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*« This is a good time to be active in research into rapidly developing European electricity markets, where the structure and context evolve every year.*

*Little by little, however, the profound changes that were initiated several years ago are now beginning to suggest the first outlines of the sector's future. »*

Jan Horst Keppler  
Scientific Director, CEEM

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# A MESSAGE FROM THE CEEM'S SCIENTIFIC DIRECTOR

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As Scientific Director of the Chaire European Electricity Markets (CEEM) at Université Paris-Dauphine, it is with great pride that I present our report of activities 2012-2017. This report gives an overview of our activities in the three areas of scientific research, public discussion and training. Over the first five years of the CEEM's existence and with the support of our partners, Réseau de Transport d'Électricité (RTE), Électricité de France (EDF), European Power Exchange (EPEX Spot) and Groupe Caisse des Dépôts (CDC), we have been able to run an ambitious research programme looking at the changes and challenges confronting the European electricity markets. The CEEM's main activity has been research into market designs capable of guaranteeing long-term sustainability of investment and security of electricity supply in the context of the energy transitions in France and the rest of Europe aimed at decarbonising electricity production. In electricity markets undergoing rapid change, this area of research also involves studying changes in electricity prices, transport and distribution infrastructures, the challenges of integrating variable renewable energies and the likely business models for the electricity industry of tomorrow.

From October 2012, when the Chaire was inaugurated, to March 2017, the CEEM has published 26 Working Papers by its researchers as part of its incentive programme for scientific research. Of these 26 Working Papers, ten were later accepted and published in peer-reviewed periodicals, including three in *The Energy Journal*, two in *Energy Economics* and three in *Energy Policy*. A symposium volume with five papers from the CEEM July 2015 conference on the Target Model 2.0 has currently been published in *Energy Policy*<sup>1</sup>. These publications all mention the support that they have received from the CEEM and its partners and have contributed to growing international recognition for energy research carried out at Université Paris-Dauphine.

The production, transport and supply of electricity are industrial activities at the heart of society. These subjects always provoke passionate reactions and a strong social demand for clarification and orientation. The CEEM's scientific research has thus been permanently

accompanied by a complementary programme of conferences and seminars providing an opportunity for debate and the dissemination of research results. Over the period 2012-2017, the CEEM hence organised 28 international scientific conferences or seminars as well as 10 internal research seminars for a more specialized circle of researchers, thus giving a platform to young researchers and PhD students from the best European centres. The CEEM also contributed to the organisation of 35 research seminars at Paris-Sciences-Lettres University (PSL) on the economics of energy.

A third aspect of the CEEM's activities as a university institution is the training of PhD students and young researchers. Since 2012, the CEEM's accredited researchers have thus supervised eight PhD theses on the economy of the electricity markets at Université Paris-Dauphine, of which the first three have recently been defended. The CEEM has also successively employed six research assistants on different projects, some of which have led to papers being published in peer-reviewed periodicals. The objective in this domain



1. See Appendix 1: Editorial - Special Section: Towards Hybrid Market Regimes in the Power Sector.



is to contribute to the emergence of a new generation of European researchers in the economy of electricity systems. Since 2012, the CEEM has established itself in France as an important centre for research and exchange on the issues relating to the electricity markets. It is now becoming well known also abroad, partly thanks to the regular participation of its PhD students at international symposia and conferences. In the medium term, the CEEM thus aims at becoming a reference at the European level and to be able to influence debates on European energy policy. A CEEM symposium in January 2017 on the European Commission's Winter Package, which represents the preliminary draft of a 4th legislative package on the subject of energy, provided the model for such a dialogue with the European authorities, enabling the proposed plans to be improved with considered recommendations, based on both industrial reality and scientific research.

This report on the CEEM's activities for 2012-2017 is very timely. In the middle of discussions about the renewal of its partnership agreement and its new scientific programme for the period 2017-2022, the CEEM wishes to acquire, during the new cycle, even greater levels of competence in a certain number of research questions (for example capacity mechanisms, network development and pricing, making the most of flexibility) with an even more distinctive methodological profile rooted in economic research.

This is a good time to be active in research into rapidly developing European electricity markets, where the structure and context evolve every year. Little by little, however, the profound changes that were initiated several years ago are now beginning to suggest the first outlines of the sector's future. Building on the solid foundations laid down over the last five years, the CEEM is preparing, with its researchers and partners – RTE, EDF, EPEX Spot and the Groupe Caisse des Dépôts – to accompany all those involved in the study and understanding of the new world of electricity over the next five years.

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## KEY FIGURES FOR THE CEEM 2012-2017

**13**

Peer-Reviewed Publications

**28**

Scientific Conferences

**26**

Working Papers

**35**

Seminars on Research into Energy Economics at PSL

**10**

Internal Research Seminars

*Paris, March 2017  
Jan Horst Keppler  
Scientific Director, CEEM*

# BRIEF PRESENTATION OF THE CEEM

The Chaire European Electricity Markets (CEEM) is part of an ecosystem of institutions at the Université Paris-Dauphine working on energy matters. It includes the Centre for the Geopolitics of Energy and Raw materials (LEDA-CGEMP), the Master programme in Energy, Finance, and Carbon (EFC), as well as the Chairs of Economics of Climate & Finance and Sustainable Development at the Université Paris-Dauphine. In this context, the CEEM pursues three objectives:

- (1) Conducting an ambitious academic research programme,
- (2) Providing a discussion forum for academic and industrial experts, and stakeholders,
- (3) Contributing to the training of future management of companies in the electricity sector.

The CEEM is the result of a partnership between the Université Paris-Dauphine, the Paris-Dauphine Foundation, and the four founding partners: Réseau de Transport d'Électricité (RTE), Électricité de France (EDF), EPEX Spot, and the Union Française d'Électricité (UFE).

## The Team



Jan Horst Keppler, CEEM Scientific Director and professor of Economics at the Université Paris-Dauphine, is responsible for the general organization of the Chaire and its research activities.



Fatoumata Diallo,  
Project Manager  
of the CEEM



Anna Creti, professor of Economics at the Université Paris-Dauphine, leads Research Axis 1 (European electricity market pricing under market quotas) since October 2013.



Dominique Finon, CEEM  
Scientific Advisor, leads  
Research Axis 2  
(Organization, structural  
changes, and regulation of  
European electricity markets).

Patrice Geoffron, professor of Economics at the Université Paris-Dauphine, leads Research Axis 3 (Transport, distribution, and demand).





## CEEM Researchers

Marie Bessec, Researcher

Charlotte Boureau, Junior Researcher

Régis Bourbonnais, Researcher

Mauricio Cepeda, Junior Researcher

Cédric Clastres, Researcher

Alexandre Coquentin, Junior Researcher

Anna Creti, CEEM Research Area 1 Director

Michel Cruciani, Researcher

Guillaume Dezobry, Researcher

Dominique Finon, CEEM Research Area 2 Director

Patricia Van Horn Florin, Researcher

Julien Fouquau, Researcher

Patrice Geoffron, CEEM Research Area 3 Director

Frédéric Gonand, Researcher

Stéphane Goutte, Researcher

Morwenna Guichoux, Junior Researcher

Jan Horst Keppler, CEEM Scientific Director

Seungman Lee, CEEM PhD Student

Yannick Le Pen, Researcher

Yuanjing Li, Junior Researcher

William Meunier, Junior Researcher

Alexis Paskoff, Research Assistant

Marie Petitet, Junior Researcher

Thao Pham, Junior Researcher

Sébastien Phan, Junior Researcher

Fabien Roques, Researcher

María-Eugenia Sanin, Researcher

Charlotte Scouflaire, CEEM PhD Student

Antoine Verrier, CEEM PhD Student

Manuel Villavicencio, CEEM PhD Student

Julie Hyun Jin Yu, Junior Researcher

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# SUMMARY OF THE CEEM'S ACTIVITIES, 2012-2017

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See Appendix 2: Detailed Report of Events and Publications from the Chaire European Electricity Markets (CEEM)'s Areas of Research, 07-2012 – 03-2017.

Since the signature, in June 2012, of the first partnership agreement guaranteeing finance for five years, the Chaire European Electricity Markets (CEEM) at Université Paris-Dauphine has established itself in the French academic landscape as a centre for discussion and research into the issues relating to electricity markets. Although the CEEM has not yet imposed itself as an essential reference in the European debate, it is beginning to become recognised as a competent research centre on the reform of European market design, particularly on questions of investment in new capacities guaranteeing security of supply, decarbonizing the system and the challenge of integrating variable renewable energies.

In its scientific programme for the period 2017-2022, the CEEM wishes, during this second five-year cycle, to develop greater competence in relation to more specific research questions and a more distinctive methodological profile. Linked to this objective, it aims to train young researchers, some of whom are PhD students today, to become university or CNRS researchers or real experts in the various fields related to the European electricity markets. A brief summary of the first five years of the CEEM's operations shows that the foundations necessary to achieve such objectives have been laid down (see also the detailed report for 2012-17 in the Appendix 2).

## Key Figures for the CEEM

28 Scientific Conferences

10 Internal Research Seminars

Participation in 35 Seminars on Research into Energy Economics at Paris-Sciences-Lettres

26 Working Papers

11 Publications by CEEM Researchers in the specialised energy reviews with three publications in *The Energy Journal*, two in *Energy Economics* and three in *Energy Policy*

8 Theses supported by the CEEM

6 Research Assistants

## Events in 2012-17

During the first five years of its existence, the CEEM organised 28 scientific conferences and seminars, including the international conference on the Target Model 2.0, on 8 and 9 July 2015, and 10 internal research seminars for a more specialised circle of researchers. The CEEM also contributed to the organisation of 35 research seminars at PSL on the economics of energy, a subject in which the CEEM is actively involved.

## Research in 2012-17

During the first five years of its existence, the CEEM published 26 articles by its researchers in the form of Working Papers, of which seventeen were written on theme two: "Market design and regulation". Among these 26 Working Papers, ten were later accepted and published in peer-reviewed periodicals, including three in *Energy Journal*, two in *Energy Economics* and three in *Energy Policy*. A symposium with five papers from the CEEM Target Model 2.0 conference has currently been published in *Energy Policy*. Of course, all these publications acknowledge the support given by the CEEM and its partners.

## Training in 2012-17

During the first five years of its existence, the CEEM has supervised and supported eight PhD theses in the economy of electricity markets at Université Paris-Dauphine, of which the first have recently been presented. The CEEM has also successively employed six research assistants on different projects. The question remains as to whether the doctorates carried out under the aegis of the CEEM are adequate to reach a level of scientific and professional maturity to constitute the reservoir of future senior managers and high-level experts that our partners wish for. This is an aspect to which the second five-year project will have to pay particular attention.

In the case of the CEEM, the review presented above is certainly a source of satisfaction, but above all an indicator towards defining the right strategy for achieving the objectives set out in the scientific programme for the second period to an even greater degree. The CEEM and its team are now, of course, able to build upon the solid relational, reputational and intellectual capital that has been developed over the first period.

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# GOVERNANCE AND OPERATION OF THE CEEM

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## Preamble

The Chaire European Electricity Markets (CEEM) is an economics research chair at Université Paris-Dauphine whose main activity is research into decarbonisation of electricity production and the sustainability of long-term investment in relation to the energy transition in France and throughout Europe. The CEEM has not been founded on the basis of altruistic sponsorship, nor on the financing of research responding to industrial priorities, but on that of an ambition shared between industrial partners and university researchers to respond to a social demand expressed as much by producers and consumers as by the general public and the political and associative spheres. This social demand aims to better understand the issues relating to the current changes in the electricity system and to offer prospects of an electricity supply that is guaranteed, sustainable and economically efficient. On a day-to-day basis, the CEEM is helped in its task by dialogue and exchanges with its partners, RTE, EDF, EPEX Spot and the Groupe Caisse des Dépôts, which have all expressed the need to be able to talk to the academic world as equals, thus feeding into their strategic thinking. The CEEM will continue to operate both through regular exchanges with its partners and one-off collaborations with them on specific research questions.

The CEEM's current system of governance – Steering Committee, Scientific Council and Publication Review Board – works well. The strategic choice of being associated with the Paris-Dauphine Foundation rather than with the Europlace Foundation was a good one, bearing fruit on a daily basis through close and

confident cooperation between the teams from the Foundation and those from the CEEM. The division of responsibilities between the different governing bodies is well understood today and the interaction between them is well established. We recall their respective responsibilities below.

## Steering Committee

The Steering Committee (CoPil) is the governing body of the CEEM. It determines its strategic orientations, validates its budget proposals and controls expenditure. The partnership agreement fixes its composition to include the CEEM's Scientific Director, the partners' representatives, a second lecturer from Université Paris-Dauphine, a representative of the Paris-Dauphine Foundation, the Scientific Advisor to the CEEM and two qualified external members. The Steering Committee meets twice a year.

**In 2016, in compliance with the partnership agreement, two meetings of the CoPil were held in April and in November.**

*« The main activity is research into decarbonisation of electricity production and the sustainability of long-term investment in relation to the energy transition in France and throughout Europe. »*

## Steering Committee members

- **Jan Horst Keppler**  
Scientific Director, CEEM and Chairman of the CoPil
- **Thomas Veyrenc**  
Director, Markets and Regulatory Affairs, RTE
- **Cédric Léonard**  
Manager, Economic Study Centre, Markets Department, RTE
- **Patrice Bruel**  
Director of Regulations, EDF
- **Marc Bussieras**  
Group Strategic Director, EDF
- **Jean-François Conil-Lacoste**  
Chairman of the Board, EPEX Spot
- **Vincent Pichon**  
Director, Strategy Department, Groupe Caisse des Dépôts (CDC)
- **Patrice Geoffron**  
Professor of Economics, Université Paris-Dauphine
- **Sandra Bouscal**  
Director of the Paris-Dauphine Foundation, Université Paris-Dauphine
- **Jean-Arnold Vinois**  
Honorary Director at the European Commission, Special Advisor to the Commissioner (non-voting member)
- **Alfred Voss**  
Chairman of the CEEM's Scientific Council, Institute of Energy Economics and Rational Energy Use, University of Stuttgart (non-voting member)
- **Dominique Finon**  
Scientific Advisor to the CEEM, and CIRED-CNRS (Observer)

## Scientific Council

The CEEM's Scientific Council is made up of five well-established researchers in the economics of electricity systems. The Chairman of the Scientific Council sits as a qualified external member on the Steering Committee. The Scientific Council meets once a year. Through its independent overview of the CEEM's

activities, the Scientific Council provides international benchmarking and gives new impetus in terms of research. During the first five years of the CEEM's existence, the Council has been an important source of ideas for proposing and validating research themes. For the period 2017-2022, however, its composition will be renewed and its operation streamlined.

In 2016, due to diary conflicts, there were no meetings of the Scientific Council.

## Current membership of the Scientific Council

- **Jan Horst Keppler**  
Scientific Director of the CEEM
- **Prof. Alfred Voss**  
Chairman of the CEEM's Scientific Council, Institute for Energy Economics (University of Stuttgart)
- **Prof. William D'Haeseleer**  
University of Leuven Energy Institute
- **Prof. David Newbery**  
Electricity Policy Research Group (Cambridge University)
- **Prof. John Parsons**  
Centre for Energy and Environmental Policy Research (MIT)
- **Prof. Jacques Percebois**  
CREDEN (Université de Montpellier)
- **Anna Creti**  
Responsible for Research Area 1, CEEM
- **Dominique Finon**  
Responsible for Research Area 2, CEEM
- **Patrice Geoffron**  
Responsible for Research Area 3, CEEM

## Publication Review Board and CEEM Publication Policy

The CEEM's Publication Review Board decides whether or not to accept *Working Papers*, as well as scientific articles that have not previously been the subject of a

*Working Paper*, written by researchers at the CEEM as part of its programme for offering financial incentive to research. Each "candidate paper" is sent to the members of the Publication Review Board, the first time for comments, and, after any revisions made on the basis of those comments, a second time for validation. The Publication Review Board is convened electronically each time a scientific paper is submitted to the research programme. Since 2013, the Board has approved 26 *Working Papers* of which ten have subsequently been published in peer-reviewed periodicals.

## Current members of the Publication Review Board

- **Jan Horst Keppler**  
Scientific Director of the CEEM
- **Thomas Veyrenc**  
Director of Markets and Regulatory Affairs, RTE
- **Cédric Léonard**  
Manager, Economic Study Centre, Markets Department, RTE
- **Marc Bussieras**  
Group Strategic Director, EDF
- **Audrey Mahuet**  
Head of Market Design and Customer Relations, EPEX Spot
- **Vincent Pichon**  
Director, Strategy Department, Groupe Caisse des Dépôts (CDC)
- **Dominique Finon**  
Scientific Advisor to the CEEM, and CIRED-CNRS
- **Patrice Geoffron**  
Director, CGEMP, Université Paris-Dauphine
- **Yannick Le Pen**  
Assistant Professor, Université Paris-Dauphine

## Paris-Dauphine Foundation

The Paris-Dauphine Foundation manages all the legal and financial aspects of the CEEM. It is the third partner in the tripartite convention that links the CEEM and Université Paris-Dauphine, which includes the Paris-Dauphine Foundation. Apart from the lecturers from the university, the CEEM's employees (coordinator, research

assistants) are, legally speaking, employees of the Paris-Dauphine Foundation. The CEEM itself has no legal existence as an employer.

## Partners and budget

The current group of senior (RTE and EDF), and junior (EPEX Spot and the Groupe Caisse des Dépôts) partners, is considered to be well balanced. At present, there are no plans to include new partners. If it becomes necessary to change the composition of the group in the future, no such initiative will be taken without discussion with the existing partners.

The partners' annual contributions to the running of the CEEM have enabled the development of a coherent set of activities. However, the budget does require some changes. In particular, the current budget does not allow the CEEM to develop and maintain its own complete model of the European electricity markets on a long-term basis, although the first efforts made in relation to theses written at the CEEM have been promising. The exploration of possible cooperation in this field will thus be a priority for the period 2017-22.



