#14
SUMMER
2017

Special issue

ENERGY

CHANGING **THE BALANCE OF POWER**

France will soon emerge from a double election campaign as it elected its new president, Emmanuel Macron, and will elect its members of parliament. More ballot boxes are on the horison, with general and federal elections in the coming months in the UK and Germany, to name but a few. As these milestones pass, Europe will hopefully be able to move forward with shaping the future of the continent and its important economic interactions with the rest of the world. In this context, the role of economists and their analysis are more important than ever. Via TSE Mag, we try to bring you an idea of how the academic contributions of the TSE community are shaping today's major policy debates.

Some of you will be reading these pages *en exclusivité* from our TSE Forum in Paris early June. To celebrate our 10th anniversary, the event is a bumper "double" edition featuring two of our most active research areas, the economics of energy and the economics of the digital era. Our aim in holding the Forum is to connect research to policy, gathering top economic practitioners and internationally renowned academics to exchange ideas and analysis, and develop solutions together. May we take this opportunity to extend a heartfelt thank you to all our impressive speakers at the event.

The special dossier of this magazine is dedicated to energy and the challenges we face in terms of market organisation, storage, and green transition. It's an important and vast topic; effective, sustainable energy transition and determined, united global action to avert the dangers of climate change rank among the most important areas of public decision-making in current and coming years. Via this special issue we bring you just a few examples of how and where our energy economists are contributing to energy policy and debate. We are delighted also to have viewpoints from leading economists in the field, and contributions from major market players.

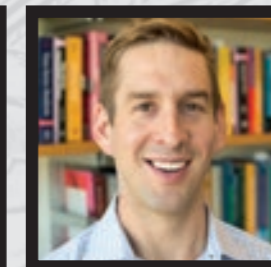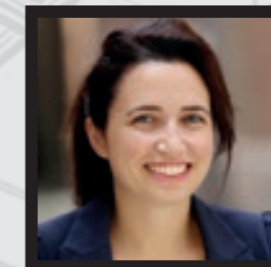We hope you enjoy reading the issue, and wish you a happy summer.

Best regards,

Ulrich Hege, TSE Director
Jean Tirole, TSE Chairman

"The economic analysis of energy challenges is crucial to understand the issues and develop new policies and regulatory tools to transition into a better production system"

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Appointments **& prizes**

Bruno Biais
wins Best Paper award

Congratulations to Bruno Biais (TSE-CNRS-CRM), Florian Heider and Marie Hoerova (European Central Bank) who were awarded the Best Paper 2017 prize for their article "Risk-sharing or risk-taking? Counterparty-risk, incentives and margins" by the Europlace Institute of Finance at the 10th Risks Forum. Europlace is a network that promotes international excellence in economics and finance.

Marc Ivaldi
joins Toulouse metro project

TSE-EHESS researcher Marc Ivaldi has been appointed member of the scientific council of Toulouse's new metro line project. As a specialist in transport economics, Marc will provide expert analysis of the socioeconomic impact of the new system, as well as advice on the project's financing and sustainability.

Astrid Hopfensitz
receives a CNRS medal

Congratulations to Astrid Hopfensitz (TSE-UTC) who has won the 2017 CNRS bronze medal for her pioneering research in experimental economics. Her research uses economic experiments and psychological methods for measuring emotions and character traits. She is one of 40 researchers awarded this year. The CNRS bronze medals are given to young, promising researchers who demonstrate excellent academic achievements and are an encouragement to reach even higher standards.

More information on
tse-fr.eu/people

Jean Tirole's book goes global

"Économie du bien commun" (Economics for the Common Good) was published in 2016 in France and sold more than 80,000 copies, an excellent performance for an economics book. It is currently being translated to English, Spanish, Italian and Korean and will be published internationally in the coming months.

Economics for the Common Good
Jean Tirole

English

Jean Tirole
La economia del bien común

Spanish

economia del bene comune
JEAN TIROLE

Italian

Researchers and students
welcome top CEOs

The French news outlet La Tribune regularly organises high-level events featuring CEOs from leading companies. In May, Christian Scherer and Frédéric Mazzella, the CEOs of ATR and BlaBlaCar, came to Toulouse to answer the questions of local economic leaders and exchange with TSE researchers Frederic Cherbonnier and Jean-François Bonnefon. TSE students also participated in the exchanges and asked some of the most relevant questions. These two events are the first of many others this year and in 2018, allowing TSE faculty and CEOs to interact on tomorrow's issues.

Save the date

13-14 JUNE 2017

Workshop on explaining institutional change in history
Toulouse

20 JUNE 2017

I.O. student workshop
Toulouse

16–17 NOVEMBER 2017

Workshop on economic analysis of environmental food policies
Toulouse

Events by invitation only:
tse-fr.eu/events

ELECTION TIME

Do we vote the right way?

At a TSE outreach event in Toulouse on 3 May, between the two rounds of the highly debated French presidential election, our political science experts Karine Van der Straeten and Michel Le Breton discussed voting methods around the world: how do systems differ and who is getting it right?

On Sunday 7 May 2017 France elected its new president Emmanuel Macron after a second-round run-off with the far right-wing Front National candidate, Marine Le Pen. The French presidential elections are conducted via a two-round system wherein individuals cast a single ballot for their favourite candidate in the first round, and if no candidate receives an absolute majority of votes, the two highest-scoring candidates participate to a run-off two weeks later. Since 1965, when the current election system was used for the first time in France, every election has gone to a second round.

This year, there will also be elections in Great Britain and Germany while France will also elect its parliament. The results will impact the policy led by M. Macron and either give him the means to govern alone or have him cooperate with other political forces. This election uses a two-round system, similar to that of the presidential election.

But there are many other voting systems around the world, across a wide range of different types of democracies. In Mexico, a presidential republic like France, the president is elected via a single-round "first-past-the-post" system. In Ireland, instead of voting for a single candidate, voters use an instant run-off or "alternative" system where they rank the candidates in order of preference, electing candidates able to combine strong first-choice support with the ability to earn second and third-choice support.

[**"Some projections show that, should France use some versions of the US electoral system, Marine Le Pen could have won against Emmanuel Macron"**
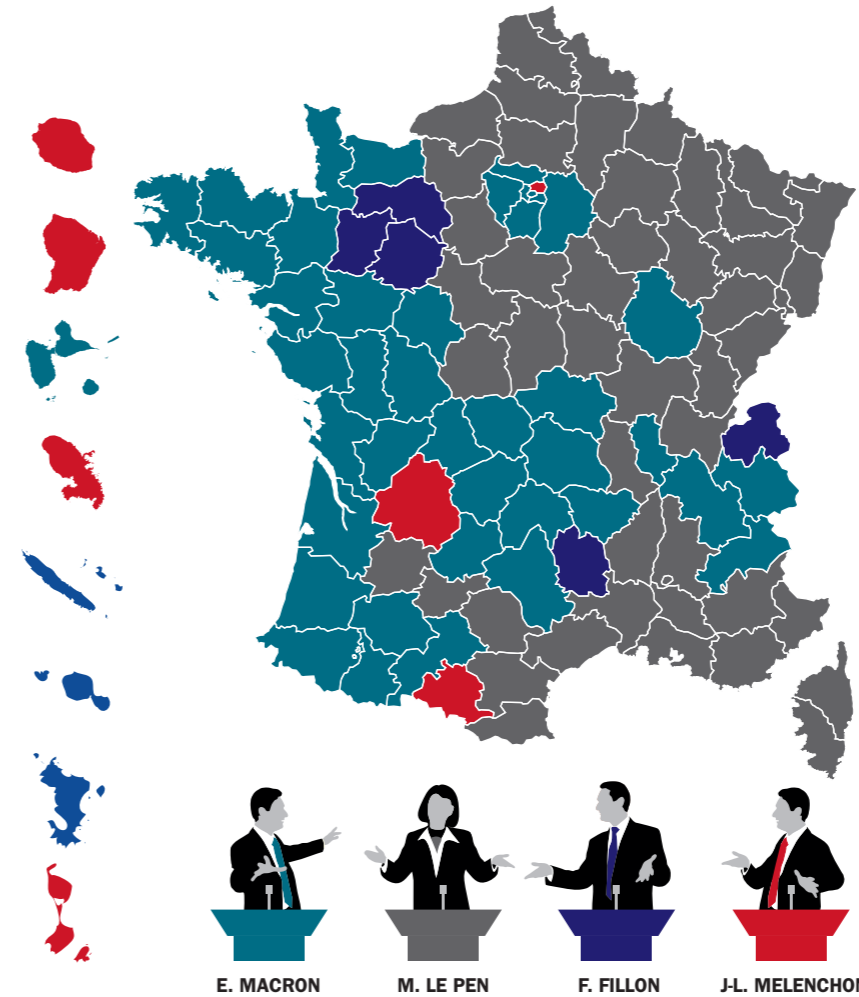
The structure of elections and a nation's choice of electoral system can have profound implications for the effectiveness of democratic governance. It is no surprise, then, that reformers in many nations continuously strive to improve the way their governments are elected. The complex US presidential election system based on electoral colleges is under fire after it led to Donald Trump being elected despite Hillary Clinton wining more actual ballot votes. In a similar fashion, some projections show that, should France use some versions of the US system, Marine Le Pen could have won against Emmanuel Macron.

