday and balancing markets.
- The development of storage and other flexibility resources requiring inter-temporal optimisation.
- The overlap with other regulatory elements which potential have an impact on locational signals, such as network connection and usage charges, and/or the geographic differentiation of levies and taxes.
- More generally, the prospects for merchant investment in transmission and infrastructure in Europe given the difference in governance and regulation.
- etc.

The objective of the conference will therefore be to discuss the pros and cons of the nodal versus zonal approach, in the light of the lessons from the US and European experience and with a focus on the new challenges for power market design associated with decarbonisation.

The first part of the discussion will review the theoretical benefits and the practical lessons from a number of countries and regions with nodal pricing. We will then discuss the differences in the electricity market design and institutional context between these countries and Europe to identify the prerequisites to a potential applicability to Europe of nodal prices. The final roundtable session will discuss the point of view of the industrial stakeholders.



### "The Interconnections of the Electricity System: What Prospects for Development after Brexit?"

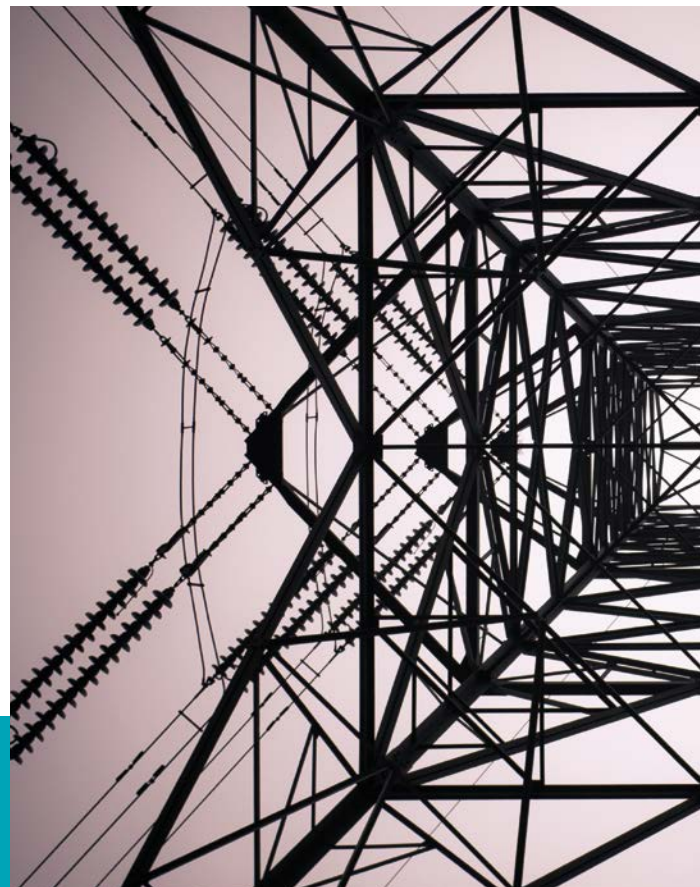
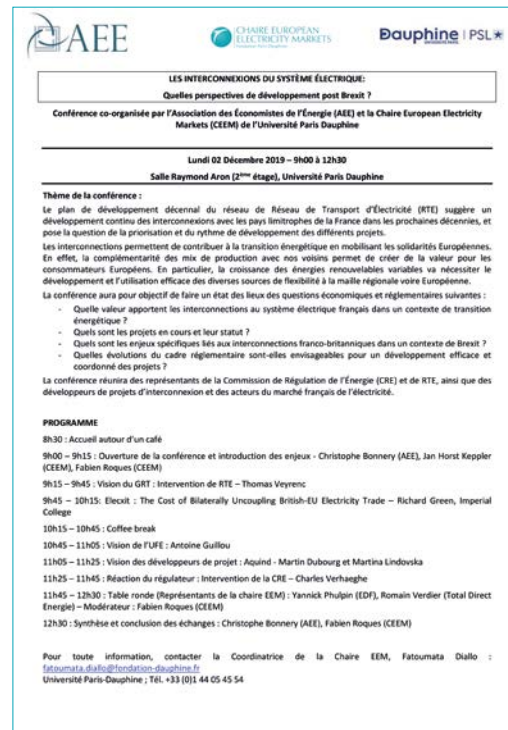
The Réseau de Transport d'Électricité (RTE) ten-year development plan suggests continuous development of interconnections with countries bordering France in the coming decades, raising the issue of the prioritisation and pace of development of the various projects.

The interconnections allow to contribute to energy transition by mobilising European solidarity. In fact, the complementarity of production mixes with our neighbours allows to create value for European consumers. In particular, the growth of variable renewable energies will require the development and efficient use of various flexibility sources both on a regional as well as a European basis.

The conference aimed was to assess the situation in relation to the following economic and regulatory issues:

- What value do interconnections bring to the French electricity system in a context of energy transition?
- What projects are currently being implemented and what is their status?
- What are the specific issues in relation to Franco-British interconnections in a Brexit context?
- What changes to the regulatory framework can be envisaged for the effective and coordinated development of projects?

