Economic perspectives

A distinctive energy policy for Scotland?

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1. Introduction

This paper explores the emergence of a distinctive energy policy for Scotland and raises the issue of the desirability of any differentiation from UK energy policy. This requires an examination of both UK and Scottish energy policies, although we adopt a rather broad-brush overview rather than a very detailed analysis.

The rationale for a distinctive Scottish energy policy reflects the rationale for devolution per se, namely to ensure that such policy better reflects the local knowledge and preferences of the Scottish people. However, the devolution settlement itself did not initially appear to allow much scope for pursuing a distinctive energy policy in Scotland since most of the main powers under this heading were reserved to Westminster. Nonetheless, this paper argues that the Scottish Government is now pursuing an energy policy that is different in a number of important respects from the policy of the UK. Furthermore, this is not simply a feature of the recently elected minority SNP government: although the policy differences may now be rather more sharply drawn, they were certainly apparent under previous administrations.

Exploration of any distinctiveness in Scottish energy policy requires a comparison of Scottish and UK energy policies. We employ the traditional framework for analysing policy in

general, and energy policy in particular (e.g. RSE, 2006, chpt. 4), to conduct this comparative analysis. This framework recognises that any energy policy in the present UK institutional setup operates in the context of liberalised energy markets. In this context energy policy instruments have to induce market participants to change their behaviour in such a way as to produce an outcome that meets the ultimate objectives/ goals of energy policy subject to a range of economic, political and legislative constraints. Typically, progress would be assessed at least partially through monitoring of intermediate targets or indicators. Implicit in this policy framework is a judgement that, in the absence of energy policies, liberalised markets would produce outcomes that were incompatible with the objectives of policy makers. These objectives include lower emissions, so as to inhibit climate change, and improved security of supply.

The fact that, as far as energy issues are concerned, Scotland is part of a multilevel governance structure that incorporates world-wide, EU, UK and Scottish-specific institutions, inevitably complicates our analysis. The theory of fiscal federalism deals with the issue of the "appropriate" allocation of fiscal powers across different levels of government, and we draw on this to inform our discussion of how the Scottish Government might most efficiently contribute to the overall goals of Scottish energy policy.

In Section 2 we identify the goals of Scottish energy policy, compare them to those of the UK to reveal the similarities and differences and consider the issue of the geographic scale to which each goal most naturally relates. In Section 3 we discuss the targets of Scottish energy, and again the spatial scale to which they relate. We analyse the instruments of Scottish policy in Section 4, and there consider the fiscal federalism issues that relate to the appropriate spatial allocation of these instruments. We consider constraints in Section 5, including the possible existence of trade-offs *among* the goals of energy policy and also *between* these and the wider objectives of the Scottish Government and briefly consider how these may be resolved. We conclude in Section 6.

2. The Goals of Scottish Energy Policy

In a statement to the Scottish Parliament on 31 May 2007 the Energy Minister, Jim Mather, explicitly identified the goals or overarching objectives of Scottish energy policy. As far as we are aware this is the first time such goals have been so clearly and publicly articulated (although it is apparent that previous Scottish administrations shared very similar objectives, e.g. Scottish Executive, 2006). They cover four main issues. These are:

- Reduce carbon emissions, and so tackle climate change **(environment)**
- Need to ensure security of energy supplies *by fostering a vibrant, diverse and competitive energy sector that is rooted here in Scotland* (**security of supply**)
- Need to deliver energy at an *affordable* price for *both individuals and businesses* (**price**)
- *Ensuring that energy policy allows the energy sector to continue to make its vital contribution to economic growth* (**growth**)

These are very similar to the goals stated in the UK White Paper, which also emphasises environment, security and price. However, there does seem to be a difference in emphasis, reflected in the phrases in italics above. This is most notable in respect of the role of (renewable) energy in growth, which is never mentioned as a goal of UK energy policy. The similar emphasis in the context of the security of supply objective is again distinctive (an issue we return to below).

Before proceeding further with our analysis, it is worth commenting on the fact that these policy goals relate to rather different spatial scales. This suggests that the most appropriate level for determining and co-ordinating policy action will vary among them. This has implications for the nature of the optimal role that the Scottish Government can play in achieving each of these goals.

The spatial scale of energy policy goals and the role of the Scottish Government

We consider the spatial scale associated with each of the Scottish Government's goals in turn, starting with the environmental objective.

Environment

Naturally, both the Scottish and UK governments recognize that climate change is fundamentally a *global* problem that would appear to require *global* solutions. Scottish, and indeed UK, contributions to the problem are simply insignificant in relation to the scale of the overall problem[1]. This would suggest that the UK and Scottish governments should be doing all that they can do to support global solutions. In principle, these solutions could be either fixed-quantity or price-based[2]. Whilst there are instances of energy taxes (including the Climate Change Levy (CCL) in the UK), in practice attempted global solutions have tended to be quantity based, such as Kyoto and the EU Emissions Trading Scheme (EU ETS)[3].

Both the Scottish and UK governments claim to be supporting global initiatives and helping to make them work. This is evidenced, for example, by their support for Kyoto, and their commitment to meeting the emissions targets that are implied, with Scotland agreeing to contribute its "fair" share to these targets. Although solutions may have to be agreed at the global level, they are implemented and delivered at the "local" level. This clearly leaves a role for UK and Scottish governments, at

the very least in terms of complementing world policies and encouraging public and private sector compliance and reinforcement. Indeed Stern (2006) argues that local knowledge is the key to the efficient implementation of climate change policy, and governments have a significant role to play in the provision of appropriate local public goods (for example, public transport systems). In particular, governments should pursue policies that avoid "locking in" established, carbon-intensive technologies. However, equally there is need for a coordinated approach, to ensure an efficient response to global policies.

The Stern Report (2006) emphasizes the importance of establishing an international, credible price of carbon so as to internalize the world-wide externality of climate change. Clearly, this cannot be done by either the UK or Scotland in isolation. Ideally, if the trading option is pursued, the price of carbon would be established in an integrated world market for carbon. The world carbon trading scheme would then ensure that, for any given level of the carbon cap, the targeted reduction in emissions would be achieved at least cost. In fact, at present, such an integrated world carbon market does not exist. However, an EU market has now been established through its ETS, and the UK (and by implication Scotland) is a member. This is inevitably associated with inefficiencies relative to a world scheme, since, for example, the EU may bear significant costs relative to the "free riders" who are not covered by its own, or some comparable, trading scheme. Again, at first sight, at least, the role of the UK and Scottish governments should be a supportive one, reinforcing the EU ETS and assisting its efficient operation.

Of course, the establishment of a credible carbon price would automatically improve the economics of non-carbon-intensive technologies and encourage their deployment and operation. In the key area of electricity generation, for example, this would favour the development of nuclear, as well as renewable, technologies. The low carbon intensity of nuclear is, of course, a crucial factor that is finding much greater favour with the UK government. But nuclear technology remains controversial and the Scottish government has said it wishes to phase out nuclear, which we consider further below (e.g Scottish Government, 2007). For now we simply note that a "no nuclear" policy makes any given carbon emissions target more difficult to achieve.

Clearly the adoption of UK- and Scottish-specific emissions targets is intended to be an expression of strong support for the wider international initiatives, but we consider whether this is in fact the case in our subsequent discussion of policy targets.

Security of supply

Watson and Scott (2008) identify four dimensions of "energy security": lack of domestic infrastructure; technology or infrastructure failure; domestic activism or terrorism; fossil fuel scarcity and external disruptions (including international terrorism). We briefly consider each in turn.