Karine Van der Straeten and Michel Le Breton head up a team of economists and political scientists at TSE and IAST studying these different systems to understand them, analyse the pros and cons, and make recommendations for the most effective systems. ■

📖 **Further reading**

"Vote Au Pluriel: How People Vote When Offered to Vote Under Different Rules?" Karine Van Der Straeten et al., *Political Science & Politics, 2013*

THE FIRST ROUND OF THE 2017 FRENCH PRESIDENTIAL ELECTION

E. MACRON   M. LE PEN   F. FILLON   J-L. MELENCHON

2016 US PRESIDENTIAL ELECTION RESULTS

ELECTORAL COLLEGE VOTES

FOR TRUMP **306**   FOR CLINTON **232**

TOTAL VOTES

FOR CLINTON **63,551,979**   FOR TRUMP **61,898,584**

■ CLINTON
■ TRUMP
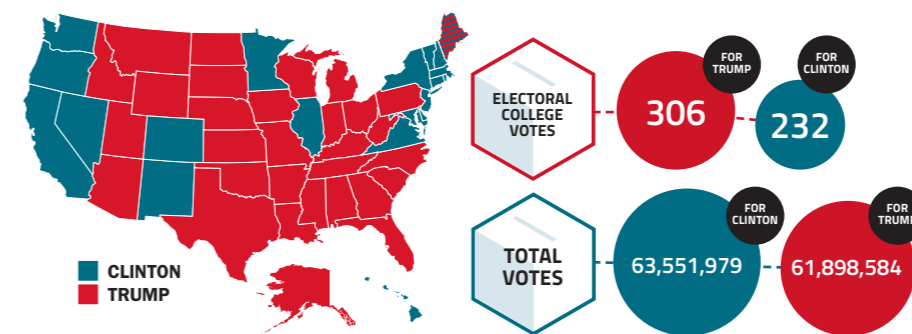
ELECTORAL SYSTEMS ILLUSTRATED

3 THEORETICAL CANDIDATES ranked by voters as follow:

1st 2nd 3rd

40% A B C

35% C B A

20% B C A

5% A B C
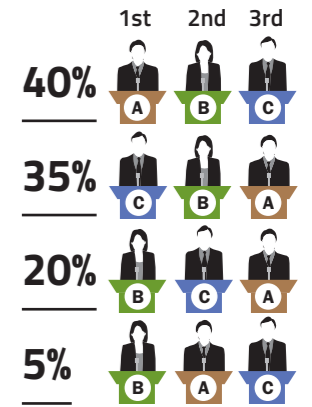
FIRST-PAST-THE-POST (SINGLE ROUND) SYSTEM

A

Round 1 - **A is elected**

TWO-ROUND SYSTEM

A C

Round 1 - **A & C win**

C

Round 2 - **C is elected**

BORDA COUNT SYSTEM
Voters rank the candidates giving 2, 1 and 0 points

B

B is elected
(assuming sincere voting)

MATT TADDY

The true potential of big data will be economic AI

Matt Taddy is a professor in statistics, economics and machine learning at the University of Chicago Booth School of Business. He is also a principal researcher at Microsoft Research New England. Here, he tells us about his work on big data and the future of economics.

What are the current benefits and limits of big data research?

Big data allows us to detect complicated and subtle patterns. That is what is called predictive analytics. Statisticians and machine learning researchers have come up with methods that allow pattern discovery in massive datasets.

> **"Economic AI will be groundbreaking, it directs machine Learning at the problems economists and policymakers care about"**

What about big data's potential benefits?

One big potential will come from the combination of machine learning (ML) and econometrics: what I call "economic AI". Econometrics targets structure and causation, while standard ML looks for correlations and patterns. But AI and ML are not the same thing; AI is about combining multiple ML tasks to solve complex and structured problems. For example, a chat bot combines natural language recognition and classification tasks to answer human questions.

In economic AI, we use our knowledge of economic and econometric theory to break policy questions into a series of ML tasks. The past 50-100 years of economics gives us a great set of rules that can be used to impose structure on problems, and we are now realising the power that comes from using cutting-edge ML inside this structure. That is why economic AI will be ground-breaking - it

Matt Taddy
University of Chicago Booth
School of Business Professor

However, these predictions are valid only for a future world that largely resembles the past one. When we make decisions that change the way the world develops (such as setting prices or deciding who goes to school, or which medicines are paid for), the data loses some of its relevance. This changing environment is the main limitation of big data.

Is there any risk of misunderstanding such large datasets?

Existing algorithms can detect patterns in datasets big and small. However, model validation is key. In ML, everything needs to be validated using data that was not used to fit the model. This allows us to rule out patterns that are not consistent with future predictions. This simple idea of 'out of sample validation' is key to the success of ML: flexibility constrained by validation allows us to be creative while avoiding overfit.

What about the implications of big data for individuals' privacy?

At Microsoft, we put a huge emphasis on privacy. But there is another aspect to your question: private companies do have this data, sometimes more data than governments, how can they share it? It is a complicated issue, and I don't have an easy answer. Many of these companies have research arms, like MSR, that use

directs ML at the problems economists and policymakers care about. Microsoft is putting a bunch of attention and resources on this area, and it is also a very active research area in academia (including people such as Susan Athey, Guido Imbens, Stefan Wager, Victor Chernozhukov, Alexander Belloni and Christian Hansen).

> **"If we can create economic or causal AI, we can unlock the huge potential of historical data that companies and governments are logging"**

data to study society and come up with solutions to improve people's lives. But we should be looking for other ways that societally useful data can be shared without hurting privacy and the tech economy; this is a market design question that economists should be looking at!

What's most exciting about economic AI?

Economists have become very good at using non-experimental data to understand the structural reasoning behind why things happen. But this type of causal reasoning is completely absent from the current slate of AI services. If we can create economic or causal AI, we can unlock the huge potential of historical data that companies and governments are logging. We will then be able to democratise economics by making data-driven causal decision-making available to a much wider set of organisations, not just those that can afford large numbers of PhD economists. ∎

DOH-SHIN JEON

Is Google abusing its power?

Doh-Shin Jeon is a TSE-UTC professor specialised in industrial organisation. He works on digital economy issues such as antitrust policies for new technologies, two-sided platforms, media, net neutrality, etc. In 2016, he received the prestigious Maekyung-KAEA Award. Here's his take on the recent Google-Android case under investigation by the European Commission.

In 2016, the European commission accused Google of abusing its dominant position by forcing smartphone makers to pre-install its applications on Android devices in an all-or-nothing manner. Whether such practice constitutes abuse of dominance is an interesting question we try to answer, with my co-author Jay Pil Choi (Michigan State University) in a working paper entitled "A Leverage Theory of Tying in Two-sided Markets".

The leverage theory of tying addresses whether a firm which has a monopoly power in one market has an incentive to leverage this power to another market by tying the monopolised good with another good facing competition. In this case, the Commission argues that Google holds near-monopolies in markets such as licensed smartphone operating systems and distribution of apps for the Android platform. It accuses Google of bundling, or "tying", its products to extend its monopolies to other markets including Internet search market in which it competes with other products such as Microsoft's Bing.

The existing literature on the leverage theory of tying developed the "single monopoly profit theorem". This theorem argues that when the monopoly's competing product is inferior to the rival's product, a company has no incentive to tie its product to extend its monopoly power. The reason is that without tying, its unique source of revenue is the

Doh-Shin Jeon
TSE-UTC Professor

monopoly profit and that if the company forces consumers to buy its inferior product (by tying both products), it has to use part of its monopoly profit to compensate consumers, which ends up reducing its overall profit.

> **"The current bundling of Google Search with Android OS and Play Store prevents Bing from using any qualitative advantage over Google Search to gain users"**

However, this theorem does not take into account specificities of two-sided markets. Namely, when it comes to products like Google's applications, prices •••

...

are zero on the consumer side while Google makes profit from the other side such as advertising.

> **"Google's advantage is reinforced by the fact that the use of a search engine makes it better as its creators can harvest more data to build better algorithms"**

In a classic market, companies could be tempted to subsidise consumers to use their search engine. Such a strategy would prove counterproductive in this case since advertisers only pay money to reach consumers who do real search. Our research shows that when prices on the consumer side cannot be negative, in a two-sided market, the single monopoly profit theorem is invalid and tying becomes profitable. Tying allows the firm to attract consumers of the tied good market and thereby to obtain the profit from the advertising side of the same market. Contrary to what happens in a one-sided market, tying does not invite aggressive response of the rival as the lowest price it can charge is zero.

In the context of the Google-Android case, our theory implies that should Bing be superior in quality to Google Search (or become superior in the future), the current bundling of Google Search with Android OS and Play Store prevents Bing from using any qualitative advantage to gain users. Google's advantage is also reinforced by the fact that the use of a search engine makes it better, as its creators can harvest more data to build better algorithms.

