Workshop

Economic Challenges for Energy

7 and 8 February, 2011

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economics for energy

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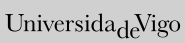

Program

Monday, 7 February

8.30 - 9.00	Registration
9.00 - 9.30	Welcome address
9.30 -11.30	**Energy demand and energy efficiency**
	Energy intensity in Spain. *María Mendiluce, World Business Council for Sustainable Development, Geneva (Switzerland)*
	Fuel prices and fuel consumption. *Nolan Ritter, Rheinisch-Westfälisches Institut für Wirtschaftsforschung, Essen (Germany)*
11.30 - 12.00	Coffee break
12.00 - 14.00	**Energy security**
	Energy security indices in Europe. *Beatriz Muñoz, Universidad Nacional de Educación a Distancia, Madrid (Spain)*
	Prospects for oil supply. *Jean-Marie Chevalier, Cambridge Energy Research Associates, Paris (France)*
14.00 - 15.30	Lunch
15.30 - 17.30	**Innovation in energy**
	Potential impacts of smart grids on building energy use and demand. *Harvey Michaels, Massachusetts Institute of Technology, Cambridge (USA)*
	Government policies for innovation in energy. *Laura Díaz-Anadón, Harvard University, Cambridge (USA)*
20.00	Gala Dinner
	Guest Speaker: *Massimo Tavoni, Fondazione Eni Enrico Mattei (Italy)* on **The economics of climate mitigation: what can integrated assessment models teach us?**

Tuesday 8 February

9.00 - 11.00	**Energy and climate policies**
	Carbon pricing for low-carbon investment. *Karsten Neuhoff, Deutsche Institut für Wirtschaftsforschung, Berlin (Germany)*
	Auctions for renewable energy support. *Pedro Linares, Economics for Energy and Universidad Pontificia Comillas, Madrid (Spain)*
11.00 - 11.30	Coffee break
11.30 - 13.30	**Long-term energy prospective**
	The future of US natural gas production, use and trade. *Melanie Kenderdine, Massachusetts Institute of Technology, Cambridge (USA)*
	Energy scenarios towards decarbonisation in the European Union by 2050. *Pantelis Capros, National Technical University of Athens, Athens (Greece)*
13.30 - 15.00	Lunch
15.30 - 16.30	**General Assembly, Economics for Energy**
16.30 - 17.30	**Economic challenges for energy**
	Session open to media and general public
	Xavier Labandeira, Pedro Linares

> Energy demand and energy efficiency

Energy intensity in Spain

Managing energy demand is a key element of energy policies by allowing countries to advance towards the goals of reducing the cost of energy supply, minimizing environmental impact and increasing energy security. Energy intensity, an indicator that reflects the relationship between energy consumption and the volume of economic activity, is often used to measure the energy efficiency of the economies. Spanish energy intensity has experienced a peculiar and undesirable path in recent years. While the rest of the countries in our geographical and economic environment presented a decreasing trend, Spanish energy intensities grew steadily between 1995 and 2005, when it began to decrease. In 2008 Spanish energy intensity was 19% higher than the EU-15.

An assessment of the drivers for this divergent behavior is made using the decomposition methodology. The analysis includes energy consumption of households and all productive sectors, covering also the power plants and transportation of passengers and goods. A methodology to analyze the direct and indirect energy consumption is presented to help identify key sectors in the Spanish energy intensity evolution.

Fuel prices and fuel consumption

A critical issue in gauging the effectiveness of efficiency gains concerns how consumers adjust to altered unit costs. While, for example, higher fuel prices raise the cost of driving, improved efficiency of automobiles reduces them, thereby stimulating the demand for car travel. Such demand increases are referred to as the rebound effect, as it offsets the reduction in energy demand that results from an increase in efficiency.

