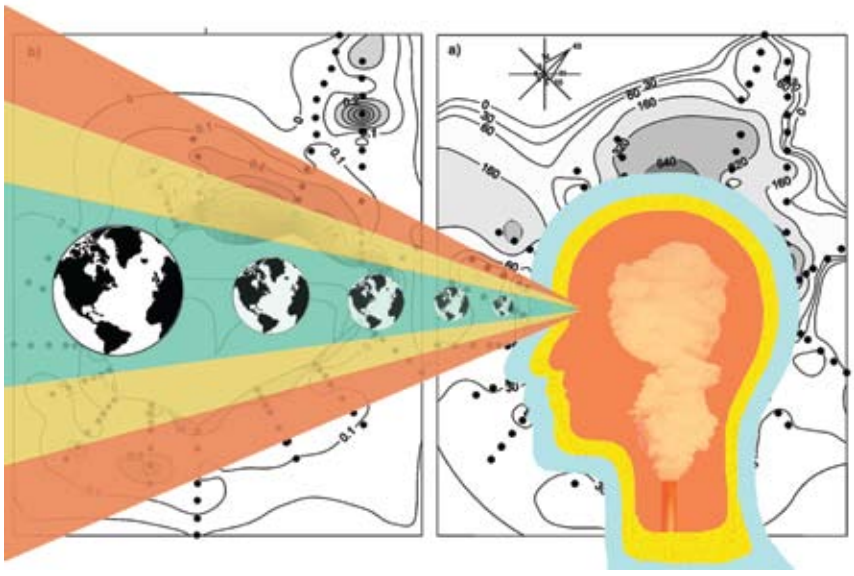
# 21st Century Environmental Challenges

## The Need For a New Economics

*By Jonathan Michie and Christine Oughton*

**The causes of climate change are complex, and to be effective, the policy response will need to be equally complex. We must go beyond the mainstream economic thinking that has been part of the problem. A richer, interdisciplinary, real-world approach is called for.**



In 2008, the Organisation for Economic Cooperation and Development (OECD) published the latest in its regular series of audits of the state of the environment, taking a global perspective and looking out to 2030. Noting that progress had been made on, for example, pollution from industrial sources (in OECD member states at least) and emissions of ozone-depleting substances, OECD nevertheless flashed a 'red-light' warning on several environmental issues, including climate change, biodiversity loss and water scarcity. In many ways its findings are reminiscent of earlier reports, such as the World Bank's well known assessment of the relationship between economic development and environmental degradation published nearly twenty years ago in which the Bank observed that while some environmental problems such as access to adequate sanitation appeared to improve monotonically with economic development, and others such as urban air quality appeared to improve only after a certain level of economic development had been attained, still others such as greenhouse gas emissions worsened monotonically with rising per capita incomes. Thus while some environmental problems seemed to be largely a symptom of poverty, there was little prospect that the world could grow out of this third category of problems, or at least not without an unprecedented societal response.

Both reports observe that what we might call 21st century environmental problems – namely those such as climate change and biodiversity loss that show no signs of being 'decoupled' from economic development – are of a particularly intractable nature. What marks them out is, roughly speaking, *interconnectedness* – they are complex and usually global in nature, and their impacts may only become apparent over long timeframes. Climate change is a clear example. A 'carbon footprint' is embodied in almost all of the goods and services transacted in the modern economy, thanks in large part to the burning of fossil fuels for energy. Once emitted, greenhouse gases mix in the atmosphere and, through a highly complex and uncertain process, eventually cause changes to climate that are distant in time and (partly) in space from the emitter.

To solve the problem by mitigation (i.e. reducing greenhouse gas emissions), it would further appear from the evidence that a broad portfolio of measures is needed, as the sheer magnitude of emissions reductions that are considered necessary ultimately overwhelms the economies of scale associated with any one currently practicable measure. That is, there does not appear to be a 'silver bullet', and action will be required on many fronts, including to deploy renewable energy technologies, carbon capture and storage technology, to improve energy efficiency at home and in businesses, and to reduce deforestation.

As their respective prefixes would suggest, *inter*connectedness is a powerful reason why an *inter*disciplinary approach to the political economy of the environment is essential.

