



ANNUAL REPORT

2018

TSE Energy and Climate Center



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EDITOR'S MESSAGE

Economic analysis is crucial to understand the transition to a cleaner energy system, to develop new policies to tackle climate and environmental issues. Energy markets are changing with the penetration of renewables and the digitalization of electricity consumption. Together with its partners, TSE is breaking new ground in the economics of energy and climate, producing innovative economic responses to important societal questions.

The TSE Energy and Climate Center completes its second year. In this annual activity report, we summarize our research activity and output during 2018. We also bring you a few examples of how and where our TSE faculty members are contributing to the public debate on energy policy. Take a close look at our scientific events and publications. We are delighted also to hear viewpoints from decision-makers in the energy industry in our policy-oriented events. We are thankful to our partners EDF, Engie and TOTAL for their continual support, which will enable us to contribute to disseminate our research and take it furthermore to new heights. Thanks to additional funding from the Sloan Foundation, we are proud to announce a two-day conference dedicated to the economics of energy and climate in June next year. Hope to see you there!

Stefan Ambec

Director, TSE Energy & Climate Center



HIGHLIGHTS

APPOINTMENTS AND POSITIONS

► **New TSE associate awarded ERC grant for energy research**



NATALIA FABRA has been awarded a five-year grant from the European Research Council (ERC) for her project 'Current Tools and Policy Challenges in Electricity Markets'.

The project aims to analyze the design of regulatory instruments which minimize the costs of energy transition towards low-carbon economies. Natalia's team will combine theoretic modelling, simulations and big data analysis to address issues such as the design of contracts and bids for new investments in renewables, and the role of consumers in managing electricity demand.

"Achieving the necessary political and social support for energy transition depends on our capacity to reduce costs and boost its benefits. Lowering emissions is not only a must, it is also a unique opportunity to modernize our economy," says Natalia, who is Professor of Economics at Universidad Carlos III in Madrid and TSE associate. In 2014, she was awarded the Sabadell-Herrero Prize for Best Young Spanish Economist.

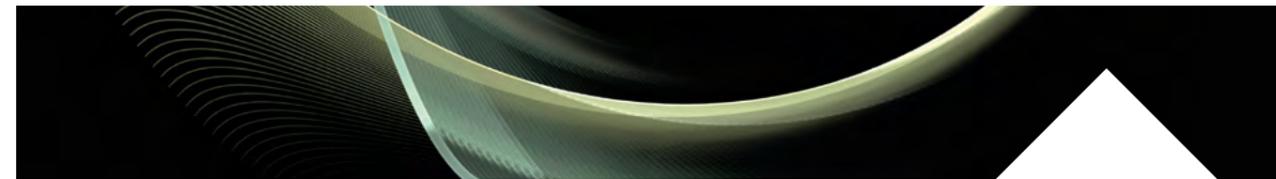
► **Gilles Lafforgues appointed member of France's commission on the social value of carbon**



In line with the commitments made by France during the signing of the Paris Agreement, the July 2017 Climate Plan set the objective of achieving carbon neutrality by 2050. To achieve this objective and to guide the investment choices of all economic actors, giving a value to greenhouse gas emissions is essential.

With the support of France Stratégie, the French Prime Minister Édouard Philippe has entrusted to economist Alain Quinet with a mission to propose a new trajectory of the social cost of carbon that is consistent with France's climate goals, and to formulate recommendations.

To help define the cost path, a commission composed of experts, representatives of the social partners, and NGOs will meet throughout the first semester, drawing on the results of macroeconomic and techno-economic models for energy transition. The commission's proposals will be integrated into the national low-carbon strategy.



SCIENTIFIC NETWORKING

TSE is just one of global array of prestigious partners in the GEMCLIME research project, which focuses on the important and complex problems of energy economics and climate change. GEMCLIME, or Global Excellence in Modelling of Climate and Energy, follows an integrated approach to modelling the impacts of public policies, with a particular focus on the economics of renewable energies and the valuation of non-marketed goods. The consortium also includes researchers from non-economic disciplines, including political scientists, sociologists, lawyers and environmental scientists.

This year one of our PhD students benefited enjoyed an academic stay in New Zealand thanks to this funding.