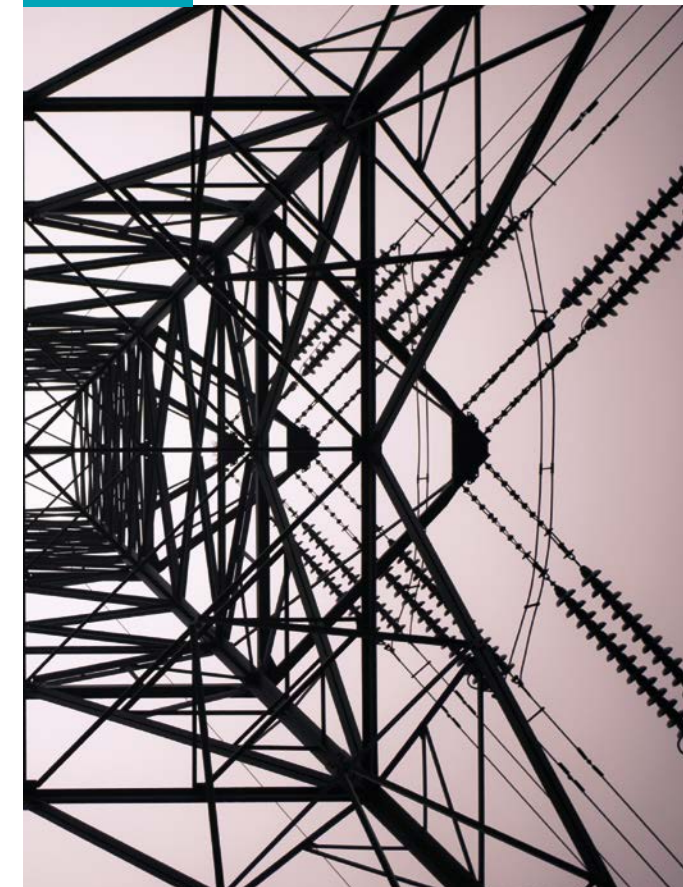
Thus, the conference brought together representatives of the Commission de Régulation de l'Énergie (CRE) and RTE, as well as interconnection projects developers and players in the French electricity market.



As part of its scientific activities, the Chaire European Electricity Markets (CEEM) holds internal research seminars, where works on specialised topics is discussed.

### "Capacity Market Design with Informational Asymmetries and Strategic Behaviour: New Insights from CEEM Research"

Capacity markets or capacity remuneration mechanism (CRMs) are a crucial building block of electricity systems aspiring at providing socially desired levels of security of supply at reasonable cost. Providing predictable revenues for levels of capacity capable of covering also extreme peak demand is thus an indispensable part of the toolbox of system operators and regulators. While the principles of the question are well understood, the design of real-world capacity markets and CRMs needs to be, both, sufficiently sophisticated and sufficiently robust to work also in the presence of complications, such as informational asymmetries and strategic behaviour. At the occasion of this seminar, two young CEEM researchers will present insights from their doctoral work and thus provide a perspective on the current frontiers of research on capacity market design. After a thorough exposition, each contribution will be followed by a discussion with the audience.



Charlotte SCOUFLAIRE

PhD Student, Chaire EEM

#### Information Value in Capacity Market Designs

In electricity markets, plants might be at the same time highly valuable for system stability (i.e. they are necessary to avoid rationing at peak demand) and insufficiently profitable, in particular given the highly uncertain nature of revenues during peak hours. To ensure security of supply, and to bring in line private profitability with social welfare, the public authority can design capacity remuneration mechanisms that stabilize and complement the revenues of plants. The purpose of capacity markets is to generate sufficient security of supply at least cost for end consumers. In capacity market design, the availability of information about likely future demand to different stakeholders is a crucial issue. The public authority does thus need to decide whether sharing this information or keeping it private is the welfare-optimizing solution. We consider a Cournot oligopsony in which the capacity buyers (mainly load serving entities) are the profit-maximizing agents engaging in strategic behaviour. Adapting a Cournot oligopoly model from Roy (2017), we analyse a capacity market where homogeneous buyers aim to be in compliance with their capacity obligation under uncertainty regarding future realized demand. Heterogeneous capacity owners bid their valuation of capacity. As information disclosure reduces uncertainty on the one hand, but also may decrease precautionary capacity buying by load-serving entities on the other, we seek the level of optimal information precision. Counter-intuitively, the welfare maximizing level can be lower than complete sharing of information. The model highlights possible disagreements between capacity buyers and capacity owners, considering that dissemination of public information might affect their surpluses in different ways. The theoretical results are illustrated with the help of an empirical case study using German data.

Léopold MONJOIE

PhD Student, RTE

#### A Survey on Electricity Market Design: Modeling Behaviors and Strategies in Capacity Markets

In recent years, the electricity sector has been characterized by the introduction of competition-based mechanisms aimed at solving the problems of adequacy between supply and demand. One of the solutions consists in the implementation of capacity markets, in which the actors owning capacities are remunerated for their availability during critical periods for the system. This remuneration takes the form of a price, which is the result of a confrontation between, on the one hand, the availability of the actors owning capacities and, on the other hand, the demand seeking to cover peaks of consumption during critical periods. Therefore, the effectiveness of such a mechanism is conditioned by price formation, itself being the result of actors' behaviors and strategies in this mechanism. Indeed, any deviation of the price from the true value of additional capacity for the system can cause adverse effects. This work aims to present the approaches and the models used by the research community to represent behaviors and strategies in capacity markets. As a first step, it proposes a grid of analysis of the different actors' motivations for the participation in capacity markets, as well as drivers impacting their behaviors. Based on the previous analysis, this work presents a survey of the most relevant publications which model capacity markets. Finally, it identifies the main topics that have not been yet addressed by the literature, which would improve our analysis of the effectiveness of capacity markets.