Perhaps the most basic aspect of energy security, in the context of electricity, relates to the fact that electricity is essentially not storable. Demand and supply therefore have to match instantaneously, and insurance against power cuts necessitates the presence of excess capacity in the system, as well as an effective transmission and distribution system. The objective is to ensure that blackouts of the kind attributable to the simultaneous loss of output at Sizewell B and Longannet (in May 2008) remain very rare events. Unbridled (spot) market forces could perhaps in principle ensure that demands and supplies are matched, but in high demand conditions the implication is that some consumers would be priced out of the market altogether, and it is not at all clear that any government would (or should) be prepared to give a credible commitment to such an outcome. Rather, it seems likely that there should be some form of government intervention, for example, through the incorporation of a market for capacity, to ensure the system typically operates with excess capacity and can respond to sudden demand surges without power cuts or unacceptable distributional consequences. On the other hand, there has been considerable investment in capacity in the UK in recent years, though all of it in combined cycle gas turbines (CCGTs), and in the absence of any policy action, this would be the market's likely choice for new capacity (Watson and Scott, 2008).

Security of supply was not a major consideration during the 1980s and 1990s, given that the liberalization and privatization of the UK electricity supply industry occurred at a time of general excess capacity (Helm, 2005). However, the gradual "sweating" of assets has eliminated this excess capacity, and there is growing awareness that this is again a real issue. With an integrated British electricity market, one role for the Scottish Government would simply be to encourage the UK government to tackle the problem at the level of the UK through encouragement of investment in new (presumably non-nuclear) generating capacity, and encouragement of modification of large coal plants to meet the European Large Coal Plant Directive (LCPD).

We consider whether the ambitious Scottish policies for increasing renewable generating capacity, with the expectation of increasing the diversity of the electricity generating portfolio, serves to mitigate security of supply concerns in our subsequent discussion of energy targets.

Technology failures have, on occasion, been dramatic (as in the case of Chernobyl), but there are many lesser examples of failures in parts of the energy system infrastructure, in part due to the impact of extreme weather conditions that may themselves be attributable to global warming (Watson and Scott, 2008). Effective action on the

environment may therefore in itself contribute to security of supply in this sense.

A further dimension of security of supply, and one that has received most emphasis recently, relates to the importance of imported energy and external threats. However, it is not necessarily the case that imports will be "less secure" than indigenous supply, in that indigenous supply could be threatened by industrial action (a major concern when generation was dominated by coal), and by protest action by road hauliers. Furthermore, indigenous provision could be subject to terrorist threat. If fuel, or electricity itself, is imported from a reliable source, there is no reason why this should be problematic. The concentrated distribution of oil (Middle East) and gas (Russia) resources gives rise to political concerns, but a diversified portfolio of generation sources and perhaps a portfolio of reliable sources of imports, together with an adequate infrastructure to guard against a range of risks, would seem appropriate. However, there is the threat of price shocks to both oil and gas, and so renewable technologies, and nuclear, provide some hedge against these risks.

Sharp rises in oil prices have had serious macroeconomic consequences in the past, generating stagflation, a simultaneous adverse shock to inflation and output and employment. The reduced oil-intensity of Scottish (and UK) production and the current conduct of monetary policy, with an independent Bank of England targeting inflation, serves to reduce the "shock" potential of the oil price, but recent experience reminds us that it does not eliminate it. Managing macroeconomic policies in circumstance less favourable than the recent "nice" (non-inflationary continuous expansion) decade has become more challenging.[4] Current debates concerning the impact of oil price rises on total tax revenues, depend critically on whether the system-wide consequences for other tax revenues partially, or even more than wholly, offset the undoubted stimulus to taxes on fuels that recent oil price rises generate.

A limiting form of the "external threat" view of security of supply suggests that Scotland should seek to be *self-sufficient* in energy in general, and in electricity in particular. While energy/ electricity is undoubtedly an important good, in a liberalised system the "trade balance" on this is entirely determined by market forces. Scotland is a small, open regional economy and under present policies e.g. electricity (or inputs to generate it) is traded in increasingly integrated European and world energy markets. The precise electricity trade balance, for example, between Scotland and the rest of the UK is the outcome of a complex combination of supply and demand-side decisions taken by households and firms in the context of liberalised markets. Currently, Scotland is a significant net exporter of electricity but this simply reflects the current balance of markets forces in the Great Britain electricity system combined with the geographic distribution of generating sources and electricity consumers.

Trying to *impose* an essentially arbitrary self-sufficiency constraint might prove disastrous economically (even if it could be achieved) and it simply may not make any economic sense to attempt to impose self-sufficiency. Finally, it is not clear that the Scottish Government has the instruments available to ensure it, even if it wished to. And why it would wish to is not clear since self-sufficiency is, as our earlier discussion clarified, not at all the same thing as security of supply.

Security of supply issues can be tackled through increased diversity of both domestic generating capacity (in excess supply), and in sources for imported fuels (and associated infrastructure including gas storage facilities). However, this is likely to be costly and subject to substantial economies of scale, so that many aspects of security of supply would be best dealt with internationally, perhaps at the level of the EU. While the integrated European electricity market remains an aspiration for now, it seems likely to be very inefficient for each of the individual nations and regions of the UK to attempt to make separate provision for their own security of supply, since there already exits an integrated electricity market. At the very least a coordinated UK-wide approach seems essential.

Against these considerations the wording of the Scottish Government's security of supply goal perhaps seems restrictive in focusing exclusively on the nature of the energy sector *within* Scotland. However, a generous interpretation would view this as implying a contribution to security of supply within the UK as a whole, given the presence of integrated energy markets, and in previous documents Scottish administrations have, for example, pressed for increased interconnector capacity (with EU and the UK), and for a review of the transmission charging regime with a view to ensuring adequate incentives to maintain surplus generating capacity in Scotland, as part of a broader approach to security of supply (e.g. Scottish Executive, 2006).[5] We consider the role of renewables targets in this context subsequently.

Price

At first sight, the affordable price objective would appear to be problematic for both UK and Scottish governments, assuming "affordable" is intended to convey something different (and potentially lower) than "market determined". Further, the impression is that the UK government has tended perhaps, to de-emphasise it in the recent past and to express it in less ambitious language[6]. Since liberalization and privatization occurred against the background of excess capacity, these policies did ultimately deliver lower prices, though these were reversed as capacity issues began to emerge and the oil price rises of the 2000s began. The latter fact also serves to remind us that the price of some key energy inputs, notably oil and gas, are in any case determined in world markets (although influenced by very large suppliers), and these are

effectively beyond the control of either the Westminster or Holyrood governments.

In our discussion of energy policy instruments below, we consider the possibility of influencing this goal through: encouragement of variations in North Sea Oil production; green taxes; and action to tackle fuel poverty. However, it is perhaps worth noting now that while the desire to provide affordable prices *for individuals and businesses* expressed in the Scottish Government's goal, while laudable in terms of sentiment, would seem to lie well beyond the abilities of the Scottish Government (or for that matter the UK or any European government), to deliver in full. Even if it could be delivered, it would seem to conflict with the environmental objectives of policy, an issue we return to Section 5 below.

