The Future of Electricity (and Gas) Regulation

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Abstract

This paper discusses whether a new paradigm is necessary for independent economic regulation of electricity (and closely associated natural gas) systems. We begin by summarising the nature of the traditional model of electricity reform and the place of economic regulation within it. Next we outline the drivers for changing the current model of electricity regulation, namely, the maturity of the existing model, the reality of changing circumstances, and the coming of age of climate change concern. We go on to discuss the premises on which a new model of regulation should be based. These are: remembering the successes of the current system of regulation; a new focus on processes not just outcomes; a recognition of the economics of climate change; and the appropriate management of uncertainty. We then highlight the key elements of a new model for regulation: new processes of regulation; new models of competition and the issues raised by a focus on climate change.The paper draws heavily on the experience of the UK, but has direct implications for the rest of the European Union countries and for other countries whose regulatory systems mirror them.

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Electricity markets in the developed world stand at something of a crossroads. Many countries have made some, often substantial, progress with market-based reforms in production and retailing and the introduction of incentive regulation of networks. During the reform period governments have sought to reduce their direct involvement in the electricity sector. Now however rising environmental concern about global warming is beginning to focus minds more clearly on the need for the reduction of carbon dioxide emissions from the electricity sector. The need for substantial decarbonisation of the electricity sector is increasingly recognised and being reflected in economic policy around the world, and particularily with EU countries.[2]

There has been significant agreement on what constitutes the elements of an electricity reform package (see Jamasb and Pollitt, 2005a). Addressing climate change seriously, however, has the potential for introducing significant divergence in policy choices between countries. This paper will argue that electricity (and, by association, natural gas) regulation in an era of significant climate change concern[3] needs to strengthen the role of competition and market forces as well as to respond to the political pressure for action on decarbonisation of the electricity and heat sectors.

The paper proceeds as follows. First we will discuss the nature of the traditional model of electricity reform and the place of economic regulation within it. Next we will outline the drivers for changing the current model of electricity regulation. Third, we will discuss the premises on which a new model should be based. Fourth, we will outline the key elements of a new model. Lastly we will conclude with lessons for independent regulatory agencies, governments and companies. The paper draws heavily on the experience of the UK, but has direct implications for most other European Union

[1] This paper is based on a talk entitled 'Regulating electricity networks in an age of rising real prices' given at the London EPRG/CEEPR conference in September 2007. Comments from that conference and audiences at BERR, SGBI and the University of Cambridge are acknowledged. The author wishes to acknowledge the support and encouragement of Ofgem. The views expressed in the paper are entirely those of the author and should not be taken to be those of Ofgem. The author also wishes to thank Richard Green, Stephen Littlechild, Steve Smith and David Newbery for detailed comments on an earlier draft.
[2] Grubb, Jamasb and Pollitt (2008) provides detailed analyses of how current and future policy can achieve this in the context of the UK.
[3] Note climate change concern could be relatively greater than or less than actual climate change.

countries who operate within the context of EU energy and environment directives aimed at achieving common goals and spreading best practice forms of action and regulation.

1. The Traditional Model of Electricity Reform

The model of electricity reform as it first emerged in Chile (1982), UK (1990) and Norway (1991), and subsequently in many other jurisdictions including Australia and Texas, had four key elements.

1. The introduction of a competitive wholesale power market.
2. The gradual extension of competition in the retail market.
3. The regulation of network services via CPI-X regulation.
4. The introduction of additional incentives for quality of service and loss reduction.

The reform model was supported by rules on the separation of generation, transmission, distribution and retail businesses in order to improve third party access to the monopoly networks.

In many jurisdictions reform involved the privatisation and restructuring of state owned monopolies (Pollitt, 1997). In some other jurisdictions with initially private monopolies legislation and voluntary agreements resulted in divestitures of generation assets in order to facilitate competition in the wholesale power market.

