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**CLIMATE CHANGE POLICIES
AFTER 2012**

*A Special Issue of
The Energy Journal*

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Preface

It is indeed a pleasure to introduce this Special Issue of *The Energy Journal* on Climate Change. The papers address a broad range of topics including emissions trading, the effects of climate policy on the magnitude and direction of technological progress, economic growth, macroeconomic effects of energy price shocks and the design of environmental taxation in the context of asymmetric information.

Some papers provide useful theoretical insights. Others contain novel empirical work which can inform the design of mitigation strategies. One paper contains an intriguing estimate of greenhouse gas abatement costs in a world where some countries opt not to participate in treaties intended to limit global warming.

Economic analysis is sometimes subject to the criticism that it does not sufficiently incorporate the exigencies of the world we live in. It is reassuring to see that so much of the work in this volume strives to recognize the practical realities that surround us.

Adonis Yatchew
Editor-in-Chief, The Energy Journal
October 30, 2009

Climate Change Policies after 2012

*Xavier Labandeira and José M. Martín-Moreno**

Climate change has become a most pressing environmental issue, as asserted by the Intergovernmental Panel on Climate Change. It may cause extensive and severe damage, given that our societies are heavily dependent on climate and only partially adaptable to its effects, and with important intra and inter-generational implications. Given the high carbon intensity in contemporary economies, corrective policies to tackle this problem also have the potential to exert an enormous (economic and distributive) impact. The global and public good nature of climate change, together with the presence of important uncertainties on the effects and economic scenarios, add further complexity to its treatment. Although there is already a large body of work in this issue, there are growing demands on the profession and an increasing sense of urgency. In this setting, this special issue intends to provide some answers and reflections to climate change policies, with a view on their future developments in the post-2012 period.

Climate change is actually just one more symptom of the unsustainability of our economic system as fossil fuels lie at the root of many other environmental externalities, and, being unevenly distributed across the planet, are the source of severe problems of dependence and vulnerability for many countries. It is not, moreover, an issue that can be ignored or postponed for very long: the inertia of greenhouse gas (GHG) concentrations in the atmosphere and the intensification of energy-related tensions call for swift action, for we may otherwise end up on particularly dangerous grounds.

Indeed, climate change is today the most significant environmental domain where economics must operate. It provides a perfect example of a public bad, whose characteristics and magnitude generate widespread market failure. Furthermore, an accurate economic valuation of the environmental damage caused by climate change-related phenomena is vital in light of the magnitudes at stake, the associated uncertainties and the number of goods involved. Finally,

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corrective public policies require the use of a large number of tools available to policy-makers.

In response to these concerns, over the last few years climate change policies have gained increasing relevance in the public sector in a number of countries, obviously fostering (and relating to) academic effort in the field. This constitutes yet another reason for the present special issue, reinforced by the fact that the new climatic regime will require more and better knowledge in this regard. Climate change policy, however, has a much broader scope than traditional corrective environmental policies. In light of the magnitude of the problem and its association with energy production and consumption, for instance, fiscal and energy policies must play an essential role.

Economics has conveyed several forceful messages on climate policies in recent years. First, a preference for flexible market instruments to improve efficiency over other more conventional regulatory alternatives; second, the importance of distributive questions in the definition and operation of policies; third, given the size of the problem, the need for hybrid approaches (combining tools) implemented in a coordinated manner, for a mere pooling of mechanisms may reduce the efficiency and effectiveness of public policies and render them unnecessarily complex. In short, the art of finding a suitable and effective combination of tools is elusive and requires the application of a number of valuation criteria, weighted in terms of social preferences.

This special issue addresses some of the aforementioned matters: the role of climate policy on technical change, the international aspects of the problem, the role of emissions trading schemes in strategies to combat climate change, and the utility of fiscal approaches as an alternative or supplement to pollution markets. This, naturally, is only a small sample of the possible subjects that could be included in an issue bearing this title, which makes no pretence to being exhaustive. Although much has been done in this field over the last few years, economics is facing a whole host of open questions on the design and impact of policies for correcting climate change. Given the perils to be confronted, reflection and academic study are needed to respond satisfactorily and take prompt and effective action.

Before briefly describing the articles in this issue, we wish to thank the University of Vigo's *rede* research team, the organizers of the 3rd *Atlantic Workshop on Energy and Environmental Economics*, from whose content it largely draws. We are also indebted to the external reviewers, in particular Scott Barrett, Dallas Burtraw and Frank Convery, whose comments helped improve the articles. Publication of this special issue benefited from funding provided by the Galician regional government (Department of Education and Universities). And of course, it could never have been released without the cooperation of the outstanding contributors or the patience and support received from David Williams at IAEE headquarters.

This special issue contains nine papers covering a number of questions relating to post-2012 climate change policies that intend to cover a number of

pending questions. In the first, **Carlo Carraro, Emanuele Masseti** and **Lea Nicita** pose a crucial question: is a climate policy designed to stabilize GHG concentrations likely to change the direction and pace of technical progress? The paper uses an upgraded version of the WITCH model, a dynamic integrated regional model of the world economy that explicitly contemplates technical change, to analyze the effects of policies designed to reduce GHG emissions. Their findings constitute an affirmative reply to the initial question, showing that the climate policy simulated clearly re-steers investment toward energy R&D and the energy industry in general, although the equilibrium total R&D expenditure is now observed to be smaller. They find no direct competition between energy R&D and other types of R&D, however. The lower total R&D investment under the climate policy is attributed to a decline in output, rather than vice-versa.