Growth

The Scottish Government gives special emphasis to the potential role of the energy sector in stimulating economic growth (as a goal of its energy policy), in contrast to Westminster.[7] The Scottish government clearly has hopes for the renewable energy sector, in particular, to provide a stimulus to growth. We argue below that there is economic development potential, although for the newer renewable and other technologies, not the onshore wind developments that currently dominate increments to renewable electricity generating capacity. There are risks, however, not unlike those traditionally associated with government's attempting to "pick winners", including rent-seeking behaviour. However, Stern (2006) certainly adopted the view that a wide range of new technologies should be encouraged, and perhaps funded internationally, so as to avoid potential winners being lost due to the development costs that may prove prohibitively large for any individual country, and Winskel (2006), argues that the Scottish government's perspective on technology policy is distinctive and appropriate. The hope here is that the new "banded" ROCs (BERR, 2008), which provide more support for the newer renewable technologies, notably wave and tidal, will stimulate the deployment of these technologies, although some have questioned the efficiency of ROCs as against the alternative of a low carbon subsidy (that presumably would extend to nuclear too). One potential defence is the economic development potential of new technologies, but it is difficult to see how this could be applied to onshore wind. We return to the issue in our discussion of energy policy instruments and then again in our discussion of seeking to resolve the conflicts between goals below.[8]

Helm (2007) has argued that the 2000s heralded a "new energy paradigm". This is characterised in part by a radical shift in policy goals towards climate change and in part by a move back towards security of supply considerations, given the gradual elimination of the excess capacity that characterized the 1980s and 90s. Whether or not the change is as radical as Helm suggests, there is no doubting the importance of both of these objectives in current Scottish (as well as UK) Government thinking. However, in neither case does the Scottish level of government appear to be the most natural one at which to seek to address the objective, a comment that seems to apply also to the affordable price goal. As we have emphasized, however, this is certainly not an argument for "doing nothing"; rather it is an argument for vigorous support for policies negotiated, and perhaps coordinated, at a higher level of spatial aggregation, namely the UK, EU or World levels.

3. Energy policy targets

The key targets of Scottish and UK energy policy include the following:

- A statutory target is proposed for the Scottish Climate Change Bill of a fall of 80% in Scottish carbon emissions by 2050, whereas in the UK the target is at least 60%.[9]

- The target for the percentage of electricity generation attributable to renewables in Scotland is now 50% by 2020, while the UK aspires to a target of 20%.

- The current target for new (and ultimately all) nuclear electricity generating capacity is 0%. The UK has no target for nuclear, but expects substantial new investment in nuclear capacity, and aspirations of 20%-30% have been mentioned by ministers. (The Prime Minister recently confirmed an expectation that new nuclear capacity will contribute more than the current 19% of UK electricity.)

- While there are no targets for carbon capture and storage (CCS) in Scotland or the UK, recent interchanges between the Scottish Government and Westminster suggest a greater emphasis and immediacy in Scotland.

- While there is no target for economic development generated by the renewables industry, the Scottish Government's Economic Strategy identifies overall growth targets and views the energy sector as "key" for growth, while no such emphasis is apparent in the UK.

- The Scottish Government has a commitment to end fuel poverty by 2016, as far as is reasonably practicable (Scottish Government, 2008b, p10). (The UK target is eradication by 2018.)

There are clearly substantial differences in energy policy targets in Scotland as compared to the UK. Scottish targets are typically more ambitious on emissions and renewables (and probably CCS), but stipulate (ultimately) no nuclear electricity generation at all. The election of the SNP

government has cast these differences in sharper relief (most notably on nuclear e.g. Scottish Government (2007a)), but the differences are certainly not new.

In the goals-targets-instruments-constraints framework that we are applying here targets are traditionally regarded as mere *indicators* of progress towards particular goals. In this context a key issue is how well the chosen targets relate to the ultimate objectives of policy. For example, RSE (2006) question the useful of renewables targets as a means of achieving lower emissions. But it seems clear that, at least for the Scottish Government, renewables targets are in part also related to their economic development potential. In a world of multiple goals, targets may have more than one purpose (though this significantly complicates interpretation of movements in targets).

In the energy policy context at least, there is a further complication in that it seems that the UK and Scottish Governments are not simply using targets as mere indicators of progress towards goals. Rather there is a suggestion that at least some energy policy targets are coming to be regarded almost as *instruments* of policy, believed to be capable of exerting an independent effect, presumably through their impact on the expectations of private sector transactors. The notion here is analogous to an indicative planning process where the government sets out its plans clearly, so that the private sector can makes its own plans of how most efficiently to react. This is an aspect of energy policy targets that we consider in our discussion of energy policy instruments below and, for now, we abstract from these possible wider impacts of targets.

Before proceeding to consider the instruments of energy policy, we first reflecting briefly on the rationale and consequences of distinctive energy targets for Scotland, and, in particular, again consider the appropriate spatial scale for action.

Environmental targets

The Scottish and UK governments of course recognise the limits of their abilities to impact directly on climate change, as we discussed in considering the objectives of energy policy. The argument appears to be a moral one, made quite explicitly in the case of the Scottish Government, about playing a leading role in addressing climate change issues and in setting an example in accepting responsibility for emissions that other countries might follow (Scottish Government, 2007b). Since its target for the overall reduction in carbon emissions is even more demanding than that set by the UK government, presumably Scotland regards itself as setting an even better example. (However, this might also, of course, reflect some judgement that targets can be achieved here at lower cost, given the concentration of renewable sources of energy in Scotland, and that this may simultaneously provide growth opportunities for Scotland. Both Scotland and the UK are intending to commit to a set of binding targets on emissions that are self-imposed. This would appear to risk a competitiveness loss vis a vis our trading partners to the extent that they do not in fact follow our example, although there may be indirect gains in terms of signals to innovators and new technologies that may be "locked out" by the existing inherited energy system. Given the extensive pattern of interregional trade between Scotland and the rest-of-the UK, there must be some concern that the adverse competitiveness effects of tougher Scottish targets may prove problematic. Furthermore, Kyoto has been in place for sometime, but leading by example has not succeeded in attracting many other voluntary participants and there have been a number of significant "free riders" who bear none of the direct costs of adjustment (Helm, 2005).

The fact that the UK and the Scottish Governments have set their own targets for emissions reduction appears to be entirely compatible with, and indeed goes well beyond, Kyoto, and in this sense they are acting to support world action on climate change, no doubt influenced by Stern (2006). However, these distinctive targets appear rather less supportive when viewed from the perspective of the EU ETS. Certainly, if the EU ETS had complete coverage and established a credible carbon price, member-specific emissions targets would seem to rather miss the point and would, if achieved, potentially frustrate the operation of the ETS to a degree. The overall EU emissions reductions would simply equal the cap and member states' own goals would increase the total costs of meeting the cap without any contribution to further emission reduction in the EU as a whole (Sorrell and Sijm, 2005). In fairness, the Scottish Government (2007b) has recognized the tension here and invites views on the scope of the targets, and whether only emissions that are not covered by ETS should be included.

Of course, there may still be a rationale for energy policies other than ETS. Indeed, at present UK and Scottish emissions targets, if achieved, seem likely in fact to contribute to overall EU emissions reductions given the incomplete coverage of ETS and the absence of a credible long-term carbon price. The interaction of individual country/ region emissions targets and ETS is something that should be closely monitored as the scope of ETS expands, and permits begin to be auctioned.

In principle, Carbon Capture and Storage offers immense potential in terms of meeting emissions targets, given the scale of emissions from large coal plants and EU and UK plans to establish demonstration plants are to be welcomed. Scotland seems again to be a possible lead position given the availability of possible natural storage facilities and the expertise available here.

Renewables targets

While the Scottish Government's target for the percentage of electricity produced by renewables has been

substantially increased, it has also been pushed well into the future. The rationale for renewables targets has been questioned, for example, by the RSE (2006). If the sole rationale for renewables targets is simply to effect a reduction in carbon emissions, the criticism would surely be valid. However, it seems clear that these targets reflect a judgement about technology policy and the nature of the market for electricity. At least a part of their justification seems to be to encourage the development and deployment of new technologies, which need some non-market incentive to overcome the "lock-in" effect of existing, predominantly large-plant generating technologies. In the Scottish context, at least, there is also a belief that the development of these new technologies can stimulate economic development, a view we consider further below.