“ ► **Charles Pebereau - PhD Student on GEMCLIME**

GEMCLIME enabled me to travel to New Zealand - thanks to its partnership with the University of Auckland - where I initiated a research project and met with academic researchers as well as with staff from the Electricity Authority, the regulator of the electricity market. The research project aims at better understanding how consumers make decisions regarding their electricity consumption. In particular, the project focuses on new services and tariffs that can be offered with smart meters.

New Zealand offers great research opportunities in this area because smart meters have been largely deployed and used for several years already. Furthermore, research in the field of electricity is very active in New Zealand, both from economists and engineers, and I have had the chance to meet academic researchers from both disciplines. Finally, as a PhD student, it was a rare and fascinating experience to spend time at the Electricity Authority and see and discuss some of the challenges and opportunities of this sector - be they technical, economic or political - at the place where they are dealt with every day.



Wairakei geothermal power station, near Taupo New Zealand. Built in 1958, it was the first wet steam power station in the world.

PRIZES AND AWARDS

- **Stefan Ambec** and **Paul Lanoie** (*HEC Montréal*) have received the Decade Award from the Academy of Management for their article "Does It Pay to Be Green? A Systematic Overview" published in 2008 and cited more than 1,220 times in scientific journals.
- **Catherine Bobtcheff** has been awarded the best young researcher in Finance and Insurance by the SCOR Corporate foundation during the 11th international Forum on Financial Risks on March 27th, 2018.
- **Christan Gollier** received the Publication of Enduring Quality (PEQ) award from the Association of Environmental and Resource Economists for his paper "Discounting an Uncertain Future", published in 2002 in the Journal of Public Economics.



Patrick Rey



Jean Tirole



Isis Durrmeyer



Mathias Reynart



Christian Gollier



Stéphane Villeneuve



Stefan Ambec



James Hammitt

GRANTS

- **ERC "Advanced Grants"** allow exceptional established research leaders of any nationality and any age to pursue ground-breaking, high-risk projects that open new directions in their respective research fields or other domains. The ERC Advanced Grant funding targets researchers who have already established themselves as independent research leaders in their own right.
 - **Patrick Rey:** COOPETITION - Cooperation and competition in vertical relations: the business strategies and industry oversight of supply agreements and buying patterns (Grant n°340903)
 - **Jean Tirole:** MARKLIM - Markets and their limits (Grant n° 669217)
- **14 TSE researchers** are involved in research projects funded by the **ANR**.
 - **Isis Durrmeyer** and **Mathias Reynart:** CAREGUL
"Breathe in, breathe out: regulation on the European automobile market and air quality"
 - **Christian Gollier:** LONGTERMISM
"Evaluation des investissements ultra-longes" (ANR-17-CE03-0010-01)
 - **Stéphane Villeneuve:** PACMAN
"Principal-Agent, Contracts and Mean-field gAmeS for eNergy" (ANR-16-CE05-0027-04)
- **PROJECT H2020**, this specific programme supports all types of research activities led by research organisations through transnational cooperation. Their aim is to build and consolidate leadership in scientific and technological fields. The funding of socio-economics and social science projects contribute to more in-depth study and a wider comprehension of complex and independent socio-economic challenges that Europe is currently facing.
 - **Stefan Ambec:** GEMCLIME
"Global Excellence in Modelling of Climate and Energy" (Grant n°681228)
- TSE is also coordinator or partner in various projects ranging from local projects to international projects
 - **James Hammitt:** AMEP
"Advancing Methods for Evaluating Environmental/health policy and wealth"

2nd TSE ENERGY AND CLIMATE FORUM, SEPTEMBER 2018

The second edition of the TSE Energy and Climate Forum brought together researchers and key industrial players for a discussion on the major issues on the development of renewable energies and the impact of their integration into the energy market. The format allowed two master classes by TSE experts followed by a round table on the challenges of renewable sources entering the energy mix.



Stefan Ambec

Living with intermittent energy

The director of the TSE Energy and Climate Center, Stefan Ambec, opened the forum by presenting his research article, co-written with Claude Crampes, on the challenge of the intermittency of renewable energy load factors that do not necessarily adjust to the demand for electricity, hence the need to rethink the organization of electricity generation to ensure sustainability.