Reform was often accompanied by the introduction of an independent regulatory agency, with an arms length relationship to government departments and with statutory duties to promote competition and to set regulated tariffs[4]. This new regulatory agency was usually a specialist in energy regulation and often combined electricity and gas regulation, where gas was available.

To understand the role of such economic regulators it is worth examining the mandate of the Gas and Electricity Markets Authority in the UK. This is the governing board of Ofgem, THE GB energy regulatory agency (see Box 1)[5].

The legislation governing Ofgem has arisen principally from the Gas Act 1986 and the Electricity Act 1989 which privatized the state owned industries. The duties of Ofgem were modified in the Utilities Act 2000 which introduced, inter alia, the protection of vulnerable customers and the Energy Act 2004 which included provisions about such things as energy security and having regard to best regulatory practice. In addition Ofgem's duties also arise from general competition legislation, namely the Competition Act 1998 and the Enterprise Act 2002, as well as arising from national implementation of European Community directives.

[4] See Larsen et al. (2005) on the duties of a sample of European energy regulators.
[5] The UK consists of Great Britain (GB) and Northern Ireland. Ofgem regulates only the GB market. In the paper we use GB where it is important to indicate that what is discussed only refers to GB and not to Northern Ireland.

Box 1: The Mandate of the Gas and Electricity Markets Authority

The Authority's principal objective when carrying out certain of its functions under each of the Gas Act and the Electricity Act is to protect the interests of consumers, present and future, wherever appropriate by **promoting effective competition** between persons engaged in, or in commercial activities connected with, the shipping, transportation or supply of gas conveyed through pipes, and the generation, transmission, distribution or supply of electricity or the provision or use of electricity interconnectors.

The Authority *must when carrying out those functions have regard to*:
• The need to secure that, so far as it is economical to meet them, all reasonable demands in Great Britain for gas conveyed through pipes are met;
• The need to secure that all reasonable demands for electricity are met;
• The need to secure that licence holders are able to finance the activities which are the subject of obligations on them ; and
• The interests of individuals who are disabled or chronically sick, of pensionable age, with low incomes, or residing in rural areas.

Subject to the above, the Authority is required to *carry out the functions referred to in the manner which it considers is best calculated to*:

• Promote efficiency and economy on the part of those licensed under the relevant Act and the efficient use of gas conveyed through pipes and electricity conveyed by distribution systems or transmission systems;
• Protect the public from dangers arising from the conveyance of gas through pipes or the use of gas conveyed through pipes and from the generation, transmission, distribution or supply of electricity;
• Contribute to the achievement of sustainable development; and
• Secure a diverse and viable long-term energy supply.

In carrying out the functions referred to, the Authority *must also have regard, to:*

• The effect on the environment of activities connected with the conveyance of gas through pipes or with the generation, transmission, distribution or supply of electricity;
• The principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed and any other principles that appear to it to represent the best regulatory practice; and
• Certain statutory guidance on social and environmental matters issued by the Secretary of State.

The Authority has powers under the Competition Act to investigate suspected anti-competitive activity and take action for breaches of the prohibitions in the legislation in respect of the gas and electricity sectors in Great Britain and is a designated National Competition Authority under the EC Modernisation Regulation and therefore part of the European Competition Network. The Authority also has concurrent powers with the Office of Fair Trading in respect of market investigation references to the Competition Commission.

(Source: Ofgem's website) [My italics and bold]

Reading the summary in Box 1 suggests that while Ofgem has a principal objective – captured in its current strap-line: 'promoting choice and value for all gas and electricity customers'[6], several other elements of economic regulation seem largely tacked on to Ofgem's duties. In particular Ofgem's role in ensuring that climate change objectives for the sector are things that it should *have regard to* rather than objectives. There also a loose requirement to *have regard to* energy security issues. I would want to suggest, that at the very least, Ofgem's mandate with regard to implementing government policy towards climate change in the energy sector is rather vague and that Ofgem's regulatory role in the politically sensitive areas of vulnerable customers, energy security and decarbonisation of the electricity sector is ill-defined and reflects the incremental addition of matters to which it should have regard to. This lack of clarity is reflected in a lack of associated powers in these areas.