The UK and Scottish renewables targets seem to be part of both governments' responses to the security of supply issue. Certainly diversity of indigenous generating sources would be expected to be an element of any rational policy response to perceived security of supply issues. Would the targets, if achieved, ensure diversity and improve security of supply? One issue here is what precisely is meant by diversity. Stirling (2007) identifies three aspects: variety, balance and disparity. Variety simply refers to the numbers of technologies, balance to the proportions in which technologies are held (since one of perhaps many varieties could completely dominate supply), and disparity relates to the extent to which the technologies differ.

The contribution of the renewables targets to the overall Scottish energy portfolio depends in part on the counterfactual: what capacity, if any, is displaced by the renewables? If the renewables are simply additional to current capacity, then balance may decline, in that portfolio shares would be significantly more concentrated than they are now, with 50% going to renewables. However, if renewables themselves constitutes a range of technologies, and not mainly onshore wind, then balance may be improved. Again, variety would not necessarily be greater if all of the increment to capacity was in wind, but would be if wave and tidal and other new renewable technologies were stimulated. Disparity would be enhanced, since the renewable technologies are quite different from the currently dominant technologies of coal, nuclear and gas.

Of course, if renewables replace nuclear capacity, other things being equal, diversity in Scotland may not increase in all dimensions, and indeed could actually decrease. However, a diversified portfolio of renewables would be likely to improve all dimensions of diversity. Notice that if increases in diversity are dependent on the diversity of renewables themselves, the current aggregate target will do nothing to ensure it, (although the banded ROCs, which we discuss below, should help in this regard). However, in these circumstances diversity would have little to do with the 50% target *per se*.

Overall, it is not absolutely clear that diversity within Scotland would increase if renewables targets are achieved, because it depends on precisely how they are met, and on which technologies they replace. So, at least in this respect, security of supply within Scotland is not inevitably improved if renewables targets are met, though it seems likely that it would be enhanced, and it almost certainly would be if nuclear were retained too.

Of course, we have earlier argued that Scotland is not necessarily the natural level of government at which to consider security of supply issues, especially in the presence of an integrated British market for electricity. From a UK perspective, major development of renewable energy sources in Scotland make achievement of UK renewables targets easier, and would almost certainly improve every dimension of diversity within the UK, since nuclear is to be retained in the rest of the UK. This argument would hold with even greater force for the EU as a whole, in circumstances where an integrated EU market in electricity is established.

Nuclear

Nuclear presently accounts for around 26.4% of electricity generated in (compared with 18.9% in the UK as a whole) in 2006 (BERR, 2007). Clearly then any decommissioning of nuclear therefore has a major impact on Scotland's total generating capacity, and it seems this has to be replaced by renewables generation. One problem here is that the output of renewables is not a perfect substitute for that of nuclear. The latter's invariance and constancy of supply is especially well-suited to providing baseload, whereas the intermittency of renewables output imposes additional costs on the system, that may be expected to vary directly with the share of renewables in total generation (Gross et al, 2006). The UK government's change of mind on building new nuclear capacity is based upon its low carbon content, and ability to deliver baseload, and its potential contribution to security of supply (though this has been challenged by Watson and Scott (2008)). The Scottish Government's position, of course, necessitates the development of alternative generating capacity (or less net exports of electricity).

The Scottish Government's intention to eliminate fuel poverty by 2014, is the only target that appears to relate directly to the affordable price goal. However, the significant qualification, that the commitment applies as far as is reasonably practicable, does raise the question of the strength of the commitment. Indeed, more generally, a key issue is whether the Scottish (and UK) Government's targets are little more than aspirations. What matters is whether the targets are credible, and that depends, to a significant degree, on whether the Scottish Government has the policy instruments with which to achieve these targets, and the willingness to apply them appropriately.

4. Energy policy instruments

We identify the energy-policy related powers that devolved to the Scottish Parliament and those that are reserved to Westminster in Box 1. Note that reserved powers include the conduct of macroeconomic policy and the tax-transfer system. Although these are not specifically energy policies, they do have a potentially major impact on energy issues. Thus the conduct of macroeconomic policy in the face of oil price shocks may be critical: indeed it has been asserted that the oil price has lost its ability to shock altogether, given the implementation of the new monetary and fiscal rules, although recent experience suggests this is overly optimistic, especially as far as really major oil price rises are concerned. In terms of direct influence over the energy industry (oil, gas, coal, electricity), it is important to recognise that the main factors that influence this (e.g. regulation, taxation) are governed by Westminster. The UK Government has the power, for example, to alter the entire regulatory framework, an option that is clearly not open to the Scottish Government. In principle, the UK Government could change the way that the energy industry is structured, owned and governed, so that there is considerable asymmetry in the powers of Westminster and Holyrood in this context.

In Box 2, we summarise the main instruments of EU, UK and Scottish energy policies. The UK Government's control of the tax system, and in particular its ability to set and adjust "green" taxes levied on energy- or carbon-intensive inputs or outputs, is potentially the most powerful economic instrument of all, whereas the Scottish Parliament currently has no power to vary taxes (other than the "tartan tax" power that allows up to a 3p in the £ variation in the standard rate of income tax). Green taxes include the fuel price escalator that seeks to progressively increase fuel prices in order to induce a trend decline in fuel use and a reduction in carbon emissions. Furthermore, control of the tax-transfer system enables the UK Government to influence fuel poverty directly through transfers to affected households. (Winter fuel payments, however, are based simply on age, not the proportion of households' income that is devoted to fuel.) The predominant influence of the UK (and EU) is also apparent through responsibilities for regulatory powers, which lie very predominantly outwith the powers of the Scottish Government, though this, of course, does not mean that they completely outwith their influence.

The links between instruments, targets and goals

At least in the conventional goals-targets-instruments-constraints framework we would expect policy instruments to be more directly linked to targets than to the ultimate goals of policy. Indeed, typically instruments of policy would be expected to impact on the goals of policy through a transmission mechanism that operates via targets. Accordingly, here we relate policy instruments primarily to the targets of policy.

Before proceeding, however, it may be worth recalling that the relationship between targets and goals may not be that straightforward, and both UK and Scottish Governments seem to share an expectation that achievement of any given target may contribute to the attainment of more than one goal. Clearly emissions targets link most directly to the environmental objective, but they may also contribute to security of supply by reducing the risks of energy system failures due to climate-change-induced extreme weather conditions. Renewables targets may be seen as contributing to the environmental objectives (at least if they replace carbon intensive generating capacity, though less clear if they replace nuclear), but there may also be a belief that they contribute to security of supply through diversity and encourage growth by encouraging new renewable energy industries. The positive nuclear target of the UK Government is regarded as contributing to environmental and security of supply goals. The negative judgement about the environmental (though not emissions-related) impact of nuclear leads the Scottish Government to believe that its zero nuclear target contributes to its overall environmental objective (though not its emissions target) (Scottish Government, 2007a).

Notice, however, that while most of the goals of policy have targets that can be linked positively to them (although there may be doubts about the strength of the linkages), only fuel poverty seems to link at all to the affordable price of energy goal. Accordingly, we give separate consideration to the links between energy policy instruments and this policy objective.