We need an interdisciplinary theory of technological change, and a similarly interdisciplinary approach to the study of human behaviour and how it influences both production and consumption choices.

### Foundations

Any scientific enquiry proceeds by questions and their resolution. Resolving environmental questions requires an un-

derstanding of their nature, of their causes and, to the extent that they are anthropogenic, of how to change human behaviour. The argument for looking at the very long run (now with respect to economic, rather than geological, history) has also been underlined by the recent financial crisis.

Expected utility theory is used by neoclassical economists to model risk and in this approach devastating events are treated in a probabilistic fashion. Calculations are more complex when costs and benefits occur in the future due to changes in the value of money over time, but such calculations can be made once an appropriate discount rate has been assumed, provided the probability distributions upon which they are based are known and stable. This assumption about known and stable probabilities also underpins real options theory, which is the extension of neoclassical analysis to irreversible investments.

But this general approach is not of much relevance in a world of uncertain catastrophic events; factors such as 'deep' uncertainty, the possibility of 'mean shifts' in the underlying probability distribution, and tipping effects all undermine the very calculations upon which inter-temporal evaluation relies. In addition, people's actual perceptions of, and attitudes to, risk are often at odds with those assumed by standard economic theory, with the consequence that behaviour may be rather different from that predicted by conventional economic analysis, absent of an all knowing self-maximizer operating devoid of the social context, but facing potentially huge global externalities.

Many of the social costs caused by environmental damage are the by-product of firms' economic activity. As firms are the target of numerous policy actions designed to limit environmental damage, it is important to have a clear understanding of firms' behaviour in order to predict their response to policy. We would point to three main limitations of the standard theory of the firm: (i) the (lack of) analysis of the decision making process and managerial discretion; (ii) the assumption of instrumental rationality; and (iii) the determinants and role of innovation and technological change. In recent years the literature on these topics has grown, providing greater understanding of firms' behaviour within a systems context and implications for the design and implementation of environmental policy.

The standard economic theory of the firm rests on the assumption of instrumental rationality (that agents have a clearly defined objective, for example, profit maximisation, and know how to achieve it) and generally focuses on price (or quantity) competition in a static equilibrium framework, assuming well-behaved cost and demand functions. Under these circumstances, firms' behaviour is reduced to calculus and, faced with the same circumstances; all firms take the same decision, so that they can be represented by a single, stylised firm. However, the strategic decision making process is not considered in a meaningful way; firms are assumed to behave like automata and respond to price and cost signals in an identical fashion. There is no scope for managerial discretion, instead a unique equilibrium position is guaranteed/imposed courtesy of a U-shaped cost curve. Well-behaved cost curves also allow theoretical determination of the effect of taxes and subsidies on price, output and profitability.

This approach contrasts markedly with the managerial approach, whereby firms compete using price and a range of other variables including product and process innovation, organisational strategy, investment and marketing. Within the managerial literature, strategy is not confined to optimising over a single choice variable but is a more complex process that involves organising and renewing the resources of the firm to meet a range of objectives that matter alongside profit. Moreover, the possibility of increasing returns to scale makes it difficult to predict a firm's response to market based policy instruments, thus complicating policy implementation. Increasing returns may also have the effect of creating lock-in to an inefficient technology, as it becomes difficult for a new technology to become established unless and until demand reaches minimum efficient scale of production.

In our book (Dietz, Michie and Oughton, 2011) we explore the limitations of instrumental rationality using a game theoretic approach under different time horizons and show that alternative models of rationality and strategic behaviour provide more profitable outcomes for firms and society than instrumental rationality. Our analysis points to a wider range of policy instruments, including not only taxes and subsidies, but also institutional and voluntary arrangements that may be catalysed or that may evolve to govern the commons.

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The neoclassical approach to modelling innovation, where it is possible to identify an optimal level of investment in R&D based on instrumental rationality and optimisation, can be contrasted with the 'systems of innovation' approach, where innovation is determined by the interaction of interconnected institutions in the private and public sectors as part of a process of interactive learning.