Stefan Lamp

Renewable energy and industry competitiveness

Stefan Lamp discussed the impacts of renewables on electricity prices and energy markets. He explained that renewable energy has lowered electricity prices in Germany thanks to the Merit order Effect, especially in years with high fossil-fuel prices.



Round Table

The challenges of renewable sources entering the energy mix

Adeline Duterque (*Engie*), Foresight department director
Christian Gollier (*TSE*), Managing director
Laurent Joudon (*EDF*), Director of economic studies
Ladislav Paszkiewicz (*Total*), Vice-president strategy and climate
 led by *Bloomberg* journalist **François de Beauvuy**



- Stefan Ambec
- Emmanuelle Auriol
- Jean-Pierre Amigues
- Henrik Andersson
- Catherine Bobtcheff
- Philippe Bontems
- Estelle Cantillon
- Sylvain Chabé-Ferret
- Claude Crampes
- Helia Costa
- Philippe De Donder
- Olivier De Groot
- Isis Durmeyer

- Natalia Fabra
- Christian Gollier
- James K. Hammitt
- Carole Haritchabalet
- Bard Harstad
- Norbert Ladoux
- Gilles Lafforgue
- Stefan Lamp
- Michel Le Breton
- Thomas-Olivier Léautier
- Yassine Lefouili
- Nour Meddahi
- Michel Moreaux

- Céline Nauges
- Manh-Hung Nguyen
- Giulia Pavan
- Patrick Rey
- Mathias Reynaert
- Arnaud Reynaud
- François Salanié
- David Salant
- Stéphane Straub
- Jean Tirole
- Nicolas Treich
- Séphane Villeneuve
- Bert Willems



SEMINARS

- Leslie Marx (Duke University), "Budget-Constrained Procurement", Industrial Organization seminar, TSE, June 11, 2018
- Katrina Jessoe (University of California - Davis), "Gains from Water Markets: Micro-level Evidence on Agricultural Water Demand", Environment Economics Seminar, Toulouse: TSE, June 5, 2018
- Andreas Lange (University of Hamburg), "The risks that farmers take: An experiment on externalities with individual thresholds", Environment Economics Seminar, TSE, May 28, 2018
- Antony Millner (Grantham Research Institute London School of Economics), "Non-paternalistic social discounting", Environment Economics Seminar, TSE, May 14, 2018
- Francesco Decarolis (Einaudi Institute for Economics and Finance), "Marketing Agencies and Collusive Bidding in Online Ad Auctions", Industrial Organization seminar, TSE, May 7, 2018
- Fredrik Carlsson (University of Göteborg), "Optimal Prosocial Nudging", Environment Economics Seminar, Toulouse: TSE, March 26, 2018
- Bård Harstad (University of Oslo), "Pledge-and-Review Bargaining", Environment Economics Seminar, TSE, March 19, 2018
- Stéphane De Cara (Économie Publique - INRA), "Optimal coverage of an emission tax in the presence of monitoring, reporting, and verification costs with an application to greenhouse gas emissions from European agriculture", Environment Economics Seminar, TSE, March 5, 2018.
- Blake Shaffer (University of Calgary), "Rational, Lazy or Confused? Evidence of misperception in consumer responsiveness to nonlinear prices", TSE, March 5, 2018
- Timo Goeschl (University of Heidelberg), "Cold Case: The forensic economics of energy efficiency labels for domestic refrigeration appliances", TSE, September 19, 2018
- Renaud Coulomb (University of Melbourne), "Environmental risk and the anchoring role of local amenities", TSE, September 24, 2018
- Bruno Lanz (University of Neuchâtel), "Pro-environmental behavior, positive self-signaling, and the design of informational interventions: Experimental evidence", October 1st, 2018



- **Edouard Schaal** (*Centre de Recerca en Economia Internacional*), "Optimal Transport Networks in Spatial Equilibrium", October 1st, 2018
- **Christian Gollier** (*TSE*), "On the efficient growth rate of carbon price under a carbon budget", September 2018
- **Sébastien Houde** (*University of Maryland*), "Heterogeneous (Mis-) Perceptions of Energy Costs: Implications for Measurement and Policy Design", TSE, November 3, 2018
- **Olivier De Groote** (*TSE*), "Subsidies and Time Discounting in New Technology Adoption", TSE, November 20, 2018
- **Valentina Bosetti** (*University of Bocconi*), "Geengineering in the Lab", TSE, November 26, 2018
- **Mar Reguant** (*Northwestern University*), "The Internal and External Costs of Wind Intermittency", December 3, 2018.