## Internal operation

The internal structure of the CEEM, around a Scientific Director, a scientific advisor, three research area managers and a coordinator has worked well. However, this structure is likely to change in relation to the new scientific priorities for the period 2017-2022, particularly in terms of the nature and number of research areas and initiatives to be run.

Today, at different levels, the CEEM associates around 20 researchers working on the European electricity markets. The association of a researcher implies collaborating to different degrees in relation to the events organised by the CEEM and participation in the CEEM's programme of copyright purchase for the *Working Papers* and publications in peer-reviewed periodicals. This approach has proved its worth and will be continued during the next period.

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# CEEM NEWS FOR 2016

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## I. RESEARCH PROGRAMME

### A. Doctoral Theses

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

PhD Student: Marie Petitet

Supervisors: Dominique Finon and Jan Horst Keppler

#### Keywords

Electricity markets, investments, renewable energy sources, capacity adequacy, *System Dynamics* modelling.

Started in 2013, this thesis studies private investment decisions in electricity generation. More specifically, it estimates the sensitivity of the generation mix to different market architectures. To this end, a simulation tool based on *System Dynamics* has been developed. This model allows a generation mix to be simulated over several decades using a representation of private investment decisions based on profitability criteria estimated for different anticipated future scenarios.

This third year was devoted to finishing ongoing work and to writing the thesis manuscript. The thesis viva voce took place on 29 November, 2016.

#### Third year results

The comparison of a capacity mechanism and different energy-only markets with or without price cap was enhanced by modelling risk aversion. To do this, a concave utility function was introduced and used for investment decisions and for bids on the capacity market. A new study, taking into account risk aversion, was carried out with this model and presented at the *European Energy Market* conference:

Petitet, M., 2016. Effect of Risk Aversion on Investment Decisions in Electricity Generation: What Consequences for Market Design? In "Proceedings of the 13th international conference on the European Electricity Market (EEM), Porto".

#### Abstract

In liberalised electricity systems, power markets are expected to ensure the long-term coordination of investments in order to guarantee security of supply, sustainability and competitiveness. The reference "energy-only" market relies on the ability of power markets – where the hourly price is aligned with the marginal cost of the system – to provide an adequate price signal for investors. However, in practice, questions have been raised about its ability to trigger investments in Low-Carbon Technologies (LCT), particularly Renewable Energy Sources of Electricity (RES-E), and its ability to ensure capacity adequacy.

After characterising these market failures, this dissertation tackles the two research topics of RES investments and capacity adequacy within a methodological framework based on a *System Dynamics* model developed to simulate private investment decisions in power markets.

First, the results show that replacing out-of-market support mechanisms for RES-E by market-based investments helped by the sole implementation of a carbon price appears to be a feasible solution to trigger RES-E development, provided that there is political commitment to a high carbon price.

Second, it also appears that the energy-only market with price cap is ineffective to ensure capacity adequacy in a context of mature markets with conventional thermal power plants under transition paths. Adding a capacity market or removing the price cap both bring benefits in terms of Loss of Load Expectation (LOLE) and social welfare. Moreover, considering two different energy transition scenarios and different assumptions about the risk aversion of private investors, the capacity market is identified as the best option among the market designs considered.

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## Analyzing the Optimal Development of Electricity Storage in Electricity Markets with High RES-E Shares

PhD Student: Manuel Villavicencio

Supervisors: Jan Horst Keppler and Dominique Finon

The beginning of the third year of the PhD research was marked by participation in the INFRATRAN workshop on "Advanced Electricity Sector Modelling" at the Berlin University of Technology (TUB) in October 2015. On this occasion, some preliminary results of the modelling work were presented and reviewed, providing useful remarks and advice on further research.

The work that followed focused on the accurate quantification of flexibility requirements and the precise representation of different sources of flexibility in competition/complementarity in a capacity expansion model. Thus, the trade-offs between investing in energy storage, hydroelectric energy, DSM capabilities and high peak thermal capacity would be better represented.

As far as the quantification of flexibility requirements is concerned, apart from current long-term flexibility for system adequacy and investment deferral, and mid-term flexibility for supply arbitrage, from seasonal to hourly time horizons, short-term flexibility for system reliability was analysed (De Vos, K. et al.; Hirth & Ziegenhagen; Stiphout et al.) and identified as an important driver of flexibility requirements for system service supply in the context of large variable renewable energy (VRE) penetration. A module of frequency restoration reserve (FRR) requirements was therefore developed, based on the Network Code on Load-Frequency Control and Reserves (ENTSO-E, 2013), for co-optimization in the capacity expansion model. The FRR requirements are based on the imbalance probability given the forecasting errors in VRE generation on a day-ahead basis.

The representation of additional flexibility options was undertaken by developing a module allowing for demand side flexibility to represent DSM services. Thus, load shedding and load shifting are enabled using the formulation presented by Zerran and Schill (2015). The results of this work ("Planning Capacity Investments and Flexibility Assets: An Investment Model Integrating the Short-Term Requirements with the Long-Run Dynamics") were presented to the CEEM internal research seminar on Power Markets with High Proportion of Variable Renewables: Analytical Tools for Studying Efficient Adaptations, which was held at Paris-Dauphine on 12 April 2016.

Additionally, the simplified representation of

hydroelectricity, using fixed capacity factors assuming pluviometric values for the year, was enhanced using weekly defined water levels and water values. A summary of these improvements was presented during the annual conference of the Swedish Association for Energy Economics (SAEE) in August 2016.

In February 2017, a CEEM Working Paper ("A Capacity Expansion Model Dealing with Balancing Requirements, Short-Term Operations and Long-Run Dynamics") was published, formally describing the model's formulation as well as the capabilities of the different modules, using a case study. A second academic publication is in preparation, dealing with an analysis of the French power sector in the case of a clean energy transition. The paper will use the model that has been developed to conduct relevant energy policy assessments dealing with the impact of VRE goals and CO<sub>2</sub> policies. The goal is to shed some light onto the feasibility and cost of introducing high proportions of VRE capacity, the implicit needs for flexibility and its value from private (market value) and public (social welfare) perspectives.

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- Zerrahn, A. & Schill, W.-P., 2015b. On the representation of demand-side management in power system models. *Energy*, 84, pp.840–845.

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## Capacity Remuneration Mechanisms: Analytical Assessment of Current Experiences and Lessons Learned for Future Market Designs

PhD Student: Charlotte Scoufflaire

Supervisor: Jan Horst Keppler

As more and more observers are questioning the ability of energy-only electricity markets to ensure security of supply, capacity remuneration mechanisms appear as a possible regulatory solution. Indeed, the poor investment climate and numerous mothballing announcements over recent years suggest that the remuneration provided

by energy-only markets is not sufficient to incentivize the development of optimal capacity. While security of supply is a high-profile political objective, it is also an externality, which makes its value difficult to estimate.

As the debate over Capacity Remuneration Mechanisms increases, academic publications tend to focus on the need for them. However, few of them seek to analyse empirical data in order to learn quantitatively from past experience.

The thesis entitled "Capacity Remuneration Mechanisms: Analytical Assessment of Current Experiences and Lessons Learned for Future Market Design" seeks to empirically estimate the effects of capacity remuneration mechanisms on energy markets. This first year has been dedicated to the understanding of existing CRMs in order to have a global view of the choices made in different countries. It appears that whereas there was a lot of heterogeneity in the mechanisms implemented from the 1990s, the past decade has seen a trend towards convergence in the design parameters. Since 2007, almost all new CRMs have a forward period of more than one year, while all generation units, as well as the full load, and participate in the market.

From that observation, a between-country econometric study has been started to assess the effect of CRM implementation on end-user industrial prices. Capacity remuneration mechanisms are divided into short-term mechanisms and forward mechanisms. Results are expected to provide an understanding of the existing relationship between capacity remuneration and end-user prices. Indeed, energy market prices will reflect the direct effect of the adjusted capacity reserve margin while the cost of capacity will be passed on to non-regulated end-users (industrial consumers). First results show a positive correlation between the implementation of CRM and industrial end-user prices: the cost of CRMs is not compensated for by the expected lower energy prices. Industrial end users are actually paying an additional price for the increased security of supply they are receiving. However, it seems that the increase in industrial end user prices is smaller for forward than for short-term mechanisms. This justifies the increased use of this design feature from a qualitative point of view. Based on those results, 2017 will be dedicated to estimating the surplus effect of a capacity remuneration mechanism. In order to do this, a better picture of the costs and benefits of CRMs from the point of view of the different agents is needed.

## Assessment of the Economic Potential of Demand Response Considering Consumer Preferences: A Quantification of the French Power System

PhD Student: Antoine Verrier  
Supervisor: Jan Horst Keppler

### Context and Research Question

Since the introduction of reforms to liberalise the power industry, electricity is partly traded through competitive markets. However, the economic efficiency of power markets can be challenged on theoretical grounds because the main underlying assumptions for competition do not hold in the case of electricity (Finon & al. 2009). Therefore economists and policy makers have been working together in order to tackle one of the main issues leading to these market failures: the two flaws of electricity demand (Stoft 2002). Nowadays the debate about Demand Response has spread to industrial stakeholders. Further to the decrease in enabling infrastructure costs, private companies from different industrial sectors are increasingly interested in Demand Response. One should note that the Demand Response business model is part of the problem. We tackle another issue: the business case for Demand Response. Therefore, we assume that a third party, called the DR aggregator, may take responsibility for providing load flexibility to power systems. Its role is to link end-users with wholesale electricity markets, the former being engaged in DR through a contract with the aggregator. Our research question regarding the economic potential of Demand Response can be stated as follows:

*In a wholesale electricity market context, can a Demand Response aggregator break even given its investment costs?*

### Contribution

Our aim is to assess the economic value of Demand Response considering three key aspects that have not so far been examined together:

- **Consumer-based constraints**, made explicit in the contract with the aggregator
- **Impact of Demand Response on market prices**
- The aggregator maximizes its profit under **uncertainty** arising from the residual electricity demand

We perform a case study on the French power system.

## Results and further work

Using 2015 French power market data we discovered a viable business case for Demand Response only for industrial end users. Regarding energy-intensive industrial processes, average annual gross profits range from 650 €/MW/year (Cement and Paper industries) to 5,500 €/MW/year (Chemicals). Within those industries, Steurer et al. (2015) estimate the annual fixed costs for the enabling infrastructure to be around [120; 830] €/MW/year. The tertiary sector uses the potential of air conditioning loads but does not derive any profit (the average annual gross profit equals 0 €/MW/year). This could be due to the fact that the French power system has been sized according to the winter peak demand, making air conditioning-based DR useless during the summer period. For the residential sector, average annual gross profit is 90€/MW/year. In France, the electrical power installed in dwellings typically ranges from 3kW to 36kW. Therefore, an average annual gross profit of 90€/MW/year implies that a household equipped with a 3kW supply would only derive 0.27 €/year. The equivalent figure is 3.24 €/year for a household equipped with a 36kW supply. According to Léautier (2014), the investment cost in a smart meter is about 25€/meter/year. This case study suggests that the economic potential for DR in the residential sector in France cannot be tapped under current market conditions.

We will consolidate these results by carrying out sensitivity analysis based on the following parameters: VoLL and variable costs of DR.

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## The American and European Lessons of Demand-Side Management and Its Market Design for Asian Countries

PhD Student: Seungman Lee  
Supervisor: Jan Horst Keppler

This work relates to Demand Side Management (DSM), especially Demand Response (DR). In order to assess a Demand Response programme at a national or regional (local) level, I will use Cost-Benefit Analysis (CBA). Previously, I studied the basic concepts and the economic mechanism of Demand Response. Also, I have researched cases of Demand Response in the U.S., European countries, such as the UK and France, and South Korea through a literature review.

This year I have conducted research into the Cost-Benefit Analysis methodology itself. I can now calculate the factors for the costs and benefits related to a Demand Response program, and the models for the 'Four California Tests' which can be conducted from various perspectives.

In addition, before calculating the specific customer baseline load (CBL), I investigated the load duration curves (LDC) for the UK, France and Germany using the datasets available on the ENTSO-E (the European Network of Transmission System Operators for Electricity) website so that I could obtain an approximation of the electricity consumption in those countries.

During the research for the CEEM with Dr Clastres and Dr Geoffron, I was able to examine the datasets relating to hourly price and volume of electricity consumption in France in 2015 using the data on EPEX Spot (the European Power Exchange). Moreover, using the datasets of the auction in the EPEX Spot Day-Ahead market I have been able to construct the demand and supply curves for each hour – in reality, I have done this for 8 sample days in 2015, 2 days for each season, and 24 hours for each day, i.e.  $8 \times 24 = 192$  representative hours. With this research project, I could calculate the elasticities, that is, the demand functions, in the absence of Demand Response – of course there was a small amount of Demand Response in 2015, such as the NEBEF (Notification of the Exchange of Blocks of Load Shedding).

Because the French NEBEF mechanism is quite important to pursuing the case study and the application of the Cost-Benefit Analysis, I have researched it in detail. I now better understand its nature and mechanism. Using data from the website of RTE (the French Electricity Transport Network for the volume of NEBEF in 2015), I have constructed several plots and checked out the volume and its pattern throughout the entire year and for each month.

## Objectives for the Near Future

In the near future, I would like to deepen my understanding of the customer baseline load so that I can set an appropriate customer baseline load in a given situation and conditions. However, I anticipate difficulties in collecting the detailed data on the customer baseline load and non-aggregated information on the behaviour and the consumption pattern of the end-user of the electricity.

In order to do the actual Cost-Benefit Analysis, I need to collect the required comprehensive data for the calculations in the models of the Four California Tests. I also need to construct the best model to represent the Demand Response mechanism among the key stakeholders in the electricity market. After having set an appropriate customer baseline load and constructed the best model for Demand Response, I will be able to calculate the load impact of Demand Response in the electricity market, such as the change in price and volume resulting from the implementation of the Demand Response mechanism.

Once I have been able to calculate this load impact of the Demand Response mechanism it will provide better data for the expected price and volume for the Cost-Benefit Analysis model, which means I can better assess the effectiveness of a Demand Response program. Also, based on those research results, I expect to be able to further analyse the changes in, or dynamics of, social welfare with Demand Response, as in one test included in the California Tests which will be useful for policy decision-making on Demand Response and Energy.

## B. Research Support

### Calculation of Electricity Producers' Rents Depending on the Allocation Method Used for Carbon Quotas

Alexis Paskoff: Civil engineering student, École des Mines, Paris  
1 September 2016 – 1 March 2017 internship

Supervisor: Jan Horst Keppler

#### Context

The European electricity system is struggling today to find a coherent price signal that will stimulate investment. The same is true for the carbon market, which is not playing its role in the European energy transition.

Now, the price level of carbon quotas has a significant impact on the rents of all the European electricity producers (whether or not they are CO<sub>2</sub> emitters). In fact, the electricity exchange price is fixed by the power station with the highest marginal cost, which is most often a CO<sub>2</sub>-emitting power station. The methods of allocating CO<sub>2</sub> quotas to electricity producers also has an influence on the distribution of these rents between stakeholders intervening in the electricity markets.

#### Description of the research

The objective of this research work is to calculate the revenues of the different stakeholders in the electricity system depending on how quotas are allocated: freely or through an emissions trading scheme.

The first part of the work consists of creating a model of the market, describing the different electricity producers. The optimisation of relevant parameters is being carried out using data from the French market in 2015 made available by RTE and EPEX Spot (production and hourly price, availability of power stations, etc...). On the basis of this model, it will be possible to calculate the rents on the European markets for the different categories of stakeholder depending on how the quotas are allocated. The key point in the modelling is to quantify the impact of a different carbon pricing both on prices but also on the volumes exchanged. In fact, the different electricity production technologies have different carbon intensities: a high price of carbon quotas could modify the relative competitiveness of the producers and hence the result of the exchanges.



## II. CEEM SCIENTIFIC OUTPUT

### A. Working Papers

#### Working Papers published in 2016

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

(Revised version submitted to Energy Policy (October 2016)) by Fabien Roques (Associate Professor, CGEMP Université Paris-Dauphine and CEEM Associate Chercheur) and Dominique Finon (CIRED-CNRS Research Director and Scientific Counsellor of the CEEM)

##### Keywords

Electricity market, decarbonisation policy, market design, long-term contracts, low-carbon investment.

