Environmental Policies for Air Pollution and Climate Change in the New Europe

Caterina De Lucia

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The interlinked issues of air pollution and energy policies in an enlarged Europe are currently subjects of major interest in economic, environmental, geography and regional sciences. This interest is understandable given the considerable consequences on human health and on climate change issues at not only a European, but a global level. In addition, the recent effects of economic fluctuation and oil prices as well as the actual restructuring of the European energy supply and security market raise a great deal of policy challenges. These issues have become an increasingly relevant concern, as the optimal design of policy by centralised European institutions has come under greater scrutiny.

This book presents an integrated approach to recent regulations on air pollution with particular emphasis on transborder air pollution, climate change and energy policies in the new Europe. This integrated vision embraces the extent to which global pollution influences policy decisions at different institutional levels; the magnitude, by virtue of policy simulation analysis, of environmental policy tools (i.e. environmental taxes) on aggregate welfare and transboundary air emissions fluxes in light of the recent enlargement process; the European Trading System and its flexible mechanisms to curb carbon emissions and fulfil the European Union Kyoto Protocol's commitments; and the developments of the new European energy strategy and its interdependencies across energy requirements, innovation, competitiveness and climate change.

The book is primarily aimed at postgraduate and postdoctoral research students in economics, environmental economics, environmental sciences or environmental policy disciplines. However, it should also be of interest to environmental economists, energy policy analysts, and members of governmental and non-governmental agencies dealing with environmental policy, climate change or air pollution.

Caterina De Lucia is Research Fellow in Environmental Economics at the University of York, UK and the University of Foggia, Italy. She is also Lecturer in Environmental Economics at the Technical University of Bari, Italy.

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Caterina De Lucia

To my parents

Foreword

The devil, as they say, is always in the details. The issues involved in the regulation of the pollution effects of energy policies play out at multiple spatial and temporal scales, and in different ways for different pollutants. The biggest issue on the table at the moment may be the impact of carbon emissions on the general circulation system – the problem of climate change – but energy production and use involves the emission of more pollutants than carbon. Carbon dioxide is not the only significant greenhouse gas. Nitrous oxide, a small proportion of which derives from the combustion of fossil fuels (from both stationary and mobile sources), is currently thought to be the primary threat to stratospheric ozone – in part because of its extraordinary long residence time in the atmosphere. Nor are the greenhouse gases the only pollutants of interest. Nitrogen oxide (NO_x) emissions contribute to ground-level ozone pollution, with implications both for human health and for the ability of plants to convert sunlight to energy. But they also have implications for acidifying nitrate deposition, with impacts on a range of ecosystem functions and services. Sulphur dioxide emissions are the primary source of 'acid rain', undergoing atmospheric chemical conversion to sulfate via gaseous sulfuric acid with well-known effects on both terrestrial and aquatic ecosystems. While both NO_x and SO_2 are relatively localized pollutants – most emissions generated within Europe are deposited within Europe – intercontinental transport of SO_2 is being recorded with increasing frequency. Managing the pollution effects of energy production accordingly requires intervention at many different scales. It is sensitive to differences in the social cost of distinct pollutants, and reflects both the spatial and temporal distribution of those costs. The result is a complex array of interlocking energy policies operating over a range of scales.

In this book Caterina De Lucia provides a way of navigating the details. Focusing on the pollution effects of energy production in the European Union (EU), she provides us with a way to integrate both scientific understanding of the fate and transport of atmospheric pollutants from energy production

with economic understanding of the consequences of the complex array of emission control policies. Exploiting the scientific research stimulated by the Clean Air For Europe (CAFE) programme, and the integrated assessment models developed out of International Institute for Applied Systems Analysis' (IIASA) Regional Air Pollution Information and Simulation (RAINS) model, she uses a computable general equilibrium model to identify the economic consequences of the 1996 EU air quality regulations currently in force. At the same time, she provides a guided tour of, inter alia, the single EU market for electricity and gas, the diversification of energy sources, and the development of the combined strategy for climate change. The result is a robust evaluation of the long-term cost of current pollution control strategies in the EU, and a methodology that will make it possible to evaluate the cost of new policy innovations at both the national and the European level.

Given the large number of new initiatives in both energy and pollution control policies this is likely to be extremely useful. So, for example, France is already committed to the introduction of new emission taxes, Slovenia is already committed to revising the concentration limits for new and existing energy plants and Sweden is implementing renewable energy use measures to close the gap between NO_2 emissions and proposed ceilings. The method of analysis described in the book provides a good way to evaluate the welfare impact of such measures.

The book evolved from De Lucia's doctoral thesis at the University of York, and bears some of the hallmarks of the programme from which she came: the integration of models of the biophysical and socio-economic worlds. This is still a major challenge for many existing assessment bodies, the Intergovernmental Panel on Climate Change in particular, for whom the socio-economic system remains a source of external shocks immune to the many and varied feedbacks from the biophysical system. Caterina De Lucia shows how these feedbacks may be internalized – brought into the decision process – and hence how they may be expected to change policy. Modeling the feedbacks in coupled human natural systems is one of the hardest problems faced by those who work on the environment. This book is a nice example of what can be achieved in this area at the scale of one region, the EU. It is also a nice pointer to what might be achieved for the world as a whole.

Charles Perrings
Tempe, Arizona
10 February 2010

Preface

The interlinked issues of air pollution and energy policies in an enlarged Europe are currently subjects of major interest in economic, environmental, geographic and regional sciences. This interest is understandable given the substantial consequences on human health and environmental ecosystem of climate change issues not only at European but also global scale. In addition, the recent developments of the enlargement process, the current effects of economic fluctuations and oil prices as well as the actual restructuring of the European energy supply and security market raise a great deal of policy challenges. These confrontations have also become an increasingly relevant issue, as the optimal design of policy by centralized European institutions has come under greater scrutiny.