New technologies offer fascinating research opportunities for economists and I'm excited to be working on other issues linked to the digital revolution. In the future, I'm planning to analyse the economic challenges of artificial intelligence and of the Internet of Things. ■

App-solute dominance
Worldwide smartphone operating systems
Market share of units shipped, %

Legend:
- Android
- IOS
- Blackberry
- Symbian
- Others

Source: Gartner
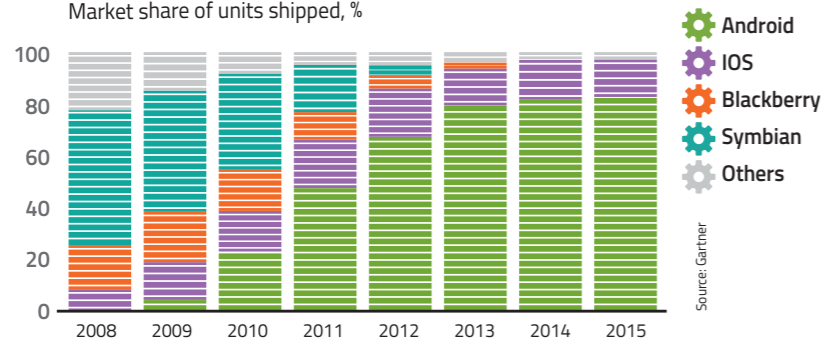
ISIS DURRMEYER

Tax reba tes in the car industry

Isis Durrmeyer is a TSE-UTC assistant professor who specialises in industrial organisation, environmental and structural economics. She mostly works on theoretical approaches and empirical analysis of the automotive industry regulation. She has analysed the French 'feebate' policy and compared it to the US system of fuel economy standards.

Isis started to work on the French automotive market in 2009, one year after a new regulation was implemented in favour of greener vehicles. "The 'bonus-malus' regulation made energy-efficient vehicles cheaper through rebates, and polluting cars more expensive through a purchase tax" she explains. "I have gathered a dataset of vehicles sold in France between 2003 and 2008 which allowed me to study this new regulation."

With her two co-authors, the researcher has tried to understand the impact of this 'feebate' policy: "Our results show that people overreacted. As French buyers massively bought energy-efficient cars following this new regulation. We believe this surprising effect is due to several elements: technological progress, making cars more efficient; the regulation and its effects on the market prices; and, finally, buyers' growing preference for greener cars. We measure the contribution of each of these factors."

To compare these results with other, different regulations, Isis is working with Mario Samano (HEC Montréal) on a comparison between feebate and standard-type regulations.

"In the US, market regulators decided to use fuel economy standards, which force car manufacturers to sell, on average, a fleet

Isis Durrmeyer
TSE-UTC Assistant Professor

of vehicles with fuel efficiency above a determined, "standard", level. Car manufacturers who don't comply have to pay taxes." This system leads companies to increase the price of polluting cars and to encourage buyers to opt for fuel-efficient models.

> **"Our model hints that the French system is more efficient on the market. It has similar effects with lower costs and we believe that this type of regulation could be duplicated"**

Analysing the data from both countries, Isis and her co-author developed a model detailing the effects of both policies on manufacturers, consumers and on tax revenue. "Our model hints that the French system is more efficient on the market. It has similar effects with lower costs in term of welfare and we believe that this type of regulation could be duplicated in many countries willing to make a move towards greener cars. Of course, other types of regulation

exist, such as heavier taxes on fuel, and should also be studied."

In parallel to this study, Isis is also working on the distributional effects of the French 'bonus-malus' policy, trying to identify which citizens were the most affected. "According to the first results, it seems that poorer and richer buyers benefited the least from the reform. It also looks like rural areas are less favourably impacted and of course, diesel cars were advantaged by this regulation which considers them very fuel-efficient as only CO_2 emissions are taken into account." The impact of diesel cars has recently sparked plenty of public debate in France as diesel engines emit more particles than traditional cars, as well as other pollutants such as nitrogen oxides.

discount. It appears that some buyers end up paying the full, maximum price of the vehicles while others succeed in get substantial discounts."
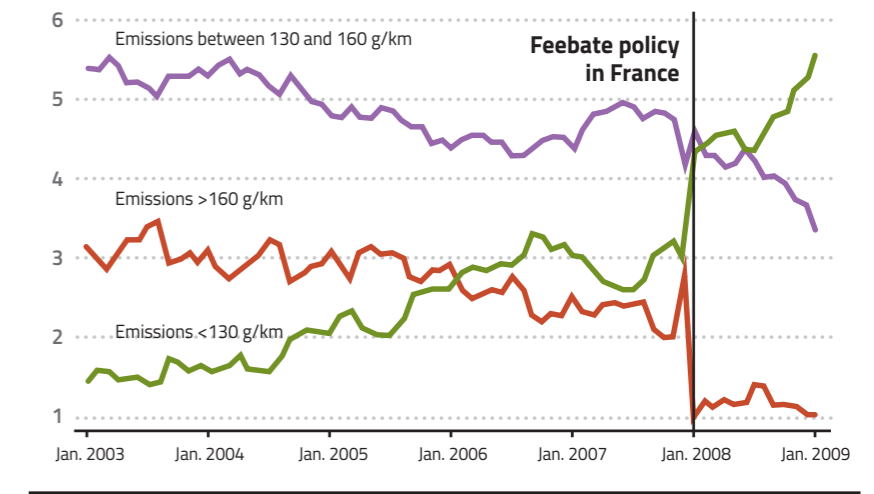
> **"French buyers massively bought energy-efficient cars following this new regulation"**

On the same subject, Isis is also working on the price range of a single vehicle series depending on options, engine specifications and quality. "I'm developing complex, flexible models to better understand how car manufacturers optimise the pricing of their vehicles. I'm hoping to propose better empirical models to understand car prices and

Feebate policy
in France

Emissions between 130 and 160 g/km
Emissions >160 g/km
Emissions <130 g/km

Isis is also developing new empirical tools to understand the automotive industry, notably how to account for the fact that the price paid by buyers differs from the price initially on display. "According to my model, the announced price is the maximum price of a car and buyers, on average, get a 10%

competition in differentiated markets more generally."

In the future, the researcher wants to cross these new tools she is developing with her regulation analysis to present a broader picture of the market and its evolution. ■

Special issue

ENERGY

CHANGING **THE BALANCE OF POWER**

TSE ON THE STAKES

Changing the balance of power

The industry view

As global demand for energy is expected to continue to rise to feed transport and housing, the industry faces two challenges: liberalisation and decarbonisation. The role of economists is to ensure that markets, regulation and institutions can adapt to these complex changes. Capacity mechanisms, consumption and production flexibility, storage management and market regionalisation are central to TSE research in this area.

Electricity is a unique sector where demand is weakly reactive to wholesale price signals whereas the product cannot be stored at large scale. Following the push towards liberalisation that began in the 1990s, the industry needs to complete its transition from traditional vertically integrated utilities to competitive separated businesses.

In Europe, a continent-wide approach is increasingly being adopted in the design of electricity markets and policies.

Member states are more interconnected by transmission capacities, through which electricity moves from one market zone to another, following the laws of physics that public regulations often forget to obey. Companies, markets and policies will have to get used to the new reality of cross-border effects. Meanwhile, global electricity generation is changing dramatically due to the need to reduce emissions and introduce mixed energy sources. This has placed new strains on transmission and distribution networks' ability to meet demand with unpredictable daily and seasonal variations.

As is demonstrated over the following pages, the future of the energy industry is bound by the challenges and opportunities surging from environmental concerns, smart appliances and meters and the social demand for a more decentralised framework. **Claude Crampes**, one of TSE's foremost experts in this field, reveals how the EU's formerly pro-competitive energy policy is being distorted by new environmental priorities. Claude has also teamed up with TSE professor **Stefan Ambec** to estimate how policymakers can more effectively harness intermittent resources such as wind and solar power.

Using data on 'green' cars in Italy, TSE post-doctoral researcher **Giulia Pavan** proposes the first fully fledged demand and supply model to study the incentives for adoption of alternative fuels. Meanwhile, fellow TSE postdoc **Stefan Lamp** has found evidence that German households' investment in solar technology is over-influenced by the current state of sunshine, which suggests that behavioural channels might explain the low take-up of otherwise profitable renewable technologies.

> "There is no life without energy. But producing energy without generating the perilous climate change remains one of the biggest challenges of our time. We have the responsibility towards future generations to face it with economic efficiency"
>
> **Christian Gollier,** TSE professor

Also in this dossier, we feature recommendations about using auctions to boost support for renewable energies given by TSE associate **Estelle Cantillon** to the European Commission. And TSEconomist founder **Georgios Petropoulos** and TSE associate **Bert Willems** examine how to provide efficient network access to low-carbon power generators. ∎

Isabelle Kocher
ENGIE CEO

▶ *"What's happening within the energy sector is more than a transition, it's a revolution: energy-makers have to adapt and profoundly rethink their models. Low-carbon energy and digital technology are ENGIE's two main assets to best serve our customers"*

Jean-Bernard Lévy
EDF CEO

▶ *"Electricity is an essential answer to global warming. Investing and innovating to face this challenge call for a robust carbon price and a European framework offering investors long-term visibility"*

Patrick Pouyanné
Total CEO

▶ *"Satisfying the energy needs of a growing world population, curbing global warming, and adapting to changing customer behaviours and expectations are the three challenges that Total, as an energy major, must meet over the next 20 years. Providing affordable, reliable and clean energy, that's what it means to be committed to better energy"*

Energy & climate at TSE

The continued scientific excellence of energy economics in Toulouse has stimulated the creation of a new collaborative platform, the TSE Energy and Climate centre. This initiative brings together academic and industrial partners – significantly, EDF, Engie and Total – to build new analytical tools and exchange data and ideas on the economics of energy and climate change. As well as producing scientific publications and hosting conferences and seminars, this initiative will facilitate the transfer of knowledge between researchers, practitioners and policymakers, and inform the public debate.