*The re-emergence of policy interventionism in electricity markets raises questions as to how market design can best be adapted to meet the investment challenge associated with security of supply (SoS) and decarbonisation objectives. This paper takes an institutionalist approach in terms of modularity of the market design, and reviews the standard historical approach towards competitive markets in order to analyse the roles and interactions of the initial and additional market "modules". We argue that a number of additional modules is required to achieve long-term policy objectives, such as decarbonisation and security of supply (SoS). But these in turn destabilise the initial modules of the market design, in particular through the entry of renewables. We review the international experience with hybrid market design and make a number of policy recommendations as to best practice, as well as suggesting ways in which the initial market modules can be improved to prevent incompatibility with the new modules. The move towards a hybrid market regime, which relies on a combination of planning, long-term risk sharing arrangements and improved markets established in a short-term coordination role, appears to be unavoidable where decarbonisation policies are adopted.*

##### "Impact of Variable Renewable Production on Electricity Prices in Germany: a Markov Switching Model"

by Cyril Martin De Lagarde (Doctorant, Université Paris-Dauphine, PSL Research University/ École des Ponts Paris Tech) and Frédéric Lantz (IFP School)

*This paper aims to assess the impact of renewable energy source (RES) production on electricity spot prices. We use a two-regime Markov Switching (MS) model that helps to clarify the so-called "merit-order effect" due to wind and solar photovoltaic production, depending on whether the price is high or low. We find that two distinct price regimes are effectively brought to light thanks to an inverse hyperbolic sine transformation that allows negative prices to be dealt with. We also show that these two regimes coincide quite well with two regimes for electricity demand (load). Indeed, when demand is low, prices are low and the merit-order effect is lower than when prices are high, which is consistent with the fact that the inverse supply curve is convex (i.e. has increasing slope). To illustrate this, we computed the mean marginal effects of RES production and load. On average, an increase of 1GW of wind power will decrease the price in regime 1 (resp. 2) by 0.77€/MWh (resp. 1€/MWh). The influence of solar power is slightly weaker, as an extra gigawatt lowers the price by 0.73€/MWh in regime 1, and 0.96€/MWh in regime 2. On the contrary, if the demand increases by 1GW in regime 1 (resp. 2), the price increases on average by 0.93€/MWh (resp. 1.18€/MWh). Although we have made sure that these marginal effects are significantly different from one another, they are much more variable than the estimated coefficients of the model. Also, note that these marginal effects are only valid inside each regime when there is no switching. The latter regime partly corresponds to the high load regime, with the exception of periods during which RES production is high. The impact on volatility could also be observed: the variance of the (transformed) price is higher during the high-price regime than in the low-price one. In addition to the switching of the coefficients, we allowed the probabilities of transition between the two regimes to vary over time, following a binomial logistic link with the relative proportion of RES production. This analysis shows that both wind and solar energy production have a significant impact on the switching mechanism, especially on the probability of switching from the high-price regime to the low-price one, and consequently on the expected duration of each regime. However, the effect of wind production on the probabilities is much higher than the effect of solar production, whereas they have a fairly similar marginal effect on the price. Finally, although the regimes are sometimes highly correlated with certain hours of the day, their endogenous determination (opposed to a semi-deterministic approach with dummy variables, for example) gives flexibility and keeps the model parsimonious.*

## "Ensuring Capacity Adequacy during Energy Transition in Mature Power Markets: A Social Efficiency Comparison of Scarcity Pricing and Capacity Mechanism"

by Marie Petitot (PhD Student CIFRE-RTE, CEEM), Dominique Finon (CEEM, and CIRED-CNRS) and Tanguy Janssen (Research Officer, Centre for Market Models and Economic Studies - Markets Department, RTE)

### Keywords

Capacity market, security of electricity supply, energy transition, mature market, system dynamics.

*This paper analyses how a capacity market mechanism can address security of supply objectives in the case of an energy transition scenario which combines high energy efficiency efforts which stabilise demand in a context of mature markets with a rapid increase in the proportion of renewables. The exogenous entry of variable renewables introduces a new challenge in terms of security of supply during peak hours. To analyse this situation, power markets are simulated over the long term with a model based on System Dynamics modelling which integrates both new investment and closure decisions. This last trait is an original aspect of the model, very relevant to studying market maturity. The addition of a capacity mechanism to a market architecture with a price cap is compared to scarcity pricing in different situations. Simulations are performed for two different cases: a case without any exogenous closure of existing power plants and a case with exogenous retirements which create a need for new investments. Under the assumption of a risk-neutral investor, the results indicate that compared to an energy-only market with price cap set at €3,000/MWh, energy-only with scarcity pricing and capacity mechanism are both efficient market designs to reach an acceptable level of loss of load. Moreover, the results highlight the fact that the advantage of one design over the other in terms of social efficiency depends on the future scenarios which are simulated. Moreover, the results illustrate the fact that the three market designs lead to different levels of risk for peaking units, suggesting that including risk aversion is a relevant further step in the modelling.*

## Working Papers published since January 2017

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

by Manuel Villavicencio, CEEM PhD Student

### Keywords

Resource-adequacy, multiservice model, renewable integration, system flexibility, electricity storage, demand side management.

*One of the challenges of current power systems is presented by the need to adequately integrate increasing shares of variable renewable energies (VRE) such as wind and photovoltaic (PV) technologies. The study of capacity investments in this context raises renewed interrogations about the optimal power generation mix when considering system adequacy, operability and reliability issues. This paper analyses the influence of such considerations and adopts a resource-adequacy approach to propose a stylized capacity expansion model (CEM) that endogenously optimises investments in both generation capacity and new flexibility options such as electrical energy storage (EES) and demand side management (DSM) capabilities.*

*Three formulations are tested in order to understand the relevance of a system dynamics representation to the valuation of capacity and flexibility investments. In each formulation, the complexity of the representation of operating constraints increases. The resource-adequacy approach is then enlarged with a multiservice representation of the power system introducing non-contingency reserve considerations. Therefore, investment decisions are enhanced by information from system operations requirements given by the hourly economic dispatch and also by a reliability criterion given by reserve needs.*

*The formulations are tested using a case study in order to capture the trade-offs between adding more details to the system representation and exogenously imposing supplementary VRE penetration. The results obtained show the importance of adopting a sufficiently detailed representation of system requirements to accurately capture the value of capacity and flexibility when significant VRE penetration levels are to be studied, but also to appropriately estimate resulting system costs and CO<sub>2</sub> emissions.*

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

by Jan Horst Keppler (Professor of Economics at Université Paris-Dauphine and the Scientific Director of the CEEM), William Meunier (Student at Mines ParisTech, and junior Researcher at the CEEM) and Alexandre Coquentin (Currently attached as a consultant to MAZARS and junior Researcher at the CEEM)

*Interconnections for cross-border electricity flows are at the heart of the project to create a common European electricity market. Currently, increase in production from variable renewables clustered during a limited number of hours reduces the availability of existing transport infrastructures. This calls for higher levels of optimal interconnection capacity than in the past. As a complement to existing scenario-building exercises such as the TYNDP that respond to the challenge of determining optimal levels of infrastructure provision, the present paper proposes a new empirically-based methodology to perform Cost-Benefit analysis for the determination of optimal interconnection capacity, using French-German cross-border trade as an example. Using a very fine dataset of hourly supply and demand curves (aggregated auction curves) for the year 2014 from the EPEX Spot market, it constructs linearized net export (NEC) and net import demand curves (NIDC) for both countries. This allows the welfare impacts for incremental increases in interconnection capacity to be assessed hour by hour. Summing these welfare increases over the 8,760 hours of the year provides the annual total for each step increase in interconnection capacity. Comparing welfare benefits with the annual cost of increasing interconnection capacity indicates the socially optimal increase in interconnection capacity between France and Germany on the basis of empirical market micro-data.*

## "The Value of Flexibility in Power Markets"

by Stéphane Goutte (Université Paris 8 (LED)/ Paris School of Business and Researcher at the CEEM) and Philippe Vassilopoulos (Head of Product Design, EPEX SPOT and Researcher at the CEEM)

### Keywords

Intraday; flexibility; auction, volatility, market design

### JEL classification

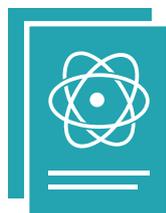
C02, C57, D44, D47, G32, C50.

*In this paper, we attempt to quantify the net revenues that can be captured by a flexible resource able to react to the short-term price variations on the day-ahead and intraday markets in Germany. We find that the difference between day-ahead and intraday revenues for a flexible resource has been increasing (although the profitability has been decreasing in both markets). This difference is more pronounced once 15mn price variations can be captured by a flexible resource. The net revenues from the local 15mn auction (which is held 3 hours after the hourly "coupled" day-ahead auction) are more than eight times higher than the day-ahead hourly auction but below the net revenues that can be captured with the high prices from the continuous market. The results of the retrospective empirical estimations allow us to distinguish and quantify two components of flexibility: (1) the "immediacy" value as we are approaching real-time and the urgency of the delivery increases (this value is revealed during the continuous intraday process and is closely linked to the stochastic nature of power supply and demand (i.e. wind/solar forecasts, forced outages of thermal generation ... forecast error risk), and (2) the "flexibility" component as a resource can react to variations of shorter granularity (15mn vs 60mn). We model and quantify the "flexibility" component.*

## B. Peer-Reviewed Publications since 2016

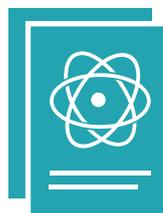
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### ENERGY JOURNAL



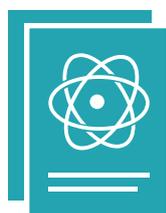
The Role of Continuous Intraday Electricity Markets: The Integration of Large-Share Wind Power Generation in Denmark, Vol. 38, No. 2, 2017.

**Fatih Karanfil** (Associate Professor of Economics, University of Paris Ovest, Nanterre) and **Yuanjing Li** (Junior Researcher, CEEM).



The Impacts of Variable Renewable Production and Market Coupling on the Convergence of French and German Electricity Prices, Vol. 37, No. 3 (2016), pp. 343-359.

**Jan Horst Keppler** (Scientific Director, CEEM, Université Paris-Dauphine), **Sébastien Phan** (Research assistant - Energy Policy Institute at Chicago, and CEEM research fellow) and **Yannick Le Pen** (Assistant Professor of Economics, Université Paris-Dauphine and CEEM Associate Researcher).



Carbon Price Instead of Support Schemes: Wind Power Investments by the Electricity Market, Vol. 37, No. 4. (2016), pp. 109-140.

**Marie Petitet** (CEEM PhD Student, RTE), **Dominique Finon** (Scientific Advisor - CEEM and CIRED-CNRS), and **Tanguy Janssen** (RTE).

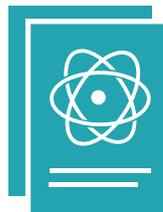
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### ENERGY POLICY



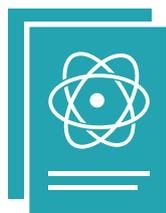
Capacity Adequacy in Power Markets Facing Energy Transition: A Comparison of Scarcity Pricing and Capacity Mechanism, Vol. 103 (2017), pp. 30-46.

**Marie Petitet** (Researcher, Chaire EEM/RTE), **Dominique Finon** (Chaire EEM and CIRED-CNRS) and **Tanguy Janssen** (RTE).



Rationales for Capacity Remuneration Mechanisms: Security of Supply Externalities and Asymmetric Investment Incentives, Volume 105 (2017), pp. 562-570.

**Jan Horst Keppler** (CEEM Scientific Director, Professor of Economics - Université Paris-Dauphine).



Adapting Electricity Markets to Decarbonisation and Security of Supply Objectives: Toward a Hybrid Regime?, Vol. 105 (2017), pp. 584-596..

**Fabien Roques** (Associate Professor, CGEMP, Université Paris-Dauphine and CEEM Associate Researcher) and **Dominique Finon** (CIRED-CNRS and CEEM Associate Researcher).

## III- SCIENTIFIC CONFERENCES

### A. 06-03-2017, Workshop on Electricity Demand: New Modelling Perspective



Joint Workshop organized by the Chaire European Electricity Markets (CEEM), the Chaire Climate Economy (CEC) and the Centre for the Geopolitics of Energy and Raw materials (CGEMP) at the Université Paris-Dauphine.

#### Abstract

*The behaviour of electricity consumers is the target of new design rules and policies. Energy efficiency, consumption of one's own production and demand management are the challenges to be addressed in such a new context, paving the way for new ways of consuming electricity. However, many questions remain unresolved regarding the true attitudes of household and industrial customers. Are they fully rational? Are they keen to change their habits, to manage energy efficiency and to shift their consumption? Is consumption of one's own production a new paradigm?*

The Chaire European Electricity Markets (CEEM), the Chaire Climate Economy (CEC) and the Centre for the Geopolitics of Energy and Raw Materials (CGEMP) at the Université Paris-Dauphine bring together a number of leading researchers and authors of recent studies to present their work on this topic as a means of discussing

these important questions, both in relation to future European electricity systems and to its low-carbon future.

#### Programme and Presentations

Welcome Address from Patrice Geoffron (Director - CGEMP, and CEEM, Université Paris-Dauphine)  
Presentation 1 by Massimo Filippini (ETH Zürich), *Investment Literacy and Choice of Electrical Appliances: The Impact of Educational Programs and Online Support Tools*  
Discussion led by Dominique Finon (CIRED-CNRS)

Presentation 2 by Lars Persson (Umeå University and the Centre for Environmental and Resource Economics (CERE)), *Is Our Everyday Comfort for Sale? Preferences for Demand Management in the Electricity Market*  
Discussion led by Anna Creti (Professor of Economics, Université Paris-Dauphine)

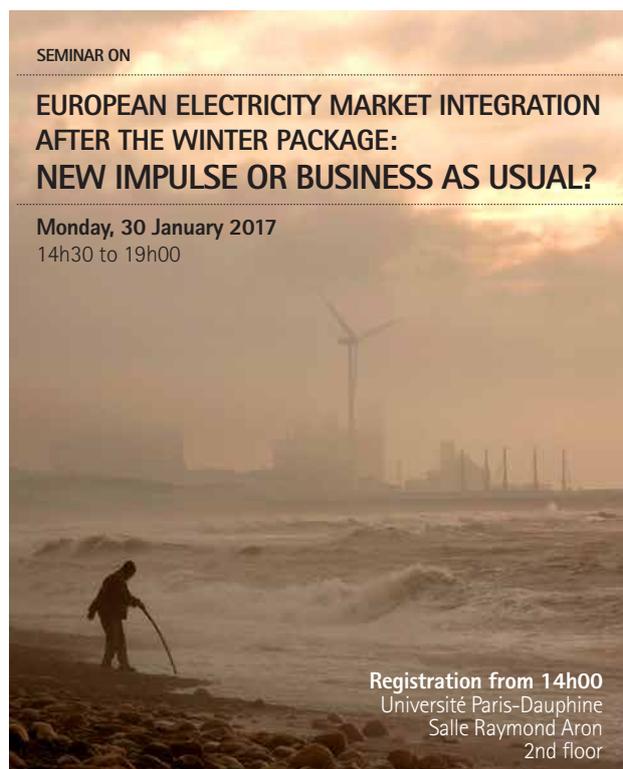
Presentation 3 by Dirk Neumann (University of Freiburg), *Value and Granularity of ICT and Smart Meter Data in Demand Response Systems*  
Discussion led by Stéphane Goutte (Université Paris 8 (LED)/ Paris School of Business)

Presentation 4 by Jean-Christophe Poudou (Professor at the University of Montpellier, member of LAMETA and Labex Entreprendre), *Prosumers and the Grid*  
Discussion led by René Aïd (Université Paris-Dauphine)

Presentation 5 by Iacopo Torriti (Associate Professor in Energy Economics and Policy, University of Reading), *Using Time Use Data to Model Residential Electricity Load Profiles*  
Discussion led by María-Eugenia Sanin (Assistant Professor of Economics, Université d'Evry, Val d'Essonne)

Concluding remarks from Fabienne Salaün (EdF) and Anna Creti (Professor of Economics, Université Paris-Dauphine).

## B. 30-01-2017, CEEM Seminar on European Electricity Market Integration after the Winter Package: New Impulse or Business as Usual?



### Abstract

On 30 November 2016, the Vice-President of the EU Commission for the Energy Union, Maroš Šefcovic, presented under the heading "Clean Energy for All Europeans – Unlocking Europe's Growth Potential" the comprehensive set of policy initiatives and regulatory proposals commonly referred to as the "Winter Package". The latter confirms the EU commitment to cut CO<sub>2</sub> emissions by 40% by 2030, all the while boosting economic growth and employment. The three dominant themes of this effort are:

- 1) A new policy push and better framework conditions for energy efficiency improvements, in particular in the building sector;
- 2) A continued commitment to renewables with a view of creating a market capable of providing the significant amounts of flexibility necessary to accommodate them;
- 3) A focus on end-use consumers, who are expected to further decentralisation, to contain costs through competitive pressures and to provide flexibility through demand response.

The electricity sector plays a key role in the Winter Package. The latter contains in fact a proposal for a "Regulation of the European Parliament and of the Council on the Internal Market for Electricity", which, if adopted, would amount to a Fourth Electricity Market

Directive, setting a new framework for the European electricity sector. While it is too early to provide a comprehensive evaluation of the policy package, a number of key themes can be identified:

- 1) An increased focus on the market and regulatory framework evolutions to stimulate the development of flexibility through dispatchable capacity, interconnections, DSM and storage;
- 2) The recognition of a "residual" role for capacity mechanisms allowing for cross-border cooperation, whose details still need to be developed;
- 3) Governance and system management in the context of an emerging notion of European security of electricity supply. This includes strengthening the EU Agency for the Cooperation of Regulators (ACER) and a focus on regional system management;
- 4) The encouragement of increased investment in electricity transport and distribution networks, in particular cross-border interconnections.

While there is likely to be little disagreement on the rather broad overall objectives of the Winter Package, two key questions emerge:

- a) Does the Winter Package provide a sufficiently concrete set of new policies to further decisively the environmental and economic sustainability of the European electricity sector, most notably in the area of investment?
- b) Does the focus on top down harmonisation help or hinder the different initiatives of European market integration that are already under way being advanced by a multitude of actors?

This seminar of the Chaire European Electricity Markets (CEEM) will bring together leading experts from European institutions, industry and academe in order to discuss the impact that the Winter Package is likely to have and where the European electricity sector is likely to go from here.