Taking Ofgem as an example of a leading independent energy regulator, we take the traditional model of electricity and gas market regulation in the reform period to centrally be aiming at promoting competition and effective monopoly regulation (a perfect complement to competition in generation and retail) with additional concerns *secondary*. This is not to say that many other jurisdictions, especially in Europe and many of the states of the United States, only ever aspired to fully implement the 'traditional' reform model (see Pollitt, 2008 for more expansion of this in a global context).

It is important to evaluate the success of the traditional reform model for its own sake but also to understand what we have learned about the regulation of electricity markets that might be enduring.

I return to the elements of the reform model to offer an assessment of the extent to which they have been achieved in GB, as the prelude to a discussion of what the future might hold for energy regulation.

1.1 Competition in wholesale markets.

The evidence on this is generally very positive. Wholesale power markets can and do work well with potentially large benefits for consumers. In GB the history of wholesale electricity market reform divides into two periods: the initial period up to the late 1990s and the more recent period. The first period was characterized by large efficiency improvements at existing plants, significant new entry but problems of price coordination between incumbents. However robust regulatory action to reduce the market share of incumbents in the price setting part of the generation mix successfully resulted in highly competitive market. Newbery and Pollitt (1997) found that the privatization and restructuring of the CEGB, the former state owned generation and transmission monopoly in England and Wales, resulted in significant welfare gains for society, but that electricity consumers paid higher prices than would have been the case in the absence of privatization (at least until 1996).[7] Evans and Green (2003), looked closely at why

[6] See www.ofgem.gov.uk, accessed on April 11, 2008.

[7] Sweeting (2007) confirmed that observed pricing behaviour between 1995 and 2000 was consistent with the existence of tacit collusion.

electricity prices subsequently came down at the beginning of the second period. They attempt to distinguish the impact of declining concentration in the power market from the introduction of new electricity trading arrangements in 2001, which eliminated the old compulsory power pool and introduced bilateral contracting with a balancing market. They found that it was the declining concentration, which explains the fall in wholesale prices (which was very marked around this period). An important lesson from the UK's experience with addressing the initial problems is that effective regulatory action to reduce incumbent market shares is more important than market design per se. The new trading arrangements (NETA) were expensive at £1 billion but did however result in a much more competitive contract market for power, made gaming in the power market more difficult and did remove capacity payments (which created certainty about the incentives to withhold plant). Now the GB wholesale power market looks very competitive by world standards with 7 major firms competing with one another.[8]

1.2 Competition in retail markets.

Retail competition has been very popular with large industrial and commercial customers, who have benefited from the competition in the wholesale market. This phenomenon is observed across the world. Retail competition for household customers has been slower to develop due a combination of initial delays in deregulating the household market (in GB these were due to a desire for an orderly run down of the domestic coal industry which supplied the electricity sector at above market prices), difficulties in obtaining third party access and the transaction costs of switching supplier. Littlechild (2000) argues strongly for the competitive advantages of full retail competition and there has been significant switching in GB, with 47.9% of households having switched from their incumbent by March 2007, 8 years after full deregulation. Gross switching rates continue to be 1-1.5% per month. It is also the case that the average price saving from switching from the incumbent to the cheapest alternative remains around 7%.[9] In addition around 5m customers are on innovative tariffs involving fixed or capped prices or green power, which were not offered prior to the introduction of competition. Wilson and Waddams (2007) examine the rationality of electricity switchers, showing that a significant minority of those who switch have switched to dearer tariffs when they thought they were switching to cheaper ones.[10] This work however does not fundamentally challenge the idea of retail competition so much as to reveal the purchasing mistakes that characterize purchases of all goods in a market economy. Indeed a study of financial services in the UK revealed an average loss per household of £70-700 p.a. via not purchasing the cheapest products (Cook et al., 2002). This is around 1-10 times the upper end of the average benefit from switching to the cheapest electricity and gas supplier. However it is clearly the case that regulatory efforts to encourage efficient switching and price transparency are necessary.

