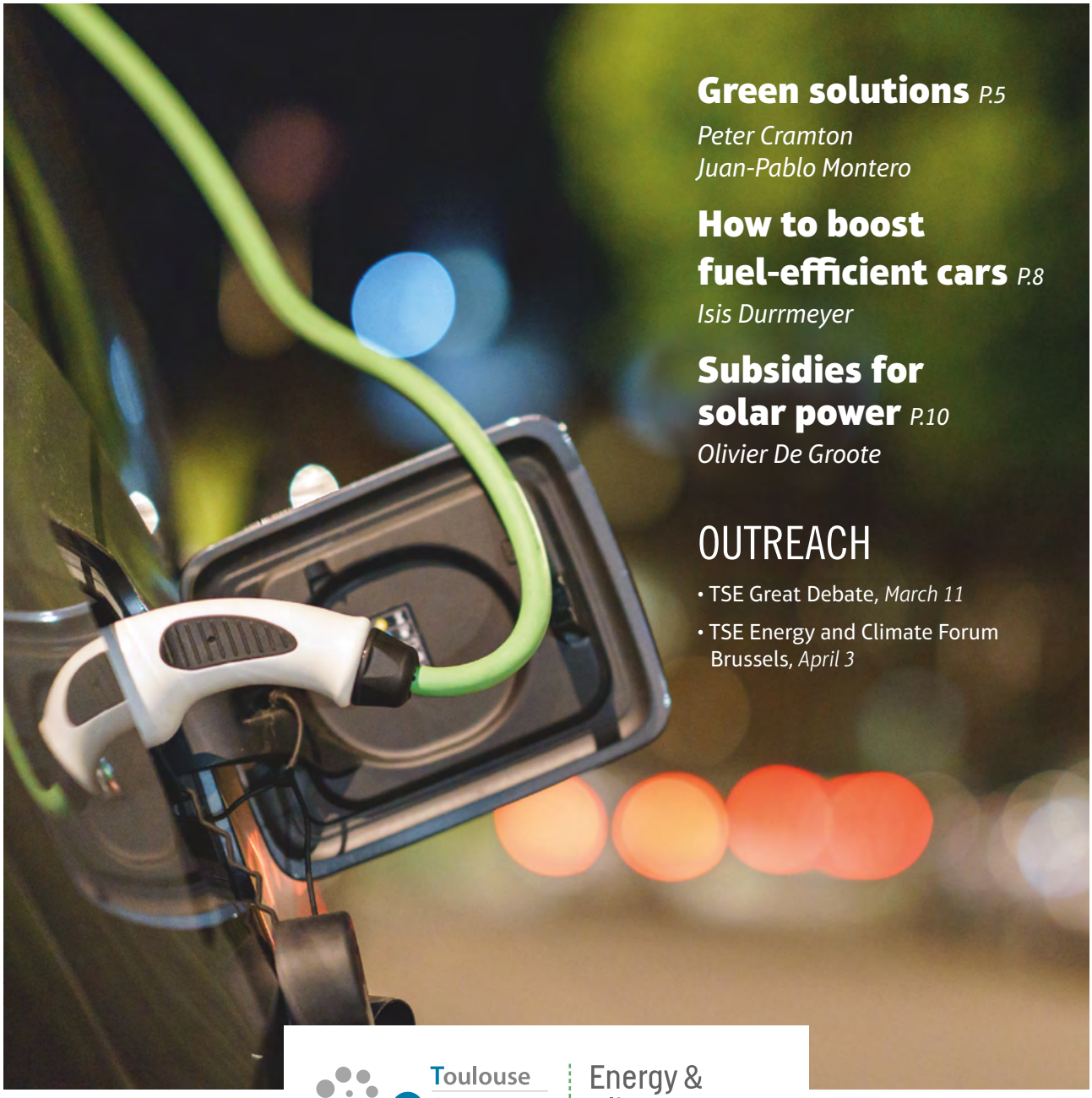
TSE
Energy & Climate Center

NEWSLETTER / May 2019



OUTREACH

- TSE Great Debate, *March 11*
- TSE Energy and Climate Forum Brussels, *April 3*

Toulouse School of Economics | Energy & Climate Center

EDITOR'S NOTE

A SPRING IN OUR STEP

This first semester of 2019 was very busy at the TSE Energy and Climate Center with a major event to host each month! We started by brainstorming on our current research with TSE colleagues, students and associates during our annual one-day Energy Workshop in January. In February, I coordinated the Winter School 2019 of the European Association of Environmental and Resource Economists.

This year's topic was the economics of energy transition. About 40 PhD students and postdocs attended lectures and presented their work over the course of a week at a beautiful venue overlooking Lake Maggiore in Switzerland.

In March, the 'Grand Débat' following the 'gilets jaunes' protest against the carbon tax was attracting media attention in France. TSE took part in the debate by organizing public events in Toulouse. TSE Director **Christian Gollier** talked about policy solutions to tackle climate change, while our colleague **Zohra Bouamra Mechemache** reminded us that agriculture is a major source of greenhouse gas emissions. On April 3, we exported our Energy Forum to Brussels. Read more about all these events in this edition of the newsletter.

We are also happy to showcase two recent research publications from the TSE Energy and Climate Center. Both papers evaluate public policies that aim to reduce carbon emissions: in transportation in **Isis Durrmeyer's** analysis of the French bonus-malus on cars and of the US CAFE standard; in electricity provision in **Oliver de Groote's** study of feed-in tariffs in Belgium.

Don't miss the Center's forthcoming academic event: ***The conference on the Economics of Energy and Climate, June 18-19***. Held every two years, this event has already attracted close to 140 paper submissions. So the evaluation process has been tough for the organizing committee, since the format can only accommodate 40 presentations. Topics covered will include: competition, carbon emissions, electricity transmission and distribution, permit markets, retail electricity markets, environmental taxes and energy prices, coal and climate, transport policies… to name a few.

The following pages will introduce you to our esteemed keynote speakers: **Peter Cramton** *(University of Maryland)* and **Juan-Pablo Montero** *(PUC-Chile)*.