POLICY TALKS

- "A perspective of climate finance for non-state actors" - **Olivier Levallois** (*Responsible finance climat Carbon Clear*) February 1, 2018, TSE
- "On the role of markets - and market based instruments-to foster a transition to a low carbon electricity sector"
César Alejandro Hernández Alva (*Electricity Senior Analyst Gas, Coal and Power Markets; International Energy Agency*)
March 15, 2018, TSE
- "The use of quantitative technique in merger control" - **Daniel Coublucq** (*Economist, European Commission*) - March 28, 2018, TSE

WORKSHOPS

- **Stefan Lamp** and **Guilia Pavan** (*TSE*), "Environmental regulation and industrial performance"
Workshop, May 17-18, Toulouse
- **Stefan Ambec** and **Claude Crampes** (*TSE*), "Workshop on Energy Economics", January 9, 2018



ARTICLES

- **Stefan Ambec** and **Jessica Coria**, "Policy spillovers in the regulation of multiple pollutants", *Journal of Environmental Economics and Management*, vol. 87, January 2018, pp. 114–134.
- **Henrik Andersson**, "Application of BCA in Europe - Experiences and Challenges", *Journal of Benefit-Cost Analysis*, vol. 9, n. 1, Spring 2018, pp. 84–96.
- **Henrik Andersson** (with **Lars Hultkrantz**, **Gunnar Lindberg** and **Jan-Eric Nilsson**), "Economic Analysis and Investment Priorities in Sweden's Transport Sector", *Journal of Benefit-Cost Analysis*, vol. 9, n. 1, Spring 2018, pp. 120–146.
- **Henrik Andersson** (with **Desheng Huang** and **Shiqiu Zhang**), "Willingness to pay to reduce health risks related to air quality: Evidence from a choice experiment survey in Beijing", *Journal of Environmental Planning and Management*, 2018
- **Claude Crampes** (with **Jérôme Renault**), "Supply flexibility in electricity markets", TSE Working Paper n. 18-964, July 2018
- **Jean-Paul Décamps** and **Stéphane Villeneuve**, "A two-dimensional control problem arising from dynamic contracting theory", *Finance and Stochastics*, 2018, forthcoming.
- **Christian Gollier** (with **Miles S. Kimball**), "New methods in the classical economics of uncertainty: Comparing risks", *The Geneva Risk and Insurance Review*, vol. 43, 2018, pp. 5–23.
- **Christian Gollier** (with **Miles S. Kimball**), "Toward a Systematic Approach to the Economic Effects of Risk: Characterizing Utility Functions", *Journal of Risk and Insurance*, vol. 85, 2018, pp. 397–430.
- **Christian Gollier**, "Variance stochastic orders", *Journal of Mathematical Economics*, vol. 80, January 2019, pp. 1–8.
- **Stefan Lamp** (with **Bryan Bollinger**, **Kenneth Gillingham**, **Gordon T. and Kraft-Todd**), "Credibility-enhancing displays promote the provision of non-normative public goods", *Nature* vol. 563, November 2018, p. 248
- **Yassine Lefouili** (with **Bruno Jullien**), "Horizontal Mergers and Innovation", *Journal of Competition Law and Economics*, 2018.
- **Nour Meddahi** (with **Prosper Dovonon**, **Silvia Goncalves**, **Ulrich Hounyo**), "Bootstrapping high-frequency jump tests", *Journal of the American Statistical Association*, 2018
- **Patrick Rey** (with **Volker Nocke**), "Exclusive Dealing and Vertical Integration in Interlocking Relationships", *Journal of Economic Theory* vol. 177, September 2018, revised 2018, pp. 183–221
- **Patrick Rey** (with **Bruno Jullien**, **Markus Reisinger**), "Vertical Foreclosure and Multi-Segment Competition", *Economics Letters Elsevier*, vol. 169, August 2018, pp. 31–34