Gas chair

In October 2016, TSE teamed up with MINES ParisTech, Paris-Dauphine University and IFP School to launch the Gas Economics Chair. Industry partners EDF, GRTgaz and Total have pledged to support the work of the Chair until the end of 2020 to strengthen cooperation with industry in the sector and to help achieve energy transition. The Chair organises its first international conference at Paris Dauphine on June 27.

CLAUDE CRAMPES ON THE TROUBLE WITH MULTIPLE TARGETS

Energy strategy mismatch

Claude Crampes
TSE-UTC Professor

Claude Crampes is a TSE professor who specialises in the economics of networks and energy markets. He has been a member of the economic council of the French regulation body for energy and is a general reference in the energy field. In two contributions to books on competition and environmental policies, he reviews the EU's targets for cleaning, greening and saving energy. In particular, he examines how the pro-competitive policy launched in the 1990s is being distorted by new environmental priorities.

The 2007 Energy Policy for Europe has three objectives: increase the security of supply; ensure competitiveness and the availability of affordable energy; promote environmental sustainability and combat climate change. Central to the policy are three targets, dubbed as the "three 20 for 2020" when launched, and recently adjusted to 2030:

- a 20% reduction in greenhouse gas emissions by 2020 compared with 1990 (40% by 2030)
- increase efficiency to save 20% of energy consumption compared with projections for 2020 (27% by 2030)
- achieve a 20% share of renewable energies in overall consumption by 2020 (27% by 2030)

The black target

To meet the target of decreasing greenhouse gas emissions, the EU launched the Emissions Trading Scheme, a cap-and-trade system. So far, the carbon price

– apparently driven by macroeconomic trends rather than the balancing of benefits from pollution abatement and expected emission costs – has remained well below the penalty for non-compliance.

The key problem is that the main party concerned with global warming hasn't yet been born. "Governments, international organisations, and NGOs are in charge of speaking on behalf of our great-grandchildren," says Claude. "Entities mandated for five or ten years by egoistic and short-sighted agents, and intensively lobbied by industrial groups, are supposed to take conflicting decisions in favour of agents with unknown preferences and technologies living a century from now. Because of structural myopia, the quantity of permits given for free or auctioned is too large. And excess supply means low carbon prices with almost no effect on industrial production and consumption. This in turn has weak effects on emission reduction, energy saving, and the encouragement of renewables."

The green target

To achieve the target of a 20% share of renewable energies (then 27% by 2030), EU member states have implemented various policies. But the most widely used financial tool is a non-market system: fixed feed-in tariffs (FITs) paid to green producers to compensate high investment costs and low reliability. Despite the benefits for technological development, Claude shows that the worldwide competition framework has forced out European manufacturers: "The FIT-based EU policy has excluded European champions from the equipment market instead of giving them a boost. Thus, the industrial policy slice of the promotion plan is a total failure."

Claude observes that the promotion of RES electricity is not accompanied by a comparable increase in flexibility on the demand side. European authorities are encouraging the development of random and cyclical sources of production,

whereas the demand by final consumers cannot be made contingent on the state of nature that prevails at the production nodes. RES plants should not be viewed as substitutes to fossil-fuel plants, which are necessary complements to satisfy demand by non-responsive consumers.

The white target

Rather than setting a quantitative objective for energy savings, the EU should have encouraged reduced consumption by creating a high carbon price or tax. "Energy saving is not the natural outcome of a competition policy that promotes price cuts," says Claude. "Increasing consumers' surplus while decreasing energy consumption requires huge investments in insulating buildings and high levels of R&D in the industries that manufacture electrical appliances. Again, this is a matter of industrial policy."

> "By defining three targets as pillars of their environmental policy, European authorities are putting out noisy signals on what the actual objective is and how to achieve it"

Increasing the flexibility of demand for electricity should also be a priority and R&D must be encouraged to create electronic tools that allow consumers to control their demand efficiently. "But the solution is not just technical," says Claude. "It also requires a regulatory framework that respects the principles of an efficient allocation of resources. The legal framework for distributed load shedding must also be clearly defined."

Intergenerational welfare

If the problem to be solved is global warming, says Claude, market mechanisms cannot work efficiently without public intervention that embraces the big picture. "The solution cannot come from the superposition of uncoordinated policies, because the promotion of renewable sources of energy and reductions in energy consumption should not
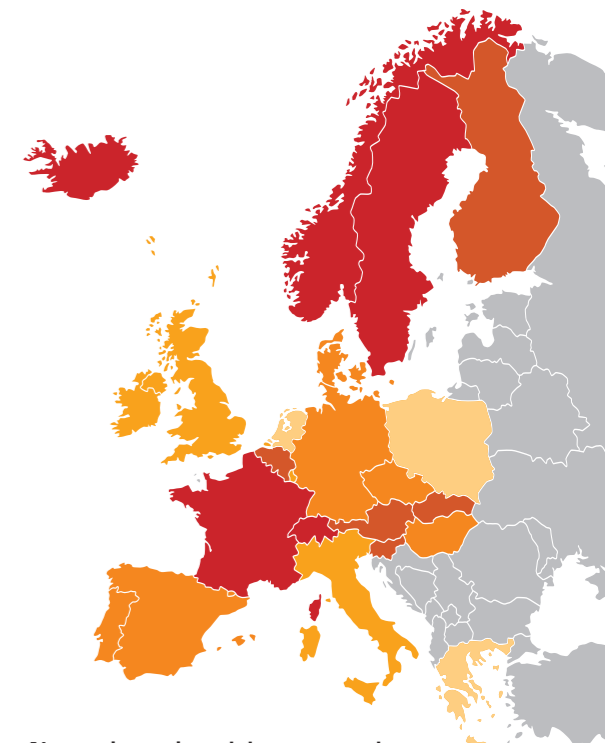
Short-circuited priorities

Claude argues that the 20-20-20 targets and their successors are bureaucratic and incoherent, pulling EU policy in many different directions at once. "They create both a financial burden that cannot be sustained within the current institutional framework and a public commitment to constrain the future structure of the energy industry. Because of these effects, the role of competition will wither, and the rationale for managing the energy industry independently from environmental policy will disappear."

A well-designed Emission Trading System could produce a much higher price for carbon emissions, providing a stronger incentive to reduce energy consumption and invest in developing green technologies. "The need for custom-made policies to sustain renewables and energy saving can be viewed at best as an acknowledgment of the failure of the current mechanism, and at worst as the inability of the authorities to understand that curbing polluting emissions is the paramount objective, next to which the two other policy tools should be subordinated."

be considered as intrinsic objectives on a par with the curbing of greenhouse gas emissions."

To effectively combine the EU's energy and environment goals will require an independent intergenerational fund created to manage common natural resources in the joint interest of present and future generations. "Such an agency will not escape the bureaucracy curse," says Claude. "However, by efficiently allocating the rights to emit pollutants and using the resulting revenue to initiate green and white R&D programmes and to sustain social programmes against fuel poverty, the proposed agency would internalise the overlapping effects of separate policies." ∎

No-carbon electricity generation in Europe (2012)

Percent of no-carbon generation

■ 81% - 100%	■ 21% - 40%
■ 61% - 80%	■ 0% - 20%
■ 41% - 60%	■ No data

STEFAN AMBEC ON INTERMITTENT ELECTRICITY

At the mercy of the elements

Stefan Ambec
TSE-INRA Professor

Policymakers' efforts to clean up electricity production have often aimed to substitute fossil fuels with renewable sources. Unfortunately, electricity produced from wind turbines and solar panels is highly unpredictable. Stefan Ambec is an INRA research professor at TSE and member of the IDEI. With TSE's Claude Crampes, he has produced the first analytical assessment of energy policies that tackles the problem of intermittent production.

Various policy instruments have been adopted to decarbonate electricity production: while several countries tax their CO, emissions, the EU caps them with tradable allowances.

"Even if electricity prices could vary with weather conditions, most consumers will not instantly react to price changes"

The type of support for renewables also differs. US states tend to opt for renewable portfolio standards (RPS) programmes which generally require a minimum fraction of electricity demand to be met by renewable sources. Most European countries have opted for the feed-in tariff (FIT), purchasing renewable electricity at a price fixed well above the wholesale price. FITs have been quite successful in fostering investment in wind and solar power in Europe, although the price difference is generally covered by a tax on consumers.

The unpredictability of wind and solar energy makes power dispatching more challenging. Supply must match demand in real time, whereas price signals do not change as quickly. Even if wholesale electricity prices vary with electricity provision, the retail prices that consumers pay do not. Even if prices could vary with weather conditions, most consumers will not instantly react to price changes.

Policy instruments

Stefan and Claude consider a model with two sources of energy: one is clean but intermittent, whereas the other is reliable but polluting. They analyse the impact of three policy instruments in a competitive electricity industry: a carbon tax on fossil fuel, FITs and RPS programmes. By increasing both the operating cost and the price of electricity produced by thermal power, a carbon tax makes renewable energy more competitive and reduces electricity production from fossil fuels. It increases investment in wind power and reduces thermal power facilities. Yet the total production capacity from both sources of energy may increase.

"A carbon tax makes renewable energy more competitive and reduces electricity production from fossil fuels"

Both FITs and RPS enhance the penetration of renewables into the energy mix. When they are designed to target the efficient share of renewable sources of energy, they induce too much electricity production, investment in thermal power and environmental pollution. They should be complemented by a tax on electricity or fossil fuels. In particular, the tax on electricity that only finances the FIT is not high enough to obtain an efficient energy mix.