The hallmark of the systems approach is that the behaviour of the system cannot be understood by analysing individual components in isolation. Environmental outcomes are produced by the interaction of natural and social systems that require a whole-systems view of the Earth. The whole systems approach is interdisciplinary, combining natural and social sciences. The problem may only be resolved by society. Over the past two decades this research has been consolidated within the interdisciplinary field of ecological economics.

The literature on ecological economics is beginning to shed

new light on the range of policy options available. The traditional dichotomy between taxes and regulations is a false one - and an effective policy may combine both. Moreover, these policies may be further enhanced by the use of governance structures and agreements that may evolve or be catalysed by government to manage common pool resources, such as the atmosphere or oceans.

## Innovation

The 'systems of innovation' approach - covering 'national systems of innovation', 'regional systems of innovation' and 'technological systems of innovation' - was originally developed by the late Chris Freeman, the heterodox economist who founded the Science Policy Research Unit at the University of Sussex. Professor Freeman recognised that the relative success of some countries over others in developing and adopting innovation was due not simply to their greater spending on research and development, nor indeed to any other single factor, but was due rather to a range of systemic features of the economy, including: its finance sector – and the availability of long-term, patient investment capital; its education and training system – and the proportion of scientists and engineers in the economy; its governmental and broader public policy approaches and institutions.

The systems approach provides a superior rationale for policy intervention in the area of environmental innovation than does the standard, neoclassical economic approach, for while the latter approach also emphasises disincentives to private firms to innovate new, clean technologies, seen as a market failure alongside the environmental externality of pollution, it does not generally allow for the two market failures to interact. The conclusion that tends to follow from this is, to paraphrase, that all that is required to solve environmental problems is a price signal reflecting the social value of pollution abatement, and that no special remedies are required in the area of innovation policy: standard, economy-wide incentives will do. The systems approach, by contrast, holds that there is indeed an interaction between the barriers to innovation and the disincentive to abate pollution, so that there are likely to be synergies arising from regulations that *specifically* promote environmentally beneficial innovation.

The 'Porter hypothesis' is that environmental regulation need not be a cost or burden on business, but, through changes in managerial decisions and corporate behaviour, can simultaneously lead to improved environmental outcomes *and* increased industrial competitiveness. Again, the possibility of a win-win outcome from the imposition of environmental regulation tends to be missed by standard economic analysis, which assumes firms operate at their efficiency frontier prior to regulatory intervention, meaning that regulation simply imposes costs. However, Porter and his colleagues have been able to point to many case-study examples, showing that, when forced to search for efficiency improvements, firms have been able to find huge opportunities. The Porter hypothesis fits well with the innovation systems approach, because both emphasise the wider social and institutional drivers of innovation, which a narrow focus on the private production costs of firms would miss.

The old economic theory of technological change, embodied in the so-called 'Solow residual', was not really much of a theory at all: technological change was simply that part of economic growth that could not actually be explained by measurable investment in capital and labour. Accordingly, the conceptual heirs to this theory in the field of energy/climate modelling simply specified innovation of clean technology as an exogenous variable ('manna from heaven'), and tended as a result to conclude that deep cuts in greenhouse gas emissions would be unaffordable. By contrast, recent theories in neoclassical economics and in other disciplines seek to model the process of technological change explicitly, including the notion that it is 'induced' by changes in government policy and private-sector investment activity. Crucially, implementation of these ideas in energy/climate modelling can lead to the conclusion that deep cuts in emissions are affordable.

Mainstream computable general equilibrium (CGE) models are limited by their inherently static nature. For instance, the assumption of diminishing returns to scale, which lies at the core of the equilibrium approach to economics, is violated in cases where learning-by-doing drives down the cost of clean technologies, in the process of deploying them at increasing scale. The idea of increasing returns to scale is linked with the notion of long waves of economic growth. Long-wave theory has been developed as an attempt to explain the major technological and economic transformations of the 19th and 20th centuries, including the emergence of steam power and computerisation. Given the structural change we face in decarbonising the global economy over the next half century or more, long-wave theory could be similarly insightful in helping design policy for the future.