### Programme and Presentations

**Introduction** by Jan Horst Keppler (Scientific Director, CEEM - Université Paris-Dauphine)  
*The EU Winter Package: Policy Drift or Turning Point?*

**Keynote Presentation** by Philipp Offenber (Expert, EU EPSC): **Setting Out the Long-Term EU Vision of a Sustainable Electricity Sector**

**Session 1: The Outlook for Wholesale Markets**  
Moderator: Fabien Roques, Senior vice President, Compass Lexecon and Associate Professor, Université Paris Dauphine

Wolfram Vogel (EPEX Spot, Director Public-Regulatory Affairs)

*Short-term Flexibility Provision and Long-Term Capacity*

*Support: Is the Current European Market Infrastructure Adequate?*

Dan Roberts (Frontier Economics, Director)  
*Operationalising a European Notion of the Security of Electricity Supply: The Challenges Ahead*

Alain Janssens (Eurelectric, Vice chairman of the Markets Committee)  
*Market Integration and Consumers' Participation: Did the Clean Energy Package Get It Right?*

**Keynote Presentation by Kristina Jankovich (EU Commission, DGE, Wholesale Markets; Electricity and Gas): The Provisions for Improving Regional Cooperation in the Winter Package**

**Session 2: The Outlook for Network and Interconnection Development – Moderator: Jan Horst Keppler**

Charles Verhaeghe (Vice President, Compass Lexecon)  
*Toward Regional System Operation: Key Issues and Challenges*

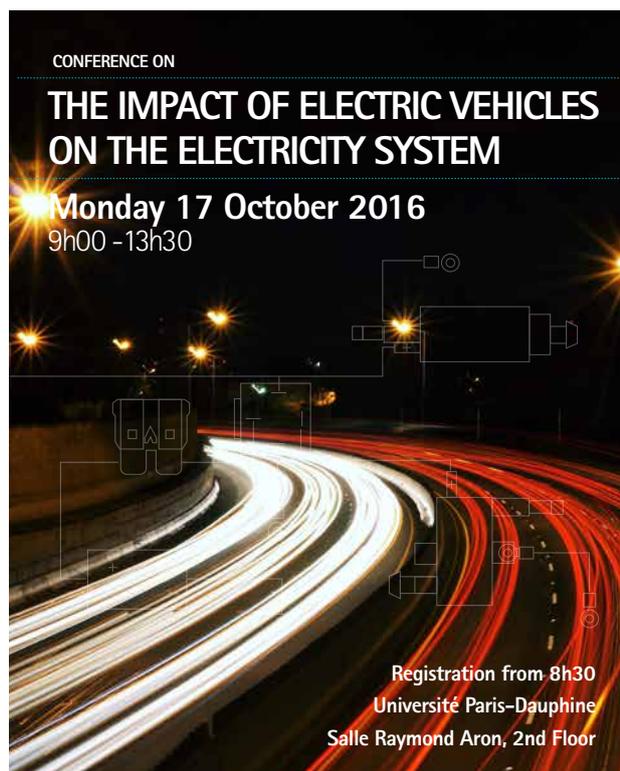
Sonya Twohig (ENTSOE, Manager)  
*The View of ENTSO-E and TSOs on Regional System Cooperation*

Jean-Michel Glachant (Florence School of Regulation, Director)  
*What is Best Approach for Greater Coordination in System Management?*

Dominique Jamme (CRE, Director of Networks)  
*Networks in the Winter Package: Much Needed Harmonization or Excessive European Regulation?*

**Concluding Roundtable** with Laurent Joudon (Directeur Délégué Études Économiques, EDF), Thomas Veyrenc (Director of Markets and Regulatory Affairs, RTE), Wolfram Vogel (EPEX Spot), Jan Horst Keppler (CEEM) and Fabien Roques (Compass Lexecon and Université Paris-Dauphine).

## C. 17-10-2016, Conference on The Impact of Electric Vehicles on the Electricity System



### Abstract

*The accelerating arrival of electric vehicles will not only impact the way we drive but will also have a profound impact on the size, layout, performance and cost of the electricity system. This transformation will touch upon all segments of the value chain from generation over transport and distribution to consumption. It will accelerate the active participation of final consumers, while posing important new challenges to producers of dispatchable power and system operators.*

This conference of the Chaire European Electricity Markets (CEEM) at the Université Paris-Dauphine co-organised with the Chaire Armand Peugeot (CAP) at CentraleSupélec will bring together leading experts from industry and academe in order to answer four interrelated questions:

1. What is the likely speed and trajectory of electric vehicle adoption in Europe over the medium term?
2. What are the different options for charging infrastructure, whose layout and technical specifications will be crucial for both the acceptability of electric vehicles as well as their cumulative impact on the electricity system?
3. What are the likely impacts on the requirements for the generation, transport and distribution system?
4. How can the contribution of electric vehicles to the electricity system be optimised by appropriate regulation and incentives for final consumers?

Clearly, the arrival of electric vehicles will pose questions for policymakers and experts in multiple dimensions, reaching from the technical over the economic to the geopolitical, for decades to come. However, it is crucial that even at this comparatively early state, it is fully understood that electric vehicles imply that private road transport will henceforth be operating as part of a network. The earlier the needs, opportunities and challenges of the electricity system are approached in a fully integrated fashion, the more likely the deployment of electric vehicles will indeed be able to make the major contribution to the low carbon energy transition that policymakers, consumers and experts so ardently desire.

### Programme and Presentations

**Welcome and Introduction** by Jan Horst Keppler (Directeur scientifique, CEEM – Université Paris-Dauphine) *Electric Vehicles: Opportunities and Challenges for the European Electricity Sector*

Yannick Perez (CAP, CentraleSupélec): *Is the European Electricity Sector Ready for Electric Vehicles?*

**Session 1: The State and Outlook of Electric Vehicle Development and Re-charging Infrastructure**

Jérôme Perrin (Renault): *Electric Vehicle Development in Europe Today*

Johannes Schäuble (KIT, Karlsruhe): *The Development and Adequacy of the Recharging Infrastructure for Electric Vehicles in Europe*

Pascal Gibiella (RTE): *The Impact of Electric Vehicle Development on Peak Demand and the Load Curve under Different Scenarios of EV Integration and Recharging Options*

**Session 2: Optimising the Interaction of Electric Vehicle Deployment with the Electricity System**

Patrick Gagnol (EDF): *The Coming Transformation of Electricity Systems Due to the Advent of Electric Vehicles*

Jean-Baptiste Galland (Enedis): *Opportunities and Challenges of the Integration of Electric Vehicles for Local Networks; What Would Efficient Pricing Look Like?*

Willett Kempton (University of Delaware): *Vehicle to Grid (V2G): Fundamentals, Potential, Willingness-to-Pay and Regulation*

Yannick Perez (Chaire Armand Peugeot, CentraleSupélec): *System Services and Flexibility Provision through Electric Vehicles in France and Europe: Regulatory Options and Institutional Requirements*

**Concluding Roundtable** with Dominique Finon (President), Marc Bussieras (EDF), Thomas Veyrenc (RTE), Gautier Chatelus (Groupe Caisse des Dépôts).

## D. 14-06-2016, Conference on The CO<sub>2</sub> Price Floor and Reform of the EU ETS: Impacts on the Electricity Industry

CONFÉRENCE SUR

# PRIX PLANCHER DU CO<sub>2</sub> ET RÉFORME DE L'EU-ETS

Mardi 14 juin 2016  
9h00 - 13h00

Université Paris-Dauphine  
Salle Raymond Aron  
2ème étage

Conférence organisée par la  
Chaire European Electricity Markets (CEEM)  
en collaboration avec la  
Chaire Économie du Climat (CEC)  
de l'Université Paris-Dauphine

This conference was organised by the Chaire European Electricity Markets (CEEM) in collaboration with the Chaire Climate Economy (CEC) of Université Paris-Dauphine

### Programme and Presentations

**Introduction** by Jan Horst Keppler (Scientific Director, CEEM): *The price of CO<sub>2</sub>, an essential issue for the electricity industry*

**Session 1: The Impacts of a Price Floor on the Electricity Industry**

**Session Chairman:** Jacques Percebois, Professor of Economics and Researcher, CEC

Christian de Perthuis (Director, CEC) : *CO<sub>2</sub> Quota Market and Electricity Market: What Interactions?*

Dominique Finon (CIRED and CEEM) : *The British Carbon Price Floor: Design, Development, Impacts*

Boris Solier (CEC) : *A Carbon Floor Price for the Electricity Industry: What Effects?*

Yves Le Thieis (Economist, FTI Compass Lexecon) : *CO<sub>2</sub> in European Countries: What Impacts on Electricity Markets and Cross-Border Flows?*

Session 2: The Possible Outlines of the EU ETS Reform  
Session Chairwoman: Émilie Alberola, Director of Carbon Policy and Pricing Programme, I4CE

Stéphanie Croguennec (Head of department – DGEC): *Room for Manoeuvre in Reforming the European System of CO<sub>2</sub> Quotas*

Raphaël Trotignon (CEC): *The EU ETS Reform: Current Situation and Perspectives*

Jan Horst Keppler (Scientific Director, CEEM): *A Pragmatic Return to the Future: Free Allocation and Reduction of the Total Cap on Emissions Permits to Clean Up the CO<sub>2</sub> and Electricity Markets*

Christina Hood (Environment and Climate Change Unit, IEA): *What Works and What Doesn't? : The International Experience with Carbon Pricing and Carbon Trading*

Benoît Peluchon (EDF R&D): *Need for Dynamic Management of Allocations to Guarantee the Efficacy of the EU-ETS*

**Concluding Session:** summaries from session chairs and exchange with the audience.

**General conclusion** to the conference by Christian de Perthuis (Director, CEC).

## E. 14-03-2016, Workshop on Market Designs for Low-Carbon Electricity Generation

WORKSHOP

### MARKET DESIGNS FOR LOW-CARBON ELECTRICITY GENERATION

Monday 14 March 2016  
14h00 - 18h30



Université Paris-Dauphine  
Salle Salle A 709, Nouvelle Aile  
7th floor

### Abstract

*Today, the defining challenge of electricity markets in Europe and elsewhere is to ensure progressive decarbonisation of power supplies while guaranteeing high levels of security of supply at affordable costs. However, under the present design of European electricity markets there is little chance of less carbon-intensive generation developing on the basis of market prices. Not only are prices low for all generators, but low-carbon generation technologies such as wind, solar, nuclear, hydro, carbon capture and storage but also ancillary technologies, such as electricity storage or energy efficiency, are characterized by high capital intensity.*

*The resulting high fixed costs increase the financial risks for investors facing volatile prices. This puts low-carbon technologies at a competitive disadvantage in liberalised energy-only markets. In principle, this disadvantage could be partly compensated for by appropriate carbon prices. However, carbon prices in the EU ETS hovering below € 10 per tonne of carbon are clearly insufficient to make low-carbon technologies competitive in combination with prices in current energy-only markets. With few exceptions, the deployment of low-carbon technologies is thus dependent on national arrangements that allow for out-of-market finance with guaranteed rates for the electricity they produce.*

*This is an inefficient and haphazard way to promote decarbonisation with complex and unpredictable outcomes. In the absence of both coherent conceptualisation and dedicated policy announcements, the proliferation of ad hoc support mechanisms also seriously undermines the integrity, transparency and efficiency of the common European electricity market.*

*The issue has naturally generated widespread interest among electricity market experts and academic researchers. Thus, over the last two years, a number of studies have been initiated that not only provide an analysis of the shortcomings of the process of overlaying market outcomes with targeted interventions but also provide proposals for alternative market designs on a coherent and transparent basis.*

The Chaire European Electricity Markets (CEEM) of the Université Paris-Dauphine has thus invited a number of leading researchers and authors of recent studies to present their proposals for establishing new market frameworks that would allow low-carbon technologies to substitute progressively for fossil fuel-based power generation. The debate is no longer whether the current framework is able to produce satisfactory outcomes on its own. Permanent meddling has shown that it is not. The challenge is now to identify the elements that can be part of a coherent and transparent European market

design for low-carbon electricity generation in the future.

### Programme and Presentations

Jan Horst Keppler (Scientific Director, Chaire EEM, Université Paris-Dauphine): *Key Elements of Market Designs for Low-Carbon Technologies*

Marco Cometto (Economist, OECD Nuclear Energy Agency (NEA)): *Nuclear New Build: Insights into Financing and Project Management*

Fabien Roques (Senior Vice President at FTI - Compass Lexecon and Associate Professor, Université Paris-Dauphine): *Market Design for High Proportions of Renewables: Is Radical Change Required?*

Aurèle Fontaine (Senior Economic Expert, RTE): *Risk and Capital Cost Considerations in Designing Efficient Support Schemes*

Dominique Finon (Scientific Advisor, CEEM and CIRED): *The Impact of Carbon Pricing for Low-Carbon Investment in Developing Countries: The Need to Align Power System Regulation*

Manuel Baritaud (Senior Energy Analyst, International Energy Agency (IEA)): *Re-Powering Markets: Market Design and Regulation during the Transition to Low-Carbon Power Systems*

**Roundtable** with Pierre Dechamps (Policy Officer, DG Research and Innovation, European Commission), Thomas Veyrenc (Director, Markets Department, RTE), Marc Bussieras (Director, Corporate Strategy, EDF), Philippe Vassilopoulos (Head of Product Design, EPEX Spot) and Vincent Pichon (Director of Projects, Strategy Department, Groupe Caisse des Dépôts (CDC)).

## F. 28-01-2016, F. Conference on the Pricing of Electricity Networks: How to Send the Right Economic Signals for the Energy Transition?

This conference was organised by the Association of Energy Economists (AEE) in cooperation with the CGEMP, the Chaire European Electricity Markets (CEEM) and the Chaire Governance and Regulation from Université Paris-Dauphine



## LA TARIFICATION DES RÉSEAUX ÉLECTRIQUES

Comment envoyer les bons signaux économiques  
pour la Transition Énergétique?

Jeudi 28 janvier 2016 | 16h00-19h00  
Salle Raymond Aron (2ème étage)

### Abstract

Pricing the use of electricity transport and distribution networks is an important issue in order to give the right localisation signals to investors and network users. The electricity industry is undergoing a great deal of change, and the services supplied to consumers are more than ever at the centre of thinking about developments in the regulatory framework of network companies, with different problems in terms of transmission and distribution. In France, the Energy Regulation Commission (CRE) and the various stakeholders have engaged in consultations on developments of the Transmission Network Use of System Charges (TURPE) in the short and medium term.

In this context, the objective of the conference was to review the economic theory as well as the European regulators' practices in order to identify avenues for improving the current regulatory framework. The conference also provided the opportunity to contrast how the issues relating to the pricing of the French networks were viewed by the different stakeholders: producers, transporters and distribution network managers.

## Programme and Presentations

Christophe Bonnery (Chairman of the AEE) : Presentation of the Issues and Conference Objectives

### The Issues of Developments in the TURPE

Dominique Jamme (Network Director, CRE): *Presentation of the CRE's Vision of the Issues and the Points that Merit Deeper Reflection*

### The Economic Criteria that Guide the Different Pricing Methods

Anna Creti (CGEMP, CEEM and Chaire Governance and Regulation): *Review of What the Academic Literature Tells Us about the Pricing of Distribution Networks*

### Benchmark for Practices in the Pricing of Distribution Networks

Fabien Roques (CGEMP, CEEM and Compass Lexecon) and Charles Verhaeghe (Senior Economist - Compass Lexecon): *Presentation of Elements of an International Benchmark of Practices in the Pricing of Distribution Networks*

### Changes in the Regulatory Framework for New Services and Uses

Leonardo Meeus (Director Energy Center, Vlerick Business School): *Changes in the Regulatory Framework for Dsos in Europe Taking into Account Ongoing Transformation (decentralized production, electric vehicles, batteries, etc.)*

### The Issues from a Distributor's Point of View

Jean-Baptiste Galland (ErDF): *Presentation of the Issues and the Key Points for Changes in the Tariff Structure from Erdf's Point of View*

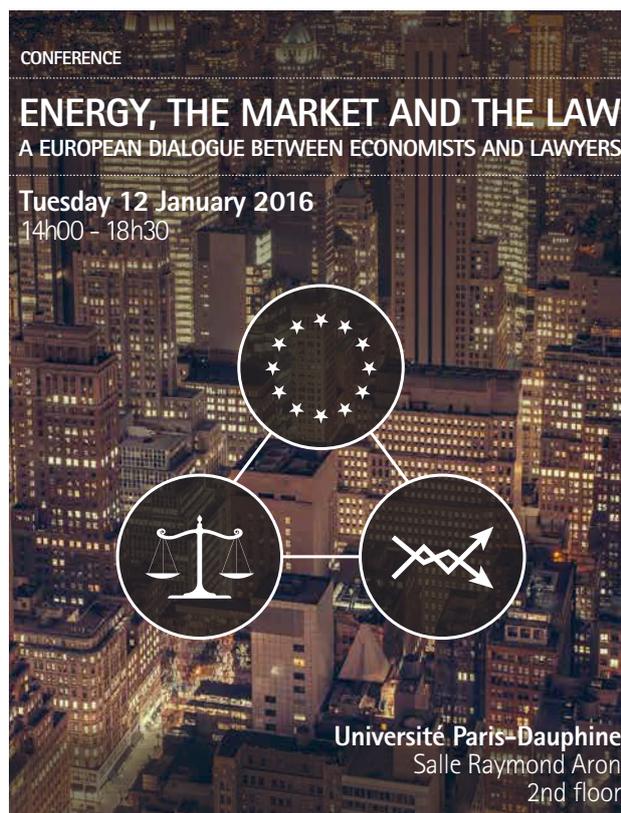
### The Issues from the Transport Network Manager's Point of View

Vincent Thouvenin (RTE): *Presentation of the Issues and the Key Points for Changes in the Tariff Structure from RTE's point of view*

### Round Table discussion with a contribution from Virginie Schwarz, DGEC

Summary and conclusion of the debates by Dominique Finon (CEEM and CIRED-CNRS) and Éric Brousseau (Chaire Governance and Regulation).