Market power

Stefan and Claude also show that if a monopolistic thermal-power producer faces competition from a fringe of wind-power producers, this does not alter its ability to exert market power. Worse still, competition from wind power encourages the fossil-fuel producer to reduce production capacity so that it can charge the monopoly price when windmills are not spinning. This increases the retail price of electricity.

Regulation is thus required to improve welfare even with competition from wind power. Stefan and Claude point out that the carbon tax that would fix the two market failures – the exercise of market power and the environmental externality – should vary with the availability of the intermittent source.

Smart solutions

This model allows Stefan and Claude to identify the social value of technological solutions for the intermittency problem. Energy storage, such as pumping water into upstream reservoirs, reduces the burden of intermittency. The marginal value of energy storage depends on the cost difference between intermittent and reliable sources of energy.

Smart meters with load-switch devices and batteries also help consumers to adapt to price changes. Making consumers reactive reduces production costs – including the back-up equipment cost and the environmental cost of thermal power – but it exposes risk-averse consumers to price fluctuations. Such risk-exposure effects should be incorporated into the cost-benefit analysis of installing smart meters.
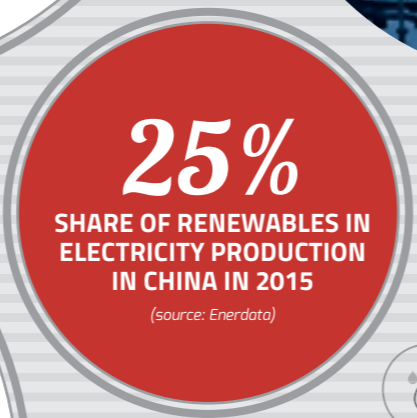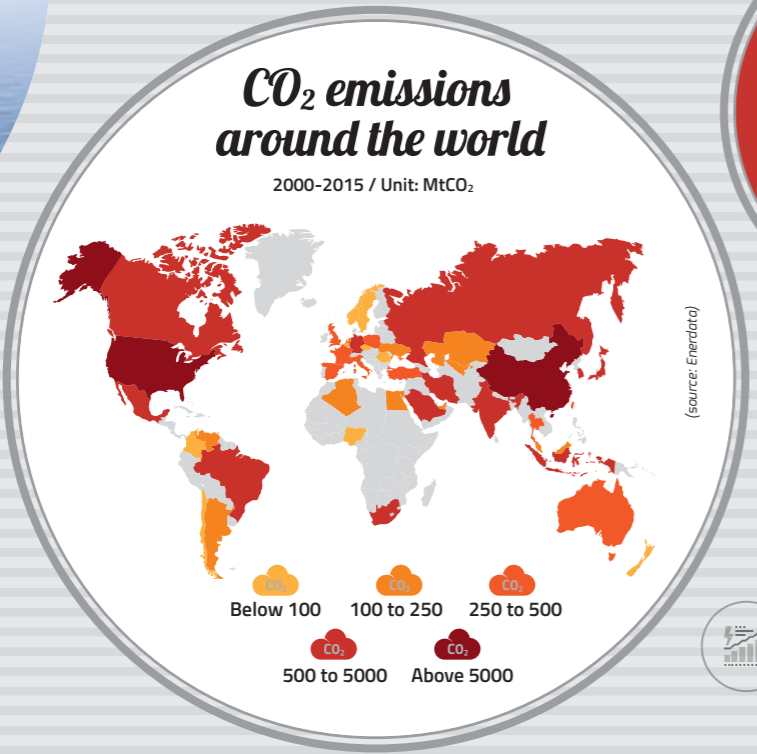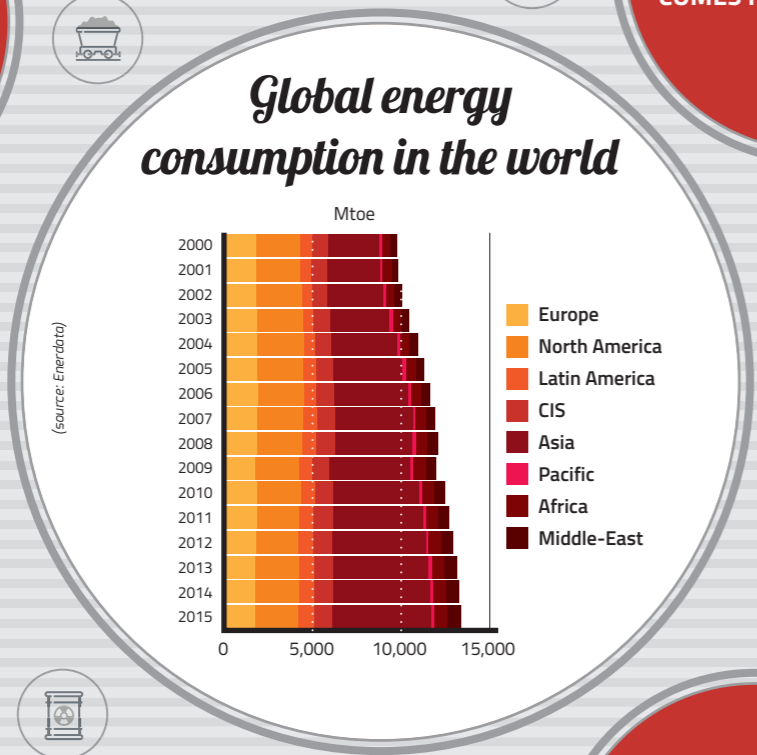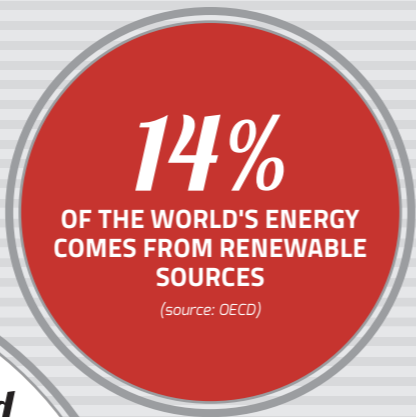
Looking forward

Much more can be done within Stefan and Claude's framework. Diversification can mitigate intermittency. Using a similar model in a 2012 paper, Stefan and Claude have shown that it is optimal to invest in two different intermittent sources that do not produce energy at the same time, even if one is more costly. Similarly, investing in wind or solar power at different locations, or using other intermittent sources such as tidal or wave power, would reduce the probability of relying only on thermal power.

Global research

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.

More information at: www.gemclime.cuni.cz

6%
GROWTH OF INDIA'S ENERGY CONSUMPTION IN 2015
(source: Enerdata)

14%
OF THE WORLD'S ENERGY COMES FROM RENEWABLE SOURCES
(source: OECD)

Global energy consumption in the world

Mtoe

(source: Enerdata)

	Europe
	North America
	Latin America
	CIS
	Asia
	Pacific
	Africa
	Middle-East

2000 – 2015 (vertical axis)

0, 5,000, 10,000, 15,000

CO₂ emissions around the world
2000-2015 / Unit: MtCO₂

(source: Enerdata)

CO₂ Below 100   CO₂ 100 to 250   CO₂ 250 to 500
CO₂ 500 to 5000   CO₂ Above 5000

25%
SHARE OF RENEWABLES IN ELECTRICITY PRODUCTION IN CHINA IN 2015
(source: Enerdata)

STEFAN LAMP ON PROJECTION BIAS

Sunspots that matter

Installing rooftop solar energy is an expensive investment for most families, and one which requires them to forecast future utility flows. TSE postdoctoral researcher Stefan Lamp has investigated solar investment decisions by German households, and finds evidence that choices are overly influenced by the current state of sunshine. Evidence for projection bias points to the importance of behavioural channels in explaining the low take-up of otherwise profitable renewable-energy technologies.

In behavioural economics, projection bias refers to people's tendency to overpredict how much future preferences will resemble current preferences. Even though projection bias is a well-established phenomenon in the theoretical literature, it has proven difficult to identify in empirical settings. Stefan's research is the first to explore projection bias in the renewable energy context, where externalities lead to low investment.

Stefan's results show that residential solar uptake increases 7-12 weeks after an exceptionally sunny week. This time lag precisely corresponds to the average

[**"In line with projection bias, Stefan's results indicate that exceptionally sunny periods lead to impulse purchases of solar technology"**

installation time. Bad weather realisations with rain and cloud cover lead to less adoption at a similar time lag. This effect is, however not fully symmetric which indicates the importance of behavioural biases for aggregate market outcomes. In line with projection bias, his

results indicate that profit expectations lead to impulse purchases in exceptionally sunny periods and to underinvestment in cloudy periods.

In these settings, it is common to find low adoption rates, even though investments in renewable technologies is financially attractive, a phenomenon known as the energy-efficiency gap. Stefan's research suggests that targeted information campaigns could help to bridge this gap and increase product uptake. As solar investments are often profitable for households as well as beneficial for the society, these interventions can improve overall welfare.

Stefan's results suggest that other important consumer decisions are also likely to be affected by projection bias. No clear recipe yet exists on how to de-bias consumers, which leaves an interesting field for future research. ■

ESTELLE CANTILLON ON COMPETITIVE BIDDING

Sold! Auctions for renewables

Auctions offer exciting opportunities to maximise the benefits of state aid for renewable energy. In her recent report for the European Commission, TSE associate Estelle Cantillon (FNRS, Université Libre de Bruxelles) identifies when competitive bidding mechanisms are useful and how they can best be designed to support renewables. Here, we present her key recommendations.