Policy instruments and the emissions targets

The fact that both Scotland and the UK are proposing committing themselves to statutory targets for emissions is surely significant. The motivation is to emphasise the seriousness of the environmental goal, to establish credibility of the emissions targets and provide the appropriate framework for transactors, in both private and public sectors, to make decisions informed by the Governments' plans. The analogy is with the independence of the Bank of England and it being tasked to set interest rates to seek to ensure that inflation remains within its target range. The Bank of England's case is regarded as very successful, and the evidence clearly supports this for the "nice" decade, though circumstances are now more challenging. A key element in the success of the new monetary regime has been its ability to lower transactors' inflation expectations, and so reduce adjustment costs.

In the climate change context the hope is presumably that transactors similarly base their expectations of emissions on published, legally-binding targets believing that policy will be adjusted to ensure that these are met. Since the targets stretch out to 2050 they potentially provide a very

Box 1: Energy Powers Reserved to Westminster and Energy Powers Devolved to Scotland

Reserved matters

- (Macroeconomic policy; tax-transfer system)
- Generation, transmission, distribution and supply of electricity
- Most aspects of the ownership, exploration and exploitation of oil and gas, including pipelines, and restrictions on other activities offshore
- Coal ownership, deep and opencast mining and subsidence from mining
- Nuclear energy and nuclear installations including safety, security and liability for nuclear occurrences
- Energy conservation by prohibition or regulation

Devolved matters

- Environmental protection and pollution, specifically discharges, air pollution and integrated pollution control, under the provisions of the Environmental Protection Act 1990 in relation to oil and gas, coal, nuclear
- Planning approval of the development of energy infrastructure other than pipelines and transmission lines under the various Town and Country Planning (Scotland) Acts
- Permissions for the manufacture of gas and non pipeline conveyance of gas
- Restoration of land affected by coal mining
- Emergency planning and civil nuclear power stations
- Environmental regulation
- Encouragement of energy efficiency
- Promotion of renewable energy and powers in relation to climate change
- Consents for power stations and overhead electricity lines
- Approvals for land based gas pipelines

Source: based on Royal Society of Edinburgh (2006), quoting Scotland Act 1998 Schedule 5, and Winskell (2006)

Box 2: EU, UK and Scottish Energy Policy Instruments

Main EU-wide instruments

- European Union Emissions Trading Scheme (EU ETS)

This is an EU-wide programme targeting carbon dioxide emissions where emitters must provide permits to cover all emissions. This operates through the "cap and trade" principle, and for the energy sectors, covers all combustion installations with a rated thermal output of greater that 20MW, mineral oil refineries and coke ovens. As such, the EU ETS "currently regulates just under 50% of Scottish CO2 emissions" (Scottish Government, 2008). European Commission proposed in January 2008 (the its Energy Policy for Europe) that the EU ETS be expanded to other emissions, including transport and domestic gas supplies, and that the EU ETS be revised to cover almost all industrial installations and, from 2012, aviation.

- Large Combustion Plant Directive

This requires member states to reduce pollution of a number of (non-CO2) pollutants from industrial (fuel-burning) processes. New electricity generation facilities must meet stated emission limit values, which the UK has a National Emissions Reduction Plan for existing electricity generation facilities and from January 2008 facilities can trade (within the UK) their allowances for emissions of sulphur dioxide, nitrogen oxide and particulates with other plants in the scheme.

- EU Directive on the Energy Performance of Buildings

This directive sets out the measuring and reporting of the energy performance of new and existing buildings, with member countries responsible for setting the minimum standards.

Main UK-wide instruments

- Green taxes

Air passenger duty, fuel duties, (the revised) vehicle excise duty are all examples of UK tax system being used to tax activities seen as causing environmental damage. A further example is the Climate Change Levy (see below).

- UK tax-transfer system

The primary route through which centrally-collected tax revenues are redistributed to individuals and corporations.

- Winter fuel payments

Annual payments to most people over age 60, with additional payments of £50 to households with someone aged between 60 and 79, and £100 to someone aged over 80.

- Proposed legally-binding emissions targets?

UK Climate Change Bill proposes binding emissions targets of 60% reduction in CO2 emissions by 2050, and Committee on Climate Change set up to advise on whether this target should be increased.

- Renewable Obligation

The RO compels electricity supply companies to provide Renewables Obligation Certificates (ROCs) – gained by accredited renewable generators for each MWh of electricity produced – corresponding to a growing share of the electricity they supply, or to pay a buyout price for the amount they are short of the necessary share (6.7% in 2006-7), and growing to 15.4% by 2015 and remaining constant to 2027.

- Climate Change Levy

From April 2001, this is a tax on the use of energy in industry, commerce and the public sector, with "revenue-neutral" cuts in employers' National Insurance contributions. In current form the CCL was originally estimated to raise £1 billion annually, with 0.3% reduction in rate of NI contributions. Initially also provides funding for the work of the Carbon Trust.

- Climate Change Agreements

Industrial sectors liable to pay the CCL could negotiate discounts in rates of levy payable alongside agreement to meet targets for energy efficiency at sectoral level.

- Carbon Emissions Reduction Target (replacing the Energy Efficiency Commitment)

Beginning in 1st April 2008 and running for three years, this is an obligation on energy suppliers to achieve targets in promoting reductions in carbon emissions in the household sector. This is described by DEFRA as "the principal driver of energy efficiency improvements in existing homes in Great Britain".

- Carbon Reduction Commitment (starting 2010)

This will encourage energy efficiency in large business and public sector organisations (responsible for 10% of UK emissions), through trading of permits for energy use emissions and electricity use (indirect emissions), where these are outside either the EU Emissions Trading Scheme or Climate Change Agreements.

- Carbon Trust

Set up in 2001 with revenues from the Climate Change Levy, this provides support for business energy efficiency programmes and the development of low carbon technologies.

- Energy Saving Trust

Responsible for the promotion of cleaner fuels for transport, energy efficiency for buildings and homes, and small scale renewable energy projects. There is a Scottish office, funded by the Scottish Government providing assistance through the Scottish Community and Householder Renewables Initiative.

- UK Renewable Transport Fuels Obligation

This is designed to work in a similar way to the Renewable Obligation, requiring suppliers of fuel to ensure that a percentage of their aggregate sales is met from biofuels. This began at 2.5% and will rise to 5% by 2010.

Main Scottish-specific instruments

- Proposed legally-binding emissions targets?

Scottish Climate Change Bill proposes target of 80% reduction Scottish CO2 emissions from 1990 base year, with annual carbon budgets and system of monitoring and reporting.

- Marine Supply Obligations

From 1st of April 2007, the MSO requires suppliers with an obligation under the Renewables Obligation (Scotland) Order (ROS) to meet a portion of their obligation through providing ROCs earned by Scottish-based wave or tidal generation, or pay a higher buyout price. Suppliers will be required to comply with the MSO when the requirements rises above zero, as accredited wave and tidal generators become operational in Scottish waters.

- Scottish Ministers' Wave and Tidal Energy Scheme

Total budget of £8 million to provides grants to businesses to support the installation and deployment of wave and tidal devices and testing of components at the European Marine Energy Centre in Orkney.

- The Saltire Prize

Announced in April 2008, this is a £10 million "challenge prize" for advances in clean energy, focusing on those which can be demonstrated in Scotland and which would take advantage of Scotland's renewable energy resources.

- Warm Deal

Provides grants of up to £500 for householders aged over 60 to have domestic insulation installed. Smaller grants available for households not in receipt of certain income-related benefits.

- Scottish Community and Households Renewables Initiative

With funding of £18million since its inception, the Scottish Government supports the development of small scale renewables principally through this mechanism. Managed by the Energy Savings Trust and Highlands and Islands Enterprise, this offers grants, support and advice to community and households interested in developing and installing renewable energy technologies.