- Bert Willems (with Gijsbert Zwart), "Optimal regulation of network expansion", The RAND Journal of Economics, vol. 49, n. 1, Spring 2018, pp. 23–42.
- Mathias Reynaert, Frank Verboven (with Laura Grigolon), "Consumer Valuation of Fuel Costs and the Effectiveness of Tax Policy - Evidence from the European Car Market", American Economic Journal: Economic Policy, 2018
- David Salant (with Luis Cabral), "Sequential Auctions and Auction Revenue", Economics Letters Elsevier, November 2018

WORKING PAPERS

- Philippe Bontems (with Marie-Françoise Calmette), "On Sharing Responsibilities for Pollution Embodied in Trade", TSE Working Paper n. 18-966, October 2018
- Claude Crampes and Michel Moreaux, "Apports naturels en eau dans les barrages-réservoirs et règle de Hotelling", TSE Working Paper n. 18-962, November 2018
- Olivier De Groote (with Frank Verboven), "Subsidies and Time Discounting in New Technology Adoption", TSE Working Paper n. 18-957, September 2018
- Isis Durrmeyer (with Mario Samano), "To Rebate or Not to Rebate: Fuel Economy Standards vs. Feebates?", The Economic Journal, 2018, forthcoming.
- Isis Durrmeyer, "Winners and Losers: The Distributional Effects of the French Feebate on the Automobile Market", TSE Working Paper n. 18-950, September 2018
- Christian Gollier, "On the efficient growth rate of carbon price under a carbon budget", TSE Working Paper n. 18-952, September 2018, revised October 2018
- Christian Gollier (with Simon Dietz and Louise Kessler), "The climate beta", Journal of Environmental Economics and Management, vol. 87, January 2018, pp. 258–274.
- James K. Hammitt (with Daniel Herrera-Araujo), "Peeling back the onion: Using latent class analysis to uncover heterogeneous responses to stated preference surveys", Journal of Environmental Economics and Management, 2018, forthcoming.
- Doh-Shin Jeon and Yassine Lefouili, "Cross-Licensing and Competition", The RAND Journal of Economics, vol. 49, n. 3, 2018, pp. 656-671.
- Yassine Lefouili (with Bruno Jullien), "Mergers and Investments in New Products", TSE Working Paper n. 18-949, August 2018
- Nicolas Treich (with Carole Bernard, Christoph Rheinberger), "Catastrophe Aversion and Risk Equity in an Interdependent World", Management Science, 2018, forthcoming.
- Alban Thomas (with Jacques Eric Bergez and Marion Robert), "A stochastic dynamic programming approach to analyze adaptation to climate change - application to groundwater irrigation in India", European Journal of Operational Research, Elsevier, vol. 265, n. 3, March 2018, pp. 1033–1045.



CONTRIBUTIONS TO PUBLIC DEBATE

TSE Debate is a portal that gathers the opinions and analysis of TSE researchers on topic of public interest. Members of the Center regularly publish blog posts that can be consulted in the TSE Debate's "Energy" section.

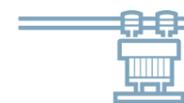
www.tse-fr.eu/debate/energy

November 2018: Carbon tax à la française, Stefan Ambec and Claude Crampes



Pressed by the so-called 'gilets jaunes' protest, the French government steps back on its plans to raise the carbon tax on fuel in 2019. The announcement, which comes as the COP24 takes place in Poland, undermines France's leadership in the international arena on climate after the Paris agreement in 2015. Does this mean the carbon tax is harder to swallow in France than elsewhere?

October 2018: Intermittence and flexibility in electricity markets, Stefan Ambec and Claude Crampes



In electricity delivery systems, whether integrated or open to competition, solar and wind power are dispatched before conventional energies due to their low generation cost. The result is a change to the wholesale price of electricity that tends to modify the composition of the overall electricity mix.