Auctions can bring down the cost of support for renewables by having bidders compete. In doing so, bidders reveal information about the minimum level of support they need. This is directly related to EU guidelines on public support for environmental protection and energy which emphasise the role of competitive mechanisms in minimising state aid.

Auctions are also selection mechanisms that reveal information that can help determine which technologies should be supported. This is easier if the service provided by different technologies is sufficiently comparable and the tendering agency can make explicit its preferences about the technology mix. To fulfill this role, the auction must have an all-encompassing or a simultaneous technology-specific format.

An auction will never extract a competitive price if there is only one bidder.

However, auction design is critical to participation and competition. It is a science because it relies on theoretical, empirical, computational and experimental analyses to ground recommendations. It is also an art because every application is special and will often warrant a tailored design. Several good practices emerge nevertheless: using different technologies, a flexible product definition, an elastic demand, ensure bidder information, stable regulation and penalties.

When the agency has very specific needs that can only be met by a limited number of suppliers, a multi-technology auction with flexible product design is unlikely to ensure sufficient competition. Instead, intense due diligence akin to the review process required in cost-plus type of regulation will be especially valuable in determining the right reserve price. In these circumstances, an administratively set tariff or premium can do the job.
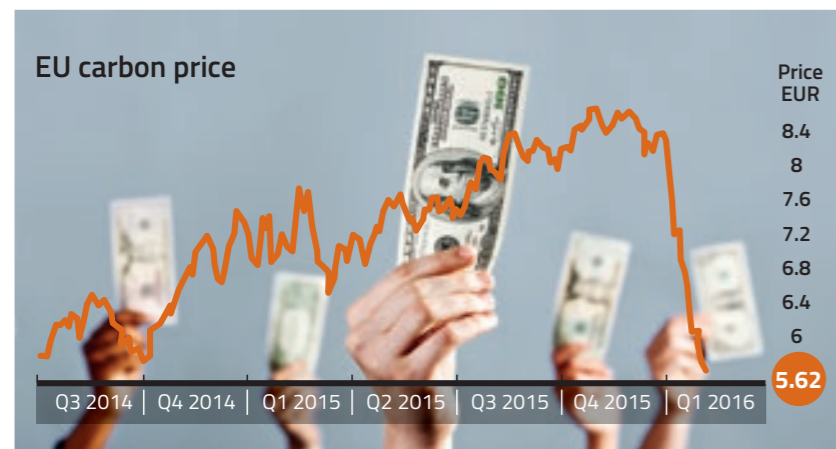
Estelle Cantillon
Université libre de Bruxelles

In case of extreme uncertainty about future costs, bidders may not be willing to commit to a project. For such technologies, remuneration schemes based on ex-post costs and production levels may be more appropriate.

[**"EU guidelines on public support for environmental protection and energy emphasise the role of competitive mechanisms in minimising state aid"**

A big challenge is to clarify how the agency will compare the different offers. If the agency's policy objective is to restore efficiency in the presence of market failures and incorrect prices, technological neutrality may require treating different technologies differently. If the aim is to minimise the cost of support, there is no reason to treat technologies differently, unless the agency has preferences over the technology mix. Ensuring a level playing-field means treating all bids equally unless there are objective differences in the service provided or the agency is pursuing an efficiency objective and there are differences in external costs and benefits.

EU carbon price

	Price EUR
	8.4
	8
	7.6
	7.2
	6.8
	6.4
	6
	5.62

| Q3 2014 | Q4 2014 | Q1 2015 | Q2 2015 | Q3 2015 | Q4 2015 | Q1 2016 |

GEORGIOS PETROPOULOS AND BERT WILLEMS ON NETWORK ACCESS

Cleaning up power markets

Coordinating the timing of new production facilities is one of the challenges of liberalised power sectors. It is complicated by the presence of transmission bottlenecks, oligopolistic competition and the unknown prospects of low-carbon technologies. Former TSE PhD student Georgios Petropoulos (Bruegel) and TSE associate Bert Willems (Tilburg) have built a model encompassing a late and early investment stage, an existing 'dirty' and a future 'green' technology and a single transmission bottleneck, and compare dynamic efficiency of several market designs.

[**"Allocating network access on a short-term competitive basis distorts investment decisions, as brown firms will pre-empt green competitors by investing early"**

Before the liberalisation of the energy sector, generation investments were centrally planned and coordinated. Because of transmission constraints, a new power plant may require existing plants to reduce production and preclude otherwise profitable future investments. In a liberalised sector, market design needs to induce firms to internalise those interaction effects.

The current practice of allocating network access on a short-term competitive basis distorts investment decisions, as 'dirty' or 'brown' firms will pre-empt 'green' competitors by investing early. Compensating early investors for future network congestion, as for instance happens in the EU with counter-trading, only exacerbates this problem.

The researchers show that dynamic efficiency is restored with long-term transmission rights that can be traded on a secondary market. Investments are efficient in two situations:

1) The brown incumbent has full bargaining power in the secondary market and fully internalises the effects of its investment timing;
2) The initial allocation of the property rights is competitive and the green entrant is an active bidder in the primary market with sufficient information about future investment costs.

Regulators could, in theory, restore efficiency by imposing an investment tax on early investment. But to determine the optimal tax level, regulators would require information about the green entrant's investment costs that is not readily available. So the researchers prefer the introduction of long-term property rights, and show that efficiency is achieved with both financial and physical transmission rights. However, as financial rights do not raise concerns regarding strategic withholding of transmission capacity (as shown by Paul Joskow and Jean Tirole), they are the preferred option.

GIULIA PAVAN ON ALTERNATIVE FUEL SUPPLY

How to promote green cars

I f customers are to buy a 'green car' that runs on alternative fuel, they need access to plenty of suitable filling stations. Meanwhile, stations are unlikely to install alternative fuel pumps if there are few 'green cars' to use them. But fuel supply is seldom considered in analysis of the adoption of environmentally friendly vehicles. Using a rich dataset from the Italian market, TSE postdoctoral research fellow Giulia Pavan has written the first paper to propose a fully fledged demand and supply model to study the incentives for adoption of alternative fuels.

In Giulia's joint model, potential green car customers consider the price and the density of stations offering alternative fuels, such as liquefied petroleum gas (LPG) and compressed natural gas (CNG). At the same time, filling stations only install alternative-fuel pumps if there are enough customers driving green cars in the area. Giulia uses this framework to compare the effectiveness of different environmental policies designed to boost adoption of green cars.

The setting for Giulia's study is the Italian market, which is characterised by a high share of new LPG and CNG cars and a heterogeneous dislocation of filling stations among markets. She assembled a novel dataset, collecting data on car sale price, fuel type and other characteristics for newly purchased cars by private holders and merging it with information on location and range of fuels offered by Italian filling stations in 2012. She was also able to exploit differences in local legislation relative to traffic limitations for traditional fuel cars, reduced taxes for alternative-fuel vehicles and laws requiring filling stations to supply at least one alternative fuel.

The main takeaway of Giulia's demand model is that consumers are sensitive to fuel availability and this effect is especially strong for alternative fuels. On the filling station side, her model allows to estimate the number of cars needed for a profitable entry of a given of filling stations.

Using her demand and entry estimates, Giulia compares two policies: a €2,000 rebate on the price of alternative-fuel cars and a 50% subsidy for the installation of an alternative-fuel pump. She finds that subsidising consumers would increase the share of LPG cars by 30% and CNG cars by 33%, leading to a 3% and 5% increase in the density of filling stations. Subsidising filling stations would increase the availability of alternative fuels by 60% and 66% for LPG and CNG respectively; increasing car share by 17% and 96% for LPG and CNG respectively. These results suggest that subsidising fuel retailers to offer alternative fuels is an effective policy to indirectly increase low-emission car sales.

[**Giulia's results suggest that subsidising fuel retailers to offer alternative fuels is an effective policy to indirectly increase low-emission car sales**