- Loan Action Scotland

The Scottish Government has provided funding of £3 million to be made available to SMEs through a "revolving" loan fund for capital investments in energy efficiency improvements for projects between £5000 and £100,000 at 0% fixed interest rate.

- Central Energy Efficiency Fund

The Scottish Government has allocated funding of £24 million to provide loan funding for capital investments in energy efficiency improvements across the public sector in Scotland.

- Energy and the Building Regulation System

Building (Scotland) Regulations 2004 and revised Building Regulations introduced in 2006

- Planning regulations – Scottish Planning Policy 6

This, announced in March 2007, set out changes to the Scottish planning system to the process by which renewable energy proposals are prepared and permission determined, specifically to "ensure the delivery of renewable energy targets as well as supporting the development of a viable renewables industry in Scotland".

Sources: UK Climate Change Programme 2006, Scottish Government Consultation on Proposals for a Climate Change Bill, Renewables Obligation Annual Report 2006-7, various Scottish and UK Government websites.

long-term framework, which could, for example, have a significant impact on the expectations of those individuals and firms who are considering investments in low carbon technologies. If the policy announcement is indeed credible and widely believed, then there should be some independent stimulus to emissions reduction from this source. So here the legal framework in which "targets" are introduced becomes, in effect, an additional policy instrument. However, it would be fortuitous to an incredible degree if the mere setting of legally binding targets changed behaviour to such an extent as to make the targets self-fulfilling. Accordingly, policy instruments directed at emissions reductions remain essential.

Credibility is critical here, as is apparent from the very recent signs of divergence of market inflation expectations from the targeted inflation range. As this example shows, credibility cannot be taken for granted, and a key determinant of this will be market confidence that the government will use policy instruments to ensure satisfaction of the emissions targets. Of course, the fact that the targets are to be legally binding helps a great deal in establishing credibility. But the analogy with the inflation case seems imperfect, since there we are dealing with adjustment of a single policy instrument, with reasonably well-known linkages to the single goal. There does not appear to be a comparable instrument with a known transmission mechanism to emissions reduction.

The EU ETS is, of course, targeted at emissions, but for the EU as a whole, not the UK or Scotland and, as we have noted, targeting the distribution of emissions within the EU may frustrate the supposed advantages of a trading scheme. Green taxes, here including the climate change levy (and associated policies), have a potentially major role to play, although the hauliers protests remind us of the apparent political limits, though these may themselves be influenced by educational policies. All of the other policies intended to encourage lower carbon intensive energy service provision are also helpful here, though none is ideal since none (other than ETS) is directed specifically at carbon content. The UK's nuclear policy helps with emissions, whereas the Scottish Government's does not (although they would argue a net environmental gain from phasing out nuclear). Finally, economic activity may change to achieve target emissions, though given these are in general positively related, a tradeoff exists, which we consider further below. Targeting fiscal policy to carbon emission might improve credibility, but the macroeconomic costs may be great.

There are, therefore, many policy instruments that can impact on carbon emissions, but the apparent simplicity of the target inflation analogy does not hold, and the possible need for a carbon tax in the absence of a truly comprehensive and effective EU ETS is something that ought to be considered.

Policy instruments and the renewables targets

Presumably the UK, and especially the Scottish, Government would hope that renewables targets would similarly provide a framework in which transactors can take better informed decisions, secure in the knowledge of the government's long-term commitment to renewables. This provides a context in which private investors are more likely to engage in risky

renewable investments. While there must be something in this, the fact that these targets on renewables are not statutory suggests that any such impact here is likely to be lower than in the emissions case. Changes in targets, and extension of the time frame, in a non-binding framework, may reduce credibility. Certainly, it is even more important in this case that the private sector be convinced that the targets are meaningful and that is likely to depend, to some extent, on a belief that the policy authorities have the relevant policy instruments and are prepared to use them to the full extent.

Of course, the main policy instrument at present in this context is the Renewable Obligation (RO). Winskel (2006) traces the development of renewables policy in both Scotland and the UK. It is quite clear that the RO has significantly stimulated renewables capacity. However, because it is "technology blind", it has had the biggest impact on the renewables technology that was closest to commercialisation, namely onshore wind. After some debate, the decision was taken to support the introduction of "banded ROCs", as the Scottish Government had wished (but DTI had initially opposed), so as to improve the incentives to develop marine technologies. Resistance to reforming the RO had been based on the kind of considerations that attend attempts to "pick winners". However, the judgement that encouraging the development and deployment of promising newer technologies required incentives to overcome initial cost barriers and inertia eventually proved persuasive.

Additionally, the Scottish Government has sought to stimulate renewables by influencing UK government policies. For example, the current structure of grid charges could inhibit the development of renewables given resource concentration in perhipheral areas located far from the major sources of demand, and there are signs of some initial success here at least in stimulating a review[10]. There has also been an attempt to modify Ofgem's behaviour, and perhaps alter its seemingly predominant "least cost" objective, to reflect some of the wider goals of energy policy.

Policy instruments and the nuclear target

While nuclear power is a reserved matter, under devolved powers any application to build a new nuclear power station in Scotland would require consent from Scottish Ministers under Section 36 of the Electricity Act 1989. While any application would need to be considered on its individual merits, the Scottish Government has made its desire to phase out nuclear very clear. The non-nuclear target therefore may be the easiest for the Scottish Government to achieve.

The UK policy position is less clear. Some form of intervention would seem to be required to encourage the scale of private sector investment in new nuclear that would be required for the UK to achieve its (as yet implicit) targets. It is not clear what form this is likely to take.

Policy instruments and price affordability

There are a number of possible policy influences on price affordability, including North Sea Oil production; tax policy and instruments aimed at fuel poverty. However, given that North Sea Oil production is small in relation to world oil production, variations in its production would be expected to have a negligible impact on world oil prices (though of course they would have a proportionately bigger impact on UK Treasury revenues).

The UK government has more options at its disposal than its Scottish counterpart, given its ability, at least in principle, to set green taxes and adjust their levels depending on circumstances. The September 2000 protests over the fuel price escalator served to remind us that the government's green fiscal powers are subject to the constraint of public willingness or acceptance of such changes, as do the (so far) less dramatic haulier protests and veiled threats of May 2008. However, the UK government can, for example, suspend the fuel price escalator, and could, conceivably, adjust fuel taxes generally partially to mitigate the impact of rising fuel prices (as current protests are suggesting), although such changes would clearly act against climate change objectives. (See the discussion of the trade off between goals below.) Since the Scottish government currently has no control over taxation (other than the "tartan tax"), it can have no such influence over net of tax fuel prices, except to the extent of its ability to influence Westminster decisions. However, the fiscal powers of the UK Government are unable ultimately to offset upward pressure on world energy prices.

To the extent that increased fuel prices are being driven by demand side factors, however, environmental concerns would strongly suggest that no attempt should be made to counter these changes. Indeed, we are likely ultimately to have to add to these prices to build in the impact on emissions, whether through a carbon tax or a trading scheme. Furthermore, Stern (2006) suggests that such action should be taken sooner rather than later.

There have been doubts expressed about just how competitive UK, EU and world markets genuinely are. There may be some scope for moderating various energy costs through vigorous pursuit of competition policy. (Though note there are some benefits to the UK of a higher oil price because of North Sea Oil.)

