Theme 1: Can low carbon societies deliver on energy policy goals, including security and affordability?

Transitions to low carbon societies will have far reaching implications for national and international energy policies. Whilst climate change mitigation remains an important driver of these policies, other policy objectives, such as energy security and affordability, are also high on the agenda in many countries. Understanding the potential and trade-offs that could result from specific policies, strategies and technologies is therefore necessary, as is identifying opportunities to maximise synergies and co-benefits.

J. Watson

Background

Making transitions to low carbon societies will have far reaching implications for national and international energy policies. Whilst there is a need for urgent action to reduce greenhouse emissions, climate change mitigation is not the only goal of these policies. Other important goals include the need to ensure that energy systems are secure and reliable, and the desire to provide affordable energy services for household and business consumers.

It is therefore important to pay sufficient attention to synergies and trade-offs between these different policy goals, and to consider what technologies, policies and institutional frameworks might be required to maximise synergies and to manage trade-offs.

Key findings

- Some trade-offs between climate mitigation and energy security goals are inevitable, but many can be addressed if a 'systems' perspective is adopted. For example, there are potential security and affordability benefits from shifting to low carbon energy

Contact person: Jim Watson
jim.watson@ukerc.ac.uk

systems by reducing the use of fossil fuels; though these benefits are partly dependent on future trends in fossil fuel prices. However, low carbon societies could mean new energy security risks, such as resource availability (e.g. of bioenergy or scarce materials) or electricity system reliability. New strategies to mitigate these risks and strengthen energy system resilience will be required.

- Energy efficiency policies should be a priority since they are likely to address all three policy goals. A 'package' of energy efficiency policies is often required to address the multiple barriers identified by research, and to address the needs of different consumers. This package could include a combination of price incentives, standards and targeted investment programmes (e.g. to upgrade the housing stock). Whilst measures to increase energy prices could help, they are unlikely to be sufficient on their own – and they will have distributional impacts on low-income consumers and energy intensive industries that need to be mitigated. Policy evaluations and assessments should focus on the impact of policy packages rather than on single policies in isolation.
- Recent advances in low carbon technologies, coupled with reforms to electricity markets, have led to an expectation that electricity will play a major role in low carbon transitions. Significant up-front investment in low carbon power technologies will be required to enable this, as will further national and international support for technology development and deployment. But there would also be co-benefits, for example from reduced expenditures on fossil fuels and reduced pollution.

In this section the focus is on the extent to which low carbon societies can meet other energy policy goals, including energy security and affordability. There are different definitions of energy security, and that tensions or synergies with other policy goals will depend on what dimensions of security are seen as important, what risks to security are being considered, and which actors are the focus of the analysis. As a result, the implications for security of policies to reduce carbon emissions are likely to be mixed, and will vary according to timescale and geography. A discussion is also included of ways in which energy policies could be more integrated so that they not only deliver lower emissions, but also lead to 'co-benefits'. Immediate co-benefits in many cases include improved air quality for example. The importance of energy efficiency is also highlighted since, if effective, it could help to meet a range of policy goals – including affordability, security, and emissions reduction.

With regard to low carbon transitions in the power sector, important features of low carbon power systems are discussed in addition to the need to support the development and deployment of low carbon generation technologies. These include significant improvements in energy efficiency, the importance of flexibility of generation and demand, the potential for using low carbon electricity to decarbonise heat and transport, and the crucial role of storage. Realising such power systems in practice is not only a technical challenge, but is also likely to require changes to incentives for investment, policy frameworks and market arrangements.

With respect to energy efficiency and the role of consumers of energy, the section focuses on the multiple barriers to implementing energy efficiency, even in the large number of cases where there would be clear economic benefits to energy users. Policies to close the 'efficiency gap' between the potential for energy efficiency and implementation in practice are also discussed. Finally, a discussion is included on the related area of energy

storage. If commercialized successfully, electricity storage could make a significant impact on the feasibility of low carbon electricity (and energy) systems – especially where they include large shares of intermittent renewables.

Way forward

An extensive analysis of the potential co-benefits of climate change mitigation policies is highlighted, and the extent to which these policies can help meet (or conflict with) other policy goals. However, there remains significant scope for further analysis to inform the development and implementation of energy policies.

With respect to the specific interactions between climate change and energy security agendas, analysis understandably tends to focus on impacts on fossil fuel imports. However, there are a range of other energy security risks such as the vulnerability national energy infrastructures to technical failures or deliberate attack. Energy security risks will also change over time. For example, the transition to low carbon electricity systems that include smarter technologies and greater contributions from intermittent renewable sources will require new strategies to ensure that they continue to meet consumer demand for reliable and affordable energy services.

It is also important to consider energy security impacts on specific energy system actors, such as consumers or utilities, as well as understanding impacts at a national level.

Turning to specific technologies and measures, further action is needed to improve energy efficiency since it can help to meet several policy goals simultaneously. Whilst there is already a lot of emphasis on energy efficiency in international assessments and national policies, a number of gaps were suggested. These include the need for more incentives for the renovation of existing buildings, the need for more action on transport, and the potential for integrating energy efficiency initiatives with broader programmes to improve resource efficiency and energy demand reduction.

A number of areas are identified, where further technological innovation (including demonstration and deployment) is required in tandem with the implementation of policies to support such innovation. These include carbon capture and storage (CCS), which remains at the demonstration stage (especially for power sector applications), and has not yet made the transition to commercial availability. Yet, many climate change mitigation assessments see CCS as an essential component of low carbon energy systems.

Electricity storage is also discussed in some detail. Storage technologies could help to facilitate electricity systems with high shares of intermittent renewables – especially if electricity systems expand to meet demand for heating and transport that has traditionally been met by fossil fuels. Further support for research, coupled with demonstration and deployment incentives, is needed if the costs of storage are to be reduced - and the potential of storage is to be realized over the medium term.

Finally, storage is one of a range of strategies that could help to deliver reliable, low carbon electricity (and energy) systems. Further assessments and, where appropriate, incentives are required to support flexible demand, the flexibility of low carbon generation technologies such as CCS and nuclear power, and investment in international interconnectors.

Jim Watson
UK Energy Research Centre (UKERC)