October 2018: Will LNG Canada increase greenhouse-gas emissions? It's complicated. Stefan Ambec and Claude Crampes



LNG Canada - a massive \$40-billion project that takes natural gas from western Canada, cools it to its liquid form, and ships it to energy-hungry destinations in Asia - just got the investment green-light.

It's good news for western Canadian gas producers facing low prices amid stiff competition from American producers. But this project will also result in more greenhouse-gas emissions in B.C., making it tougher to meet B.C.'s legislated emissions targets. After all, adding up the emissions from liquefying the gas and all



the upstream emissions from production, LNG Canada represents roughly 10 million tonnes of CO₂-equivalent per year. This is one quarter of B.C.'s entire greenhouse-gas budget for 2030, or two-thirds of B.C.'s 2050 target. In other words, to meet B.C.'s emissions targets and have LNG Canada, the rest of the province will need to largely decarbonize. So the LNG development seems inconsistent with Canada's commitment to climate action.

September 2018: Learning by doing in the solar panel industry, Stefan Ambec and Claude Crampes



Every industry benefits from learning-by doing (LbD). Learning effects reduce production costs and increase the quality of products by acquiring experience, better organising tasks and sharing knowledge. In the photovoltaic solar panel sector, in just a decade LbD has led to a spectacular drop in cell costs. But it has also caused much of the manufacturing business to be transferred to Asian countries.

June 2018: The Value of Lost Load, Stefan Ambec and Claude Crampes



In situations where the electricity grid is under pressure, the operator of the system can either increase the input of energy by calling on an additional power station or reduce the demand by rationing supply. The best choice is the least expensive one. But how do you assess the cost of power cuts?

June 2018: Smart meters fulfil basic needs, Stefan Ambec and Claude Crampes



In France, the new generation of smart meters for household electricity consumption are causing quarrels. In South Africa, such smart meters for water consumption have helped to reduce the risk of rioting by preventing Cape Town from running out of water. The meters' accuracy and interactivity make them a valuable management tool in periods of water shortage or high demand.

April 2018: In search of a level playing field for electricity costs, Stefan Ambec and Claude Crampes



Electricity is generated by a wide range of technologies. To compare their relative performance, the pros and cons of each are translated into a single economic variable: the generation cost per megawatt hour. As with any average, this cost hides considerable disparities and leads to political decisions based on poor economics.

March 2018: 100% renewable energy: climate in the courtroom, Stefan Ambec and Claude Crampes



Is it possible to generate our electricity exclusively from renewable energy? While this issue has given rise to lively debates in most countries, it can end up in court in the USA. If this has to be the ending of scientific controversies in years to come, then lawyers have a bright future ahead of them.

January 2018: The European Commission's green resolutions, Stefan Ambec and Claude Crampes



The European Commission (EC) provided its contribution to the One Planet Summit in Paris on 12 December 2017 by publishing its "Ten Initiatives for a Modern and Clean Economy".[1] Like the 12 international commitments[2] made by Paris on the evening of 12 December, the CE's contribution talks a lot about the billions of euros that need to be found to finance the transition to a carbon-free economy. But it also discusses buildings and mobility, young people and Africa, islands, urbanisation and technology.