C

#### Paris-Sciences-Lettres Energy Economics Research Seminar

The Paris-Sciences-Lettres Energy Economics Research Seminar is organised jointly by CERNA (Mines Paris Tech), CGEMP (Paris-Dauphine University – PSL), Chaire European Electricity Markets (CEEM (Paris-Dauphine University – PSL)), and i3 (Interdisciplinary Institute for Innovation), members of PSL. It is led by François Lévêque (CERNA and Mines Paris Tech), Dominique Finon (CEEM and CNRS-CIRED) and Patrice Geoffron (Director of CGEMP, Paris-Dauphine University – PSL).

13-02-2019

43<sup>RD</sup> SESSION

PARIS-DAUPHINE UNIVERSITY – PSL:

"Economics and Regulation of Gas Infrastructures"

Olivier MASSOL

IFPEN

*The Technology and Cost Structure of a Natural Gas Pipeline: Insights for Costs and Rate-of-Return Regulation*

Joint paper with Florian PERROTTON,  
*Utilities Policy*, 2018.

Jann T. KELLER

University of Groningen

*Mergers of Germany's Natural Gas Market Areas: Is Transmission Capacity Booked Efficiently?*

Joint paper with G.H. KUPER et M. MULDER,  
*Utilities Policy*, 2019.



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08-04-2019

44<sup>TH</sup> SESSION

ÉCOLE DES MINES PARIS TECH:

"Social and Redistributive Effects  
of Energy-Climate Contribution"

Emmanuel COMBET

ADEME Economist, former CIRED researcher

*What Are the Socio-Economic Effects of Carbon Taxation Beyond a Zero-Sum Game?*

Presentation based on E. COMBET and J.C. HOURCADE  
(2017) Carbon taxation and climate finance.

A Social Pact for our Time ed. Petits Matins, 2017,  
and on COMBET et alii (2018) "Making Carbon  
Pricing Work for Citizens" (with David KLENERT, Linus  
MATTAUCH, Ottmar EDENHOFER, Cameron HEPBURN,  
Ryan RAFATY and Nicholas STERN).

Nature Climate Change, volume 8, pages 669–677  
(2018).

Thomas DOUENNE

Doctoral researcher, Paris School of Economics  
and Paris 1

*The Vertical and Horizontal Distributive Effects  
of Energy Taxes: A Case Study of a French Policy*

Presentation based on the PSE Working Paper:

DOUENNE T., 2018, FAERE Working Paper, 2018.10.



# COMPREHENSIVE OVERVIEW OF THE CHAIRE EUROPEAN ELECTRICITY MARKETS (CEEM) ACTIVITIES - 2017-2019

Scientific research

#

Key figures

5

Doctoral theses defended

7

Doctoral theses in progress

2

Research assistants thanks to a collaboration with the École des Mines

1

Research assistant thanks to a collaboration with the Paris-Dauphine Master in Energy Carbon Finance

2

Chancellery prizes from Paris – La Sorbonne universities

2

Scientific and academic awards and distinctions of PSL researchers, members of CEEM

2

European collaborative research projects

I. DOCTORAL THESES DEFENDED

ACTIVITY

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2019

1

"Analyzing the Optimal Development of Electricity Storage in Electricity Markets with High Variable Renewable Energy Shares"

Manuel VILLAVICENCIO

Thesis defended on 14 December 2017, at Paris-Dauphine University – PSL

Supervision: Jan Horst KEPPLER

2

"The Economic Potential of Demand Response in Liberalised Electricity Markets: A Quantitative Assessment for the French Power System"

Antoine VERRIER

Thesis defended on 19 March 2018, at Paris-Dauphine University – PSL

Supervision: Jan Horst KEPPLER

3

"Optimization and Simulation Based Cost-Benefit Analysis on a Residential Demand Response: Applications to the French and South Korean Demand Response Mechanisms"

Seungman LEE

Thesis defended on 3 December 2019, at Paris-Dauphine University – PSL

Supervision: Jan Horst KEPPLER

4

"Capacity Remuneration Mechanisms: An Assessment of their Performance and Implications for Market Design"

Charlotte SCOUFLAIRE

Thesis defended on 04 December 2019, at Paris-Dauphine University – PSL

Supervision: Jan Horst KEPPLER

5

"Auction and Continuous Market for Power: Organization and Microstructure"

Clara BALARDY

Thesis defended on 10 December 2019, at Paris-Dauphine University – PSL

Supervision: Bertrand VILLENEUVE and David ETINGER

05 – 06 – 2019

45<sup>TH</sup> SESSION

PARIS-DAUPHINE UNIVERSITY – PSL:  
"The Efficiency of Energy Efficiency"

Magali DELMAS

Professor of Management, University of California at Los Angeles, Institute of the Environment and Sustainability

*Are Residential Energy Efficiency Programs Effective? An Empirical Analysis in California?*

Presentation based on a December 2018

*Working Paper* of IES-UCLA, co-written with Yating CHUANG

and Stéphanie PINCETL, researchers at IES.

Katherine FARROW

Economist at OECD, PhD from Montpellier University  
*Less Is more in Energy Conservation and Efficiency Messaging: Insights from Experimental Economics.*

Presentation based on a joint paper, with Gilles GROLLEAU (INRA-Montpellier) and Naoufel MZOUGHIC (INRA-Avignon), and published in *Energy Policy*, Vol. 122, November 2018.



09 – 10 – 2019

46<sup>TH</sup> SESSION

ÉCOLE DES MINES PARIS TECH :  
"Energy Efficiency Policies or How to Miss the Target?"