## G. 12-01-2016, Conference on Energy, the Market and the Law: A European Dialogue between Economists and Lawyers



### Abstract

**Energy, both a private and a public good...**

*Energy and electricity are private goods but touch directly and indirectly on far too many socially and politically sensitive issues to leave their production and consumption entirely to market forces. An increasingly complex web of legal provisions both at European and national levels is thus trying to steer the sector in a direction that conforms with public policy objectives. European energy markets are thus caught in a trilemma between supranational, national and market forces whose ultimate outcome is increasingly difficult to understand, and even less to predict, even for the informed observer.*

*Even if the completion of the internal energy market announced for 2014 is still not a reality in 2015, the Juncker Commission made the Energy Union one of the priorities of its term. The creation of the Energy Union should contribute towards a secure, sustainable and competitive single energy market. In this context, Article 194 TFEU, adopted in the Lisbon Treaty, could become the focal point of energy policy. However, energy touches on some strong national sovereignty issues, the principle of subsidiarity and the priority of action of Member States in the matter of their energy mix. Questions about the right level of intervention in electricity markets are thus complex, render market designs more unstable and may ultimately discourage investors.*

...evolves in a force field defined by the market, Member States and the EU Commission

*At the same time, the DG for Competition asserts its prerogatives in the energy field, not only to decide on issues of market power, but also to strengthen its investigative powers in matters of state aid following the adoption of the guidelines on state aid in the fields of environment and energy. Its goal is to monitor the compliance of public policy instruments adopted by Member States and their implementation to encourage the development of specific equipment or contribute to energy security and adequacy of electricity capacity, whatever the possible impact of this control on their effectiveness. In fact, we observe that the articulation of article 194 with competition policy on the one hand, and with the control of State aid and the rules of free movement on the other, remains unclear. Decisions are taken on a case-by-case basis, which does not create a sufficiently clear jurisprudence when the law is faced with complex economic facts.*

*In order to clarify some of the complex issues arising from this tension, the Chaire European Electricity Markets (CEEM) and the IREDIES are organising a dialogue between economics and law experts in the energy sector to clarify the issues surrounding the search for a delicate balance between market forces, the European Commission and EU Member States.*

## Programme and Presentations

**Welcome address:** *The Market, the Member State and the Commission – the EU Energy Trilemma*

Jan Horst Keppler, Scientific Director, Chaire European Electricity Markets (CEEM), Université Paris-Dauphine

**Introductory allocution:** *The Difficult Exercise of the EU's Jurisdictional Powers on Energy Issues*

Philippe Maddalon, Professor of Public Law, Université Paris I and Director of the IREDIES (Centre for International and European Law)

### Session 1 State aid: Balancing Competition and Long Term Public Goods

Chaired by Sven Rösner, Deputy Managing Director of the Franco-German Office for Renewable Energies (OFAEnR)

François Lévêque (Professor of economics, Mines-ParisTech, PSL Research University): *An Economist's Perspective on Recent State Aid Cases in Renewables and Nuclear Energy under State Aid Guidelines*

Jean-Yves Ollier (Director General of the French Regulatory Commission on Energy): *How to Reconcile National and EU Law in the Daily Practice of a National Regulator?*

### Session 2 Long Term Contracts: How to Reconcile EU Antitrust Jurisprudence and Long Term Investment Needs?

Chaired by Jan Horst Keppler, Scientific Director, CEEM, Université Paris-Dauphine

Christine Le Bihan-Graf (Lawyer at De Pardieu Brocas Maffei, former Director General of the French Regulatory Commission on Energy): *Long Term Contracts and Competition Rules in the European Union*

Frédéric Marty (Senior Economist, GREDEG, Université de Nice Sophia-Antipolis): *From "Essential Facilities" to Social Efficiency: The Legal Doctrines behind the Criteria for Public Goods at the EU-Level*

### Session 3 Capacity mechanisms: Their Compatibility with Regard to State Aid Rules and the Principle of Free Movement

Chaired by Adrien de Hauteclocque, European Union Court of Justice, Luxembourg

Fabien Roques (Senior Vice President at Compass Lexecon and Associate Professor, Université Paris-Dauphine): *The Viability of the EU Approach to Cross-Border Participation in Capacity Mechanisms?*

Guillaume Dezobry (Associate Professor, Université d'Amiens and Lawyer at the Paris bar): *A Legal Analysis of the EU Debate on Capacity Mechanisms and Cross-Border Participation*

### Roundtable: Article 194 and Member States' Sovereignty in Choosing their Energy Mix

Chaired by Claude Blumann (Emeritus Professor of Law, Université Panthéon-Assas-Paris II), Dominique Finon (Scientific Advisor – CEEM and CIREN-CNRS), Patrice Geoffron (Director – CGEMP, Université Paris-Dauphine and CEEM), Adrien de Hauteclocque, Philippe Maddalon and Jean-Yves Ollier.

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**Proposed international scientific conference during the second semester of 2017:**

**"The Future of Business Models and Market Designs in the European Energy Sector"**

**September 2017, 9:00 to 19:30, Université Paris-Dauphine, Room Raymond Aron, 2nd Floor**

## IV. INTERNAL RESEARCH SEMINARS

As part of its activities since 2012, the Chaire European Electricity Markets (CEEM) has held open research seminars. Between 2012 and 2016, the seminars were coordinated by Dominique Finon, the CEEM's Scientific Advisor during that period.

At first, the seminars were uniquely given over to work by the Chaire's own PhD students and researchers, their findings being compared with that of other researchers working on the same subject, who brought their expertise to discussions on the internal papers. In the period 2012-2014, the seminars covered the econometry of day ahead and intraday electricity markets with a high proportion of renewables, the short-term modelling of electricity markets using "unit commitment", models for long-term simulation of markets with endogenous development of renewable energies using approaches including System Dynamics and the economic value of storage.

Since 2015, the series of seminars has moved beyond its role of discussing exclusively internal research. The mission of the research seminars has widened to very specialised questions that cannot be dealt with in CEEM's ordinary conferences and which require the use of complex formalised methods: market econometry with the objective of short-term forecasting, the contribution of foreign capacity to capacity mechanisms, the value of zoned pricing for electricity transport, etc... (See the details of the three seminars from 2016 below). These seminars provided an opportunity to bring young researchers from Belgium and Germany, countries where formalised research into the operation of the electricity markets has been made complex by the arrival of renewable energies with variable supply. The questions dealt with fit into the CEEM's research programme. The subjects are always chosen in relation to the work of the Chaire's researchers (the work of our PhD students remaining one of the focal points of the seminars), as well as to the interests of the Chaire's partners. At the same time, invitations to the seminars have become wide open, the presentations thus becoming accessible to all the participants after the sessions of the seminar.

Over the whole of the period 2012-2016, the objectives of the research seminars – to discuss internal research and to stimulate progress in the work of the PhD students associated with that research – were completely fulfilled. The sessions dealing with the subject or the methods used by this or that PhD student gave them the opportunity to validate their work and to benefit from

advice to improve their approach.

Over the period 2014-2016, the seminars met with genuine interest from the community of electricity market experts from companies and consultancies, while at the same time offering dialogue with academics, particularly young PhD and post-doctoral students carrying out research work in France on subjects that are very specific to the electricity markets. The fact that between 30 and 50 people attended each seminar demonstrates their success.

Generally speaking, these seminars contributed to strengthening the Chaire's scientific reputation, and that of its competence in the particular subjects dealt with, while at the same time enabling certain internal work to be consolidated.

In the future, this type of seminar will be continued with the same objectives of demonstrating the CEEM's ability to organise in-depth debates on very specialised research questions relating to changes in the electricity markets and to reinforce the projects that will be developed as part of the Chaire's new research programme for the period 2017-2022. These include: the adaptation of market designs to better integrate variable renewable energies into the European markets, the articulation between the respective coordination methods used by the transport network managers and the distribution network managers with the objective of achieving equilibrium in the system at national level, the economy of storage, the possibilities of financing different types of new equipment (variable renewable energies, dispatchable low-carbon technology, flexible resources, etc.) using the revenues from the different markets, particularly in the new market design.

### Internal Research Seminars – 2016

Three seminars were held in 2016, the first in April on the tools for analysing the adaptation of markets and electricity systems to the introduction of a significant proportion of production by variable-supply renewable energies, the second in June on the analysis of the participation of the aggregators' demand response programmes in the electricity markets, and the third in December on the participation of consumers in demand response programmes and the viability of the aggregators' business model.

## A. 13-12-2016 CEEM Research Seminar on The Issue of Consumer Participation in the Electricity Markets via Platform Market and Aggregators

Université Paris-Dauphine, Salle A 709, New Wing (7th Floor)

### Presentations

Laura-Lucia Richter (NERA Consulting, PhD from Cambridge University)

*Which Smart Electricity Service Contracts Will Consumers Accept? The Demand for Compensation in a Platform Market*

This paper considers the heterogeneity of household consumer preferences for electricity service contracts in a smart grid context. The analysis is based on original data from a discrete choice experiment on smart electricity service contracts concerning 1,900 UK electricity consumers in 2015. The results suggest that while customers are willing to pay for technical support services, they are likely to demand significant compensation to share their usage and personal identification data and to participate in automated demand response programs.

Based on these findings, potential platform pricing strategies that could incentivise consumers to participate in a smart electricity platform market are discussed. By combining appropriate participation payments with sharing of bill savings, service providers could attract the number of customers required to provide the optimal level of demand response. We also examine the significant heterogeneity among customers to suggest how, by targeting customers with specific characteristics, smart electricity service providers could significantly reduce their customer acquisition costs.

Antoine Verrier (PhD Student, Chaire EEM)

*Viability of the Business Model of Demand Response Aggregators: Spot Energy Market Based Revenues for an Aggregator under Uncertainty and Contractual Limitation*

Economic viability of enabling technologies is often considered as a barrier to large-scale deployment and use of Demand Response resources in power systems. Compared to investment costs in such technologies, we carry out a quantification of expected annual revenues that a Demand Response aggregator might earn from a real-time energy market. We tackle this business case in the context of the French power system. Our contribution especially highlights the opportunity cost that the Demand Response aggregator might face given market uncertainty and consumer-based contractual limitations.

*"Since 2015, the series of seminars has moved beyond its role of discussing exclusively internal research."*

## B. 23-06-2016, CEEM Research Seminar on Demand Response in Liberalized Electricity Markets: Analysis of Aggregated Load Participation in the Power Markets

Université Paris-Dauphine, Salle C-Bis (3rd floor)

The focus of the seminar is the economics of the integration of aggregated load responses into the markets. In a context of increasing variable renewables production in electricity systems, there is a particular interest in understanding how the demand response, through the role of aggregators and innovative retail pricing, could participate in the markets.

### Presentations

Rudi Hakvoort (Professor, Faculty of Technology, Policy and Management, Technical University Delft (NL))

*How Could the Demand Response Be Integrated into Energy Markets?*

There is an increasing recognition of consumer behaviour and the provision of Demand Response (DR) in market designs. The aggregation of small loads as a DR flexibility resource allows end-users to participate in electricity markets and aid in maintaining dynamic system stability. An analysis of a balancing mechanism illustrates that DR is undermined by three mechanism design aspects: minimum bidding volume, minimum bid duration and binding upper and lower bids. We also examine under which market conditions a viable business model can be developed for an independent demand response aggregator in the European power markets. (Presentation of research work from TU Delft).

Cédric Clastres (Assistant Professor at PACTE-EDDEN laboratory - Université Grenoble-Alpes, and CEEM Associate Researcher) and Patrice Geoffron (Professor of Economics, Director of CGEMP, CEEM, Université Paris-Dauphine)

*Economic Analysis of Decentralised Demand-Response Products in Active Distribution Grids*

We study the integration of DR programs based on different pricing schemes (buying the baseline or second best pricing). We analyse the relationships between

stakeholders – generators, suppliers, DR providers, consumers – with a revenue function combining purchases and sales of electricity. We study social efficiency improvement: to reduce peak demand, buying the baseline or second best pricing have the same impact; only allocations of revenues differ.

## C. 12-04-2016, CEEM Research Seminar on Power Markets with High Share of Variable Renewables: Analytical Tools for Studying Efficient Adaptations

Université Paris-Dauphine, Salle A 709, New Wing (7th Floor)

### Presentations

**Alain Burtin** (EDF R&D: Vice-President, Energy Management): *Technical and Economic Analysis of the European Electricity System with 60% RES* and **Vera Silva** (EDF R&D): *Methodology for the Analysis of the European System with High RES Scenarios*

The presentation examines the impacts of the integration of a large proportion of variable renewable production into the generation mix of the European interconnected electricity system. The analysis, which is based on the results of long-term studies performed by EDF R&D, aims at improving the current understanding of the technical and economic feasibility of a massive deployment of wind and PV across the European system. These results rely on an EU-system-wide approach based on a chain of advanced power system simulation and optimization tools. The study addresses several aspects of the integration of variable generation into the

system, including the characterization of variable RES generation, the need for generation and interconnection infrastructure, the role of demand response and storage, the impacts on short-term system operation and VRE market profitability.

**Discussion: Marco Cometto** (Economist, OECD Nuclear Energy Agency (NEA)) co-author of the NEA study: *Short-Term and Long-Term System Effects of Intermittent Renewables on Nuclear Energy and the Electricity Mix*

**Manuel Villavicencio** (PhD Student, Chaire CEEM) *Planning Capacity Investments and Flexible Assets: An Investment Model Integrating the Short-Term Requirements with the Long-Run Dynamics*

The current scenario, created by the increasing proportions of variable renewable energies, introduces novel questions about the optimal power generation mix when considering system adequacy, operability and security issues. This paper analyses the impact of such constraints over the power system and proposes a stylized model for capacity planning from a total cost perspective that incorporates investments in conventional and renewable energy technologies, but also in new technologies able to optimally accommodate new system requirements, such as electrical energy storage and demand side management. The model is tested on a hypothetical case in order to show the importance of providing enough detail on the representation of the economic dispatch and reserve requirements for investigating the factual value of variable generation technologies and its relationship with flexible assets while planning generation investments.



## V. SEMINARS ON RESEARCH INTO ENERGY ECONOMICS AT PARIS-SCIENCES-LETTRES

Since 2012, the Chaire European Electricity Markets (CEEM) has been a stakeholder in the Seminars on Research into Energy Economics at Paris-Sciences-Lettres by co-organising them with the CERNA from Mines ParisTech and the Interdisciplinary Institute for Innovation (I3), and since the beginning of 2016 with the Centre for the Geopolitics of Energy and Raw Materials (CGEMP) from Université Paris-Dauphine. This initiative has developed under the aegis of Paris-Sciences-Lettres. Each seminar is run by Dominique Finon (CEEM, CNRS-CIRED) and François Lévêque (CERNA, Mines PARISTECH), joined in 2016 by Patrice Geoffron, Director of the CGEMP.

### Overview of five years of PSL seminars on Energy Economics

Thirty-five sessions have been held in five years, i.e. about seven per year. The seminars have kept the same objectives since 2012:

- First, make questions that are proper to the economics and politics of energy more visible. These questions were somewhat neglected during the 1990s and 2000s in favour of questions about climate policies, which tend to annex those raised by what has become known as the "energy transition".
- Next, give young researchers, French or otherwise, the opportunity to present their work, in parallel with interventions from established researchers: in fact, at each session on a given theme, two papers are presented and discussed, one from an established researcher, the other from a young researcher, both often being invited from overseas.
- Also, provide an opportunity for dialogue between researchers, professional economists (consultants, energy companies) and civil service experts: the seminars are thus not only aimed at researchers and academics.
- Finally, survey the various issues relating to research into energy economics in the different sectors and policy fields, including (but without the list being exhaustive), the imperfect competition in the electricity and gas markets, the economics of fixing the price of oil (uncertainty, link with the prices of other commodities, macroeconomic effects), the economics of gas contracts, the econometrics of prices in the different energy

markets (electricity, gas, oil), the efficacy of energy efficiency policies in different fields (vehicles, housing, various types of equipment, etc.), the economics of innovation in different fields, energy transition policies (including China's). In the field of electricity, one can quote the comparison of instruments used to promote renewables (in terms of social efficiency), the economic value of MWhs of variable renewables, the economics of storage and the possibilities for activating consumer response, etc.

Since 2012, the seminars have continued to be very successful, often attracting between 70 and 120 participants, particularly in 2016. This shows that they meet a real need to confront innovative academic work, not only with the academic world, but also with professional economists and energy experts. Subjects much in the news do not take precedence over the complex themes whose analysis requires formalised methods branded as "scientific", even if the audience does thin out when the subject is rather narrow<sup>1</sup>. This being said, in order to maintain the dynamism of the meetings and continue to attract a large audience, the co-organisers of the PSL Seminars have decided that for 2017 they will reduce their frequency by half in order to avoid saturating the potential audience for energy and environmental economics seminars in Paris, where numerous initiatives tend to overlap one another.

### Appraisal of the CEEM's participation in the PSL seminars on Energy Economics

As explained above, not all the seminars are in the field of the politics and economics of a sector and the electricity markets. Questions related to the electricity industry are only one of the major subject areas dealt with in the PSL seminars. Having said this, at least a quarter of the subjects are in this field. It should be stressed that the PSL seminars in this field overlap neither with the CEEM's own research seminars, which are on very specialised subjects and on complex research methods, nor with the CEEM's conferences, which approach the chosen subject in a very broad and pluralist manner. In fact, the CEEM's involvement in the PSL initiative has two very positive effects:

- In the first place, it contributes to enhancing the Chaire's scientific image as one of the initiators of an operation that has proved to be very successful as described above;
- Secondly, subjects concerning the economics of the electricity markets and associated policies are approached in a manner that is highly complementary

1. This was the case, for example, with work on the efficacy of certifying energy-efficient renovation professionals or the bonus-malus system for car buyers.

to that used within the Chaire (in-depth scientific and policy debate on aspects of regulation or general aspects of market design by the conferences on the one hand; examination of very specific subjects by the research seminars on the other hand). To put it another way, the PSL seminars covering the field of electricity allow the subjects to be approached on the basis of "common knowledge".

Given the benefits described above, the CEEM will remain involved in the PSL Seminars on Energy Economics in the future. Questions related to the electricity industry will remain one of the major fields dealt with in the PSL seminars.