The paper by **William Nordhaus** examines the crucial link between the extent of country participation in a treaty to limit global warming and the efficiency of global climate change policies. This is clearly a timely issue, inasmuch as the negotiations for a new global agreement are presently underway. The author uses a cost function to estimate the economic dysfunctions associated with partial participation. While partial participation was already known to be inefficient because it raises the cost of reaching a given target, the paper estimates an order of magnitude of such costs, found to be roughly equal to the inverse of the square of the rate of participation. The large scale of these costs confirms the need for high levels of participation in world-wide treaties to ensure the efficiency of (global) climate policies designed to tackle global warming.

In their paper 'Cross Border Trading and Borrowing in the EU ETS', **Denny Ellerman** and **Raphael Trotignon** empirically assess a real-world carbon pricing mechanism. To this end, they use an under-exploited data resource in the European Union Emissions Trading System's (EU ETS) central registry to analyze trading and borrowing during the first trading period (2005- 2007). They maintain that these are controversial features of cap-and-trade systems and that most academic discussions have been based on theoretical, rather than empirical, approaches. According to their empirical findings, cross-border flows were small in the aggregate, but remarkably frequent in matching allowance deficits and surpluses at the installation level in the EU as a whole. The data also show that allowance borrowing for forward allocation to meet current compliance requirements, a novel feature of the EU ETS, was also used. The paper likewise provides evidence of the widespread use of trading opportunities, a prerequisite for efficient abatement in any cap-and-trade system, during the first period that the EU ETS was in effect.

Addressing a related topic, **Michael Hanemann** explores the role of emissions trading within climate change policies. The paper focuses on two specific design issues: the upstream or downstream allocation of the cap, and the capacity of trading alone to achieve a desired environmental outcome. The author concludes that, as regards GHG, a downstream system is the more suitable option and should be supplemented with measures other than R&D policies

(e.g. efficiency and renewable portfolio standards). To reach these conclusions he discusses the theory of emissions trading and reviews actual US experience with sulfur dioxide trading in detail, analyzing the similarities and differences between GHG markets and previous trading applications.

Juan-Pablo Montero also analyzes emissions trading in his review of the literature on market power in pollution permit trading. The paper is more than a mere survey, however, as it reports new findings and discusses and successfully relates theoretical and empirical aspects. Montero begins his study with Hahn's static dominant-firm model, which he subsequently extends to cover cases in which two or more firms strategically interact in the output market. Then he takes the discussion to a dynamic setting, which is relevant when permits are storable (quite common in practice) and/or when two or more strategic firms are engaged in repeated interaction. Although the paper highlights the empirical evidence on market power in US sulfur and nitrogen oxide markets, it contains an explicit reference to the interest of this issue for GHG emissions. In this regard, market power may still be of concern in large global markets because countries or regions, rather than individual facilities, may be the relevant players.

The paper by **Santiago Rubio, José R. García** and **José L. Hueso** deals with socially optimal patterns of economic growth and environmental quality in a neoclassical growth model with endogenous technological progress. They assume that environmental quality affects not only consumer welfare but also production through its beneficial effects on labor and capital productivity. Therefore, such beneficial effects arise when investment in environmental R&D leads to output with a cleaner technology. In this context, the optimal investment pattern in capital and R&D leads to an inverted U-shaped pattern of pollution to income (the Kuznets environmental curve). Yet the model shows that economic growth cannot be used to face the climate change problem. While polluters may be keen on reducing emissions because of the positive effects on production, investment will not be optimal because environmental quality is a public good. Therefore, climate change policies should close the gap by encouraging further investments by polluters in abatement technologies.

Manel Antelo and **Maria Loureiro** look at the potential impacts and limitations of environmental price-control policies established in heterogeneous informational environments. Their paper examines optimal environmental taxation in an incomplete-information, two-period model in which a monopolistic firm produces and pollutes. Their main results highlight the fact that the informational context has a high impact on tax effectiveness to correct environmental externalities. They show that soft fiscal policies based on initial low-taxes, which are later increased, may be used in the context of asymmetric information to provide incentives for a firm to reveal its true level of emissions and mitigate opportunistic behavior. Such results are relevant to correct externalities in countries where the regulator operates under poor informational conditions with respect to the nature of the polluting firms, and are of obvious interest in light of the increasing role of pricing devices in climate change policies.

The redefinition of energy policies that will obviously be needed to guide post-2012 climate change mitigation efforts will very likely have significant effects on energy prices. Hence the renewed interest in analyzing the impact of energy, particularly fossil fuel energy, prices on economic activity, given the crucial role they have played in developed economies in recent decades. In this context, **Carlos de Miguel, Baltasar Manzano, José M. Martín-Moreno** and **Jesús Ruiz** use a new Keynesian stochastic dynamic model designed on a small, open, monetary, oil-importing economy that is particularly well-suited to study the effects of high energy prices and the feedback effects on the economy. They apply the model to Spain to explain why the effects of oil shocks on output and inflation were rather small from the mid-1980s onward. Their findings support the hypothesis that the limited effects were attributable to certain features of the economy: the decline over time of labor market rigidities and share of oil in the energy market, and the increasing focus of monetary policy on controlling inflation.

Finally, **Xavier Labandeira, Pedro Linares** and **Miguel Rodríguez** advocate the use of an integrated methodological approach to study the effects of the (cost-effective) enlargement of the current coverage of the EU ETS to all industries and sectors (expanded scheme or simulation). To increase reliability, the paper proposes a soft-link relationship, until convergence is reached, of a general equilibrium and a specific electricity supply model. This approach is justified by the fact that the integrated model has greater explanatory capacity than either of the other two taken separately. The joint model furnishes quantitative evidence for a well-known fact, i.e., that when the number of industries subject to a pricing regulation is expanded, the negative impact declines. The authors' findings may be useful for designing supplementary policies to the EU ETS and for explicit consideration in those countries where new cap-and-trade systems are being pondered.