We hope to welcome you in Toulouse this June!

Stefan Ambec
Director, TSE Energy & Climate Center

NEWS

WHAT WILL IT COST TO DEAL WITH CLIMATE CHANGE?

New book by Christian Gollier: ***"Le climat après la fin du mois"***

Christian Golllier

TSE Director and President-elect of the European Association of Environmental Economists (EAERE), Christian Gollier is internationally renowned for his work on the economics of uncertainty and the environment.

Humanity has an appointment with its destiny. The exploitation of fossil fuels that has led to our prosperity is now putting us at risk. With the production of greenhouse gases and excessive energy consumption, we urgently need to make a significant change in our way of life. To win this global war against climate change, reasonable sacrifices are needed, starting with the application of the polluter-pays principle. Are the French ready for this? Will we accept our responsibilities towards the welfare of future generations?

An original and insightful thinker, Christian expresses his hope as well as his doubts about our ability to meet the climate challenge and proposes concrete economic solutions to preserve the future of all.

TSE ENERGY WORKSHOP

Organized by Stefan Ambec, this year's TSE Energy Workshop focused on electricity markets and air-quality regulation. The one-day event was attended by most of the center's researchers and associated members and included presentations by Stefan Ambec *(TSE)*, Natalia Fabra *(Universidad Carlos III)*, Juan-Pablo Montero *(Pontificia Universidad Católica de Chile)*, Matti Liski *(Aalto University)*, Leslie Martin *(University of Melbourne)*, Imelda *(Universidad Carlos III)*, as well as the TSE PhD students Charles Pebereau and Yuting Yang.

The scientific contributions focused on both theoretical and empirical projects dealing with a broad range of topics including environmental regulation, electricity markets, the adoption of energy-efficient technologies, and road user charges.

In her ongoing project *"Real Time Pricing for Everyone"*, Natalia Fabra and her co-authors analyze the impact of the default real-time pricing (RTP) option in the Spanish retail electricity market. The authors rely on detailed consumption data from roughly four millions residential accounts. Preliminary findings show that RTP did not significantly reduce household electricity consumption. The authors are currently exploring the detailed mechanisms leading to the low consumption response. Similarly, TSE PhD student Charles Pébereau is studying the decision of households to adopt RTP in New Zealand. His empirical analysis builds on detailed data of tariff choices and shows that consumers that spent

www.tse-fr.eu/conferences/2019-energy-workshop

less time with RTP and experience a negative price shock are more likely to switch back to traditional tariffs compared to users that had a longer history with RTP. Different rational and behavioral factors might lead to the observed behavior. Charles is currently working on a microeconomic model to study the underlying mechanisms.

In her paper *"The Margins of Response to Road Use Prices"*, Leslie Martin and her co-author Sam Thornton use a large field experiment to document the potential mismatch between who contributes the most to congestion and who responds the most to road-use prices. The authors show that constant charges do not reduce congestion. Instead, charges targeted at peak times or central areas are more successful in relieving congestion. Moreover, as the current system of road usage charges in Melbourne puts a disproportionate burden on low-income households that live further from the city, reform of congestion charges might alleviate the distributional concerns of this tax instrument. *"Our research indicates that despite opposition on the grounds of fairness, congestion charges may be a fairer way to charge for roads. We show that while road use charges do impact the poor disproportionately, conditional on owning a car, existing fuel taxes are even more regressive."*

EAERE WINTER SCHOOL

Focus on 'The Economics of Energy Transition'

Stefan Ambec (TSE) and Lucas Bretschger (ETH Zurich) organized the 2019 Winter School of the European Association of Environmental and Resource Economists (EAERE) last January in Ascona, Switzerland.

During the five-day event, mornings were devoted to state-of-the-art classes on several dimensions of the energy transition: the problem of intermittent supply from wind and solar power *(by Stefan Ambec)*, the regulation of multiple air pollutants from fossil-fuel combustion *(by Jessica Coria from the University of Gothenburg)*, energy-efficiency polices and their impact on people's behavior *(by Matthieu Galchant, from Mines Paris Tech)*, the impact of environmental policies on innovation *(by Antoine Dechezleprêtre from the OECD)* and technological change in the energy sector *(by Itziar Lazkano from the University of Wisconsin-Milwaukee)*.

In the afternoons, students had the opportunity to present their own work, discussing the challenges they face in their research. It was also an opportunity to meet fellow students and to get feedback from senior researchers. The students clearly enjoyed the learning-friendly atmosphere in the conference center overlooking Lago Maggiore: 95% of them ranked the quality of the school as 'high'. Improving on this grade will be a challenge for EAERE Winter Schools to come!

BUSINESS TALKS

Organised by the career services, these conferences are intended to broaden our students' understanding of economics, to put into perspective what they have learnt from theoretical lectures, and to arouse their curiosity.

https://www.tse-fr.eu/talks-2018-2019

January 17, 2019: Andreas Ehrenmann

The Chief Analyst at Engie addressed students on the market design challenges of the green transition.

March 14, 2019: Mauricio Bermudez

Mauricio Bermudez, Principal Director, Accenture and a TSE Alumni delivered a talk on sustainibility in business.

PORTRAIT

GREEN SOLUTIONS

On June 18-19, at the Conference on the Economics of Energy and Climate organized by the TSE Energy and Climate Center, leading experts will 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. Here we present the two keynote speakers PETER CRAMTON and JUAN-PABLO MONTERO

Peter Cramton

"Electricity is front and center in debates on climate change"

Peter Cramton is Professor of Economics at the University of Cologne and the University of Maryland. With a PhD in Business from Stanford, his research appears in leading economics journals and focuses on the design of auction-based markets. Applications include communications, electricity, and financial markets.