The impact upon the economy of economic policy interventions does not always work 'at the margin', with a rise in price (caused for example by a tax on carbon) leading to marginal changes in consumption and production. On the contrary, historically, there have been steep changes in the way that economies operate, with major shifts in whole technology and productive systems. We are not talking of a marginal move towards or away from some equilibrium – were that concept to have any use, the equilibrium itself would be shifting, involving a dynamic disequilibrium. Looked at in terms of such major shifts in trajectories and long swings in economic cycles and their accompanying productive systems, it was hoped by many that just as the Great Depression of the 1930s gave rise to the New Deal, so the first global recession since the 1930s, namely the global economic downturn of 2009, following the 2007-08 credit crunch, would give rise to a global 'Green New Deal', with government intervention leading to a major shift towards green technologies and environmentally sustainable production.

At the time of writing in September 2011, the opportunity appears to have been lost, with the banks returning to their pre-credit-crunch focus on short-term financial returns, and governments scaling back their spending and investments rather than promoting any major green technologies. However, provided that policy globally sets clear, long-term requirements to achieve environmental improvements, there will be commercial advantage to be had by being in the lead in the new green technologies, which will need to be adopted and diffused globally. The accompanying infrastructures will most likely require public sector provision, so a Green New Deal may yet emerge in the course of the global economy recovering, within the context of having to accommodate to increasingly tough environmental standards.

One interpretation of the various critiques of rational choice theory, and the integrative theory that reconciles them, is that the contemporary mantra of 'hands-off' governance is misguided.

## Sustainable production and consumption

In the rational choice model of human behaviour, individuals confront choices ranging from the everyday to the once-in-a-lifetime by carefully computing the expected net private benefits of various courses of action, with a view to choosing the alternative that is expected to maximise these benefits. This rational choice model is widely used, but is particularly notable for its central role in the economic theory of consumer preferences. Yet a number of important criticisms have over the years been levelled at rational choice theory.

The first well-known critique focuses on the assumption that individuals carefully compute their expected net private benefits over a complete range of alternatives. In the face of limited resources, a rich tradition shows that individuals do not always (perhaps even usually) maximise expected utility, instead falling back on satisficing behaviour (i.e. selecting alternatives that are simply 'good enough'), or various rules of thumb. Another line of attack has been forged by those emphasising the role of emotion in guiding behaviour. The second critique focuses on the assumption of individuality; that is, the individual as the fundamental unit of analysis in rational choice theory. This may miss the point, some social psychologists have argued, because individuals' sense of identity is socially constructed, through interactions with others. In addition, individualism may overlook the important role played by social structures in decision making. Frequently, these social structures have much longer lifetimes than individuals, and it is possible to find many examples of institutions to which individuals belong, despite there being no obvious benefit to the individuals concerned. The third critique focuses on the assumption that individuals act in the pursuit of their own interests, instead emphasising what is rather abstractly termed 'other-regarding behaviour'. It is technically possible to incorporate such behaviour in the rational choice model, by assuming that individuals obtain utility from, for example, altruism, but for the critics this stretches the rational choice model to the point of being meaningless, tautological even.

To take these critiques seriously, an integrative theory is required, which builds on the insights from social psychology, sociology and other disciplines to generate a richer model of consumer behaviour, including both internal and external drivers (i.e. to the individual), and where the internal drivers extend beyond the evaluation of expected net private benefits to embrace factors such as emotion, habits and values.

One interpretation of the various critiques of rational choice theory, and the integrative theory that reconciles them, is that the contemporary mantra of 'hands-off' governance is misguided. Government intervenes in the fabric of society in many ways, far beyond the direct imposition of environmental policies, which is the boundary of many conventional analyses. Government is partly responsible for the culture of (over-) consumption, and one might then conclude that it is widely responsible for re-orientating consumer culture. Put another way, the scope of government intervention in the sustainability debate might go far beyond piecemeal regulatory intervention, to address the underlying goals of development, and the expectations and motivations people imbibe from those goals.

*These arguments are substantiated with supporting evidence by the various contributors to S. Dietz, J. Michie and C. Oughton (eds), The Political Economy of the Environment – an interdisciplinary approach, Routledge, 2011.*

## About the authors

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