Overall, it is not clear how either the UK or Scottish governments could be in a position to deliver "affordable" energy prices, unless perhaps they have in mind the price of

energy delivered to particular target groups, such as the fuel-poor. Not surprisingly, measured fuel poverty diminished with the fall in energy prices of the 1980s and 1990s, but has increased with the rise in energy prices of the current decade. It is not clear how energy policy per se can tackle this issue: if it is a distributional issue, the natural set of instruments are those embodied in the tax-transfer system. This would suggest that, under current constitutional arrangements, this would become primarily a UK responsibility. Of course, there may be Scottish-specific elements of this problem (e.g. attributable to lower average temperatures here), but distributional issues are more efficiently tackled by Westminster, and this may be an advantage of membership of the UK.

However, the Scottish government can and indeed does assist "affordability" more generally through, for example, its Central Heating Programme, and re-establishment of the Scottish Fuel Poverty Forum.

The spatial allocation of energy policy instruments

While Boxes 1 and 2 indicate the current allocation of energy policy instruments between the Scottish and UK (and EU) Governments, this does not necessarily reflect the most efficient allocation. However, it is worth keeping in mind that the formal allocation of policy instruments may give a rather misleading impression of the ability of the Scottish Parliament to conduct a distinctive energy policy. The provision of nuclear electricity generating capacity is a striking example of this. While in principle a reserved matter, it is now clear that the Scottish Government would be very reluctant to approve any commercial applications to establish new nuclear capacity. In practice, the extent of differentiation in Scottish energy policy is perhaps surprising given the formal devolution settlement.

The debate on fiscal federalism and the appropriate degree of fiscal autonomy relates to the most efficient allocation of policy instruments among the different levels of government in the context of a system characterised by multilevel governance. In the present context the natural levels relate to the EU, Westminster and Scottish Governments. The allocation of powers between Westminster and Scotland is broadly compatible with fiscal federalism principles, except in respect of the very limited devolution of tax powers (McGregor and Swales, 2005). The gains to further devolution relate to the possible efficiency gains of bring tax and spending powers together. However, there are potential efficiency losses, as when policies have significant spillover effects to other regions.

For example, suppose green taxes were to be devolved and a greener Scottish Government were to raise these relative to the rest of the UK. We would expect adverse competitiveness effects in Scotland given the extent of interregional trade with RUK, though there may be some offsetting gain in terms of the stimulus to development and deployment of low carbon technologies. These tax changes would inevitably have an impact on regional economies furth of Scotland, in this case probably positive impacts, at the expense of a loss of activity and population from Scotland. Certainly this would sharpen the trade off between emissions in Scotland and economic activity there. However, there may well be scope for further devolution of energy policies from Westminster to Scotland, but if efficiency criteria dominate, this should be on a case by case basis.

5. Constraints on Scottish energy policy

Our discussion of goals, targets and instruments has already alluded to a number of effective constraints on energy policy. Some of these constraints impinge on UK as well as Scottish energy policy. World oil prices are outwith Scotland's and the UK's control, and, notwithstanding short-run apprehension of the fallout from the credit crunch, long-term projections continue to suggest growing demand, though this of course depends on World economic and population growth (with China and India exerting major pressure). Forecasts for oil prices are now often in the $200 per barrel range, though the detailed demand and supply assumptions that underly such forecasts are rarely clear, and the extent to which oil and other commodity prices are currently under speculative pressure resulting from the credit crunch is also unclear.

Furthermore, EU policies clearly impose constraints on the UK directly and, less directly, on Scotland. We have already discussed the EU ETS though it currently covers only 50% of Scottish emissions. Of course, more generally, EU policies impose constraints on Scottish energy policy, for example, through the EU's Large Coal Plant Directive (LCPD); buildings & energy regulations and binding targets for renewables in the UK. UK policies impose constraints through, for example: liberalised markets; the regulatory framework and BETTA (though here change is feasible through Westminster Government action). Of course, the regulatory framework is under the control of the Westminster Government.

As explained in the preceding section, the devolution settlement reserves many key energy issues to Westminster and this imposes further constraints on the conduct of Scottish policy. However, we have also seen that despite this there has proved to be considerable scope for pursuing a distinctive energy policy. For example, planning powers would permit resistance in Scotland to any attempt to impose UK policies, such as the establishment of new nuclear capacity. Infrastructure issues are also key here if the renewable resource is to be usefully harnessed, and this could involve offshore grids and cabling and upgrading of Beauly-Denny, for example. Ofgem's emphasis on least-cost provision could be interpreted as down playing the environmental objective and could militate against

the development of renewables. Overall, tighter constraints through the devolution settlement inhibit but do not preclude a differentiated Scottish policy

While it is not always recognised in policy documents, it seems likely that the goals of policy may conflict, so that there may be tradeoffs among them. These trade-offs make policy choices more painful, but they cannot be ignored in any analysis of policy: in effect, they impose additional constraints on the conduct of energy policy.

The potential tradeoffs between goals

Tradeoffs among energy policy goals?

There are potential trade-offs between each pair of energy policy goals. Improving the environment by reducing emissions seems likely to be costly. Correcting the climate change externality involves pricing carbon emissions (either through a carbon tax or a trading scheme), and so a *rise* in the cost of carbon-intensive processes seems unavoidable.

Improving the environment on the other hand may enhance security of supply if it reduces the likelihood of extreme weather conditions threatening energy systems. However, while environmental issues require a cooperative global solution, many security-of-supply concerns appear to arise out of suspicion of any cooperative global solutions. In the limit, lack of trust would lead to possibly extremely inefficient "self-sufficiency solutions" to the security of supply problem, though, as we have seen, these are not genuine solutions. Achieving the environmental goal through larger numbers of onshore wind farms is unlikely to enhance economic development through energy sector growth. There may well be negative growth effects to the extent that this frustrates the development of indigenous competitor technologies, such as marine. Again there is the potential for conflict, although stimulating wave and tidal technologies offers the prospect of complementarity between environment and economic development through new energy technologies. The real trade-off here is likely to be between general economic and population growth and the environment, which we consider below.

As we have seen there are many dimensions to security of supply, but it does seem very unlikely (though not impossible) that improvements in security of supply can be secured without pushing up energy prices. Thus the need for diversity would appear to preclude simple adoption of the least-cost energy source, and so must result in greater energy prices. Encouragement of excess capacity in electricity generation would seem to require some premium to be paid for unused capacity. The affordable price and security of supply objectives probably do conflict. Our discussion of renewables targets makes it clear that the security of supply and growth objectives may not always be aligned. For example, growth in renewables may ultimately not add to diversity, although it does seem likely to do so for the UK as a whole.

Finally, the goal of growth stimulated by the development of indigenous renewables generating capacity appears to conflict with the affordable price objective of energy policy. It is in the nature of many new technologies that they are initially more costly than old technologies, and this is especially so for energy systems which tend to have very long-lived assets. The UK energy system is dominated by low-cost (if emissions are ignored), large-scale production that tends to "lock-in" carbon intensive production. New technologies require assistance in the early stages if they are to break in to the market, and the renewables obligation has been the main instrument for this in the UK. Of course, this induces higher electricity prices (Bellingham, 2008).

Tradeoffs between energy goals and other policy objectives?

The Scottish Government's economic strategy emphasises sustainable growth of both the economy and population. In general, we would expect that the greater the degree of success in achieving growth in the Scottish economy and in the population of Scotland, the greater greenhouse gas emissions would be. This is an example of the trade-off between two goals: "success" in one (growth) makes achievement of the other – lower emissions – more difficult.
The trade-off is, however, sensitive to the precise nature of growth the sectoral composition of growth and its source matter. If, aggregate growth is concentrated in service sectors, with lower growth or even decline in energy-intensive manufacturing, then emissions can fall even in the presence of growth. Also, if growth arises out of renewable energy industries being established in Scotland, this would limit emissions.

