

## **Complexity Economics for Sustainability**

**Research Seminars series, supported by the ESRC and the Environment Agency**

<http://www.see.leeds.ac.uk/research/sri/projects/esrc-research-seminar-series.htm>

**Seminar 2: Applying complexity economics to environmental and resource issues  
University of Leeds, 23-24 June 2009**

### **Introductory lecture: ‘Pathways towards a One Planet Economy’**

**Joe Ravetz, Centre for Urban and Regional Ecology, University of Manchester**

Joe Ravetz argued for the need to start from the complexity of economy-environment relationships and move to relative simplicity, by taking account of both physical/resource supply chains and economic/social value chains for goods and services. He argued for a relational approach, combining economic insights on investment and returns with social insights, such as trust and reciprocity, and institutional contexts. Key themes of a relational economy approach include:

1. Economic flows, incentives and signals, focussing on the material exchange dimension;
2. Combining this with other dimensions – political, social and cultural;
3. To “re-socialise” the economy, we need links between these, both in theory and in practice, and at micro and macro scales;
4. Firstly, revisiting key assumptions and paradigms to break down barriers, such as a rigid boundary between production and consumption.

This approach incorporates complexity-based ideas of emergence, where higher order systems emerge from lower order sub-systems, and resilience and self-organization. It examines institutional relations between different actors, including households, firms, government, financial sector and science/technological innovators. A paradigm shift is needed to a relational governance approach, in which policy is responsive and interconnected; there is co-production of knowledge and decisions by all relevant stakeholders; and the public is pro-active, entrepreneurial and self-organised.

As an example, he looked at the competing discourses around the proposed (and failed) introduction of congestion charging in the city of Manchester. Here the claimed economic and environmental benefits of this scheme were defeated by arguments focussing on narrow views of economic costs and the strength of anti-government feelings. He argued that a ‘one planet transport’ discourse incorporating wider social and economic changes between all types of stakeholders could have been more effective.

Using this relational approach in work for WWF-UK, Joe and his colleagues have developed a number of pathways towards a one planet economy, which weave together economic flows and incentives, political benefits, ideological commitments and social rewards. These pathways include:

1. *Stewardship/procurement pathway*, in which public stewardship and fiscal commitment enables policy goals and real prosperity;
2. *Service value chain*, e.g. energy service companies (ESCOs), linked into sector route maps to lower risk and raise commitment;
3. *Stakeholder finance*, in which environmental financial vehicles, coming from the financial sector, are coordinated with stakeholder finance.

Different pathways could be important at different stages of the innovation and deployment curve for different technologies.

Working with real world complexity in this way enables:

- ecological thinking - an approach to looking at whole systems not just the parts;
- relational analysis – look for systems of relations & values;
- design & innovation with algorithms, leading towards self-organizing value chains and loops, such as the Fair Trade movement;
- embedding the algorithms as self-learning loops in the institutions that are running the system;
- working with the economy as a subset of society and culture;
- re-thinking of ‘market barriers’ as ‘institutional opportunities’ for change.

In his response, David Feeney, Head of Economics and Planning at Leeds City Council, welcomed the insights in Joe Ravetz’s talk, and but highlighted some of the institutional barriers that he has come across that inhibit taking a long-term holistic view. Local authorities have to take into account national Policy Planning Statements (PPS) on a range of issues, including sustainable development, renewable energy and spatial planning, but these can give rise to policy conflicts and challenges between different priorities at national, regional and local levels. For example, the Regional Spatial Strategy for Yorkshire and Humber set a target of 4,300 additional new houses per year for the Leeds City-Region to 2026, but many of these would need to be built in areas at risk of flooding. More broadly, it is not clear how the aspiration of regional economic development can be made consistent with challenging social and environmental objectives, such as affordable housing and renewable energy targets. He argued for the need for a longer range strategic view to be implemented in a more flexible way with higher levels of public and social engagement, and greater consistency. This will require political leadership to create a positive, practical vision of change and processes for long-term dialogue with the public and stakeholders.