However, Giulia emphasises that the two policies' results are mixed and should be evaluated at the local market level. The higher cost effectiveness of the price rebate is due to the substitution between traditional-fuel and alternative-fuel vehicles, which is smaller in case of filling-station subsidies. Although consumer rebates are more effective in terms of CO_2 per car reduction, they do not indirectly support the entry of filling stations. Therefore, the effect of the policy would disappear once the subsidy expired. On the other side, the effect of a filling-station subsidy on alternative-fuel market shares would be more persistent since filling stations would remain in the market. Both policies imply, on average, a 1% CO_2 reduction per car, showing high variability among markets. ∎
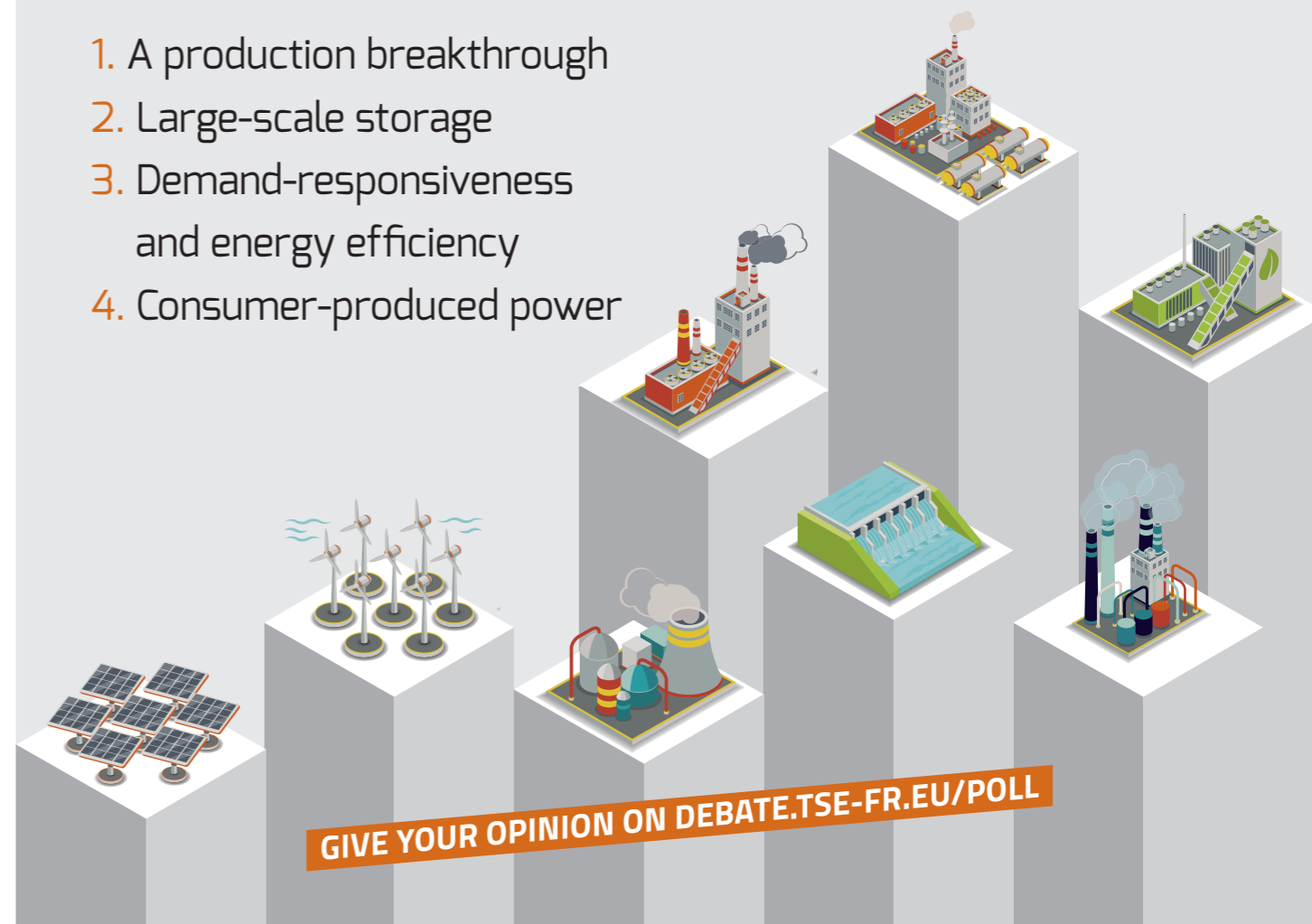
Map of Natural Gas Vehicle (NVG) Compressed Natural Gas (CNG) filling stations in Europe

Last Update: April, 2017

Source: http://cngeurope.com/
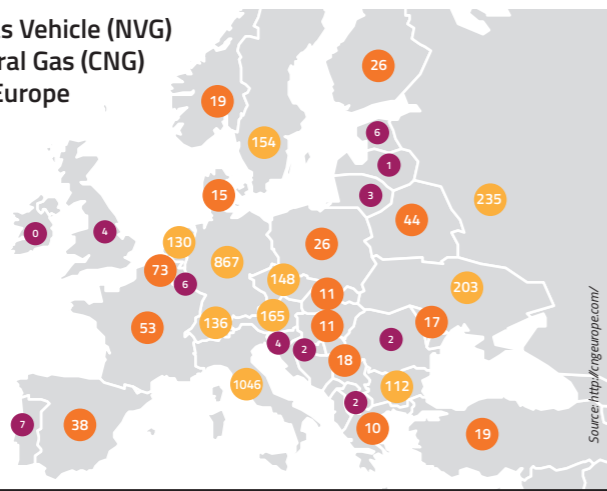
What is the next big evolution in the electricity industry?

1. A production breakthrough
2. Large-scale storage
3. Demand-responsiveness and energy efficiency
4. Consumer-produced power

GIVE YOUR OPINION ON DEBATE.TSE-FR.EU/POLL

RECENT POLL RESULTS FROM TSE DEBATE:

71%
don't see "uberisation" as an economic threat

68%
don't believe intelligent software and robots will create mass unemployment

59%
think economic growth is not necessary to eliminate extreme poverty

85%
believe a federal Europe is the way forward

debate.tse-fr.eu

PHILIPPE TRAINAR, SCOR CHIEF ECONOMIST

Finding a port in the storm

Terrorism and solar storms are among the many new risks that must be faced by 21st-century society. The size and complexity of such risks in a globalised world demand big ideas and complex solutions. This is the stage set for reinsurance companies like SCOR, which cover the risks of direct insurers. Here, SCOR's chief economist Philippe Trainar explains why he values the TSE-SCOR partnership so highly. Together with TSE's Stéphane Villeneuve, he also outlines some of the new challenges facing the industry.

With a balance sheet of €41.6bn and more than 2,500 employees, SCOR is a giant of the global reinsurance industry. In its search for creative answers to complex problems, Trainar says the company is "extremely satisfied" with its long-standing partnership with TSE. "It has brought us great rewards. The research deals with the economy of risk, an area to which French economists have contributed enormously. As a reinsurer, we at SCOR are very interested in this question, but above all, we want to understand how risk transforms and influences economic decision-making."

The reinsurance industry is in excellent health, says Trainar, and it will continue to grow and diversify as the sources of risk become increasingly complex: "The proof is that today all investors are turning to the reinsurance market. We are now witnessing a kind of equalisation of profits because when you increase the capacity of a market, prices tend to drop. But this market benefits from the expansion of the universe of risks, especially extreme risks."

The growth and enrichment of the world population has multiplied the risks faced by humans, Trainar explains: "When you are richer, you have more things to lose; when you have more interactions, some will be negative and require coverage. Climate change also contributes to the growth of risks – Toulouse has already worked hard on this issue. People often congregate in dangerous areas, along coastlines and rivers, probably because this is where contacts are made more easily. This also increases the need for reinsurance. So this is a market that has a great future."

> **"What is being written today is completely different from what we wrote 10 years ago. For that, we are extremely grateful to the Toulouse researchers"**

Stéphane Villeneuve is a TSE-UTC maths professor and coordinates the "Risk Markets and Value Creation Chair", which is sponsored by SCOR. The big news in insurance, he says, is the globalisation of risks: "The event that woke everyone up to this was the terrorist attack on the World Trade Center in 2001, which had a global financial impact. Another example is the risks of drought in Ukraine which led to a spike in agricultural prices that sparked a revolution in Tunisia."

The complexity of such multi-dimensional phenomena is daunting, but Villeneuve emphasises that taking risks can also be very positive, and coverage offers opportunities for growth and cooperation: "An investor must take risks. The role of an insurer or reinsurer is to share risks, to accompany economic actors and find the mechanisms which mitigate catastrophes."

Philippe Trainar
SCOR Chief Economist
External member, TSE board of directors

Digitalisation is another revolutionary force in the reinsurance industry, and a key focus of TSE research. "Whether we like it or not, our insurance contracts in future will be increasingly individualised," explains Villeneuve. "Machines will measure the way we drive, eat and exercise. This will considerably alter the relationship between insurers and policyholders, raising new ethical and legal issues."

The TSE-SCOR partnership has already gone above and beyond its original goals, says Trainar. "There has been excellent, extremely precise research at the international level. This research is also very enriching for SCOR because it allows us to address direct questions to the TSE team. These may sometimes seem a bit 'clumsy', but the researchers have a great capacity to listen, to reformulate the questions in a general framework and, above all, to provide answers. To what extent are risk premiums insurable or reinsurable? What are the optimal ways of sharing very high risks? How should risk-based profitability evolve?"

The support of TSE economists on these issues, says Trainar, has helped to reshape SCOR's business strategy. "With Christian Gollier, Stéphane Villeneuve, and the rest of the Toulouse team, we have already made a lot of progress. What is being written today is completely different from what we wrote 10 years ago. For that, we are extremely grateful to the Toulouse researchers. TSE researchers have brought us solutions on issues that transcend everyday activities. These are often questions that will influence our long-term strategy. Today, we can celebrate a truly extraordinary record and a very fruitful partnership."

Cutting-edge research

Since 2008, the SCOR Chair "Risk Markets and Value Creation" has supported theoretical and applied research at TSE on regulation of insurance markets and risk management, combining methods from financial economics, industrial organisation and econometrics. Key topics include:
- *Longevity risk, long-term care and (social) insurance*
- *Risk management of large environmental risks*
- *Methodology of credit risk models*
- *Regulation, liquidity and solvency risks*
- *Risk attitude*

More information in the IDEI special dossier on Risk-sharing Mechanisms on the IDEI website.

TSE COURSES

The art of the nudge

TSE will open a new course this September on the concept of 'nudges', a popular tool among governments that uses insights from behavioural economics to influence people's conduct without coercion. Taught by TSE researchers, including psychologist Jean-François Bonnefon (TSE-CMR-CNRS), the course is characteristic of TSE's increasingly interdisciplinary, open and innovative approach.