Matthieu GLACHANT

Professor of Economics, Mines Paris Tech

*Are Home Energy Retrofits Profitable? An Ex-Post Evaluation based on Panel Data.*

Presentation based on a *Working Paper* from I3-Cerna from June 2019, co-written with Gaël BLAISE.

Joachim SCHLEICH

Professor at Grenoble School of Management and associate researcher at Karlsruhe Fraunhofer Institute ISI

*Energy Efficient Technology Adoption in Low-Income Households in the European Union – What Is the Evidence?*

Presentation based on an article published in *Energy Policy* (2019) Vol. 125, p. 196-206.

11 – 12 – 2019

47<sup>TH</sup> SESSION

ÉCOLE DES MINES PARIS TECH :  
"Carbon Taxation at the EU Borders: What Return?"

Philippe QUIRION

Director of research at CNRS, CIRED (Pont ParisTech and CNRS)

*Would Border Carbon Adjustments Prevent Carbon Leakage and Industry Competitiveness Losses?*

Presentation based on an article co-written with Frédéric BRANGER, and published in *Ecological Economics*, n° 99, pp.29-39.

Susanne DROEGE

Senior Fellow, German Institute for International and Security Affairs

*Designing Border Carbon Adjustments (BCA) for Enhanced Climate Action.*

Presentation based on an article co-written with Michael MEHLING (CEEPR-MIT) and alii, and published in *The American Society of International Law*, doi: 10.1017 / ajil.2019.22.





## II. PHD THESES IN PROGRESS

- 1** "The Efficiency of Short-Term Electricity Markets with Variable Renewables and their Impact on Forward Prices and Hedging Strategies"

Ángela TORRES CORONA

Thesis funded exclusively by Chaire EEM

Supervision: Jan Horst KEPLER

- 2** "Activation and Remuneration of Flexible Distributed Resources: What Incentive Mechanisms for a Global Economic Optimisation in the Context of Emerging Community Markets?"

Marion PICHOU

CIFRE thesis with RTE

Supervision: Jan Horst KEPLER

- 3** "Challenges and Impact on the Design of Electricity Markets due to Emerging Local"

Théo DRONNE

CIFRE EDF thesis

Supervision: Fabien ROQUES

- 4** "How Market Design Affects Actors' Behaviors and Price Formation in an Imperfect Environment: The Case of Capacity Markets"

Léopold MONJOIE

CIFRE RTE thesis

Supervision: Fabien ROQUES

- 5** "The Short-Term Supply-Demand Balance of the Electricity System in 2025–2050: Impacts of Decarbonisation on the Architecture and Economic Fundamentals of European Balancing"

Florent COGEN

CIFRE EDF thesis

Supervision: Fabien ROQUES

- 6** "Analysis of the Economic Challenges Associated with the Integration of Electric Vehicles into the Electricity"

Maria-Juliana SUAREZ FORERO

CIFRE thesis with Renault

(in collaboration with IFPEN)

Supervision: Patrice GEOFFRON

- 7** "Energy Transition and Translation: How Electricity Companies Gain, Maintain and Repair their Legitimacy? Observation in Corporate Discourse"

Arnaud LEMANT

Executive Doctorate in preparation, employee at EDF Renewables

Supervision: Patrice GEOFFRON



## III. PARIS – LA SORBONNE UNIVERSITIES CHANCELLERY PRIZES

Each year, 50 young doctors of all nationalities, from 17 universities and 6 major Île-de-France higher education institutions are awarded a prize for the excellence of their research work in the areas of law, economics and management, medicine, science, letters and humanities and pharmacy. Two doctoral students from Chaire EEM received an honorary award in 2017 and 2018.

- 1** 2017 NOGARO HONORARY PRIZE

Marie PETITET

"Long-Term Dynamics of Investment Decisions in Electricity Markets with Variable Renewables Development and Adequacy Objectives"

- 2** 2018 VOUTERS HONORARY PRIZE

Manuel VILLAVICENCIO

"Analyzing the Optimal Development of Electricity Storage in Electricity Markets with High Variable Renewable Energy Shares"

## IV. SCIENTIFIC AND ACADEMIC AWARDS AND DISTINCTIONS BY CEEM/PSL RESEARCHERS

- 1** AEE SPECIAL PRIZE:

Anna CRETI, professor of Economics at Paris-Dauphine University – PSL, member of LEDA and director of the Climate Economics Chair, as well as Fulvio FONTINI, for their work "*Economics of Electricity: Markets, Competition and Regulations*", published in 2019 by Cambridge University Press. On Monday 25 November 2019, the Association of Energy Economists (AEE) awarded prizes rewarding three books, by French authors, which are remarkable due to their contribution to the economics of energy. AEE's mission is to reveal the best work currently in this field, whilst giving the floor to the most competent experts on current affairs subjects which dominated the year.

- 2** PRIZE FOR THE BEST STUDENT RESEARCH ARTICLE IN ENERGY ECONOMICS

Clara BALARDY, Paris-Dauphine University – PSL. The Association of Energy Economists awarded, on 25 November 2019, the prize for best student research article in energy economics to Clara BALARDY, doctoral student at LEDA, the Paris-Dauphine economics laboratory. This price, endowed with 1000 Euros, rewards Clara BALARDY for her article "*Vertical Integration, Real-Time Pricing and Market Power*".

## V. RESEARCH ASSISTANCE

### 1 Collaboration with Paris École des Mines

#### Alexis PASKOFF

Civil engineering student  
at Paris École des Mines

**Research mission:** Calculation of producers' electricity rents according to the mode of allocation of carbon allowances.