### Seminars on Research into Energy Economics at Paris-Sciences-Lettres 2016

The nine seminars organised in 2016 and early 2017 are listed below, starting with the most recent. They have a wide variety of themes: the efficacy of the measures and instruments for energy efficiency, the economics of the choice of nuclear investments and the perception of the risks of accidents, the efficiency of the instruments supporting renewable energies and their respective impact on electricity markets, the management of technical change in the fuel efficiency of new cars, the economics of the energy transition in China, and the economics of parachuting wind energy capacity into the electricity system, etc...

#### A. 15-03-2017 35th Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

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

Université Paris-Dauphine, Amphitheatre 5 (2nd Floor)

##### Presentations

Rolf Golombek, Statistics Norway (Research Department)

*The Future of Russian Gas Exports*

For more than a decade, disputes between Russia and Ukraine have led Russia to build gas pipelines to Europe that circumvent Ukraine. The Russia-Ukraine disputes, also affecting countries farther west, caused the EU to consider reducing its dependence on Russian natural gas. This in turn gave Russia incentives to target new markets for its gas exports. The current paper examines potential implications of the Russia-Ukraine conflict on the Russian and European natural gas markets.

Using a numerical energy market model (LIBEMOD), we find that if Russia stops using the pipelines to and via Ukraine, total gas export from Russia will drop by one third. The impacts on the European gas market are, however, moderate. Similar conclusions are reached if the EU decides to halve its gas imports from Russia. Furthermore, building the planned pipeline to Turkey ("Turkish Stream") has only modest effects on Russian gas exports, except in the case where trade to and via Ukraine is blocked. Finally, export of Russian gas to Europe is hardly affected by the new Russia-China gas trade agreement. (Working Paper co-written with Finn Roar Aune (Ragnar Frisch Centre, Oslo Univ.), Arild Moe (Fridjoff Nansen Institute), Knut Einar Rosendahl (Norwegian University of Life Sciences) and Hilde Hallre Le Tissier (Ragnar Frisch Centre)).

Catherine Locatelli, Chercheur CNRS, GAEL, INRA-CNRS-Université Grenoble-Alpes

*EU-Russia Trading Relations: The Challenges of a New Gas Architecture*

Gas security is a key factor in the European Union's energy policy. Contractual relations based on long-term contracts during the 1970s and 1980s led to relative stability in energy trade between the EU and its gas suppliers. But since the mid-1990s, the process of opening up the EU's gas industries to competition and the desire to create a single gas market has led to comprehensive reorganization of the sector. The EU now intends to redefine the way in which it manages its relations with its main suppliers, such as Russia, by attempting to impose a model based on competition, unbundling of network industries and privatization. Russia does not intend to implement this "EU model" in its gas sector, despite the big changes taking place in its domestic market. An approach based on the preferential use of state instruments conflicts with the multilateralism and principles of competition upheld by the EU. The EU's normative power is thus in contradiction with the Russian energy sector's institutional environment. It is therefore unlikely that energy relations between the EU and Russia will be structured solely on standards stemming from international rules and institutions.

(Paper published in: *European Journal of Law and Economics*, April 2015. Vol. 39, Issue 2, pp.313-329; DOI: 10.1007/s10657-013-9423-y).

## B. 14-12-2016 34th Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### New Nuclear Economics: How to Estimate Risks?

School of Mines Paris Tech (60 Boulevard Saint-Michel 75006 Paris)

#### Presentations

**Marco Cometto**, Senior Economist, OECD Nuclear Energy Agency

*Nuclear New Build: Institutional and Regulatory Conditions for Gaining in Efficiency in Financing and Project Management*

This presentation will identify perspectives for commercially and economically sustainable new build in two areas (i) managing long-term electricity price risk and allocating financial risk among stakeholders, and (ii) project and supply chain management. It will concentrate on the issue of net present value and price and technology risk management, given the high fixed cost of the technology in different electricity industry regimes. It will emphasize the important specific features of countries keeping open the nuclear option, comparing EU countries, other OECD countries, Russia and emerging countries with strong industrial policies. (From the OECD/NEA report, Nuclear New Build: Insights into Financing and Project Management (August 2015) co-authored with **Jan Horst Keppler**).

**Romain Bizet** (PhD student, CERNA, Mines ParisTech)  
*Ambiguity Aversion and the Expected Cost of Rare Energy Disasters: an Application to Nuclear Power Accidents*

Assessing the risks of rare disasters due to the production of energy is paramount when making energy policy decisions. However, the costs associated with these risks are most often impossible to calculate due to the high uncertainties that characterize their potential consequences. In this paper, we propose a non-Bayesian method for the calculation of the expected cost of rare energy disasters that accounts for the ambiguity characterising the probabilities of these events. Ambiguity is defined as the existence of multiple and conflicting sources of information regarding the probabilities associated with the events. We then apply this method to the particular case of nuclear accidents in new builds. Our results suggest that the upper-bound of the expected cost of such accidents is 1.7 €/MWh, which is consistent with most of the recent estimates. (I3/CERNA Working Papers, 16-CER-01, co-authored with **François Lévêque**).

## C. 13-10-2016 33rd Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### What Are the Best Support Schemes to Integrate Renewables?

School of Mines Paris Tech (60 Boulevard Saint-Michel 75006 Paris), Room L 118

#### Presentations

**Philippe Quirion** (Directeur de Recherche CNRS, CIRED)  
*Which Type of Support for the Development of Renewables in Power Generation?*

While most developed and emerging countries support renewable energies in the power sector, they do so in different ways. The three main existing support systems are feed-in-tariffs, feed-in-premiums and tradable renewable quotas. We provide a survey of the literature which compares these support systems. We conclude that tradable renewable quotas suffer from many weaknesses compared to the other two: bad reaction to uncertainty, important risk for funders which increases investment cost, higher transaction costs. Both feed-in-tariffs and premiums have pros and cons and there is little evidence that the transition from the former to the latter, currently occurring in Germany and France, is justified. Finally, beyond the choice between tariff and premium, many concrete choices are at least as important, such as how to finance the support and the differentiation between market segments, necessary to limit the rents but potentially a source of inefficiency. (Paper published in *Revue Française d'Économie*, 2015/4 Volume XXX | pages 105 to 140).

**Jenny Winkler** (Research fellow - Fraunhofer Institute for Systems and Innovation Research ISI (Karlsruhe, Germany))  
*Impact of Renewables on Electricity Markets - Do Support Schemes Matter?*

Rising proportions of renewables influence electricity markets in several ways: among others, average market prices are reduced and price volatility increases. Therefore, the "missing money problem" in energy-only electricity markets is more likely to occur in systems with high proportions of renewables. Nevertheless, renewables are supported in many countries due to their expected benefits. The kind of support instrument can however affect the degree to which renewables influence the market. While fixed feed-in tariffs lead to higher market impacts, more market-oriented support schemes – such as market premiums, quota systems and capacity-based payments – decrease the extent

to which markets are affected. This paper analyses the market impacts of different support schemes. For this purpose, a new module is added to an existing bottom-up simulation model of the electricity market. In addition, different degrees of flexibility in the electricity system are considered. A case study for Germany is used to derive policy recommendations regarding the choice of support scheme.

(Paper co-authored with *Mario Ragwitz* (FhF-ISI) and published in *Energy Policy*, Vol.93, June 2016).

## D. 13-06-2016 32nd Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### Are Electricity Consumers Smart?

School of Mines Paris Tech (60 Boulevard Saint-Michel 75006 Paris)

#### Presentations

**Bettina Hirl** (Assistant, Università della Svizzera Italiana (USI, Lugano, Switzerland))

*Rational Habits in Residential Electricity Demand*

In this presentation, we use a novel approach to improve the understanding of the dynamics of residential electricity demand and the effects of possible energy policies. Rational households looking at the constant maximization of utility over time would also take into account expectations about future prices or consumption of electricity when making their consumption and investment decisions. Hence, expectations about future prices or consumption may have an impact on current decisions. To our knowledge, no study of residential electricity demand considers expectations about future consumption or prices. A recent exception, focused on gasoline, by Scott (2012), estimates rational habit models for gasoline demand in the US, but it is focused on the price as the leading explanatory variable. In this paper, we use the lead time before consumption in our theoretical model. We thus propose a rational habit model with forward-looking consumers for residential electricity demand. We estimate a lead-consumption model using fixed-effects, instrumental variables, and the GMM Blundell-Bond estimator. We find that expectations about future consumption significantly influence current consumption decisions, which suggests that households behave rationally when making decisions about electricity consumption. This novel approach may improve our understanding of the dynamics of residential electricity demand and the evaluation of the effects of energy policies.

(CERT-ETHZ Working paper co-authored with **Massimo**

**Filippini** (Professor at ETH Zurich and USI (Lugano)).

**Luis Mundaca** (Associate Professor, International Institute for Industrial Environmental Economics (IIIEE), Lund University (Sweden))

*Behavioural Energy Economics: Drivers, Concepts and Policy Implications*

How do behavioural failures affect the adoption of low-carbon energy technologies? How are behavioural barriers treated in modelling exercises? What can behavioural economics say about the design of policy instruments? These are some of the questions addressed by this presentation. A critical review is presented of the rational choice theory and technology paradigm that dominates energy and climate policy assessments. Major assessments, initiatives and E-3 models are discussed and confronted with key concepts and research gaps from a behavioural science perspective. The growing discipline of Behavioural Energy Economics is outlined and research is presented focusing on standard vs. behaviourally-oriented real-time feedback in Nordic countries.

## E. 10-05-2016 31st Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### Economics of Adaptation of Housing to Climate Constraints

Université Paris-Dauphine, Amphi 5 (2nd Floor)

#### Presentations

**Dorothee Charlier** (Maître de conférences, Université Montpellier 1)

*Energy-Efficiency Investments under a Variety of Incentives among French Households*

The residential sector offers considerable potential for reducing energy use through energy-efficient renovation. The objective of the presentation is twofold. First, it aims to provide initial empirical evidence of the extent to which incentives split between landlords and tenants may lead to underinvestment. Second, it investigates the influence of tax credits and energy burdens on energy efficiency expenditure. Given the complexity of studying the decision to invest in energy-saving renovations, a bivariate Tobit model is used to compare decisions about energy-efficient works and repair works, even when the renovation costs seem quite similar. The analysis shows that tenants are doubly penalized: they have high energy costs due to energy-inefficient building characteristics, and because they are poorer than homeowners, they

are unable to invest in energy-saving systems. The results confirm that tax credits are ineffective in the split-incentives context. In terms of public policy, the government should focus on low-income tenants, and mandatory measures such as minimum standards seem appropriate. Financial support from a third-party financier may also be a solution.

(Paper published in *Energy Policy*, 2015, vol. 87, pp.465-479).

**Matthieu Glachant** (Professor, Mines ParisTech)  
*Adaptation of American Homes to Climate Change*

This paper assesses the economic cost of adapting US dwellings through home improvements and changes in energy consumption. Using household-level data, we estimate the adaptation cost per household to be low: 90 USD for a 1°F increase. This is driven by the fact that the installation and more intensive use of additional air-conditioners are partially offset by lower needs for space heating. These findings deliver an optimistic message about the adaptive capacity of US houses.

(Working Paper co-authored with F. Cohen (LSE) and M. Sodeberg (Mines ParisTech)).

## F. 13-04-2016 30th Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### Arbitrage and Strategic Behaviours in Regional Gas Markets

School of Mines ParisTech (60 Boulevard Saint-Michel 75006 Paris)

#### Presentations

**Yuri Yegorov** (Faculty of Business, Wien University)  
*Arbitrage in Natural Gas Markets: Drivers and Constraints*

Natural gas markets are characterized by the increasing role of liquefied natural gas (LNG) and spot markets, along with deregulation, liberalization and growing competition in many national markets. Rising flexibility in LNG contracts' destination clauses combined with large spreads across locations create the impression of large opportunities for arbitrage. However, technical, contractual and market restrictions, differences in LNG qualities, capacity limits in shipping, liquefaction and re-gasification, as well as high transportation costs are important barriers for any arbitrageur. Taking these costs and barriers into account, arbitrage opportunities seem to exist in particular from the low-cost US to high-cost regions in Europe and Japan. Since it is difficult to be satisfied with explanations based on these

simple economic incentives, further explanations are needed: capacity constraint (US liquefaction plants), high investment costs at the individual level, rational expectations and US government interventions, current and future.

**Robert Ritz** (EPRG, Cambridge University)  
*Strategic Investment, Multimarket Interaction and Competitive Advantage: An Application to the Natural Gas Industry*

This paper presents a game-theory-based analysis of multimarket competition with strategic capacity investments, motivated by recent developments in international natural gas markets. It studies the competitive implications of heterogeneity in company structure arising from asset specificity. A single-market focus confers advantage even in the absence of superior value or cost. Lower costs and a sharper organizational focus are self-enforcing in generating competitive advantage. The paper draws out the implications for core themes in strategy: the intensity of rivalry between firms, different routes to achieve competitive advantage and their interaction, as well as the degree of value capture across different markets. This establishes a novel connection between two of Porter's generic strategies: cost leadership and focus. The model speaks to competition between pipeline gas and liquefied natural gas (LNG) in the post-Fukushima context of intensive competition in the global LNG market.

## G. 16-03-2016 29th Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### Technology Transfer in Green and Efficient Energy Technologies

Université Paris-Dauphine, Amphi 6 (2nd Floor)

#### Presentation

**Antoine Dechezleprêtre** (Grantham Institute, LSE)  
*Carbon Taxes, Path Dependency and Directed Technical Change: Evidence from the Auto Industry*

Can directed technical change be used to combat climate change? We construct new firm-level panel data on auto industry innovation distinguishing between "dirty" (internal combustion engine) and "clean" (e.g. electric and hybrid) patents across 80 countries over several decades. We show that firms tend to innovate more in clean (and less in dirty) technologies when they face higher tax-inclusive fuel prices. Furthermore, there is

path dependence in the type of innovation (clean/dirty) both from aggregate spillovers and from the firm's own innovation history. We simulate the increases in carbon taxes needed to allow clean technologies to overtake dirty technologies.

(Paper co-authored with **Philippe Aghion** (Harvard University, NBER) and **David Hemous** (INSEAD and CEPR)).

## H. 17-02-2016 28th Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### Energy and Low Carbon Transition in China

School of Mines Paris Tech (60 Boulevard Saint-Michel 75006 Paris)

#### Presentations

**Fergus Green** (Policy Analyst, Grantham Institute on Climate change and Environment (LSE))

*China's "New Normal": Structural Change, Better Growth, and Peak Emissions*

In the light of Chinese economic and policy trends affecting the structure of the economy and the consumption of fossil fuels, particularly coal, across power generation, industry and transport, it appears that the peak in China's carbon dioxide emissions from energy, and in overall GHG emissions, is unlikely to occur as late as 2030, and more likely to occur by 2025. It could well occur even earlier than that. This suggests that China's international commitment to peak carbon dioxide emissions "around 2030" should be seen as a conservative "upper limit" from a government that prefers to under-promise and over-deliver. It is important that governments, businesses and citizens everywhere understand this fundamental change in China, reflect on their own ambitions on climate change, and make an upward adjustment in expectations about the global market potential for low-carbon and environmental goods and services.

After the emissions peak, in order to reduce its emissions at a rapid rate, China will need to deepen its planned reforms in cities and in the energy system, supported by a concerted approach to clean innovation, green finance and fiscal reforms.

(Grantham Policy Report, June 2015, co-authored with **Nicholas Stern**).

**Xin Wang** (Research Fellow, Institut du Développement Durable et des Relations Internationales)

*Exploring Linkages among China's 2030 Climate Targets*

China published its Intended Nationally Determined Contribution (INDC) to the UNFCCC on 30 June 2015. In this document, China promised to reach its CO<sub>2</sub> emissions peak no later than 2030, reducing its carbon intensity by 60–65% by 2030 relative to the 2005 level, and to increase the proportion of non-fossil fuels in primary energy consumption to 20% by 2030. Using a simple method and official data, this article aims to explore the linkages among these three targets. The carbon emissions peak and the non-fossil fuel proportion of the energy mix can be considered as two main pillars of China's post-2020 climate pledges. To understand the relationship between the two targets, we use a very simple non-modelling approach to demonstrate the implications of the achievement of China's non-fossil fuels target in terms of its carbon emissions peak and the linkage between achieving carbon intensity and non-fossil fuel targets under different growth and energy elasticity assumptions. We illustrate the relationship between the 2030 non-fossil fuels target and the carbon emissions peak, highlighting the potential inconsistency between GDP carbon intensity and non-fossil fuels targets.

We show that as long as China achieves its 2030 non-fossil fuel target, its carbon emissions peak can be attained prior to 2030. We provide a panoramic view of the link between carbon intensity and non-fossil fuel targets with different levels of GDP growth rate and energy elasticity. Two further conclusions based on this finding are: first, that a GDP carbon intensity target may help to control the absolute level of the carbon emissions peak, but it could be inconsistent with the development of non-fossil fuel power; and second, that a GDP energy intensity objective, together with a non-fossil fuel target, is necessary to ensure target consistency.

(Paper co-authored with **Shuwei Zhang** and published in *Climate Policy*, January 2016).

## I. 13-01-2016 27th Session of Seminars on Research into Energy Economics at Paris-Sciences-Lettres

### The Entry of Wind Power into the Electricity Markets

Université Paris-Dauphine, Amphi 5 (2nd Floor)

#### Presentations

**Thomas-Olivier Léautier** (Professeur de Gestion à l'Université de Toulouse et Directeur de recherches à l'École d'Économie de Toulouse)

*Do Costs Fall Faster than Revenues? Dynamics of Renewables Entry into Electricity Markets*

In many countries, the entry of renewable electricity producers has been supported by subsidies and financed by a tax on electricity consumed. This article derives, analytically, the dynamics of the residual generation mix, subsidy, and tax as renewable capacity increases. This enables us to complement and extend previous work by providing analytical expressions for previously obtained simulation results, and deriving additional results. The analysis yields three main findings. First, the subsidy to renewables may never stop, as the value of the energy produced may decrease faster than the cost as renewables capacity increases. Second, high renewables penetration leads to a discontinuity in marginal values, after which the subsidy and tax grow extremely rapidly. Finally, reducing the occurrence of negative prices, for example by providing renewables producers with financial instead of physical dispatch insurance, yields significant benefits.