In the following discussion, participants asked how we can avoid complexity being used as an excuse for inaction, and whether we need a new system of governance to overcome the conflicts highlighted in the current system.

### **Session 1 – Linking production and consumption: global and regional scales**

#### ***‘Accounting for CO<sub>2</sub> emissions: UK, China and International Trade’***

Dr Klaus Hubacek (Sustainability Research Institute, University of Leeds)

In his presentation, Klaus Hubacek argued that taking a consumption-based approach to accounting for CO<sub>2</sub> emissions enabled a focus on why emissions occur. This approach combines ‘bottom-up’ life cycle analysis (LCA) of goods and services with ‘top-down’ input-output analysis at a country level. In contrast to the figures calculated on the current producer basis, UK’s CO<sub>2</sub> emissions on a consumer basis have risen significantly since 1992. This is due to the embodied CO<sub>2</sub> emissions in imported goods from China and other countries. Despite efficiency improvements, China’s production-related CO<sub>2</sub> emissions have risen by 59% from 1992 to 2002, mostly due to large increases from construction and other capital investments, and from urban household demand.

In the UK, the largest increases in the carbon footprint from final demand have come from travel and recreation activities. Taking a consumption-based approach enables linking the global production system to local consumption. The fact that rich countries have stabilised their production-based emissions but increased their consumption-based emissions brings into question claims for decoupling of economy and emissions. This raises the question for international negotiations of 'Who owns China's (and other countries') pollution?'. As well as scientific challenges of uncertainty and data collections, this raises policy and regulatory challenges. He argued for the need for a 'shadow consumption-based indicator' alongside official accounting, and for national actors to operate outside of their 'territory', for example by the UK investing in reducing production emissions in China.

***'Sustainable consumption and production – Modelling and applications'***  
Dr John Barrett (Stockholm Environment Institute, York)

John Barrett also highlighted the need to account for international trade in relation to carbon emissions. For example, UK's greenhouse gas emissions on a consumption basis were nearly 1000 MtCO<sub>2</sub>e compared with below 650 MtCO<sub>2</sub>e on the UN accounting basis. Decomposition analysis shows that, from 1992 to 2004, the increased contribution of +200 MtCO<sub>2</sub>e from final demand was only just balanced by decreases due to efficiency improvements and structural demand changes. This indicates that the current pattern of economic growth is incompatible with a low carbon economy. Economic growth, as measured by increases in GDP, has helped to alleviate poverty, but has not generally delivered improved welfare or happiness.

In the example of the supply chain for meat products, a significant contributor to household emissions, there is relatively little scope for further efficiency improvements, and hence a need to focus on levels of consumption, in order to reduce emissions. In a study of the Leeds City-Region, the largest potential contributors to reducing the carbon emissions from the household sector were found to be retrofitting existing housing stock; behavioural change; and the adoption of low/zero carbon energy technologies. Emissions reductions of 38 MtCO<sub>2</sub>e were found to be possible by 2030, which would put the region on track for achieving the UK target of reducing emissions by 80% by 2050. However, no-one is currently implementing this required policy package at the regional level.

A more detailed breakdown of household consumption showed significant variation between different household types in levels and type of consumption and resulting emissions, ranging from above 40 tCO<sub>2</sub>/capita for 'corporate chieftains' and 'cultural leaders' to below 20 tCO<sub>2</sub>/capita for 'elderly people' and 'tower block livers'. Despite being sympathetic to green issues, 'caring professionals' still had relatively high emissions of 28 tCO<sub>2</sub>/capita. In conclusion, he argued that changes to incentive systems were needed in relation to:

- *Fiscal policies*, to internalise externalities at the production stage, in order to 'use markets for what they are good for';
- *Infrastructure lock-in*, to reverse the commitment to road and airport building that encourages unsustainable transport patterns;
- *Awareness*, to encourage public debate;
- *Refine values*, to produce better measures of wealth and welfare, in order to indicate what is important to people.