#### Amaury TESTU DE BALINCOURT

1<sup>st</sup> year engineer student of the civil engineering cycle of the École des Mines

**Research mission:** Preparation of a quantitative analysis of the value of flexibility using methodologies developed by CEEM researchers and market data from EPEX Spot.

**Objective:** Developing a scientific report which could represent the basis for a scientific publication.

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### 2 Collaboration with the Master in Energy Carbon Finance Paris-Dauphine University – PSL

#### Lamine DUCARD DAKE

Master student in Energy Carbon Finance  
at Paris-Dauphine University – PSL

**Research mission:** Assistance in a research project on the green funding opportunities in the electricity sector.

- Inventory of existing funding, analysis of the needs of the sector and identification of gaps, as well as the development of proposals to facilitate green funding, in particular through the development of rating criteria at European level.

- In particular, the research project included the assistance in the preparation of a major European conference on "Sustainable Finance for Investing in a Low-Carbon European Electricity Sector: Optimising Market Designs, Risk Allocation, Reporting and Instruments", on 23 September 2019.

## VI. EUROPEAN COLLABORATIVE RESEARCH PROJECTS

### 1 The OSMOSE<sup>3</sup> project: A H2020 EU project (2018-2021) led by RTE with 31 partners.

### 2 The Magical Project: Market and Grid-Oriented Integration of Central and Local Energy Markets

### 3. Optimal System-Mix Of flexibility Solutions for European Electricity.

## Scientific publications

### # Key figures

- 21 Working Papers
- 2 Publications in *Energy Journal*
- 8 Publications in *Energy Policy*
- 1 Publication in *La Revue de l'Énergie*

## I. WORKING PAPERS

### 1 "Hybrid Electricity Markets with Long-Term Risk-Sharing Arrangements: Adapting Market Design to Security of Supply and Decarbonisation Objectives"

WP 23

#### Fabien ROQUES

Associate Professor, CGEMP, Paris-Dauphine University – PSL and CEEM Associate Researcher and **Dominique FINON** CNRS Research Director in the CIRED and CEEM Scientific Counsellor, Paris-Dauphine University – PSL

### 2 "Determining Optimal Interconnection Capacity on the basis of Hourly Demand and Supply Functions of Electricity"

WP 24

#### Jan Horst KEPPLER

Professor of Economics at Paris-Dauphine University – PSL and Scientific Director of the CEEM, **William MEUNIER** Student at Mines ParisTech, and junior Researcher at the CEEM and **Alexandre COQUENTIN** Consultant to MAZARS, and junior Researcher at the CEEM



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**3** "A Capacity Expansion Model Dealing with Balancing Requirements, Short-Term Operations and Long-Run Dynamics"

**WP 25** **Manuel VILLAVICENCIO**  
Paris-Dauphine University - PSL, LEDa, [CGEMP] and CEEM

**4** "The Value of Flexibility in Power Markets"

**WP 26** **Stéphane GOUTTE**  
Université Paris 8/LED and researcher at CEEM and **Philippe VASSILOPOULOS**  
Director of Product Design, EPEX Spot

**5** "A Prospective Economic Assessment of Residential PV Self-Consumption with Batteries and Its Systemic Effects and the Implications for Public Policies : The French Case in 2030"

**WP 27** **Hyun Jin Julie YU**  
I-tésé/ Das / CEA Saclay – CEEM Researcher

**6** "The Value of Electric Energy Storage in Electricity Systems with High Shares of Wind and Solar PV: The Case of France in the Energy Transition"

**WP 28** **Manuel VILLAVICENCIO**  
Paris-Dauphine University - PSL and Chaire EEM

**7** "Assessing Cross-Border Integration of Capacity Mechanisms in Coupled Electricity Markets"

**WP 29** **Mauricio CEPEDA**  
Paris-Dauphine University - PSL / Chaire EEM – Gazprom Marketing Et Trading

**8** "SiSTEM, a Model for the Simulation of Short-Term Electricity Markets"

**WP 30** **Marie PETITET**  
EDF R&D and CEEM Researcher  
**Marie PERROT** and **Yannick PHULPIN**  
from EDF R&D (France), and **Sébastien MATHIEU** and **Damien ERNST**  
from University of Liège (Belgium)

**9** "Capacity Remuneration in Power Markets: An Empirical Assessment of the Cost of Precaution"

**WP 31** **Charlotte SCOUFLAIRE**  
Doctoral Student, University Paris-Dauphine - PSL, LEDa, Chaire EEM

**10** "Drivers and Diffusion of Residential Photovoltaics in France"

**WP 32** **Cyril Martin DE LAGARDE**  
Paris-Dauphine University - PSL, École des Ponts ParisTech

**11** "On the Efficiency of Decentralized Decision-Making in Self-Dispatch Power Systems"

**WP 33** **Marie PETITET**  
EDF R&D and CEEM researcher, **Marie PERROT** and **Yannick PHULPIN**  
all from EDF R&D (France), and **Sébastien MATHIEU** and **Damien ERNST**  
from Université de Liège (Belgium)