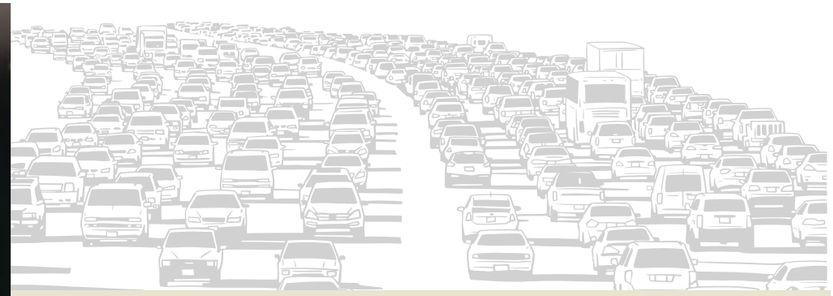
He is an independent director on the board of the Electric Reliability Council of Texas and an advisor and chief economist to several companies. Since 1993, he has advised 13 governments and 41 bidders in spectrum auctions. He is a co-inventor of the spectrum auction design used in Canada, Australia, and many European countries. Since 2001, he has played a lead role in the design and implementation of electricity and gas auctions in North America, South America, and Europe. He has advised on the design of carbon auctions, including conducting the world's first greenhouse-gas auction held in the UK in 2002. He has led the development of innovative auctions in new applications, such as auctions for airport slots, wind rights, diamonds, medical equipment, and internet top-level domains.

Peter is also the lead editor of ***Global Carbon Pricing: The Path to Climate Cooperation*** (MIT Press, 2017), a book which features contributions from TSE director Christian Gollier and multiple Nobel laureates including TSE president Jean Tirole. See *http://www.cramton.umd.edu/papers2015-2019/cramton-mackay-ockenfels-stoft-global-carbon-pricing.pdf*

As a keynote speaker at the TSE Conference on the Economics of Energy and Climate on June 18-19, Peter will discuss ***'Renewables and Electricity Market Design'.***

"Electricity generation is the single largest emitter of carbon to the atmosphere. Efforts to address climate change will shift generation from fossil fuels to wind, solar, nuclear, and other non-emitting resources. Electricity market design must be able to handle this transformation. The task is non-trivial as the main renewable resources, wind and solar, are intermittent sources of supply with zero marginal cost of production and no inertia. Today's markets can easily handle a moderate share of renewable generation, but what if generation is dominated by renewables? Are adjustments to the market design needed to handle such major shifts in the generation mix? I am optimistic that electricity market designs will continue to improve and meet the coming challenges. The key is good governance, forward planning, and a strong focus on basic market principles to achieve market objectives."

PORTRAIT



Juan-Pablo Montero

"Congestion charges and car restrictions can provide benefits for all"

Juan-Pablo Montero is Professor of Economics at Pontificia Universidad Catolica de Chile (PUC-Chile) and member of the Chilean Ministry of Transportation's Expert Panel on Public Transport.

With a PhD in Industrial Economics from MIT, his fields of interest include Industrial Organization, Environmental and Energy Economics, Resource Economics. He has served on the editorial boards of numerous prestigious journals and his research has appeared, among others, in the *American Economic Review, Journal of Political Economy and Review of Economic Studies*.

He was named Chilean Economist of the Year awarded by El Mercurio *(Chile's main newspaper)* based on a poll of 400 Chilean economists. With A.D. Ellerman, P. Joskow, R. Schmalensee, and E.M. Bailey, he is the author of a book entitled: *Markets for Clean Air: The US Acid Rain Experience (Cambridge University Press, 2000)*.

He has also been a consultant on topics of industrial organization, environmental and resource economics for Chile's Ministry of the Economy, Ministry of the Environment, Ministry of Foreign Affairs, and Competition Authority; private corporations in Chile and international organizations such as the World Bank and the US Environmental Protection Agency.

As a keynote speaker at the TSE Conference on the Economics of Energy and Climate on June 18-19, Juan-Pablo will discuss ***'Practical Approaches for Correcting Car Externalities'.***

"Authorities rarely turn to pricing schemes, such as congestion charges and pollution-based registration fees, to persuade drivers to give up their cars in favor of public transport or to switch to cleaner ones. Instead, they increasingly rely on schemes that face less public resistance, such as driving restrictions or license-plate bans, despite studies that show they typically result in more congestion and pollution. Using a transport model calibrated to capture Santiago's current congestion and pollution reality, we advance a restriction proposal that prevents the purchase of additional vehicles while leaving consumers of all income groups better off: driving restrictions with toll and vintage exemptions, where toll revenue is spent on improving public transport. A driver of a restricted car has the option to pay a toll to have it exempted, as long as the car's pollution level is below a certain threshold. Under the more ambitious format - five-day restriction, $14 toll, and 2000 and 2005 vintage thresholds for petrol and diesel, respectively - per-year net benefits from lighter traffic and cleaner air amount to almost 0.5% of Chile's GDP".

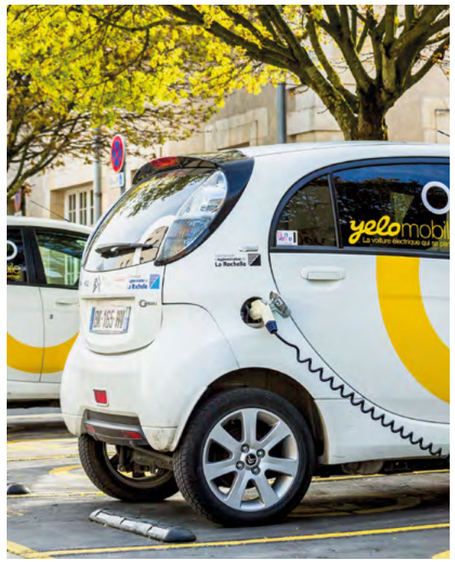
RESEARCH HIGHLIGHTS

LATEST SCIENTIFIC STUDIES

HOW TO BOOST GREENER CARS

ISIS DURRMEYER

Isis has been an Assistant Professor of Economics at TSE since September 2016. Her research is on empirical industrial organization and environmental economics. Her work focuses on the evaluation of environmental policies in the transportation sector. She also develops new empirical models and methodologies to perform policy evaluations with limited data.



What is the best way to incentivize the use of fuel-efficient cars? In a new paper, TSE's Isis Durrmeyer compares the contrasting policy approaches adopted in France and the US.