Over the last years, the increasing number of regulations on atmospheric pollution and the new energy landscape concept of the twenty-first century pose the pillars of current and future scenarios of European environmental policies to mitigate climate change.

This book presents an integrated approach for recent regulations on air pollution with particular emphasis to transborder air pollution, climate change and energy policies in the new Europe. The integrated vision embraces the extent to which global pollution influences policy decisions at different institutional scales at central as well as Member State level; the magnitude, by virtue of policy simulation analysis, of environmental policy tools (i.e. environmental taxes) on aggregate welfare and transboundary air emissions fluxes in the light of the recent enlargement process; the incidence of the European Trading System and its flexible mechanisms to curb carbon emissions and fulfil the European Union Kyoto Protocol's commitments; and the developments of the new European energy strategy and its interdependencies across energy requirements, innovation, competitiveness and climate change.

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Abbreviations

BAT	Best Available Technology
BATRDs	Best Available Technology Reference Documents
BAU	Business as Usual
BEMIP	Baltic Energy Market Interconnection Plan
CAFE	Clean Air For Europe
CBA	Cost-Benefit Analysis
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CES	Constant Elasticity of Substitution
CFCs	Chlorofluorocarbons
CGE	Computable General Equilibrium
CLRTAP	Convention on Long Range Transboundary Air Pollution
CO_2	Carbon Dioxide
DG	Directorate General
DICE	Dynamic Integrated Model of Climate Change and the Economy
EBRD	European Bank for Reconstruction and Development
ECPP	European Climate Change Programme
ECRP	European Commission for Regional Policy
EERA	European Energy Research Alliance
EIB	European Investment Bank
EMEP	European Monitoring and Evaluation Programme
ERU	Emission Reduction Unit
ETS	Emission Trading System
EU	European Union
EUA	European Allowance
EU-FP7	EU Seventh Framework Programme
EV	Equivalent Variation
FDI	Foreign Direct Investments
GDP	Gross Domestic Product
GHGs	Greenhouse Gases

GTAP	Global Trade Analysis Project
hcl	Hydrogen Chloride
hf	Hydrogen Fluoride
ICCS	Institute of Communication and Computer System
IIASA	International Institute for Applied System Analysis
IO	Input–Output
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
ITER	International Thermonuclear Experimental Reactor
JI	Joint Implementation
kt	Kilo Tonnes
LCPD	Large Combustion Plant Directive
LPG	Liquid Propane Gas
MFT	Maximum Feasible Technology
MW	Megawatt
$\mu g/m^2$	Microgram Per Metre Square
N2O	Nitrous Oxide
NAP	National Allocation Plan
NEC	National Emission Ceiling
NECD	National Emission Ceiling Directive
NETS	New European Transmission System
NGO	Non-Governmental Organizations
NH_3	Ammonia
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
OPEC	Organization of the Petroleum Exporting Countries
POLES	Prospective Outlook on Long-term Energy Systems
R&D	Research and Development
RAINS	Regional Air Pollution Information and Simulation
RICE	Regional Integrated Model of Climate and the Economy
ROW	Rest of the World
SAM	Social Accounting Matrix
SEEA	System of Environmental and Economic Accounting
SET-Plan	Strategic Energy Technology Plan
SME	Small and Medium Enterprise
SNA	United Nations System of National Accounts
SO_2	Sulphur Dioxide
toe	Tonnes of Oil Equivalent
UNECE	United Nations Economic Commission for Europe
UNFCC	United Nations Framework on Climate Change
VOC	Volatile Organic Compound
WI	Waste Incineration

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1 Introduction

Over the last decades air quality and energy issues achieved considerable attention in the European Union (EU). European citizens and institutions constantly acknowledge the need to reach a sustainable pattern between human activities and the natural ecosystem. European environmental regulation is moving fast to comply with the increasing number of international agreements and domestic laws to reduce global emissions. Most of the air pollution problems affecting the EU have their effects at either local or transboundary scale. Acidification as well as ozone depletion and greenhouse gases (GHGs) are pollution problems which are of primary interest to European countries. In the case of acidification, the physical formation process, due to sulphur dioxide (SO_2), nitrogen oxides (NO_x) and ammonia (NH_3), when released in the atmosphere and transformed to acids is deposited either via rain precipitation (wet depositions) or falls directly (dry depositions) on the Earth's surface. Either ways the natural ecosystem is damaged. At the same time, these depositions, together with fine particles in the atmosphere, deplete the ozone layer. Primary precursors of acidification and ozone depletion are mostly generated from stationary sources (coal burning power plants, industrial boilers or agricultural activities in the case of NH_3) and mobile sources such as vehicle emissions. The 1997 European Commission staff working paper on acidification (European Commission, 1997a) showed that although progress has been made in the short term, the long-term strategy of 'no exceeding ever of critical loads and levels' of the Fifth Environmental Action Programme appears difficult to achieve. The main effect of the acid depositions varies spatially, depending on the sensitivity of the receptors. Critical loads reflect the sensitivity of a certain ecosystem by defining the exposure to pollution that each ecosystem can tolerate before damage occurs. Among European countries, sensitivity varies across different areas. For example, northern EU countries suffer high-sensitivity levels to acid depositions. Nevertheless, even if reduction in acidification takes place, acidification itself will not