(Working Paper TSE-691, July 2015, co-authored with Richard Green).

**Marie Petitet** (Doctorante CIFRE chez RTE, Chaire EEM, Université Paris-Dauphine)

*Carbon Price instead of Support Schemes: Wind Power Investments by the Electricity Market*

The paper studies wind power development within electricity markets with a significant carbon price as the sole incentive. Long term simulation of day-ahead electricity markets and investment decisions by System Dynamics modelling is used to trace changes in the electricity generation mix over a 20-year period from an initial thermal system. A range of constant carbon prices is tested to determine the value above which market-driven development of wind power becomes economically possible and at what scale. This requires not only economic competitiveness versus traditional fossil-fuel technologies in terms of levelled cost, but also profitability because of the variability in the economic

value of wind MWhs. In each carbon price case the proportion of renewable energy production reaches an equilibrium which depends on the carbon price level. Results stress that wind power is profitable for investors only if the carbon price is significantly higher than the price required for making wind power MWhs cost-price competitive. In this context, the market-driven development of wind power only seems possible if there is a strong commitment to climate policy, reflected in a stable, high carbon price. Moreover, market-driven development of wind power becomes more challenging if nuclear power, even costly, is among the investment options.

(Article to be published in *The Energy Journal*, 2016, vol. 37 n° 4, co-authored with Tanguy Janssen and Dominique Finon).



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#### Proposed PSL seminars for the first semester of 2017

- May 2017, *The Objectives of Voluntary Reduction in Greenhouse Gas Emissions in the National Energy Industries*

- June 2017, *Electricity Storage and the New Business Models to Be Set Up Depending on the New Market Rules in a Given Country*

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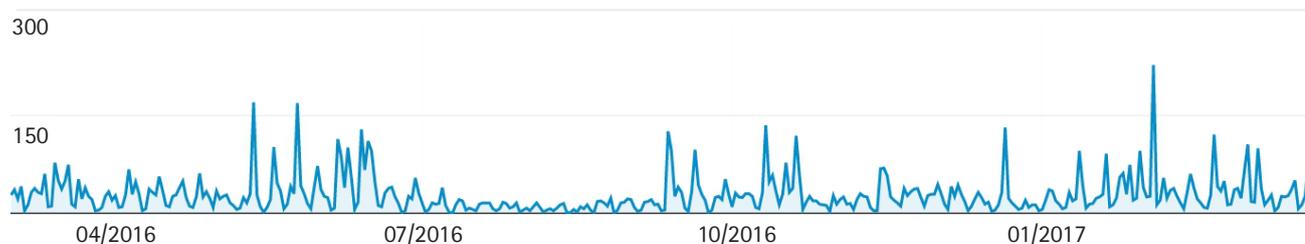
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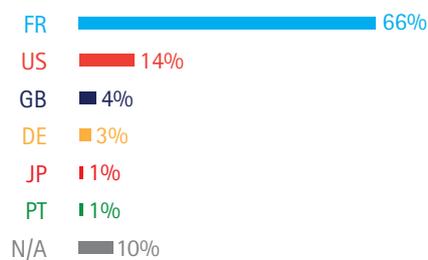
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**Visits**  
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Sessions	10 930	Pages/session	2,17
Users	6 684	Rebound rate	64,28%
Page views	23 769	New sessions	60,68%



Source : Google Analytics

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# APPENDIX 1: EDITORIAL SPECIAL SECTION

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## TOWARDS HYBRID MARKET REGIMES IN THE POWER SECTOR

Dominique Finon, Jan Horst Keppler, Fabien Roques, *Energy Policy*, Volume 105 (2017), pp. 547-549.

The context and the policy objective guiding the liberalisation of the electricity industry have changed significantly over the past decades. Policy priorities in favour of decarbonisation and maintaining security of supply have taken centre stage on the policy agenda in many countries. The emergence of new decentralised and variable technologies and the change toward fixed cost technologies have profound implications for market dynamics.

Yet the design of liberalised electricity markets has largely failed to evolve and be reconciled with these changes in context and well as policy objectives. As a result the initial "energy market" model is being questioned and a number of reforms have been implemented around the world to the initial market designs.

The Chaire European Electricity Markets (CEEM) organised a conference at the Université Paris-Dauphine University in July 2015 in order to improve our understanding of the evolution required for electricity markets to satisfy the competing objectives of sustainability, security of supply and competitiveness, and to adapt to other changes including new technologies and change in the industry cost structure. For two days, leading scholars from Europe and the Americas discussed the issues raised by market failures and the short-comings of the initial "target model" market design.

One of the key issues that emerged from the discussion is the question of the ability of market price signals to generate sufficient and adequate (i.e. in the optimal generation mix) investment, given the series of market and regulatory imperfections that prevail in current electricity markets, and the many types of policy

interventions. Despite a great variety of points of view on specific issues, a consensus emerged that adding *ad hoc* "patches" to energy-only markets to address some market or regulatory failures and/or support some technologies is not a sustainable option.

Reconciling public policy objectives and free price formation in electricity markets requires the theorisation and implementation of "hybrid market" regimes capable of reconciling public policy objectives and free price formation in a comprehensive and forward-looking fashion. The five articles in this special section all cover different aspects of these "hybrid market" regimes in order to respond to the issues raised by tensions between initial objectives of market liberalisation and the long-term policies goals of decarbonisation whilst maintaining security of supply.

Since the liberalization of the electricity industry in the 1990s in OECD countries, the underlying policy objectives have changed. The objective of the initial reforms was to improve the efficiency of the electricity industry which was then organised around public- or private vertically integrated monopolies. The rise of information technology and combined cycle gas turbines (CCGT) enabled fragmentation of the value chain possible and the introduction of competition in retail and production activities. In the European Union, the liberalisation was also driven by the objective of creating an internal integrated market as the networks were sufficiently developed to facilitate competition between various producers on a large territorial scale. Investment was facilitated by the low capital-intensive profile of CCGT, and there was not much focus on security of supply as often most markets were in an overcapacity situation.

*"Adding ad hoc patches in energy-only markets to address a growing list of specific market or regulatory failures combine with the selective support of individual technologies is not a sustainable option."*

In this context, the main focus of the initial reforms was on the efficient functioning of energy markets and the extension of retail competition in industrialized countries with mature demand. The experience in some developing countries with significant



growth of demand and need for new investment in the early 2000s casted some doubts on the ability of energy markets to provide timely and efficient investment incentives. This led a number of Latin American countries, for instance, to reform the initial market designs and adopt capacity remuneration mechanisms (CRM) and/or auctions for long term contracts to shift risks to consumers.

Since the mid-2000s, new long term policy priorities have emerged in Europe and the US, as well as in other OECD countries: the decarbonisation of the electricity industry and security of supply. This has profound implications for the functioning and optimal design of electricity markets. Priority is given to investing in RES and low-carbon technologies and in peaking units and back-up technologies, whose share of CAPEX per MWh in the cost structure is high, casting a new light on the relationship between market design and the need to allocate risks efficiently in order to minimize financing costs. The use of long term arrangements – feed in tariffs (FITs), fee-in-premium (FIPs), and contracts for difference (CfDs) --to promote variable RES has enabled large-scale deployment of RES production with low variable cost.

But as a result, the investment and coordination signals by market prices have been largely undermined, which raises a number of questions regarding the ability of the

current market design to provide adequate operational and investment incentives. For this reason the market architectures of electricity markets must evolve and a number of countries have embarked on wide ranging reforms of their electricity markets. The energy, reserves and ancillary markets need to be improved to provide better scarcity signals in the short term, whilst mechanisms need to be introduced to facilitate risk transfers and provide long term signals to investors. Downstream, electricity demand must be made more price-responsive to facilitate hourly adjustments and physical supply-demand equilibrium. On the grid side, price signals are needed which better indicate supply constraints in order to provide locational signals to new resources, and changes in the regulation of network tariffs are needed to facilitate their transformation into smart grids.

In the conclusion of the workshop, the overarching question that remained was whether the different reforms point toward a common direction and reveal a structural change of the market regime of the power industry. Indeed we observe a great variety of reforms in response to regulatory imperfections and market failures that characterize current market architectures. For the time being, it appears that a coherent consensus model of comprehensive market design for emerging and advanced economies is still outstanding.

## 1. The contributions in this Special Section

During the conference, a large spectrum of issues was covered. These included short term issues such as the effects of increasing shares of variable renewable energy (VRE) on energy markets and the need for operational flexibility, as well as long term issues such as investment and large scale deployment of low carbon technologies, the impact of VREs on security of supply, and the lack of appropriate locational signals to electricity markets investors and operators, as well as the increasingly important roles of demand response and distribution grids in the integration of decentralised production.

This Special Section gathers some of the key contributions to the Conference that deal with the upstream issues of the electricity system. The papers cover the issues associated with risk allocation and coordination of electricity market participants through price signals for dispatching and investment in generation. The first three papers deal with changes in market designs (capacity mechanisms, long-term arrangements for risk transfer, and reform of support for variable renewables) intended to address some of the well documented market failures. The other two papers explain these changes in market design with an institutional approach and conceptualise the shift towards a hybrid market regime.

The issues related to the downstream of the electricity system are voluntarily left out of this special issue, as the research presented at the conference on these issues did not seem to be as mature and consensual as the research on the upstream part of the value chain. In future, a myriad of changes could coalesce into new business models and bring about new types of market players in different domains, in particular at the end of the value chain : aggregators of RES generation or demand response, decentralised storage, prosumer collectives, etc.). For now, however, these changes remain at too earlier stage to imply a "change of paradigm". While there is a clear possibility, there is also no guarantee that this change will happen. At the present stage, the mutation of the market appears more mature upstream.

This special section presents two original features compared to recent special issues of *The Energy Journal* and *Energy Policy*, which deal with changes in electricity systems and markets resulting from the RES promotion policies<sup>1</sup>. First, it covers market and regulatory imperfections that arise independently from the introduction of renewables in electricity markets, even though the latter's impact is fully recognised. Second, it

1. The special issue of *The Energy Journal*, co-edited by Carlo A. Bollino and Richard Madlener (2016, Volume 37) entitled "High Shares of Renewable Energy Sources and Need for Electricity Market Reform", with sixteen papers, and the special issue of *Energy Policy* entitled "European Union: Markets and Regulators" coordinated by M.T. Costa-Campi, M. Giugetti, and E. Trujillo-Baut (*Energy Policy*, 2016, Vol. 94).

includes papers that adopt a comprehensive approach to the changes resulting from the attempt to amend the market design and the new policy priorities towards long term objectives such as decarbonisation and security of supply. In particular two papers attempt to conceptualize and explain the shift towards a new hybrid market regime that consciously integrates the contributions of decentralised market actors and centralised coordination in a coherently conceptualised notion of hybrid markets.

## 2. Overview of the contributions to the special issue

The first three papers deal with market and regulatory imperfections in the market and point toward some of the key elements characterizing the new hybrid market. The first paper studies the limitations of the long-term price signal in the presence of non-convexities. The second paper focuses on rationales for capacity remuneration mechanisms (CRMs) as indispensable complements to energy-only market at the current stage of development. The third paper studies the conditions for social efficiency in the use of contracts for difference (CfD), reliability options and CRMs. These normative papers are followed by two institutional papers investigating the trajectory of the necessary evolution of electricity market regimes given the structural tension between the policy objectives of competitiveness, security of supply (reliability) and sustainability (decarbonisation). The first of these papers develops an institutional framework to conceptualize the different elements of hybrid market regimes, while the second provides a review of recent developments by drawing on the UK and Irish market reforms.

1. Miguel Vasquez, Michele Hallack and Carlos Vasquez<sup>2</sup> discuss the limitation of price signals for long term decisions, given the problem of electricity price definition which is raised in the presence of non-convexities, in particular binary start-up decisions. Short term electricity price setting rules and their long term implications are a highly topical issue, given the large and increasing impact of significant shares of variable renewables on price formation and the relevance of non-convexities due to the permanent adaptation of the conventional equipment that is required by the variability of VREs. Starting from possible pricing regimes that allow for side payments in a short-term setting, the paper then proposes various pricing schemes that contain additional criteria to define the right long term signals, including the opportunity costs for energy pricing. As the authors underline, there exist solutions such as the complex bidding offers on the former

2. Paper entitled "Price Computation in Electricity Auctions with Complex Rules: An Analysis of Investment Signals".

British pool or the PJM market in the US or capacity mechanisms that complement the revenues from energy markets to trigger investment decision in conventional technologies. Ultimately, the paper provides insights into the various pricing models considered in the specialised literature and thus promotes the debate over the methods and objectives that can be pursued by market designers and operators.

2. Jan Horst Keppler's paper<sup>3</sup> is a building block in the argument in favour of capacity remuneration mechanisms (CRM) versus scarcity pricing, a debate which has been particularly intensive in the European Union during the 2015-2016 discussion on the new Directive for the design of the power market. Challenging the belief in the efficiency of the energy market price signals with scarcity pricing (VOLL pricing) in order to guarantee reliability of supply, this paper provides some conceptual guidance on the rationales for adopting CRMs, which are eyed with suspicion by a profession wedded to the theoretical benchmark model. The profession tends to ignore the two market failures that make CRMs the practically appropriate and theoretically justified policy response to capacity issues. First, energy-only markets fail to internalize security-of-supply (SOS) externalities as involuntary curbs on demand under scarcity pricing generate social costs beyond the private non-consumption of electricity that is not captured in the VOLL. Second, when demand is inelastic and the potential capacity additions are discretely sized, investors will underinvest at the margin rather than overinvest. These two explanations distinguish themselves from the usual explanations in terms of "missing money" resulting from regulatory imperfections such as price caps and imperfect or incomplete markets that would not allow consumers to express their private willingness to pay for security of supply. The paper concludes with some consideration regarding design of CRM, which must include voluntary demand response programs as a way to internalise security of supply externalities and to align private and social preferences for security of supply.

3. Andreas Ehrenmann, Gauthier de Maere d'Aertrycke and Yves Smeers<sup>4</sup> consider the issue of investment decisions in market designs including capacity remuneration mechanisms by integrating the risk faced by decision-makers in a formalized approach that combines a long-term market equilibrium approach and investment modelling with techniques stemming from the finance literature. This yields a fresh perspective because the current literature on market failures regarding investment in liberalized markets is focused

more on reduced investment incentives due to market power or price caps, and less on the high risks for investors in those markets. Long-term contracts and capacity remuneration mechanisms can indeed reduce those risks and accelerate capital cost recovery. The objective of the paper is to demonstrate that remedies to market failures such as long-term contracts, CfDs or reliability options as well as capacity remuneration mechanisms can be assessed by a framework combining stochastic equilibrium modelling with risk management criteria. The main result is that almost all of these instruments require liquidity levels that are unlikely to be met in current markets. If liquidity cannot be provided in each case, as is currently the case, the value of such long-contracts in terms of social welfare is strongly diminished. Capacity markets can serve as an alternative to long-term contracts, but also do not significantly improve welfare if liquidity is limited. The paper concludes by interpreting the respective results for the three mechanisms in terms of the hurdle rate implied by the different risk-management solutions.

4. Fabien Roques and Dominique Finon<sup>5</sup> develop an institutionalist analysis of the ongoing mutation of the electricity market regime. The emergence of policy interventionism in electricity markets raises questions as to how market design can best be adapted to meeting the investment challenge associated with security of supply and decarbonisation objectives. The move from the market regime towards a hybrid regime, which relies on a combination of planning, long-term risk sharing arrangements and improved market signals for short-term coordination, appears to be unavoidable where economic growth necessitates significant development of generation capacities and/or where ambitious decarbonisation policies are adopted. The paper introduces a framework to analyse the role and interactions of the different "modules" or building blocks of the historical market regime. They then show that current reforms lead to the addition of new modules, required to achieve long-term policy objectives, which destabilise the functioning of the modules of the initial market design. The paper reviews a number of international experiences with reforms introducing such hybrid regimes. Whilst there is a wide range of approaches in different countries, the paper identifies some key recurrent elements which characterise a new hybrid regime of the electricity sector that structurally integrates security of supply and decarbonisation objectives. The key changes are the introduction of long term risk sharing and coordination mechanisms and improvements in short-term price signals through the reform of intra-day, real time and reserve markets.

3. Paper entitled "Rationales for Capacity Remuneration Mechanisms: Security of Supply Externalities and Asymmetric Investment Incentives".

4. Paper entitled "Investment with Incomplete Markets for Risk: The Need for Long-Term Contracts".

5. Paper entitled "Adapting Electricity Markets to Security of Supply and Decarbonisation Objectives: Toward a Hybrid Regime".