There are two major types of environmental policies that target carbon emissions from new vehicles: fuel-efficiency standards that constrain manufacturers, and taxes or subsidies for cars buyers. In the US, the Corporate Average Fuel Economy (CAFE) standards impose a minimum level of fuel efficiency that each car manufacturer must reach and a fine is paid in case of non-compliance. These standards were implemented in 1978 in response to the OPEC oil crisis, and were strengthened twice during the past 40 years.

Other countries have instead introduced subsidies for fuel-efficient and alternative-fuel, hybrid, and electric vehicles. Examples include Sweden's *"Green Car Rebates program"* and Canada's *"Running on Green Power"* rebate program for electric vehicles. Schemes which combine fees and rebates, known by the portmanteau feebate, have been adopted in large jurisdictions, such as California in the US and Wallonia in Belgium, and in entire countries, such as France.

Bonus malus

Isis started to work on the French automotive market in 2009, one year after new regulation was implemented in favor 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."*

Her results show that French buyers overreacted to this 'feebate' policy, opting for fuel-efficient cars in large numbers: *"We believe this surprising effect is due to several elements: technological progress, making cars more efficient; the regulation and its effects on market prices; and, finally, buyers' growing preference for greener cars."*

France vs USA

In a new article, Isis and her co-author Mario Samano (HEC Montreal) compare the CAFE standards of the US with France's bonus-malus regulation, considering different levels of stringency. *"Our comparison keeps constant the two main outcomes of these policies: the fuel-efficiency gains and the tax revenue. This allows us to concentrate on the comparison of gains and losses for consumers, car manufacturers and the carbon emissions avoided across the two types of regulation."*

A key aspect of the study is that it accounts for the fact that cars are differentiated goods and therefore imperfect substitutes for each other. This has two consequences for environmental regulation. First, not all individuals will switch towards purchasing fuel-efficient vehicles when a tax levied on low-fuel economy cars is introduced. Second, car manufacturers will adjust their pricing strategies in response to the regulation.

"Both policies generate economic losses that increase with the policy stringency. However, the losses from a standard-type policy in the US are 10% higher than those of an equivalent feebate-type policy. In France, this difference is 70%"

Key results

The researchers find that feebate policies are consistently better than CAFE standard policies in both countries. This is the case because the feebate policy directly affects all car manufacturers while the standard-type policies do not directly impact car manufacturers that are above the standard. However, the effects vary across manufacturers. Feebate-type policies reward fuel-efficient car manufacturers and penalize the least fuel-efficient manufacturers but standard-type policies favor car manufacturers that are close to the standard.

"Both policies generate economic losses that increase with the policy stringency. However, the losses from a standard-type policy in the US are 10% higher than those of an equivalent feebate-type policy. In France, this difference is 70%. This gap is due to the differences in the fleet composition and consumer preferences in each country."

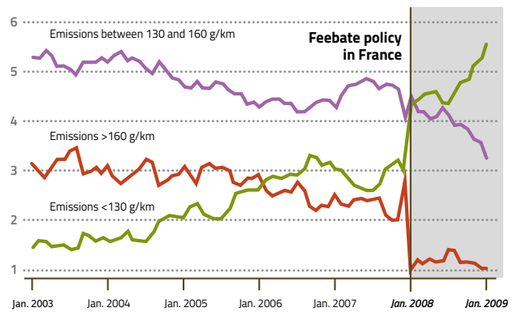
US reforms

Over the past decade, CAFE standards in the US have been reformed to make them more flexible for manufacturers. One modification allows for trading of fuel-efficiency credits among car manufacturers. In addition to the regular standard policy, this makes the CAFE standard equivalent to a feebate policy. Another reform consists of using attribute-based standards that impose lower fuel-efficiency standards on larger cars. Isis finds that this modification weakens the stringency of the policy for the US but not for France.

"It is very likely that environmental regulation triggers innovation, such as the introduction of hybrid versions of existing car models," Isis writes. *"In this scenario, feebate regulation generates net gains in both markets while standard regulation has positive effects only in the US and when accounting for the benefits from the reduction in carbon emissions."*

"It is very likely that environmental regulation triggers innovation, such as the introduction of hybrid versions of existing car models. In this scenario, feebate regulation generates net gains in both markets"

The 2008 'feebate' had a powerful impact on French buyers, who opted for fuel-efficient cars in large numbers



Taxing fuel

The researchers also compare standard and feebate policies to a fuel tax, which constitutes the simplest solution since it is based on car utilization. However, if a gasoline tax was put in place to achieve the same improvements in fuel efficiency as the standard and the feebate regulations, it would be necessary to have a fuel tax of 32% in the US and 15% in France. *"These high taxation levels would be necessary because fuel cost has only a mild effect on car purchase decisions. These numbers indicate that an effective fuel tax would not be politically feasible."*

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 favorably 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.

SUMMING UP

Isis's research suggests we need to take a step back in the design of environmental policies aimed at improving fuel efficiency and reducing greenhouse gas emissions from cars. Some policies perform consistently better than others even if the markets are very different.

"Our model hints that the French system is more efficient on the market," she says. "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."

FIND OUT MORE

Read *'To Rebate or Not to Rebate: Fuel Economy Standards vs. Feebates'* and other research by **Isis Durrmeyer** at www.tse-fr.eu

LATEST SCIENTIFIC STUDIES

SUBSIDIES FOR SOLAR POWER

OLIVIER DE GROOTE

Olivier is an assistant professor at TSE. His research is on applied microeconomics, within the fields of education, (labor) economics and industrial organization. He has worked on different topics, household decisions about new technologies and high-school students' educational choices. In most of his work he develops and estimates dynamic discrete-choice models to answer important policy questions.

How should subsidies be used to promote the adoption of solar photovoltaic (PV) systems? Analyzing the impact of a successful program to encourage the use of this technology in Belgium, Olivier De Groote finds that subsidizing upfront investment costs, rather than investment benefits, would have been a less expensive way to achieve the same results.