## ***Discussion***

The discussion following these two talks focussed on the need for better data at regional and household level to guide policy-making; the implications for allocating emissions in international negotiations; and the implications in relation to economic growth. Some participants felt that the main problem is the political focus on economic growth as a proxy for welfare improvements, which is driving the rises in consumption and related carbon emissions. Another participant argued there is a need for massive capital investment in low-carbon technologies, and hence that a 'zero growth' economy would not be appropriate for mitigating climate change. These questions of economic growth and the relative contributions of changes in technologies and consumption patterns will be further addressed in the next seminar in the series. Finally, the need for consistency of policy incentives was pointed out, because of the dangers of the 'rebound effect', i.e. increasing levels of consumption arising from efficiency improvements. The London congestion charge was given as an example of introducing an incentive to change behaviour directly, rather than trying to change attitudes first.

## **Session 2 – Drivers of energy consumption and co-operative behaviour**

### ***'Social and psychological drivers of energy consumption behaviour and energy transitions'***

Dr Lorraine Whitmarsh (School of Psychology, University of Cardiff and Tyndall Centre)

Lorraine Whitmarsh argued for the need for a societal engagement with energy transitions. The role of public(s) at individual and community level relates to:

1. Direct energy use (40% of emissions are from domestic energy use and travel) and indirect energy use (products and services);
2. Support for policies (for new technologies/infrastructures and behaviour change);
3. Community engagement and grassroots innovation.

This requires social science research on the social and psychological drivers of energy use, and on the active and passive roles of the public in energy transitions. Despite high awareness of the public on climate change and carbon emissions, these are seen by most people as low-priority issues compared to other day-to-day concerns, and as a social, not a personal, risk. Surveys also found diverse understandings of 'carbon' and little connection to personal choices/actions. Most people support actions to tackle climate change, but take few actions themselves, due to individual and institutional barriers. Political engagement on environmental issues is also very low.

Research on individual and structural drivers of consumption has found that energy use is embedded within wider cultural trends towards consumerism, and is often 'irrational' and unconscious. This implies that policies need to target multiple (not only economic) motivations, and change structures to facilitate lower energy use. Recent work on socio-technical transitions has suggested that there is more likely to be a supporting/passive role for energy consumers in centralised energy supply systems, e.g. through the use of 'smart meters', but there is potential for a more active *innovation* role for energy consumers if there is a move to a more decentralised (distributed) energy system, with opportunities for restructuring consumer/producer

relationships. Recent research by Lorraine Whitmarsh with Mike Nye and Tim Foxon has proposed five ways to facilitate active roles for consumers in energy transition:

1. Facilitating deliberate energy conservation via changes in energy visibility;
2. Changes in habits/routines to more sustainable lifestyles;
3. Changes in normative/conventional understandings of proper energy use;
4. Increased demand for, & new uses of, low-carbon/more efficient technologies;
5. Influencing the shape of the socio-technical regime.

### ***'Institutions and co-operative behaviour'***

Prof. Arild Vatn, Norwegian University of Life Sciences

Unfortunately, Arild Vatn was unable to deliver his lecture due to family medical reasons, but his slides on the role of institutions in promoting co-operative behaviour are available on the seminars website.

### ***'What is a niche?'***

Dr Jonathan Köhler (Fraunhofer Institute for Systems and Innovation Research)