After introducing the various definitions and the scope of the rebound found in the scientific literature on automotive travel, a recent study by Frondel, Ritter and Vance (2010) using both panel estimation and quantile-regression methods on household travel diary data collected in Germany between 1997 and 2009 is presented in detail. This study investigates the heterogeneity of the rebound effect in private transport. With the average rebound effect being in the range of 57% to 62%, which is in line with a recent German study by Frondel, Peters, and Vance (2008), it is substantially larger than those obtained from other studies. Furthermore, the quantile-regression results indicate that the magnitude of estimated fuel price elasticities -- from which rebound effects can be derived, depends inversely on the household's driving intensity: Households with low vehicle mileage exhibit fuel price elasticities, and hence rebound effects, that are significantly larger than those for households with high vehicle mileage.

> Energy security

Energy security indices in Europe

The term energy security is common currency in the energy field. However, a degree of conceptual heterogeneity has led to something of a lack of consensus on its definition. At the same time, a variety of studies have aimed to analyze, classify and measure energy security and risk. However, this has not led to a convergence on a shared understanding: different authors have produced a set of assorted indicators, responding to different factors. Therefore, a distinction can be drawn between simple (or disaggregated) and composite (or aggregated) indicators. In this regard, the Socioeconomic Energy Risk Index has been developed by the Research Group on International Political Economy and Energy (UNED) for the project Risk of Energy Availability: Common Corridors for European Security of Supply (REACCESS). This project, financed by the 7th Framework Programme of the European Commission, has been carried out with the participation of 14 partners.

Thus, in this session, we will approach to the qualitative and quantitative analysis of risk of energy security of supply, providing some examples of attempts to measure this concept. Moreover we will emphasize on the elaboration and results of the Socioeconomic Energy Risk Index, as well as, on the evolution and outcomes of the REACCESS project up to now.

Security of oil supply

The evolution of world primary oil demand presents a wide range of uncertainties between now and 2035. The three basic scenarios of the International Energy Agency give very contrasted images for the year 2035. On the demand side, the demand for crude oil and petroleum products will be different from one country to another. The main driving forces are economic growth, the price, and the environmental constraints. A "peak demand" has probably already appeared in the United-States. On the supply side, reserves are here with possible substitutions of oil by natural gas. The main question is not geological resources but the amount of investment to be done for transforming existing reserves into productive capacity. Factors limiting investments are country and technical risks, oil nationalism, environmental constraints. The "peak oil" is once more delayed. Oil and gas resources are highly concentrated in the hands of a few countries, most of them being "countries at risk". One conclusion is to decrease our oil dependence and to diversify our energy balances.

> Innovation in energy

Potential impacts of Smart Grid on building energy use and demand

Building energy impacts are an important part of the determination as to whether Smart Grid investment is cost-effective for utilities and society. Smart Grid network architecture choices made today, which are strongly guided by the policies of state and federal regulatory authorities, will influence the future impacts of the Smart Grid on energy use in buildings. What is the ideal combination of meter, network communication and customer-side technologies? MIT's analysis of the implications of different architectures, looking 5 to 10 years ahead, seeks to inform policymakers on questions such as:

- Demand Response: How much potential exists to save energy as well as demand through control strategies?
- Dynamic Pricing: How does time-differentiated pricing impact consumer energy behavior? What characteristics of technology and analytic support to will encourage consumers to further respond?
- Granular Data: What is the potential of short interval energy data to support diagnostics that impact behavior and help identify malfunctioning controls and equipment? How may collective information feedback (community/GIS) add to individual motivation?

Government policies for innovation in energy

Most researchers and analysts agree that if the world is to meet the interlinked environmental, security, and economic challenges associated with our current energy system, we will need to accelerate innovation in energy technologies. The innovation process includes research, development, demonstration, market formation, and widespread diffusion. These stages depend on and feed into each other. Innovation involves various types of institutions, ranging from national and local governments, to private firms, trade associations, and universities. According to an innovation systems perspective, government policies affect all stages and all actors.

The Energy Technology Innovation Policy (ETIP) research group at Harvard is using this innovation systems perspective to learn about effective, efficient, and socially and culturally appropriate policies to accelerate energy innovation. This presentation will discuss some of ETIP's research, including:

- Government investment portfolios.
- Private sector investment in energy RD&D and the role of policy.
- Government RD&D institutions.
- Policies stimulating technology adoption and diffusion.

The economics of climate mitigation: what integrated assessment models teach us?