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[8] Using 2005 figures, Matthes (2007) reports a HHI of less than 1000 for the Great Britain power market, indicating a competitive market. In contrast there is an HHI of 1450 in Germany ('the upper end of a moderately conscentrated market' and over 4000 in the joint France-Belgium-Luxemberg-Netherlands market.

[9] See Ofgem (2007a) for details on the state of retail competition in Great Britain.

[10] The study also only focuses on electricity only tariffs not dual fuel tariffs and hence misses joint savings for both electricity and gas for dual fuel switchers. This biases the result to an extent that is unclear.

1.3 Regulation of network services via RPI-X

The introduction of incentive regulation of electricity transmission and distribution networks has been a notable success story for electricity reform. Following Littlechild's seminal report (1983) the UK introduced a system of price cap regulation for all of its privatized natural monopoly industries. This was practically implemented via a regular price control review process. Under this process the revenue requirements of the regulated companies were assessed via the benchmarking of their existing operating and capital costs and the auditing of the their plans for investment going forward. This review involved assessing individual efficiency improvement factors for each firm (X) which were fixed for the period of the next review relative to the retail prices index (RPI)[11]. This has the effect of providing strong incentives for cost efficiency and transferring significant shares of the efficiency gains to consumers. In electricity transmission this resulted in prices being reviewed and reset in 1993, 1997, 2001 and 2007 (for five years). In electricity distribution reviews have resulted in prices being reset in 1995, 2000 and 2005 (for five years). Between 1993 and 2005 prices declined by 30% in real terms in electricity transmission and by 50% in real terms in electricity distribution. Domah and Pollitt (2001) show the substantial gains this system of regulation delivered in electricity distribution to 2005, while Newbery and Pollitt (1997) included electricity transmission in their positive assessment of the privatization of the CEGB. In comparison to regimes where rate of return regulation continued, with limited incentives for cost improvement the UK system of monopoly regulation has performed very well (see Hattori et al., 2005 for a comparison of cost improvement in UK and Japanese electricity distribution over the period 1986-2003).

1. 4 Additional incentives for quality of service and losses

The price control review process aimed at determining regulated prices for electricity distribution and transmission has been supplemented by additional incentive schemes to cover other performance metrics of interest. Yu et al. (2007) discuss the operation of quality of service incentives and energy loss reduction incentives in the UK. Quality of service incentives have targeted the number of customer interruptions (CI), average customer minutes lost (CML) as well as certain other quality of service metrics such as the quality of telephone response to customer queries. These incentives have been progressively increased such that companies might receive +/-4% of regulated revenue as a result of over/under performance against its individual quality of service standards. Strong incentives have also been added to incentivise energy loss reduction within distribution networks. As a result average losses across distribution networks in Great Britain have fallen from 7.0% to 6.0% between 2000/01 and 2003/04 (though a significant portion of this may be due to better measurement). Across the world, such incentive payments are generally not incorporated directly into assessments of the relative efficiency of distribution networks, which form the basis of the calculation of

[11] See Jamasb and Pollitt (2007) for details of how the system has operated in electricity distribution. In the UK the retail prices index (RPI) was used, in other countries (e.g. the Netherlands) the formula was CPI-X, signifying the use of the closely related consumer price index (CPI).

individual X factors. Some jurisdictions, notably Norway, have tried to include the value of customer interruptions in the assessment of allowed regulated revenue for distribution companies. A clear conclusion is that such targeted incentives can, if large enough, motivate significant improvements in performance. However it is unclear whether the collection of separately determined individual incentive payments is optimal in aggregate (see Yu et al., 2007, for evidence that this is a problem in the UK). Such a piecemeal approach extends into the area of regulatory incentives to connect distributed generation or private wire networks placed on distribution companies.