Many countries have relied on subsidies to promote the adoption of renewable energy technologies for electricity production, such as wind power and solar PV systems. This support has often been motivated on the grounds that there is not only an environmental externality (CO_2 emissions from fossil sources), but also a technology market failure (insufficient incentives to innovate and adopt a new technology). Subsidies for the green technologies often consist of a combination of investment subsidies, paid upfront at the moment of installation, and production subsidies, paid in the future when the systems are producing electricity (or equivalently, a combination of investment and production tax credits).

In a recent paper, forthcoming in the American Economic Review, Olivier and his coauthor Frank Verboven (KU Leuven) investigate the role played by upfront investment and future production subsidies. *"The adoption decision involves a fundamental trade-off between the immediate investment costs and the future benefits from electricity production,"* they write. *"The successful adoption of the new technology thus depends on how much households discount future benefits, and on the extent to which subsidies apply to the upfront investment costs or the future electricity production."*

Belgian largesse

Olivier's paper focuses on a generous program for residential solar PV systems, running in Belgium during 2006-2012, and responsible for a particularly high adoption rate compared with other countries. The program relied heavily on future production subsidies in the form of Green Current Certificates (GCCs), which were committed for up to 20 years. The program was similar to the German feed-in tariff system and several other European programs. US programs also involve production subsidies, but tend to rely more heavily on upfront investment subsidies.

The GCC subsidy program revised its conditions many times at preannounced dates. These revisions typically consisted of reductions in the future production subsidies, and applied only to new adopting households. This variation in future subsidies allows Olivier to identify the households' implicit discount factor in a reliable way. Furthermore, because the program mainly consisted of future production subsidies instead of upfront investment subsidies, it potentially enabled the government to shift the financial burden to future electricity consumers. Based on the estimated discount factor, Olivier can assess how costly this was.

To estimate how households discount the future benefits of a new technology, the researchers develop a dynamic discrete choice model, where in each period households face the decision to adopt the new technology or to postpone their investment. They first develop a model to be estimated with aggregate, country-level data. Next, to evaluate the robustness of their findings, they extend the model to account for rich forms of persistent observed and unobserved local market heterogeneity in a tractable way. This approach does not require specifying an explicit stochastic process for the expected state transitions, which would be particularly difficult for a new technology.

"The successful adoption of the new technology depends on how much households discount future benefits, and on the extent to which subsidies apply to the upfront investment costs or the future electricity production"

Results and policy implications

Although the program led to a massive adoption of solar PV systems, Olivier and his colleague find that households significantly discounted the future benefits from the new technology. They use an implicit real interest rate of 15% in evaluating these future benefits, which is much above the real market interest rate of about 3%. *"Put differently, this implies a considerable undervaluation of the future benefits from electricity production: consumers are willing to pay only approximately €0.50 upfront for €1 of discounted future benefits from electricity production."*

This finding of considerable time discounting is robust with respect to various assumptions about households' expectations on the value of current and future PV systems. It can either be interpreted as intrinsic consumer myopia or as mistrust in the government's commitment to pay out the future subsidies.

"This raises specific policy concerns, at least from a budgetary and distributional perspective. Upfront subsidies instead of future production subsidies would have reduced public expenditures by €1.9 billion (or 51% of the amount spent). This is a saving of more than €700 per household, a very large number given that only 8.3% of the households had adopted a PV at the end of the program." The researchers conclude that there was a high public cost in shifting the subsidy burden to future households, as they pay for the subsidy through higher electricity prices.

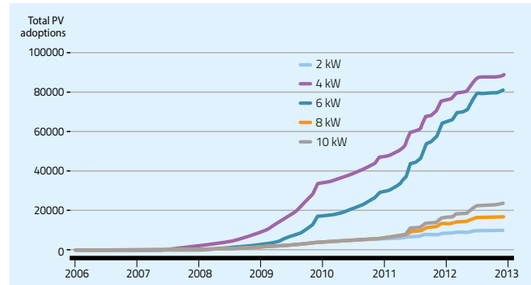
"Upfront subsidies instead of future production subsidies would have reduced public expenditures by €1.9 billion (or 51% of the amount spent). This is a saving of more than €700 per household"

Future research

Recent evidence points to moderate undervaluation to correct valuation for energy-saving investments of existing, mature technologies (such as cars). Olivier's findings indicate that consumers may discount the future benefits more when adopting an entirely new green technology.

Several directions of future work are possible. *"First, in our sensitivity analysis we found little heterogeneity in discounting across consumers. If such heterogeneity is more important, subsidization policies would have additional distributional effects, and may need targeting to consumers with a low discount factor. Another path of research is to extend the model to account for peer effects, which may provide a rationale for a subsidy path that is declining over time. Third, it would be interesting to use our framework to study the adoption of new technologies in other applications. Regarding renewables, we focused on residential PV adoption, and further work could investigate whether commercial PV adopters discount future benefits in the same way. It would also be interesting to apply our framework to other countries or regions, or to other renewable technologies, such as wind power, to analyze how different subsidy schemes may influence the outcomes."*

2006-2012: Solar panel adoption in Flanders, according to capacity



FIND OUT MORE

Read *'Subsidies and Time Discounting in New Technology Adoption: Evidence from Solar Photovoltaic Systems'*