**12** "System Contributions of Residential Battery Systems: New Perspectives on PV Self-Consumption"

**WP 34** **Hyun Jin Julie YU**  
I-tésé/ Das / CEA Saclay – CEEM Researcher

**13** "An Empirical Analysis of the Bid-Ask Spread in the German Power Continuous Market"

**WP 35** **Clara BALARDY**  
PhD Candidate, EPEX Spot, Paris-Dauphine University - PSL, LEDa

**14** "The Social Efficiency of Electricity Transition Policies Based on Renewables: Which Ways of Improvement?"

**WP 36** **Manuel VILLAVICENCIO**  
Paris-Dauphine University - PSL and Chaire EEM and **Dominique FINON**  
Emeritus Research Director at CNRS, associate Researcher at the Chaire EEM

**15** "Network Connection Schemes for Renewable Energy in France: A Spatial Analysis"

**WP 37** **Cyril Martin DE LAGARDE**  
Paris-Dauphine University - PSL, École des Ponts ParisTech

**16** "Effects in Terms of Excess Demand Response in Intelligent Electrical Networks"

**WP 38** **Cédric CLASTRES**  
University of Grenoble-Alpes, CNRS, INRA, Grenoble INP, GAEL (UMR 5313) and Chaire EEM and **Patrice GEOFFRON**  
Paris-Dauphine University - PSL, LEDa, UMR CNRS-IRD) and Chaire EEM

**17** "Comparing Methods for Customer Baseline Load Estimation for Residential Demand Response in South Korea and France: Predictive Power and Policy Implications"

**WP 39** **Seungman LEE**  
PhD Student, Paris-Dauphine University - PSL, LEDa [CGEMP] and Chaire EEM

**18** "Counting on the Neighbours: Challenges and Practical Approaches for Cross Border Participation in Capacity Mechanisms"

**WP 40** **Fabien ROQUES**  
Associate Professor, Paris-Dauphine University - PSL, LEDa [CGEMP] , and Chaire EEM

**19** "Market Design and the Cost of Capital for Generation Capacity Investment"

**WP 41** **Benoît PELUCHON**  
EDF R&D EFSE Department, EDF Lab Paris-Saclay

**20** "Evaluate the Cost of Renewable-Based Electricity Transitions: Good Use of Sector Optimisation Models"

**WP 42** **Dominique FINON**  
CNRS Emeritus Research Director, associate Researcher at CEEM

**21** "Modelling Participation in Residential Demand Response Mechanisms in South Korea and France: The Impacts of Inconvenience, Customer Baseline Estimation and Marginal Pricing"

**WP 43** **Seungman LEE**  
PhD Student, Paris-Dauphine University - PSL, LEDa [CGEMP] and Chaire EEM

## II. PUBLICATIONS IN PEER-REVIEWED JOURNALS

ACTIVITY REPORT  
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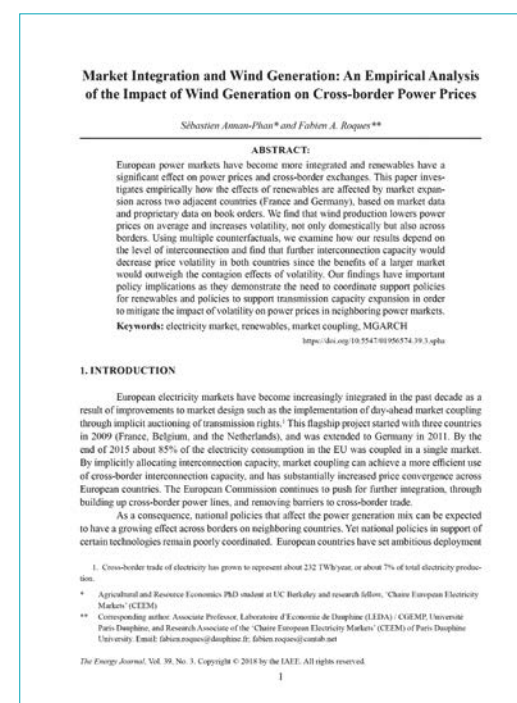
### 1. Energy Journal

"Determining Optimal Interconnection Capacity on the basis of Hourly Demand and Supply Functions of Electricity"

Jan Horst KEPLER and William MEUNIER  
*The Energy Journal*, Vol. 39,  
No. 3, pp. 117-139

"Market Integration and Wind Generation: An Empirical Analysis of the Impact of Wind Generation on Power Prices Cross-Border"

Sébastien PHAN and Fabien ROQUES  
*The Energy Journal*, Volume 39,  
No. 3, pp. 1-23



### 2. Energy Policy

"Capacity Adequacy in Power Markets Facing Energy Transition: A Comparison of Scarcity Pricing and Capacity Mechanism"

Marie PETITET, Dominique FINON  
and Tanguy JANSSEN  
*Energy Policy*, Volume 103 (April 2017),  
pp. 30-46

"Adapting Electricity Markets to Decarbonisation and Security of Supply Objectives: Toward a Hybrid Regime?"

Fabien ROQUES and Dominique FINON  
*Energy Policy*, Volume 105 (June 2017),  
pp. 584-596

"A Prospective Economic Assessment of Residential PV Self-Consumption with Batteries and Its Systemic Effects: The French Case in 2030"

Hyun Jin Julie YU  
I-tésé / DAS / CEA Saclay / UPSay /  
LEDA-CGEMP and Chaire EEM  
*Energy Policy*, Volume 113 (February 2018),  
pp. 673-687