The concept of nudges appeared several decades ago in behavioural economics as researchers sought to better understand how individuals make daily decisions and to identify the key factors that influence them. A nudge is a gentle, discreet incentive that has been proven more efficient in influencing people than direct instruction, regulation or penalties.

"This new course offers students insights on how psychology can interfere with rationality and how to better mitigate these effects and bias"

Nudges can be used in many different situations: for instance, to encourage people to eat more fruits and vegetables; to decrease their energy consumption; or to take better security precautions. Psychologists and economists agree that nudges can be quite powerful tools when incorporated into the design of regulatory policies.

Several governments are already using nudges to help citizens improve their decisions or behaviour, and the Behavioural Insight Team (BIT) in the UK or the Social Behavioural Sciences Team (SBST) in the USA have carried out many experiments on the subject. TSE faculty are also very active in the field.

"A key objective of the new TSE course," says Jean-François Bonnefon, "is to offer students insights on how psychology

can interfere with rationality and how to better mitigate these effects and bias. As future decision-makers, both public and private, our students need to better understand how nudges work to be able to implement them in their future roles, and to recognise a nudge in action. It's an extremely relevant concept for future economists and citizens who must also be aware of ethical issues regarding the use of these tools."

Nudges are relatively new tools, and as such they generate new issues, says nudge expert and economist Nicolas Treich (TSE-INRA). "As psychological instruments with highly context-dependent effects, the effects of nudges are extremely hard to predict, and they should hence be used with great caution. Moreover, it's dangerous to lead people to make choices we believe would be better for them when it has been shown that our brains derive high pleasure from
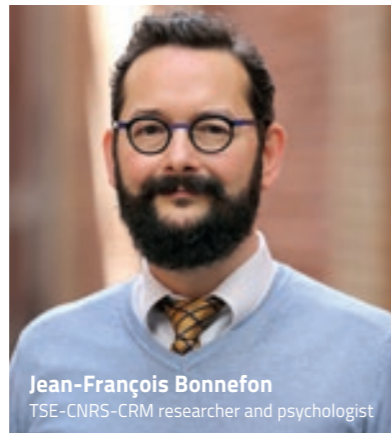
Jean-François Bonnefon
TSE-CNRS-CRM researcher and psychologist

"Our brains derive high pleasure from making others do things our way. Nudges should not be used to that end"

making others do things our way. Nudges should not be used to that end."

Paul Seabright (TSE-UTC), director of our interdisciplinary institute, IAST, agrees that nudges need to be used with great care. He explained in a recent public talk that virtuous indignation is highly-addictive drug, and that regulating people's behaviour is a perilous affair.

In the words of Tim Harford, Financial Times columnist and economist: "'Nudging' doesn't always help navigate a complicated policy maze. Nudging means using default options, information design and similar techniques to achieve policy goals. It can be very successful. But careless nudges are no more welcome in public policy than at a domino-toppling event. If you pick a questionable target (bottled water) and fudge a key policy dilemma (the environment vs health), then nudging isn't going to solve your problems."

The new TSE course will equip our students and future world economists to find their way through the complex nudge maze. ∎
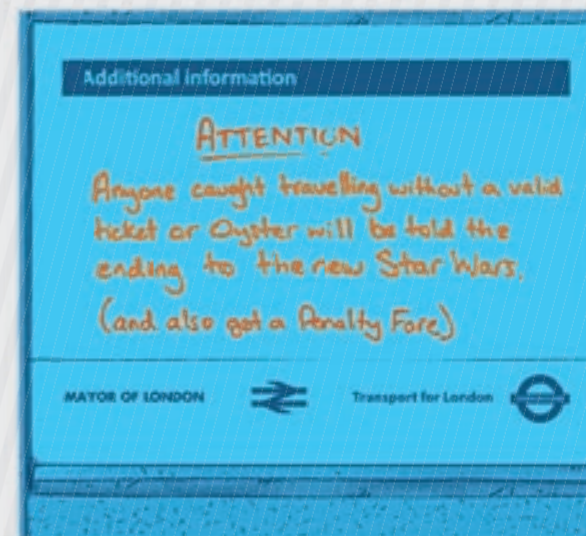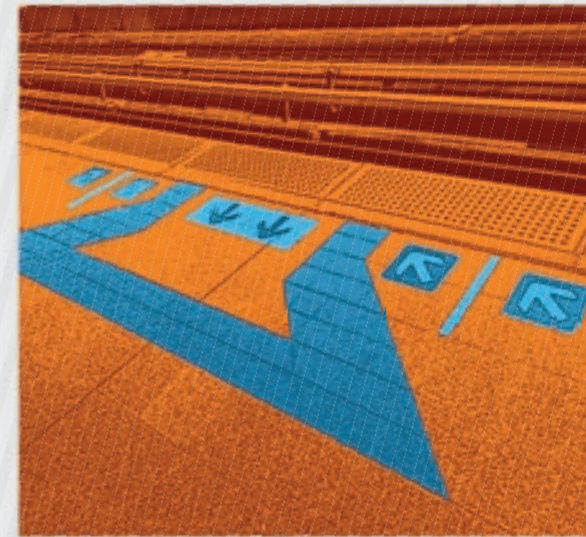
FOCUS ON
Training energy and climate experts

How do today's energy markets work? How does the increasing use of renewable energies impact electricity markets? What is the effect of EU regulation aimed at reducing CO_2 emissions on firms and market competition? These questions are at the core of the TSE course on energy economics and climate change, led by Stefan Lamp (TSE).

Over recent decades, energy markets have become some of the most dynamic in the world. Traditional fossil-fuel and electricity markets have shifted away from centralised planning and regulation to liberalisation and market-centric organisation. At the same time, rising environmental concerns have led to an array of new regulations and environmental markets. The growth of renewable energies, initially driven by policy and more recently by economic forces, is another source of rapid change and brings a new set of technical and policy challenges.
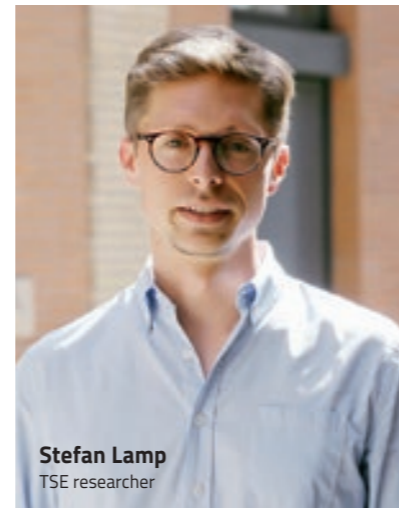
> **"Interactions between climate and energy choices and economic policy are actually very complex"**

Stefan Lamp
TSE researcher

To prepare students for a career in and around energy and carbon markets, TSE offers a specialised course within its masters programme on environmental and natural resource economics, taught by TSE faculty, leading policy experts and practitioners in the field. The course is led by TSE researcher Stefan Lamp whose research focuses mainly on the diffusion of renewable energy sources and the impact of environmental regulation on firm outcomes. Students learn about the theoretical foundations of pollution regulation and how modern econometric tools can be used to analyse the impact of climate-change regulation on firms and markets.

Students also learn how regulation works in practice thanks to practitioners like Mauricio Bermudez. With many years

Economics of energy markets and networks

TSE students looking to work within the energy and environment sectors can also take a course on the economics of energy markets and networks, focusing on how to reconcile the conflicting objectives of fuelling economic growth and conserving scarce natural resources. More specifically, students are given the analytical tools to design optimal and innovative energy market policy strategies in order to manage greenhouse gas emissions, using the industrial organisation models that TSE faculty are renowned for. Looking at how microeconomic models are applied in the power industry to issues such as peak-load pricing of energy, nodal pricing of transmission, and imperfect competition, on completing the course the students come away with an in-depth investment and policy skillset offering a competitive advantage on the job market.

of consulting experience in the energy industry, Mauricio, who is also a TSE alumni, is able to share with students his insights on the history of the European emissions trading scheme (EU-ETS), its mechanisms and potential future developments: "Cap-and-trade systems such as the EU-ETS are smart, efficient and flexible policy solutions to control greenhouse gas emissions. Cap-and-trade systems are also complex regulations, which can make them prone to design failures that can be exploited by industry to capture rents, that can damage international competitiveness, or that can dilute their incentives if not well aligned with other components of energy policy. Understanding both the theoretical and real-world aspects of cap-and-trade systems is key for future practitioners and policymakers."

Philippe Gérard, engineering and nuclear energy expert in the electricity sector, briefs students on technical constraints such as the interconnection of European networks. Gilles Lafforgues (TSE-TBS), brings a macroeconomic perspective on

> **"Understanding both the theoretical and real-world aspects of cap-and-trade systems is key for future practitioners and policymakers"**

the potential implementation of a carbon tax and its economic impact on climate change. As Gilles tells us, "Interactions between climate and energy choices and economic policy are actually very complex. To better understand them, we use a modelling approach to identify the main variables and analyse their impacts."

Augustin Lagarde, who graduated from TSE in 2014 and now works at Simetrica, a consulting company, details how important TSE has been for his career. "Thanks to TSE's reputation in environmental and natural resource economics, I was recently asked to co-author a policy paper with top economists on climate policies in the world." The former TSE students adds "The energy and climate courses I followed at TSE perfectly introduced me to the main tools in these fascinating areas and the knowledge I gained at TSE has been a key element of the success of my career." ■

Find out more on the TSE website

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FRIDAY 24 NOVEMBER 2017
9H - 17H / TOULOUSE
MANUFACTURE DES TABACS

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