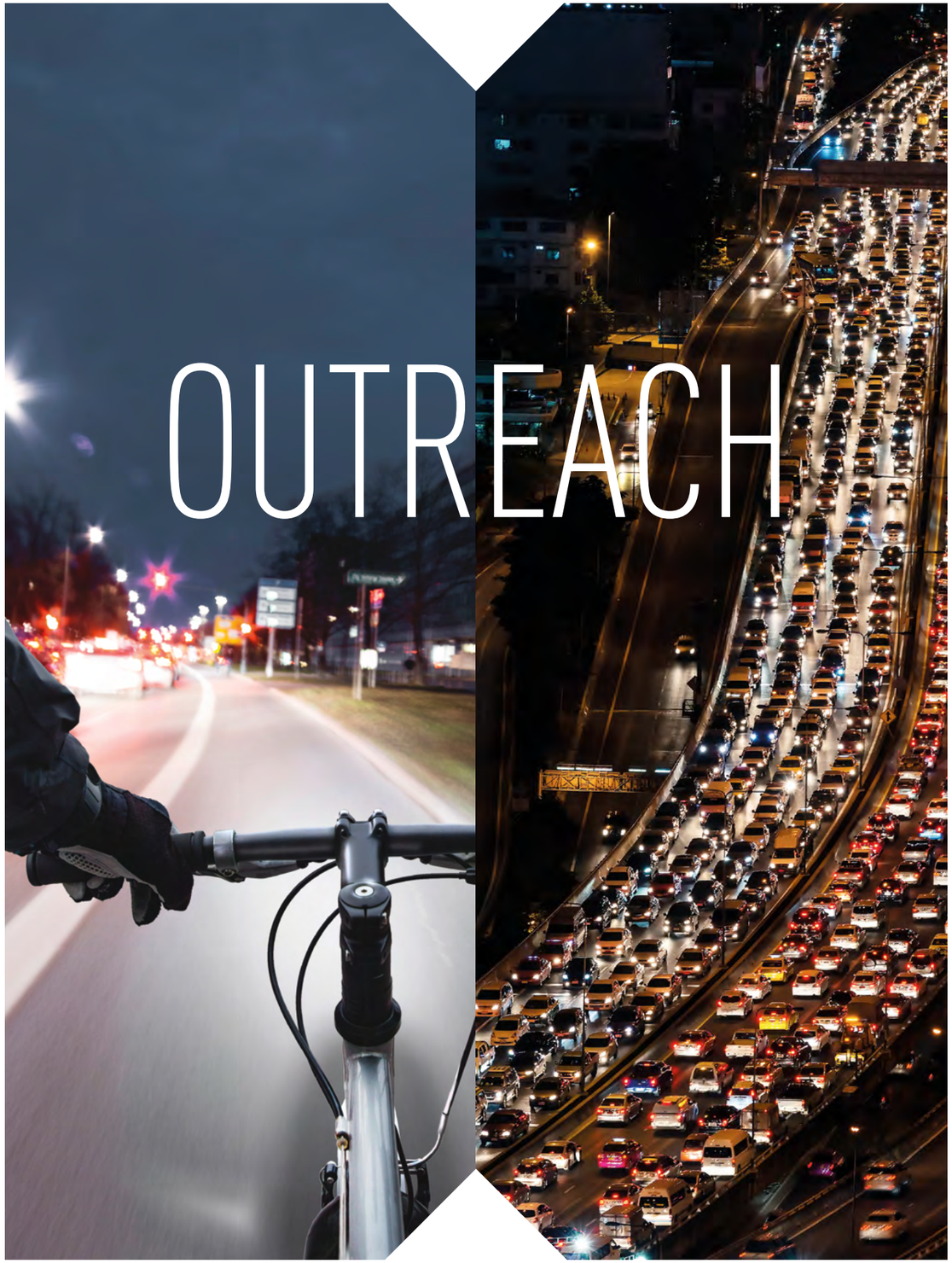
and other research by

Oliver De Groote

at www.tse-fr.eu

SUMMING UP

This paper studied the incentives to adopt a new renewable energy technology for electricity production, and the role played by upfront investment and future production subsidies. The researchers considered a generous subsidy program for solar PV adoption, and exploited rich variation at pre-announced dates in the future subsidy conditions. Although the program led to a massive adoption of solar PV systems, they find that households significantly undervalued the future benefits from the new technology. The government could have saved 51% or €700/household by giving upfront investment subsidies, and it essentially shifted the subsidy burden to future electricity consumers.



TSE Great Debate
March 11th

ECOLOGICAL TRANSITION

On the occasion of the National Great Debate initiated by the French government, TSE organised a debate on the ecological transition in which more than 100 participants engaged with two of the Center's economists. *(Video: https://bit.ly/2GV3Ffq)*

What solutions to climate change?

Debate led by TSE Director, ***Christian Gollier***

KEY PROPOSALS

- Implement effective policy to limit global temperature increase to 2°C
- Establish a global and universal carbon price set at around €40 per tonne of CO_2
- Organize a coalition of countries willing to tax carbon and imports from non-members
- In France, eliminate all hidden subsidies and exemptions for CO_2 - emitting products

The fight against climate change is now at the forefront of international issues; the human impact of the impending disruption is widely recognized. Climate change takes the form of global warming of the planet, due to greenhouse gas emissions and in particular CO_2. Climatologists predict that the increase target set during the Paris Agreement will be exceeded by 2°C in 20 years' time, if the amount of CO_2 emitted each year continues in this direction.

If we want to fight climate change, we must therefore fight against the emission of this gas.

The measures taken so far have not had the expected effects: subsidies are complicated to implement in a difficult budgetary context, the addition of standards has not prevented some companies from cheating, biofuels contributed to the hunger crisis of the 2000s due to the use of agricultural land that used to produce consumer goods, solar panels have proved to be expensive and inefficient…
As climate change is largely linked to individual behavior, it is at this level that measures must be effective: the danger is to make the population think that the solution can only come from "above".

In response to these findings, economists propose setting a global carbon price.

The aim here is to realign individual interests with the general interest through an incentive system. There is now an imperfection in the carbon market, as its price does not reflect the cost to society. This negative externality should therefore be taken into account in the carbon price, in order to modify the quantities consumed so that they adapt to the ecological constraints we face.

OUTREACH

Using the polluter-pays principle, the price of CO_2 should be around €50 per tonne, compared to €24 (price of permits in Europe) and €44 (carbon tax in France).

The result of this measure would naturally be a reduction in CO_2 emissions due to the increase in its price, so that we would fall below the emission limits that would lead to a 2°C increase in global temperature.

To be effective, this price should necessarily be global and not suffer from any exceptions. It would apply to both households and businesses, regardless of the type of transport or fuel, which is not the case today with the exemption from taxes for kerosene, shipping, taxis, etc.

Such a proposal, leading to an increase in the carbon price, is subject to the risk of political implementation difficulties, because it may appear socially unfair. Social movements in France, particularly the recent yellow-vest movement, show that the idea of a carbon tax is not well received. President Emmanuel Macron has stopped the increase in the carbon tax planned by the previous government, which was supposed to increase until 2030.