Integrated assessment models (IAM) are important tools for assessing the feasibility and the strategies needed to achieve a low carbon economy, as for example can be seen by their role in the IPCC reports. This talk will provide an insider view of the status of international modeling and of the main insights and limitations that can be drawn from their analysis.

> Energy and climate policies

Carbon pricing for low-carbon investment

The European Directive on Emission Trading provides a legal framework for the European carbon market that is lasting beyond 2020. However, the UN conference in Cancun and the discussions on international carbon credits (CDM) illustrated the shift of international climate cooperation, from carbon markets to nationally defined mitigation policies and a set of public finance and technical cooperation mechanisms to provide international support.

With less emphasis on international carbon markets, the primary focus of the European Emission Trading scheme is to support low-carbon development in Europe. CPI and CS explored, whether the EU ETS is an effective policy instrument to capture the attention of firms, provide clear guidance for strategy and investment choices and support the implementation of low-carbon choices:

- The EU ETS is a visible policy instrument that can demonstrate that governments are serious in translating emission reduction targets into action. It captures the attention of decision makers in organizations, which is the first step to prioritize climate against many competing interests. International Financial Reporting Standards need to make carbon costs and opportunities fully visible to investors.
- The EU ETS is an effective mechanism to translate an emission trajectory into a carbon price. This allows the integration of climate policy in strategic decision making processes. Its implementation needs to be further simplified so that business can assess the new opportunities and challenges the EU ETS creates when making operational, investment and strategic decisions.
- The EU ETS delivers a carbon price today, and established a robust mechanism for future carbon price formation. The carbon price enhances profitability of low-carbon processes and products and is thus essential for shifting corporate and finance choices. The response to EU ETS remains however limited in sectors where the stringency and carbon price is not high enough to warrant action.

Auctions for renewable energy support

The large increase in renewable energy deployment in many countries is making much more salient the economic support required for this deployment, and therefore increasing the pressure for reducing it. On the other hand, the coordination required in many regions between higher-level economic support and lower-level licensing also asks for mechanisms able to incorporate naturally this coordination.

In this presentation we revisit an often maligned instrument for the promotion of renewable energy, auctions, which however are theoretically superior in many respects to the current feed-in-tariffs or green certificate systems, particularly regarding coordination between different administrations, and also regarding the achievement of lower support levels. After many negative experiences, auctions have been readopted in some countries, Brazil being probably the most relevant example.

Based on these experiences, we propose a new design for renewable energy auctions, which tries to address some of its shortcomings and may become an interesting tool for pushing forward renewable energy deployment globally.

> Long-term energy prospective

The future of US natural gas production, use and trade

The overarching conclusions of the MIT Future of Natural Gas Interim Study, released in June, 2010, is that there are significant global supplies of conventional and unconventional natural gas and that gas natural gas will play a leading role in reducing greenhouse-gas emissions over the next several decades, largely by replacing older, inefficient coal plants with highly efficient combined-cycle gas generation. The focus of the study is on North American gas markets but also reviews key aspects of the global gas marketplace.

Kenderdine's discussion will focus on the study's set of findings and proposals for legislative and regulatory policies, as well as recommendations for industry actions that maximize the impacts of gas consumption on mitigating greenhouse gas emissions. Some of the study's key findings include:

- The US has a significant natural gas resource base, about 92 years' worth at present consumption rates. Much of this is from unconventional sources, including gas shales. Globally, baseline estimates show that recoverable gas resources probably amount to 16,200 trillion cubic feet (Tcf), a total that does not include unconventional gas resources other than those in the US and Canada;
- Environmental issues associated with producing unconventional gas resources are manageable but challenging;
- In a carbon constrained environment, natural-gas consumption will increase dramatically and will largely displace coal in the power generation sector by 2050;
- There will be a smaller role for natural gas in the transportation sector, largely in the form of compressed natural gas vehicles, with some opportunities for methanol
- The introduction of large intermittent power generation from wind and solar will have specific proximate and long term effects on the mix of generation technologies; and
- A global "liquid" market in natural gas with diverse supplies, and transparent prices set by supply and demand, is desirable for consumers.