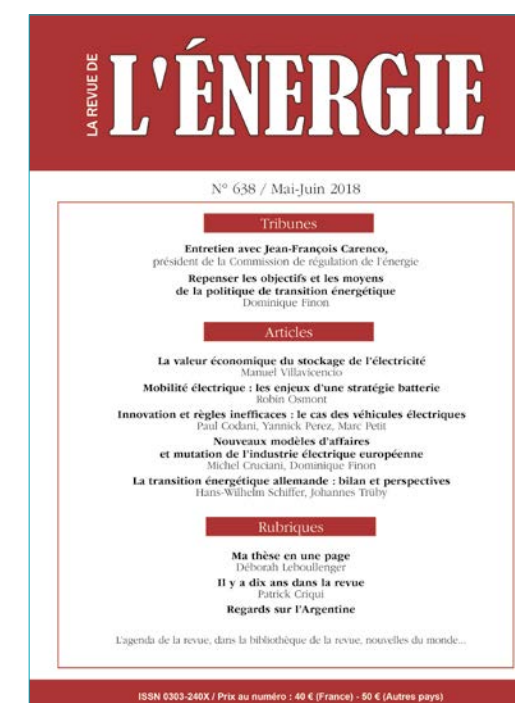
"The Value of Flexibility in Power Markets"

Paper co-written with Stéphane GOUTTE  
University Paris 8 / LED and CEEM Researcher  
and Philippe VASSILOPOULOS  
Director of Product Design / EPEX Spot  
*Energy Policy*, Volume 125 (February 2019),  
pp. 347-357

### 3. La Revue de l'Énergie

"The Economic Value of Storing Electricity"

Manuel VILLAVICENCIO  
Paris-Dauphine University - PSL and Chaire EEM  
*N°638 / May-June 2018, pp. 13-28*



"How Renewable Production Depresses Electricity Prices: Evidence from the German Market"

Paper co-written with Cyril Martin DE LAGARDE  
École des Ponts Paris Tech /  
Paris-Dauphine University - PSL / LEDa - CGEMP  
and Chaire EEM  
and Frédéric LANTZ  
IFP School  
*Energy Policy*, Volume 117 (2018), pp. 263-277

"Assessing Cross-Border Integration of Capacity Mechanisms in Coupled Electricity Markets"

Mauricio CEPEDA  
Paris-Dauphine University - PSL / Chaire EEM -  
Gazprom Marketing & Trading  
*Energy Policy*, Volume 119 (2018), pp. 28-40

"Impact of Gate Closure Time on the Efficiency of Power Systems Balancing"

This research paper was co-written  
with Marie PETITET  
EDF R&D and CEEM researcher,  
Marie PERROT and Yannick PHULPIN  
all from EDF R&D (France),  
and Sébastien MATHIEU and Damien ERNST  
from the University of Liège (Belgium)  
*Energy Policy*, Volume 129 (2019),  
pp. 562-573, Petit et al.



## Scientific conferences and seminars

### # Key figures

- 16 Scientific conferences
- 3 Internal research seminars
- 2 Research seminars reserved for partners
- 13 Sessions of the Paris-Sciences-Lettres Energy Economics Research Seminar



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## I. SCIENTIFIC CONFERENCES

06-03-2017

WORKSHOP

- 1 "Electricity Demand: New Modelling Perspectives"

27-09-2017

CONFERENCE

- 2 "The Future of Utilities: From Bankruptcy Risk to New Business Models" and Ceremony for the renewal of the CEEM Partnership agreement.

23-10-2017

CONFERENCE

- 3 "The first Capacity Markets in Europe – Feedback and developments"

24-11-2017

CONFERENCE

- 4 "Public Intervention in the Energy Transition: A Legal and Economic Perspective on State Aid Policy"

30-05-2018

CONFERENCE

- 5 "Electricity Storage – Challenges and Perspectives"

11-06-2018

SEMINAR

- 6 "Private Value and Systemic Contribution of Demand Response: Economic Representation, Industrial Potential and Incentive Systems"

27-09-2018

CONFERENCE

- 7 "Flexibilisation Options for Energy Transition: System Services, Networks and Demand Management"

08-11-2018

SEMINAR

- 8 "European Electricity and Carbon Markets after the ETS Reform: Is a New Reform Needed?"

18-12-2018

CONFERENCE

- 9 "The Role of Nuclear Power in Low Carbon Electricity Systems"

21-01-2019

CONFERENCE

- 10 "The Regulatory Framework of Electrical Networks: What Are the Evolutions Necessary for Efficient Investment and to Stimulate Innovation Aimed at Energy Transition?"

15-02-2019

CONFERENCE

- 11 "Law and Economics at the Crossroads of Energy Transition"

16-04-2019

CONFERENCE

- 12 "The Market Architecture for Enhancing Flexibility Provision in the EU Target Model"

29-05-2019

CONFERENCE

- 13 "Local Flexibility Platforms: Which Design and Governance to Support an Efficient Interface with National and European Markets?"

23-09-2019

CONFERENCE

- 14 "Sustainable Finance for Investing in a Low-Carbon European Electricity Sector: Optimising Market Designs, Risk Allocation, Reporting and Instruments"

20-11-2019

CONFERENCE

- 15 "Nodal versus Zonal Prices Revisited: Lessons from the US Experience and Applicability to Europe?"

02-12-2019

CONFERENCE

- 16 "The Interconnections of the Electrical System: What Prospects for Development after Brexit?"

## II. SCIENTIFIC SEMINARS



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### 1. Research seminars reserved for partners

The Chaire European Electricity Markets set up, in 2018, a regular research seminar reserved for its partners and invited academics, aimed at deepening specific research subjects. The objective is to combine cutting-edge research on topical issues with exchanges allowing great freedom of speech.