"To become socially acceptable, the cost of the tax would have to be offset by a fairer redistribution of income. The measure should also take into account the impact on businesses"

To become socially acceptable, the cost of the tax would have to be offset by a fairer redistribution of income. The measure should also take into account the impact on businesses.

The second problem with a global carbon price is the difficulty of reaching an agreement between countries. However, this agreement is necessary to avoid the phenomenon of free riders, which means that some countries take advantage of the efforts made by others wihtout contributing themselves, which leads to general inaction.

A solution to this problem has been proposed by William Nordhaus, 2018 Nobel Prize winner in economics, who suggests forming, as a first step, a coalition of several governments that would agree to tax carbon and imports from countries that are not part of their coalition, in order to encourage them to be part of this agreement. In this way, we would leave the agreement *"on the lowest common denominator"*; countries that refuse a global carbon price, set by the coalition, would suffer a major handicap in international trade. This could lead them to align with the rules and objectives set.

In addition, this measure should be followed by an evolution of the analysis, in particular with the implementation of new tools to take into account the negative externalities brought to nature and the environment. The Gross Domestic Product (GDP), which is now widely used in economic analysis, is therefore not very suitable since it does not take environmental costs into account.

It is strange that these new tools and indicators have not really emerged, even though we have a fairly reliable monitoring of CO_2 emissions. The legislature should therefore rely on this data to develop other units of measurement and implement complementary measures.

TSE Great Debate
March 11th

Where's the beef?

*Debate led by **Zohra Bouamra Mechemache**, researcher at TSE and INRA - (Video: https://bit.ly/2GV3Ffq)*

KEY PROPOSALS

- Increase awareness of the importance of CO_2 emissions from agriculture, and livestock in particular
- Focus on the link between health and environmental impacts
- Implement combined measures to influence supply and consumption, through incentives to reduce demand
- Direct meat consumption towards products that are both nutritional and environmentally friendly

With 20% of total carbon emissions, agriculture is the third-largest contributor. Adding the food sector, this increases to a quarter of these emissions. Despite the positive impacts of grasslands, this sector remains extremely polluting, mainly because of methane emission and the intensive crops necessary for the production of food for livestock, which forests do not absorb.

Eating less meat and more vegetables is healthier, for us and for the planet.

Of all animal products, beef is the most CO_2-emitting product. On the other hand, vegetable products are the most virtuous.

It therefore seems necessary to reduce meat consumption, for environmental reasons on the one hand, but also because such a policy would also have a positive impact on health.

However, the solutions to this problem are unclear. Studies show that tax leverage is not very effective in reducing demand. A tax of €200 per tonne of CO_2 would, for example, reduce the quantities emitted by 6% while representing an increase in costs of 3% for the consumer. Taxes therefore do not seem to be a good solution to reduce the impact of this sector on the environment.

Other solutions such as food-labelling policies were then considered. But again, the results of these initiatives have been disappointing. Information campaigns are few and far between.

However, despite these failures, demand for meat can decrease in a more natural way. Indeed, demand for meat in France takes form of an inverted "U": demand increases when incomes increase up to a certain threshold where the demand starts to decrease, which could be explained by the impact of nutritional information on high-income consumers.

Some initiatives have been put in place, such as the organization of *"Green Mondays"*, encouraging the population not to eat meat on that day. The increase in consumption of processed products that generally contain little meat also has a negative impact on demand, although these products pose other health-related problems.

The authorities have a simple way to reduce meat consumption and improve the education of the youngest children on this subject by reducing the quantities of meat served in school canteens, with catering outside the home accounting for nearly 20 to 30% of meal.

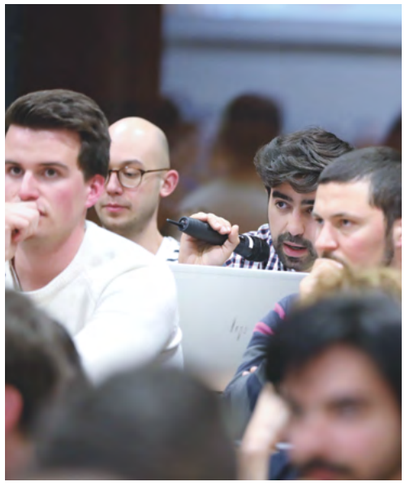
In a survey, most participants in this debate said they were ready to reduce their meat consumption.

This may indicate that behavior is not completely fixed and that debate can be useful to make citizens understand that a reduction in their meat consumption is necessary.

It is also a question of directing this meat consumption towards more responsible types of production. The negative impact of livestock farming can be limited if we promote high-quality products, which also have virtues such as the protection of certain regions, and which represent part of France's heritage in terms of culture and way of life.

Producers could also benefit from such a change, as shown by the evolution of the wine sector, where the quantity consumed has decreased while the quality has increased.

"It therefore seems necessary to reduce meat consumption, for environmental reasons on the one hand, but also because such a policy would also have a positive impact on health"



TSE Energy and Climate Forum

THE RENEWABLE ENERGY CHALLENGE

Organised in collaboration with **CCI France Belgium** with the overwhelming participation of over 80 stakeholders, this forum served as a platform **to bring together researchers and key industrial actors, who exchanged views on the major issues of renewable energy development and the impact of their integration into the energy market.**

TSE researchers ***Stefan Ambec*** and ***Stefan Lamp*** presented their research projects followed by a round table on: ***"The challenges of the penetration of renewables in the energy mix"*** moderated by Simon François, RTL Belgium.

Stefan Ambec

Stefan Lamb

The panel consisted of **Tom Van de Cruys**, *(VP, Total Gas & Power)*; **Christian Gollier** *(Director, TSE)*; **Jean-Pierre Hansen** *(Advisor, Engie)* and **Jacques Merley**, *(Head of the Downstream Division in the Group Strategy Department, EDF).*

The opinions of the round-table participants on the future of the energy mix were both diverse and convergent. Christian Gollier, TSE Director, initially acknowledged that the energy transition would be costly, but that the Pigouvian principle of a carbon tax is fairer than the existing environmental policies: the implicit carbon cost of the latter is at the level of €1,300 per tonne of CO_2, well above the level of around €50 per tonne of CO_2 proposed by the French government.