The Scottish Government has made it clear that it sees a moral case for Scotland contributing to a global movement to tackle climate change, so importing electricity as a means of meeting emissions targets would seem to be ruled out (but would a reduction in exports be similarly precluded?). In fact, attributing responsibility for emissions in an open regional economy is difficult, but there are various formal techniques that could allow us to make progress in monitoring this.[11] Of course, different sources of energy have different environmental consequences: none is completely free of negative impacts on the environment.

Resolving the tradeoff between economic growth and the environment

Scotland's main challenge in the present context is how simultaneously to achieve an 80% cut in emissions ***and*** higher economic and population growth. There are a number of

possible candidates, including: energy efficiency improvements; development of renewable energy sources; carbon capture and storage; combined heat and power; transport policies; microgeneration; changing behaviour (Scottish Government, 2008).

However, resolution of the conflict among goals is often difficult, and policies may not always have straightforward consequences. Arguments that increases in resource (especially energy) efficiency reduce the burden of economic activity on environment are now widespread - and influential in policy formulation. In a system-wide context, however, this is not guaranteed. For example, a 5% increase in energy efficiency lowers the price of an effective unit of energy. This tends to stimulate demand for energy, measured in efficiency units, and the actual reduction in energy use will generally be less than 5% ("rebound") and there might even be an increase energy use ("backfire"). Our research suggests these effects may be non-trivial (Allan et al, 2007a, and Hanley et al, 2008). While this does not imply that energy efficiency improvements should not be sought, it does suggest that other energy policies may be required to ensure environmental as well as economic benefits arise from energy efficiency improvements.

A further example is the use of renewables to stimulate growth and benefit the environment. Growth in new renewables has mainly occurred through ***onshore wind***, but research suggests that this has little "multiplier impact" on Scottish economy (Allan et al, 2007b). Onshore windfarms tend not to be extensively integrated into the host economy, and with extremely limited "backward linkages" through purchases from local suppliers or from direct employment. Also, there appears to be little potential for supply-side benefits, given largely imported technology. However, windfarms can generate important benefits for rural communities, though our research suggests that this depends critically on the scale of community benefit payments and, potentially even more importantly, the share of ownership (Allan et al 2008a).

Most recent emphasis on economic development opportunities has been on ***marine*** (wave and tidal) renewables. Our research suggests that there is potential for simultaneous economic development opportunities and environmental benefits arising from the development of marine renewables. However, this is going to depend on policy, on the speed at which learning rates with the new technologies reduce unit costs, and the manner of the integration of renewables into the existing portfolio of electricity generation (Allan et al, 2008b).

While these illustrative analyses are suggestive, much more detailed research would be required to assess the feasibility of the Scottish Government's energy objectives and targets, taking full account of the implications of eliminating the nuclear base load and of the potential for CCS, for example.

6. Conclusions

The Scottish Government is, and indeed has for some time been, pursuing a distinctive energy policy. Further compared to UK energy policy this has more ambitious goals and more demanding targets (including one of no nuclear electricity generation), but is subject to tighter constraints and has fewer instruments. Moreover, tradeoffs exist among the price, security of supply and environmental objectives of policy, and between these and the Scottish Government's economic and population growth targets, which add significantly to the difficulty of simultaneously achieving all of the stated goals of policy. On the other hand, to the extent that EU and UK policies align with the goals of Scottish Energy Policy this facilitates their achievement.

In these circumstances would it be better to increase the number of energy policy instruments, perhaps through further devolution of powers to the Scottish Parliament from Westminster? Or would it be preferable to adopt fewer targets? Or could each be preferred in different circumstances and for different policies?

The answers to such questions depend to a significant degree on the kind of considerations that are central in theories of fiscal federalism. These theories deal with the appropriate allocation of powers to different levels of government. So, for example, would it be efficient for security of supply to be dealt with at the level of individual regions or countries of the UK? Economies of scale and scope suggest that the security of supply issue might be most efficiently tackled at the level of UK, or perhaps even the EU, with trading relationships within the block providing security of supply for member countries and regions. However, this is once the problem is resolved on behalf of the block as a whole. Clearly there are concerns at the UK level about the ability of the EU to deliver this anytime soon: but are there real concerns for Scotland vis a vis the UK?

A further issue relates to the rationality of each of the individual countries and regions of the UK having separate and distinctive targets for emissions. Clearly climate change is a global concern and UK and Scottish emissions are trivial in relation to the scale of the problem. However, the argument here, as the Scottish and UK Governments acknowledge, is a moral one of setting an example of responsible behaviour. But if there genuinely was established a market for carbon that achieved the internalization of the climate change externality, this moral stance would make little sense, since the geographic distribution of emissions under the trading scheme would simply reflect the least cost way of correcting the externality. Action to alter this distribution would frustrate the fundamental, and presumed most efficient, mechanism of the trading scheme. This suggests that the UK and Scottish Government's country-specific targets should be monitored as the influence of the EU

ETS grows through time. Perhaps targets should only relate to uncovered emissions, though this raises problems of its own, as the proposed Climate Change Bill recognizes.

Naturally, as we have emphasized, even if it was felt that some policies should be agreed at, and coordinated from, a higher level of the governance hierarchy, this is not an excuse for inaction at lower levels of the multilevel system. Delivery would still be critically dependent on local actions, but these might be more efficiently organized and coordinated through a higher level of government.

Of course, in other areas further devolution of powers to the Scottish Government might improve efficiency in the conduct of energy policy, as well as economic policy more generally. The most obvious area here is tax policy, but the fiscal federalism literature, and the available evidence, is not unambiguous in the policy advice it implies. There are costs as well as benefits associated with increasing the degree of fiscal autonomy, and the issue of desirability is therefore an empirical one. In the present context, a Scottish Government that pursued a "greener" tax agenda than Westminster might suffer important adverse competitiveness effects, especially given the mobility of both labour and capital across the border to the rest of the UK. However, the overall tax burden could be held constant and, on the other hand, greener taxation may further stimulate innovation in non- carbon- intensive technologies.

Increased research into the detailed costs and benefits of more and/ or less centralization would undoubtedly improve our understanding of the appropriate conduct of energy policy within a system of multi-level governance. We look forward to the outcome of the deliberations of the Calman Commission, which will presumably be exploring exactly these issues.

Endnotes:

[1]Scottish CO2 emissions are estimated to be around 0.2% of global emissions and 0.15% of global greenhouse gas emissions due to human activities. (Scottish Government, 2008a).

[2]Under uncertainty the choice between them would be informed by the shapes of the marginal cost and damage functions (Wietzman, 1974).

[3]Helm (2005) suggests such targets may be more credible.

[4]Current circumstances have been christened "vile": volatile inflation, less expansionary, by Michael Saunders of Citigroup. See e.g. Britann (2008).

[5]The Scottish Government (2008b, p3) has secured a commitment from the Office of Gas and Electricity Markets (Ofgem) and the National Grid to a review of transmission charging.

[6]For example, in the UK White Paper DTI (2007, footnote on p7) the objective is expressed as "to ensure that every home is adequately and affordably heated". The objectives stated therein are the same as those expressed in the earlier White Paper (DTI, 2003).

[7]In DTI (2007,p7) one objective is "to promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity". However, the energy sector does not receive any special emphasis here as a potential engine of growth.

[8]This is not to say that devolved government cannot improve the growth rate. For a review of the evidence see Roy (2006).

[9]Whether the target is to be framed in terms of CO2 or greenhouse gas emissions has not yet been determined.

[10]The Scottish Government has a commitment from Ofgem and the National Grid to review transmission charges.

[11]See, for example, McGregor, Swales and Turner (2008).

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