20-02-2018 1<sup>ST</sup> SEMINAR

"The Economic Value of Flexibility in the Electricity Market"

24-05-2018 2<sup>ND</sup> SEMINAR

"The Current Key Challenges of the European Electricity Markets: Goalposts and Global / Local Articulation of the Electricity System"

### 2. Internal research seminars

As part of its scientific activities, the Chaire European Electricity Markets (CEEM) holds internal research seminars, where works on specialised topics are discussed.

30-01-2017 1<sup>ST</sup> SEMINAR

"European Electricity Market Integration after the Winter Package: New Impulse or Business as Usual?"

28-03-2018 2<sup>ND</sup> SEMINAR

"Nuclear Energy and Variable Renewable Energy in Carbon-Free Electricity Systems: Conflict or Complementarity?"

01-07-2019 3<sup>RD</sup> SEMINAR

"Capacity Market Design with Informational Asymmetries and Strategic Behaviour: New Insights from CEEM Research"

### 3. Paris-Sciences-Lettres Energy Economics Research Seminar

The Paris-Sciences-Lettres Energy Economics Research Seminar is organised jointly by CERN (Mines Paris Tech), CGEMP (Paris-Dauphine University - PSL), Chaire European Electricity Markets (CEEM (Paris-Dauphine University - PSL)), and i3 (Interdisciplinary Institute for Innovation), members of PSL. It is led by François Lévêque (CERN and Mines Paris Tech), Dominique Finon (CEEM and CNRS-CIRED) and Patrice Geoffron (Director of CGEMP, Paris-Dauphine University - PSL).

15-03-2017 35<sup>TH</sup> SESSION

"The Political Economy of the EU-Russia Gas Exchanges"

31-05-2017 36<sup>TH</sup> SESSION

"The Economics of the Development of Electric Vehicles in Electricity and Transport Systems"

09-10-2017 37<sup>TH</sup> SESSION

"Evaluation of the National Determined Contributions (NDC) of Countries committed to the Paris Agreement"

13-12-2017 38<sup>TH</sup> SESSION

"Towards an Economy of Electric Decentralization"

13-02-2018 39<sup>TH</sup> SESSION

"Adapting the Market Design of Electricity Markets to the Introduction of Large-Scale Renewables"

26-04-2018 40<sup>TH</sup> SESSION

"The Oil Market between New Competitive Forces and the Constraint of Low Carbon Transition"

03-10-2018 41<sup>ST</sup> SESSION

"The Economic Efficiency of Electricity Transition Policies based on Renewable Energy"

12-12-2018 42<sup>ND</sup> SESSION

"Towards Manageable Nuclear Costs?"

13-02-2019 43<sup>RD</sup> SESSION

"Economics and Regulation of Gas Infrastructures"

08-04-2019 44<sup>TH</sup> SESSION

"Social and Redistributive Effects of Energy-Climate Contribution"

05-06-2019 45<sup>TH</sup> SESSION

"The Efficiency of Energy Efficiency"

09-10-2019 46<sup>TH</sup> SESSION

"Energy Efficiency Policies or how to Miss the Target?"

11-12-2019 47<sup>TH</sup> SESSION

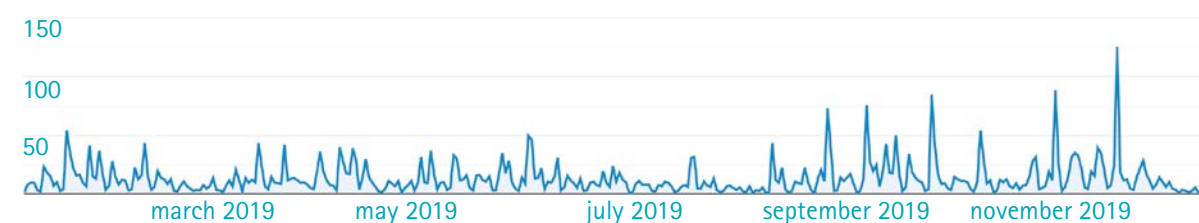
"Carbon Taxation at the EU Borders: What Return?"



## ADDITIONAL INFORMATION ON THE CEEM

### Website usage statistics

VISITS FROM JANUARY 2019 TO DECEMBER 2019



SESSIONS

10 532

USERS

7 080

PAGEVIEWS

20 849

PAGES / SESSION

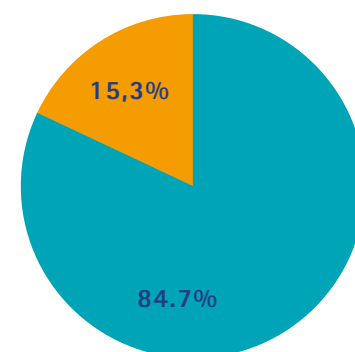
1.98

BOUNCE RATE

71 %

NEW SESSIONS

85 %



FR 45.27%

US 38.76%

GB 4.28%

DE 2.86%

KO 1.01%

IT 0.84%

BE 0.69%

● New visitor  
● Returning Visitor

Source: Google analytics

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### Website

<http://www.ceem-dauphine.org/home/en/>

It allows the dissemination and coordination of CEEM activities and of various CEEM research projects. The "Members" secure access provides several research works and presentations of internal CEEM research seminars.

Several *Working Papers* are online according to a unique model specific to the CEEM:

<http://www.ceem-dauphine.org/working/en>

All slides of organised scientific events are available online and downloadable.

### Social networks

You can also find CEEM on LinkedIn:

<https://www.linkedin.com/in/ceem-universit%C3%A9-paris-dauphine-55410b87/>

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