Tom Van de Cruys presented Total's vision, explaining that Total already calculates investments using a carbon price, and that the company has been evolving over the past few years from a pure oil tanker to a *"gas, oil and electricity company"*. VP Total Gas & Power explained that this change will come mainly from large groups that have the ability to make the necessary investments. The company is now investing in

energy storage facilities and in a demand-side management system. To respond to the intermittency of renewable energies, it is a strong predictor of the growth of gas in the energy mix.

On EDF's side, Jacques Merley questioned the social sustainability of a strategy relying only on a *"carbon price signal to end user"*, explaining that parts of the population do not all have the same redeployment possibilities, and that this would have an income effect depending on its price elasticity. Christian Gollier refuted this point, explaining that this inelasticity only exists in the short term, and that individuals adapt in the medium and long term. The Head of the Downstream Division in the Group Strategy Department advocated a strategy mixing market carbon pricing and regulations made consistent through shadow value of carbon. He was also confident in the low-carbon energy vector produced by EDF, chose to talk more about solutions in mobility or housing, such as electric buses or house insulation. This point also interested Jean-Pierre Hansen, who questioned the investment delays in energy saving in buildings.

"Change will come mainly from large groups that have the ability to make the necessary investments"

The latter, as an advisor at Engie, shared three ideas from the forum and the round table: that uncertainties are still present and renewable technologies also carry them, that integrating them into the energy mix will be costly, and that it will be imperative to diversify your electricity fleet. Jean-Pierre Hansen explained that the guiding principle will rather come from policies, because markets are not able to give these price signals and do not have the opportunity to do so when policies *"crop the wings"* of the industry. He concludes that it is necessary to diversify its energy mix but in a flexible way, taking the United Kingdom as an example.

The degree of interventionism on the part of the state in the choice of the energy mix was a central theme of this round table. Tom Van de Cruys (Total) pointed out the uncertainty even in the related roles of the state and industry, so Jean-Pierre Hansen (Engie) and Jacques Merley (EDF) agreed on the importance of consistency in the process, stressing that it is often difficult and rare to give market forces the freedom to act naturally. Jean-Pierre Hansen, in response to a question from the public, explained that this is one of the reasons why liberalisation in Belgium in the 1990s was disappointing, advocating the use of other methods, such as market auctions.

The implicit carbon cost of existing environmental policies is at the level of €1,300 per tonne of CO^2, well above the level of around €50 per tonne of CO^2 proposed by the French government.

The round table concluded with a question about Europe's role in decarbonising the world, in a context where environmental policy decisions are not necessarily aligned. After presenting the divergent strategies between nations, Christian Gollier raised the idea of climate coalitions with an import tax on carbon for other countries. EDF and Total speakers concluded by indicating that it would be easier to promote low carbon solutions by stressing their advantages in regards to outcomes in health and pollution.

ANALYSIS

PUBLIC DEBATE

TSE researchers regularly express their opinions and analysis on topics of public interest in the media and on the TSE Debate blog. All the blog posts of the members of the Center can be consulted in the *"Energy"* section of the portal.

Here we feature some of the recent posts, articles and media interviews.

POSTS

- **Can trees and poles live side by side?** - *Stefan Ambec, Claude Crampes - April 15, 2019*
  https://www.tse-fr.eu/can-trees-and-poles-live-side-side
- **Which standard should be implemented for charging electric vehicle batteries?**
  Claude Crampes, Yassine Lefouili - February 7, 2019
  https://www.tse-fr.eu/which-standard-should-be-implemented-charging-electric-vehicle-batteries
- **Regulated access to incumbent nuclear electricity?** - *Stefan Ambec, Claude Crampes - January 15, 2019*
  https://www.tse-fr.eu/regulated-access-incumbent-nuclear-electricity
- **Carbon tax à la française** - *Stefan Ambec, Claude Crampes - December 13, 2018*
  https://www.tse-fr.eu/carbon-tax-la-francaise

ARTICLES IN PRESS

- **L'industrie financière doit s'engager à prévenir la menace d'une prochaine grande crise écologique et sociale**
  Stephane Villeneuve & collective - Le Monde, January 29, 2019
- **Cut out meat and fish once a week, say French stars**
  Nicolas Treich - The Connexion, January 03, 2019
- **L'appel des 500 pour un "lundi vert" : *"Nous nous engageons à remplacer la viande et le poisson chaque lundi"***
  Nicolas Treich - Le Monde, January 02, 2019
- **Qu'attendons-nous pour sauver la planète ?**
  Christian Gollier and Jean Tirole - Le Point, October 24, 2018

INTERVIEW

- **Green "meat free" Monday campaign kicks off in France**
  Nicolas Treich - RFI, January 7, 2019
- **Marc Ivaldi, économiste : *"Le diesel et l'essence ont encore de l'avenir"***
  Marc Ivaldi - La Dépêche du Midi, January 02, 2019
- **Taxer pour mieux respirer**
  Christian Gollier - France Culture, November 15, 2018

Toulouse School of Economics

Energy & Climate Center

TWELFTH CONFERENCE ON THE ECONOMICS OF ENERGY AND CLIMATE

TOULOUSE, JUNE 18-19, 2019

The objective of the conference, organized by the TSE Energy and Climate Center at Toulouse School of Economics, 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.

GEMCLIME
Global Exchange in Modelling of Climate and Energy

Alfred P. Sloan FOUNDATION

Publication Director: Stefan Ambec
Editor in chief and Production Manager: Priyanka Talim
Editorial contributions: Valerie Furio - James Nash
Graphic design and layout: Olivier Colombe
Photos: StudioTchiz, Boris Conte, I-Stock
Pictures: I-Stock

Toulouse School of Economics

www.tse-fr.eu
21 Allée de Brienne
F-31015 Toulouse Cedex 6
Tel. : +33 (0) 5 67 73 27 68

Contact: priyanka.talim@tse-fr.eu