Energy scenarios towards decarbonisation in the European Union by 2050

Using the energy model PRIMES, E3MLab is quantifying energy system scenarios for the European Union member-states which aim at reducing greenhouse gas emissions by 80% in 2050 compared to 1990 and by 40% in 2030. The scenarios simulate considerable changes in fuel and technology mix in all demand and supply sectors, assuming a combination of bottom-up policy measures (such as technology or consumption standards) and price signals (such as carbon pricing). Decarbonisation in power generation allows electricity to substitute for fossil fuels in demand sectors, including in transportation. The power sector evolves by deploying a balanced mix of low carbon options with great emphasis on renewables complemented with CCS development and nuclear energy in some member-states. Energy efficiency progress is shown as a cornerstone of the decarbonisation scenarios, enabled by considerable savings in buildings and the wide use of eco-design appliances and equipment. Electricity saved in houses and buildings is replaced by new demand for electricity arising in transport. A series of sensitivity analysis scenarios explore the impact of possible failures in the deployment of key decarbonisation options. The model-based analysis provides insights about the impacts on costs, prices and investment. The results show that an ambitious decarbonisation roadmap to 2050 is feasible but requires a steady and well regulated investment effort to be undertaken by both demanders and suppliers of energy. Stable long-term policies and anticipations with reduced uncertainty are crucial for limiting cost and price impacts.

María Mendiluce, *World Business Council for Sustainable Development, Geneva (Switzerland)*

María Mendiluce is Manager in the World Business for Council Sustainable Development in Geneva, where she has focused her efforts in the past two years in developing business positions on the areas of technology and finance, coordinating position reports on enabling frameworks for technology deployment, R&D, IPR, among others. She has directed a project on engagement models of the private sector in international processes contracted by DG Entreprise (European Comission). She works closely with the UNFCCC Secretariat and the International Energy Agency on these areas. Previously she was the Advisor on Sustainable Development to the Spanish Prime Minister, a role that included the preparation of the Spanish Strategy on Sustainable Development. She previously worked as Chairman Staff in Iberdrola, and as energy analyst in the International Energy Agency. She has a PhD degree in the Universidad de Comillas (Madrid) with her thesis being on "The evolution of the Spanish energy intensity". She holds an MBA from the Henley Management College (United Kingdom) and a Bachelor degree in Business Administration from the University of Navarra (Spain).

Nolan Ritter, *Rheinisch-Westfälisches Institut für Wirtschaftsforschung, Essen (Germany)*

Nolan Ritter studied Economics at Universität Duisburg, Germany. His thesis on volatility analysis of stock returns was awarded the First Prize of the Duisburger National-Bank-Preis. He is a Research Associate for the competence area Environment and Resources of Rheinisch-Westfälisches Insitut für Wirtschaftsforschung (RWI), a modern center for scientific research and evidence-based policy advice.

Since 2008, Nolan Ritter worked on several projects, among them: the CO_2-Monitoring of the voluntary agreement on climate protection of the German manufacturing industry, the estimation of the energy consumption of private households that is based on a survey panel of 10.000 households, and, finally, the analysis of the social dimension of the rebound effect.

Nolan Ritter has published in peer-reviewed national and international journals, such as Accident Analysis and Prevention and Energy Policy. In addition, he was a reviewer for a host of journals, not least The Energy Journal. The emphasis of his research is on applied econometrics in the fields of environmental, resource, and energy economics. He presents his research at international conferences, e.g. those of the International Association for Energy Economics (IAEE) in Vienna (2009), Vilnius (2010) and Calgary (2010).

Beatriz Muñoz, *Universidad Nacional de Educación a Distancia, Madrid (Spain)*

Beatriz Muñoz Delgado is a Researcher at Department of Applied Economics (UNED). Graduated in Economics at UAM (Universidad Autónoma de Madrid). PhD Student granted by UNED on energy corridors and security of supply, especially on MENA countries, EU and Turkey. Member of the Research Group on International Political Economy and Energy (UNED), GANETU (UAM), Hispanatolia and the Spanish Oriental Society.