Jonathan Köhler examined the concept of a niche, which is a key idea in recent approaches to understanding system transitions. In order to understand how and why niches grow and challenge existing regimes, better insight is needed into the structures of niches and regimes and how they interact. The transitions literature includes concepts of a *niche market*, a small (segment of a) market where a sub-set of consumers are willing to pay extra money for an extra service, and a *niche technology*, a technology initially adopted by only a few users. Frank Geels and Johan Schot take a more technology-based view, in which new technologies, markets and user preferences co-evolve. Here, niches involve experimental projects, designed to build social networks to develop and use new technologies, and to articulate expectations and visions for their future potential. In this view, the growth of niches depends on a supportive environment, “like a tender flower coming out of the ground”, and niches grow and stabilise through the development of a network of actors that share certain rules relating to the understanding and use of the technology. From an integrated systems analysis perspective, Derk Loorbach and Jan Rotmans see niches as subsystems within a transition representing a fundamental change in structures, culture and practices. In complex systems terms, niches are far-from-equilibrium dissipative structures, representing front runners in this transition process. This leads to the idea of *transition management*, in which niches are empowered through providing them with resources, and through the creation of *transition arenas*, in which all relevant actors – government, business, users/consumers, NGOs, come together to facilitate change. Niches grow through networks of actors with common interests and complementary expertise coming together, leading to increasing returns to scale and non-linear growth. This suggests the use of *social network analysis* to examine the empirical growth of niches, modelled as developing networks of actors.

### ***Discussion***

The subsequent discussion began with the question of how to motivate change from niche to regime. It was suggested that positive visions of change are needed, as well as niches where new ideas and practices are tried out. It was pointed out that marketing practices already identify ‘niche’ groups of consumers, and suggested that more positive narratives are needed to challenge the dominant narrative of increasing

consumption. It was noted that economic signals can be a strong driver for change, but that, in certain circumstances, they can ‘crowd out’ other social signals, relating to shared norms or trust, for example. It was argued that the price mechanism works well for switching between well-defined choices, but not for stimulating major structural changes in social and technological systems.

### **Session 3 – Modelling change in socio-ecological and socio-technical systems**

#### ***‘Social and environmental impacts of global change on regional food systems’***

Dr Evan Fraser (Sustainability Research Institute, University of Leeds)

In his presentation, Evan Fraser focussed on the challenge of adding some socio-economic perspectives to examining and anticipating global food security problems. He argued that deep social science analysis is largely ignored in policy making, which is dominated by narratives coming from a natural science perspective, which claim ‘global reach’ and ‘universal applicability’. So, social scientists need to engage with ‘modelling society’. His work with colleagues under the “Quantifying and Understanding the Earth System” (QUEST) program has aimed to find key socio-economic indicators that have made harvests in China susceptible to drought. Examination of past drought events has found cases of both resilience, in which major droughts have only led to minor crop failures, and sensitivity, in which minor droughts have led to major crop failures. They then examined socio-economic factors that give rise to this increasing vulnerability. They aim to use this work to create ‘vulnerability maps’ which will identify regions (1) likely to be exposed to drought and (2) unlikely to have the capacity to adapt. The generic lessons from this work are that scoping a problem down and taking a problem-oriented rather than a particular disciplinary approach, is a useful way forward.

### **Final Discussion Session**

The final discussion session reflected on the common lessons from all the presentations. It was argued that they represent the beginnings of an emergent, multi-causal worldview to replace the current dominant linear worldview. However, this does not automatically solve political problems. For example, one lesson is that diversity and slack in the system are needed to enhance resilience, but this costs money, and it is not clear what the ‘optimal’ level of variety is in any situation. Political economy factors were also argued to be important. For example, when food systems are largely controlled by six multi-national corporations, how can we move to more local and more sustainable food systems. Lessons from complexity thinking include the need to generate variety, and to have a broader concept of social optimisation than current narrow views predominantly used by large firms. Regulation is needed to avoid monopolistic behaviour, but there are no adequate global regulatory structures. The dominance of large firms, such as food production corporations and banks that are ‘too big to fail’, is seen to inhibit positive change, but innovation theory suggests that big organisations can be slow-moving and vulnerable when external circumstances change. Transition management, which is now being applied in The Netherlands, is a positive example of building variety. It was argued that a range of incentives, alongside price incentives, could make fossil fuels more expensive and create space for entrepreneurs. Positive visions for change are also likely to be needed to provide hope for the creation of more sustainable socio-economic systems.