5. David Newbery<sup>6</sup> illustrates the current evolution of the electricity market regime towards a hybrid market regime to overcome the tensions between sustainability, security of supply and competitiveness, while at the same time maintaining market competition as the principal allocation mechanism. Focus is on the UK electricity market reform which explicitly strives to go beyond the EU energy-only target model for the electricity sector; it is considered impossible to deliver these three conflicting objectives through a short term market price signal alone. In the UK, capacity auctions with long-term contracts for new entrants are considered the least-cost solution compared to relying on expectations of future prices to deliver an adequate generation and demand side response. The UK combines these with feed-in tariffs (FITs) for small scale renewables, while the EU is pressing for feed-in premiums (FIPs). This paper also draws on the UK experience to highlight the problems that have arisen between the diagnosis of the problem and the delivery of solutions. It sets out the theory and practice of delivering low carbon capacity, and security of supply via the auctioning of long term contracts both for large-sized low carbon and RES technology as well as through a capacity remuneration mechanism that allocates long term capacity contracts for new units. While the auctions provide sufficient incentives to reveal information on the anticipated costs of developing capacity, problems may appear with respect to monitoring the capacity auctioned by the regulator. Some reliability risk may be unavoidable in the present system. In Ireland, reforms illustrate the problem and possible answer of how best to deliver security of supply with high shares of intermittent renewables by transforming the system from capacity payments to reliability auctions. Moreover, the new market design also aims at remunerating system services and ancillary services (seven different system service products are indeed recognised) to help develop the supply of such services through auctions that would provide long-term contracts for new installations. Both cases are presented in contrast with the EU energy trilemma and highlight the difficulty of current EU energy policy to integrate long-term concerns adequately.

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6. Paper entitled "Tales of Two Islands: Lessons for EU Energy Policy from Electricity Market Reforms in Britain and Ireland".

### **Jan Horst KEPLER**

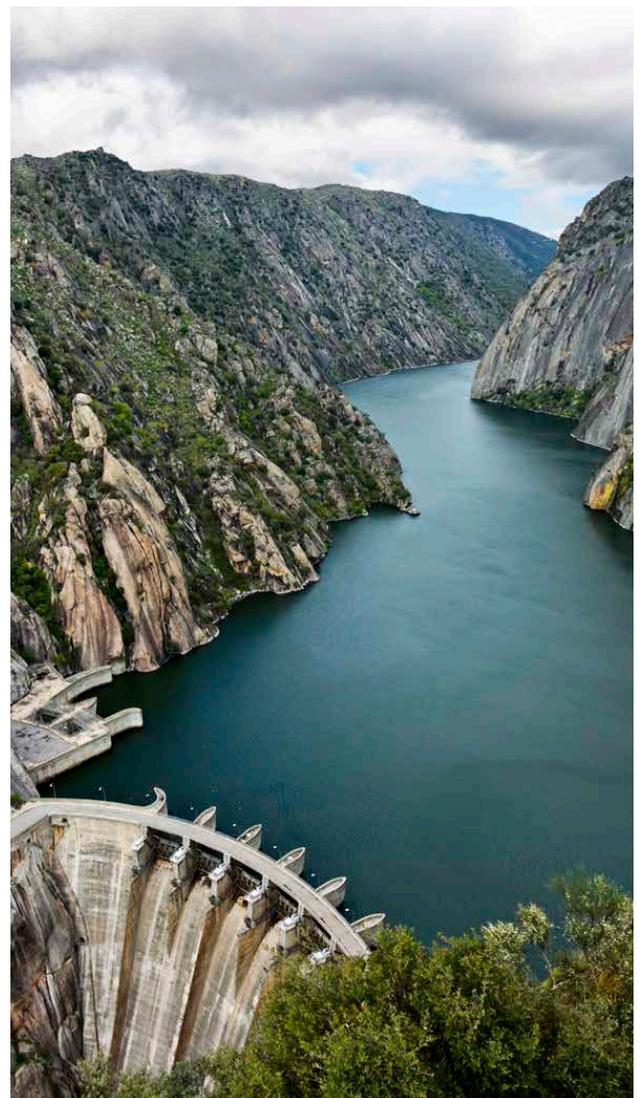
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### **References**

- Bollino C.A. and R. Madlener (co-editors), 2016. "High Shares of Renewable Energy Sources and Need for Electricity Market Reform", *The Energy Journal*. 37, Special issue, 1-4.
- Costa-Campi M.T., Giuletti M., Trujillo-Baut E. (co-editors), 2016. Special issue on the European Union: Markets and Regulation, Editorial. *Energy Policy*. 94, 396-400...



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# APPENDIX 2: DETAILED REPORT

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## EVENTS AND PUBLICATIONS IN THE DIFFERENT AREAS OF RESEARCH AT THE CEEM, JULY 2012 – MARCH 2017

### RESEARCH AREA 1: PRICE FORMATION IN EUROPEAN ELECTRICITY MARKETS

#### A. Scientific Conferences

06 March 2017

Workshop on "Electricity Demand: New Modelling Perspectives"

01 June 2015

Workshop on "Renewables and Electricity Prices: Modeling Approaches"

28 April 2014

European Workshop on "Electricity Price Forecasting"

#### B. Working Papers

*"Impact of Variable Renewable Production on Electricity Prices in Germany: a Markov Switching Model"*

by Cyril MARTIN DE LAGARDE and Frédéric LANTZ

*"The Value of Flexibility in Power Markets"*

by Stéphane GOUTTE and Philippe VASSILOPOULOS

*"Hedging Strategies in Energy Markets: The Case of Electricity Retailers"*

by Raphaël Homayoun BOROUMAND, Stéphane GOUTTE, Simon PORCHER and Thomas PORCHER

*"Wind up with Continuous Intraday Electricity Markets? The Integration of Large-Share Wind Power Generation in Denmark"*

by Fatih KARANFIL and Yuanjing LI

*"Revisiting Short-Term Price and Volatility Dynamics in Day-Ahead Electricity Markets with Rising Wind Power"*

by Yuanjing LI

*"Impacts of Subsidized Renewable Electricity Generation on Spot Market Prices in Germany: Evidence from a GARCH Model with Panel"*

by Thao PHAM and Killian LEMOINE

### RESEARCH AREA 2: ORGANISATION, STRUCTURAL CHANGE AND REGULATION OF EUROPEAN ELECTRICITY MARKETS

#### A. Scientific Conferences

30 January 2017

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

17 October 2016

Conference on "The Impact of Electric Vehicles on the Electricity System"

14 June 2016

Conference on "The CO<sub>2</sub> Floor Price and the Reform of the EU ETS: Impacts on the Electricity Industry"

14 March 2016

Workshop on "Market Designs for Low-Carbon Electricity Generation"

12 January 2016

Conference on "Energy, the Market and the Law: A European Dialogue between Economists and Lawyers"

08 and 09 July 2015

Conference on "Elements of a New Target Model for European Electricity Markets"

26 March 2015

Seminar on "Lessons to the European Power Sector from the USA"

9 March 2015

Conference on "National Energy Policies with Respect to Capacity Remuneration Mechanisms (CRM) in the Context of European Targets"

24 November 2014

International Conference on "Investing in European Electricity Markets Today: Challenges and Opportunities"

14 October 2014

International Workshop on "Changing Renewables Support in the EU Electricity Markets"

9 July 2014

European Workshop on "Drifting Apart? Costs, Prices and Tariffs in EU Electricity Markets"

3 April 2014

Seminar on "The European Electricity System in Crisis: The Ways Forward"

21 March 2014

Seminar with John E. Parsons (MIT) on "A Dynamic Model for Risk Pricing in Generation Investments"

18 December 2013

Workshop on "Long-Term Contracting in Electricity Markets: How to Ensure Investments for Supply Security and Climate Policy?"

01 October 2013

Seminar on "The Integration of "Demand-Response" into the Electricity Markets"

06 June 2013

Seminar on "The Regimes of Electricity Markets Based on Long-Term Contracts: What Lessons from the Brazilian Model?"

30 May 2013

Conference on "Energy Transitions in France and Germany: Convergences, Divergences and Impact on Europe"

16 April 2013

European Workshop on "Capacity Mechanisms in EU Power Markets: Are They Necessary? How Can We Harmonise Them?"

31 January 2013

Seminar on "The Systemic Effects of Intermittent Renewable Energies: Measurement and Internalisation."

## B. Working Papers

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

by Manuel VILLAVICENCIO

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

by Jan Horst KEPPLER, William MEUNIER and Alexandre COQUENTIN

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

by Dominique FINON and Fabien ROQUES

*"Is the Depressive Effect of Renewables on Power Prices Contagious? A Cross Border Econometric Analysis"*

by Sébastien PHAN and Fabien ROQUES

*"Ensuring Capacity Adequacy during Energy the Transition in Mature Power Markets: A Social Efficiency Comparison of Scarcity Pricing and Capacity Mechanism"*

by Marie PETITET, Dominique FINON and Tanguy JANSSEN

*"Le besoin de marchés de la flexibilité : L'adaptation du design des marchés électriques aux productions d'énergies renouvelables"*

by Dominique FINON

*"Les coûts associés à l'insertion des ENR intermittentes dans le système électrique – une revue de la littérature"*

by Renaud CRASSOUS and Fabien ROQUES

*"Architecture de marché et gestion de la demande électrique"*

by Vincent RIOUS and Fabien ROQUES

*"Carbon Price Instead of Support Schemes: Wind Power Investments by the Electricity Market"*

by Marie PETITET, Dominique FINON and Tanguy JANSSEN

*"First Principles, Market Failures and Endogenous Obsolescence: The Dynamic Approach to Capacity Mechanisms"*

by Jan Horst KEPPLER

*"The Impact of Intermittent Renewable Production and Market Coupling on the Convergence of French and German Electricity Prices"*

by Jan Horst KEPPLER, Sébastien PHAN, Yannick LE PEN and Charlotte BOUREAU

*"Capacity Mechanisms and Cross-Border Participation: The EU Wide Approach in Question"*  
by Dominique FINON

*"Assessing Long-Term Effects of Demand Response Policies in Wholesale Electricity Markets"*  
by Mauricio CEPEDA and Marcelo SAGUAN

*"Can We Reconcile Different Capacity Adequacy Policies with an Integrated Electricity Market?"*  
by Dominique FINON

*"Estimation de l'élasticité prix de la demande électrique en France"*  
by Régis BOURBONNAIS and Jan Horst KEPLER

*"European Electricity Market Reforms: The "Visible Hand" of Public Coordination"*  
by Dominique FINON and Fabien ROQUES

*"Sept propositions pour une Europe électrique efficace et dynamique"*  
by Jan Horst KEPLER, Dominique FINON and Patrice GEOFFRON

*"How to Correct Long-Term System Externality of Large-Scale Wind Power Development by a Capacity Mechanism?"*  
by Mauricio CEPEDA and Dominique FINON

*"Le rôle croissant de la main visible dans les marchés électriques européens"*  
by Dominique FINON

## RESEARCH AREA 3 TRANSPORTATION, DISTRIBUTION, INTELLIGENT NETWORKS, STORAGE AND DEMAND MANAGEMENT

### A. Scientific Conferences

28 January 2016  
Conference on "The Pricing of Electricity Networks: How to Send the Right Economic Signals for the Energy Transition?"

26 October 2015  
Conference on "The Effects on Employment of Choices Made in the Electricity Industry: Smart Grids and the Energy Transition."

04 May 2015  
Conference on The Report Submitted to François Hollande Entitled "Energy, Networked Europe: Perspectives for Cooperation among the European Energy Networks".

09 April 2015  
CEEM Participation in the Symposium "Energy Transition and Regions: What Place for Local Authorities?"

28 January 2015  
Conference on "What Changes in Network Pricing to Send the Right Economic Signals?"

24 January 2014  
Conference on "What Economic Models and Regulatory Tools for Smart Grids?"

### B. Working Papers

"An Analytical Approach to Activating Demand Elasticity with a Demand Response Mechanism"  
by Cédric CLASTRES and Haikel KHALFALLAH

"Les lignes directrices concernant les aides d'État à la protection de l'environnement et à l'énergie pour la période 2014-2020"  
by Guillaume DEZOBRY

### CEEM PEER-REVIEWED PUBLICATIONS

*"Sept propositions pour une Europe électrique efficace et dynamique"*  
by Jan Horst KEPLER, Dominique FINON and Patrice GEOFFRON (Revue de l'énergie n°612, 1er mars 2013, pp. 95-105).

*"Le besoin de marchés de la flexibilité : L'adaptation du design des marchés électriques aux productions d'énergies renouvelables"*  
by Dominique FINON (Revue de l'énergie n°622, novembre-décembre 2014)

*"Hedging Strategies in Energy Markets: The Case of Electricity Retailers"*  
by Raphaël Homayoun BOROUMAND, Stéphane GOUTTE, Simon PORCHER and Thomas PORCHER (Energy Economics 51 (2015), pp. 503-509)

*"An Analytical Approach to Activating Demand Elasticity with a Demand Response Mechanism"*  
by Cédric CLASTRES and Haikel KHALFALLAH (Energy Economics 52 (2015), pp. 195-206).

*"The Impacts of Variable Renewable Production and Market Coupling on the Convergence of French and German Electricity Prices"*  
by Jan Horst KEPLER, Sébastien PHAN and Yannick LE PEN (The Energy Journal, Vol. 37, No. 3 (2016), pp. 343-359).

*"Carbon Price instead of Support Schemes: Wind Power Investments by the Electricity Market"*

by Marie PETITET, Dominique FINON and Tanguy JANSSEN (The Energy Journal, Vol. 37, No. 4. (2016), pp. 109-140)

*"Assessing Long-Term Effects of Demand Response Policies in Wholesale Electricity Markets"*

by Mauricio CEPEDA and Marcelo SAGUAN (Electrical Power and Energy Systems 74 (2016), pp. 142-152)

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

by Marie PETITET, Dominique FINON and Tanguy JANSSEN (Energy Policy Vol. 103 (2017), pp. 30-46).

*"The Role of Continuous Intraday Electricity Markets: The Integration of Large-Share Wind Power Generation in Denmark"*

by Fatih KARANFIL and Yuanjing LI (The Energy Journal, Vol. 38, No. 2, 2017).

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

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

*"Rationales for Capacity Remuneration Mechanisms: Security of Supply Externalities and Asymmetric Investment Incentives"*

by Jan Horst KEPPLER (Energy Policy, Volume 105 (2017), pp. 562-570).

## INTERNAL RESEARCH SEMINARS

13 December 2016

"The Issue of Consumer Participation in the Electricity Markets via Platform Market and Aggregators"

23 June 2016

"Demand Response in Liberalized Electricity Markets: Analysis of Aggregated Load Participation in the Power Markets"

12 April 2016

"Power Markets with High Share of Variable Renewables: Analytical Tools for Studying Efficient Adaptations"

8 December 2015

"The Issue of Intraday Market Design Confronted with the Development of Variable RES Generation Production"

19 May 2015

"Plant Level Modelling of the Power Market: between Long- and Short-Term Planning"

16 December 2014

"Do We Need Sub-National Bidding Zones in EU Electricity Markets?"

11 June 2014

"The Impact of Foreign Capacity on EU Capacity Markets: Conditions and Justifications"

29 April 2014

"Modelling the Integration of Electricity Storage in Electricity Markets"



28 January 2014

"Econometrics of Electricity Markets for Short-Term Forecasting"

12 December 2013

"Modelling Electricity Markets with System Dynamics"

## PARTICIPATION IN PSL SEMINARS ON RESEARCH INTO ENERGY ECONOMICS

Since January 2013, 35 seminars on research into Energy Economics at Paris-Sciences-Lettres have been jointly organised by the CERNA (Mines ParisTech), the CGEMP and the Chaire European Electricity Markets (CEEM).

## THESES SUPPORTED BY THE CEEM

Charlotte SCOUFLAIRE

*"Capacity Remuneration Mechanisms : Analytical Assessment of Current Experiences and Lessons Learned for Future Market Designs"*

(Supervisor: Jan Horst Keppler)

Manuel VILLAVICENCIO

*"Analyzing the Optimal Development of Electricity Storage in Electricity Markets with High RES-E Shares"*

(Supervisors: Jan Horst Keppler and Dominique Finon)

Antoine VERRIER

*"Assessment of the Economic Potential for Demand Response Considering Consumers' Preferences: A Quantification of the French Power System"*

(Supervisor: Jan Horst Keppler)

Seungman LEE

*"The American and European Lessons of Demand-side Management and its Market Design for Asian Countries"*

(Supervisor: Jan Horst Keppler)

Marie PETITET

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

(Supervisors: Jan Horst Keppler and Dominique Finon)

Viva voce held in November 2016

Hyun Jin Julie YU

*"Public Policies for the Development of Solar Photovoltaic Energy and the Impacts on Dynamics of Technology Systems and Markets"*

(Supervisor: Patrice Geoffron)

Viva voce held in June 2016

Yuanjing LI

*"New Dynamics in the Electricity Sector: Consumption-Growth Nexus, Market Structure, and Renewable Power"*  
(Supervisor: Anna Creti)

Viva voce held in November 2015

Thao PHAM

*"Market Power in Power Markets in Europe: The Cases of the French and German Wholesale Electricity Markets"*  
(Supervisor: Sophie Méritet)

Viva voce held in May 2015

## RESEARCH SUPPORT

Charlotte Bureau worked on differences in electricity prices between France and Germany.

Sébastien Phan continued this work under the supervision of Jan Horst Keppler. The work resulted in a publication in a peer-reviewed periodical ("The Impacts of Variable Renewable Production and Market Coupling on the Convergence of French and German Electricity Prices", by Jan Horst Keppler, Sébastien Phan and Yannick Le Pen (The Energy Journal, Vol. 37, No. 3 (2016), pp. 343-359)).

Alexandre Coquentin worked on "Cost-benefit analyses of the optimal quantities of electrical interconnexions between the main European markets" (Joint supervisors: Jan Horst Keppler and Dominique Finon).

William Meunier continued this work under the title "Determination of the maximal capacities of electrical interconnexion as a function of the production of variable renewable energy" (Supervisor: Jan Horst Keppler).

Seungman Lee worked on the econometric estimation of the elasticity of demand based on data on prices and hourly electricity consumption in France (Joint supervisors: Cédric Clastres and Patrice Geoffron).

Alexis Paskoff is currently working on the calculation of electricity producers' rents as a function of the allocation method used for carbon quotas. The objective of this research is to calculate the revenues of the various stakeholders in the electricity system depending on how quotas are allocated: freely or through an emissions trading scheme (Supervisor: Jan Horst Keppler).

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