Jean-Marie Chevalier, *Cambridge Energy Research Associates, Paris (France)*

Jean-Marie Chevalier is currently Professor of Economics at the University of Paris-Dauphine, Director of the Centre de Géopolitique de l'Energie et des Matières Premières (CGEMP). He is also a Senior Associate at Cambridge Energy Research Associates (IHS/CERA, Paris office), member of the Conseil d'Analyse Economique (CAE) of the French Prime Minister, member of the Cercle des Economistes. He has published numerous books and articles on energy economics and industrial organization. The most recent are: Les grandes batailles de l'énergie (2005), Les marchés européens du gaz et de l'électricité: un défi pour l'Europe et pour la France (2008), Les 100 mots de l'énergie (2008), The

New Energy Crisis: Climate, Economics and Geopolitics (2009), Report on Oil Price Volatility (Report for Mrs Christine Lagarde, French Minister of Economy, Industry and Employment 2010). Jean-Marie Chevalier graduated from the Institut d'Etudes Politiques de Paris and holds a PhD in economics from the University Pantheon-Sorbonne. He is professeur agrégé des Facultés de Sciences Economiques.

Harvey Michaels, *Massachusetts Institute of Technology, Cambridge (USA)*

Harvey Michaels teaches energy efficiency with focus on strategy innovation, and directs the MIT Energy Efficiency Strategy Project, which includes business/policy studies of utility, community, and smart grid-enabled efficiency deployment models. Harvey also participates in the MIT Energy Initiative and the Campus Energy Task Force.

From 1997 to 2007, Harvey led Nexus Energy Software (now Aclara Software) which builds utility efficiency and customer service Web sites, as well as Meter Data Management systems. Before founding Nexus, Harvey was president of XENERGY (now part of Kema Consulting and Con Edison Solutions), which specialized in efficiency resource studies and analysis systems.

Laura Díaz-Anadón, *Harvard University, Cambridge (USA)*

Laura Díaz-Anadón is the Director of the Energy Technology Innovation Policy research group and the Associate Director of the Science, Technology, and Public Policy Program at the Harvard Kennedy School of Government at Harvard University. Dr. DíazAnadón investigates the patterns and processes of energy-technology innovation, and especially the role of government policy in the development and deployment of advanced and cleaner energy technologies.

Díaz-Anadón has worked as a consultant for the United Nations Framework Convention on Climate Change (UNFCCC) Expert Group on Technology Transfer on the role of intellectual property rights enabling climate mitigation and adaptation in the emerging economies and developing economies. She has also worked as a consultant for Climate Strategies on a World Bank InfoDev project on how to utilize the experience of UNIDO's National Cleaner Production Centers to design Climate Innovation Centers to help developing countries accelerate the deployment of climate technologies, companies and industries. She has served as an expert in the strategic review of the U.S. Department of Energy Office (DOE) of the Chief Financial Officer, and presented her work on portfolio analysis to several high-level policy makers at DOE and the Whitehouse. She also serves on the advisory board of the International Energy Agency's project on Accelerating Energy Technology Innovation. She has been consulted by policy organizations including China's Energy Research Institute of the National Development Reform Comission and the EU Directorate General for Research, and firms, such as Exxon Mobile, and Google.org.

Díaz-Anadon holds a Ph.D. in Chemical Engineering from the Magnetic Resonance and Catalysis Group at the University of Cambridge (UK), a Master in Public Policy from the Harvard Kennedy School, and a Master in Chemical Engineering from the University of Manchester (UK). She has also studied and worked on research on fuel cells at the University of Stuttgart (Germany).

Massimo Tavoni, *Fondazione Eni Enrico Mattei, Venice (Italy)*

Massimo Tavoni is senior researcher at FEEM and research associate at the Princeton Environmental Institute. His research is about energy and climate economics. He focuses on the eval uation of international climate mitigation policies, with a focus on technological evolution and uncertainty, and the role of tropical deforestation. He is also interested in the relation between consumption and environment, especially in countries in economic transition.

Massimo holds a Laurea cum Laude in Engineering from the University of Bologna, an MSc in Mathematical Economics from the London School of Economics, and a PhD in Political Economics from the Catholic University of Milan.