DON'T MISS IN 2019

- **Stefan Ambec**
"Energy Economics Workshop",
January 23, 2019, Toulouse

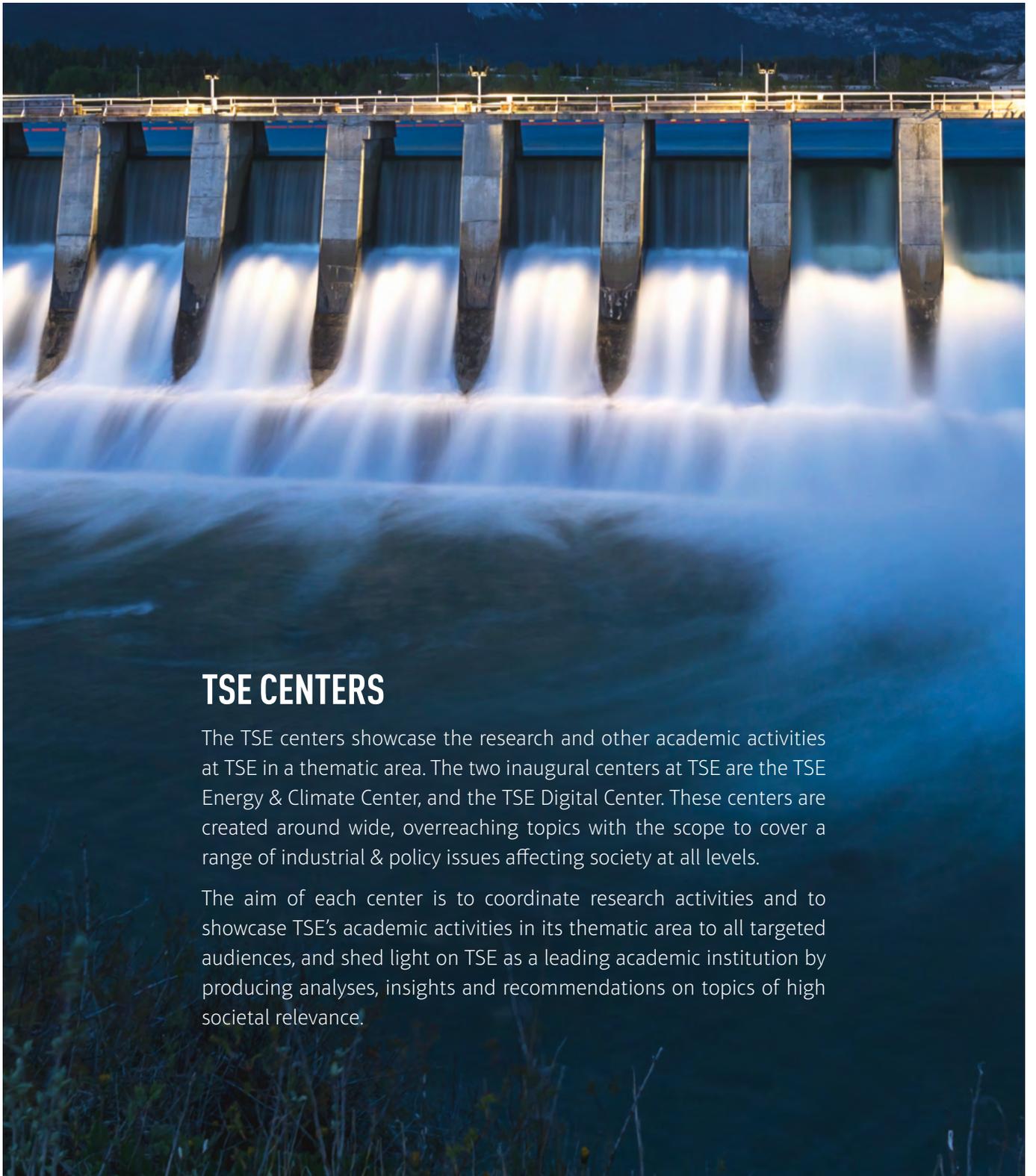
This workshop will focus on electricity markets and air quality regulation, with a mix of applied theory and empirical papers.

- **The 12th Conference on the Economics of Energy and Climate**
June 18-19, 2019 at Toulouse

The primary objective of this conference is to discuss recent scientific contributions to the understanding of energy markets and the design of environmental and climate policies. Keeping the spirit of previous years, the conference will feature theoretical, empirical, experimental and policy-oriented contributions.

Key note speakers:

- **Peter Cramton** (University of Maryland)
- **Juan-Pablo Montero** (PUC-Chile)



TSE CENTERS

The TSE centers showcase the research and other academic activities at TSE in a thematic area. The two inaugural centers at TSE are the TSE Energy & Climate Center, and the TSE Digital Center. These centers are created around wide, overarching topics with the scope to cover a range of industrial & policy issues affecting society at all levels.

The aim of each center is to coordinate research activities and to showcase TSE's academic activities in its thematic area to all targeted audiences, and shed light on TSE as a leading academic institution by producing analyses, insights and recommendations on topics of high societal relevance.

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