Karsten Neuhoff, *Deutsche Institut für Wirtschaftsforschung, Berlin (Germany)*

Karsten Neuhoff is a Research Director at the German Institute for Economics Research (DIW Berlin) and Director of the Berlin office of the global network Climate Policy Initiative. He studied in Freiburg and Granada and graduated in 1999 with a Masters in Physics from the University of Heidelberg (Germany), and in 2000 with a Master in Economics from The London School of Economics (UK). He received a PhD from the Faculty of Economics, University of Cambridge, in 2003 on the topic of market power in networks, supervised by Professor David Newbery.

From 2003 to 2009 he was senior researcher at the Faculty of Economics, University of Cambridge, and visiting researcher at MIT, leading projects on the future of the power system, renewable integration and technology policy. With the research network Climate Strategies he coordinated European and international projects on the implementation of the European Emissions Trading Scheme and North-South Climate Cooperation. He has published 71 articles in academic journals and reviewed working papers, was member of the Auctioning Working Group and Renewables Review Panel of UK the government and presented at several occasions to committees and working groups of the European Parliament and European Commission.

Pedro Linares, *Economics for Energy and Universidad Pontificia Comillas, Madrid (Spain)*

Pedro Linares is Associate Professor of Industrial Engineering and Vice-Dean for Economic and Institutional Affairs of the ICAI School of Engineering at Universidad Pontificia Comillas, Madrid, research affiliate at the Institute for Technology Research (IIT) and the BP Chair on Energy and Sustainability, and Research Associate at the Harvard Kennedy School, and MIT-CEEPR. He is also a Director of Economics for Energy. He holds a M.S. and Ph.D. in Agricultural Economics from U. Politécnica, Madrid. His research focuses on the relationship between energy, economics and environment, and specifically on sustainable energy, renewable energy and environmental policy, and multicriteria methods applied to resource allocation. He has published about these issues in most journals relevant in the field. He has also been a consultant for several private and public institutions in Spain, Europe and Latin America.

Melanie Kenderdine, *Massachusetts Institute of Technology, Cambridge (USA)*

Melanie A. Kenderdine joined the MIT Energy Initiative in March, 2007. She is a member of a three-person management team of this large and growing program, designed to help meet the world's energy challenges through research, education and outreach. In this capacity, she is a member of the research and analysis group for MIT's Future of Natural Gas Study and is the rapporteur, report author and editor for the MITEI Symposium Series.

Before joining MITEI, she served as the Vice President of Washington Operations for the Gas Technology Institute. She was a co-founder of the Research Partnership to Secure Energy for America, a non-profit research management company, which now manages a $375 million federal research contract and has 170 consortium members.

From 1993 to 2001, Kenderdine served in several key posts at the U.S. Department of Energy (DOE) as an appointee of President Bill Clinton. Her last position at DOE was Director of the Office of Policy. She has testified before the U.S. Congress on numerous occasions, most recently on the Strategic

Petroleum Reserve and ARPA-E. She has published articles in the World Energy Forum magazine, Harts E&P and Physics Today, and co-authored a chapter in "Energy Security in the 21st Century: A New Foreign Policy Strategy," entitled "Technology Development and Energy Security" published by the Woodrow Wilson Center.

Pantelis Capros, *National Technical University of Athens, Athens (Greece)*

Prof. P. Capros is a Professor of Energy Economics and Operation Research at the Department of Electrical and Computer Engineering of National Technical University of Athens. He has been until September 2004 the Chairman of the Regulatory Authority for Energy in Greece since 2000. He was a member of the Board of Directors of the Greek Public Corporation for 5 years. Prof. Capros holds an engineering degree from NTUA, 3 DEAs in Economics, Informatics and Operations Research form ENSAE, University of Dauphine, Paris and a Doctorat d'Etat in Mathematical Economics from University Pierre et Marie Curie, Paris. He has widely published (more than 100 publications) and conducted research programmes in the areas of Energy Modelling, Macroeconomics, Operations Research and Mathematical Programming. He has built and used a variety of large-scale mathematical models and has more than 20 years professional experience of consultancy in the domain of energy and economic policy.

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