2. Drivers of change

I identify three drivers of change for energy regulation in the UK (and hence other deregulated energy markets): the maturity of the existing (traditional) model; the reality of changing circumstances; and finally the coming of age of climate change concern.[12]

2.1 The maturity of the existing model

Ofgem's mandate is to achieve its principal objective by **promoting effective competition.** It is legitimate to ask how would we know if we had established 'effective competition'? And if we had achieved it what are the implications for the existing model of regulation?

Independent sectoral regulatory agencies exist for a purpose. Usually that purpose is related to the idea that the markets they are regulating need special attention that cannot be provided by the general competition authorities, such as the Office of Fair Trading or the Competition Commission in the UK. This special attention is due to the immaturity of the markets being regulated and hence their need for considerable ongoing monitoring and/or the complexity of the assessment of whether the market is competitive and hence the need for specialist staff best organized into a separate regulatory agency.

In terms of its principal objective we have already seen that Ofgem (and its predecessor Offer) has witnessed notable success. The wholesale market was substantially competitive by 2001 when the market shares of the leading companies had been reduced by divestiture. Incentive regulation and tough reallocation of costs between distribution and retail had ensured that there was a level playing field in retail competition between incumbent retailers and new entrants, such that the residential switching rates in GB are among the highest in the world (see Littlechild, 2006).

In terms of promoting the efficiency of network companies, real prices fell in all the price review periods up to 2005. There was also significant convergence in costs observed between electricity distribution companies.

[12] Helm (2005) in his review of UK energy policy suggests the need to replace existing generating capacity, the low carbon economy and the volatility of world energy commodity markets as giving rise to the need for a 'new' energy policy.

We suggest that scope for Ofgem's efforts to impact prices by promoting competition and incentivising efficiency in electricity (and gas) supply further is now limited by the achievement of de-concentration in generation asset ownership and significant price convergence between suppliers and by the elimination of initially high levels of inefficiency in network companies. This is not to say that incumbents have not got considerable scope to lose more market share in the household sector but that this trend is now well established (3% per year since 2002).

There may also be specific issues associated with gas distribution in the UK, where the recent breakup and sale of National Grid's former monopoly seems to be resulting in significant efficiency improvements.[13] This suggests that gas distribution's former structure was inefficient and that introducing comparative competition between regional monopolies, as was already the case in electricity, will yield significant improvements. It remains to be seen how long these efficiency gains will take to be realized, especially within National Grid's remaining four gas distribution areas, now that the scope for efficiency savings has been revealed by the new operators of the divested regions.

2.2 The Reality of Changing Circumstances

If the traditional model has had significant success in achieving its mandate, it is also the case that the environment in which it is being practiced is changing.

The most visible sign of this is seen in the outcomes of the most recent price control reviews that Ofgem has carried out. Three of the four most recent reviews have resulted in significant projected rises in capital expenditure compared with the previous price control review period. While rising capital investment is not new its impact in driving prices up overall is new.

[13] National Grid gas distribution was reorganised into 8 regions. 4 of these were sold off in 2005, two to a consortium led by Scottish and Southern Energy, one to a consortium including United Utilities and one to a consortium led by Macquarie Bank.

Table 1: Rising Investment Requirements in Recent Price Reviews

	Latest Price Control Review Period Dates	*P0 (+ implies price increase)*	*RPI-X formula after first year of price control*	*Increase in investment over previous price review*
Electricity Distribution	2005-10	+1.3%	RPI-0	+48%
Electricity Transmission	2007-12	+4%	RPI+2	+125%
Gas Transmission	2007-12	+17%	RPI-0	-7%*
Gas Distribution	2008-13	+3.5%	RPI+1.1%	+30%

*This fall is relative to a rapid rise in gas distribution investment towards the end of the previous five years.

The P0 adjustments indicate a rise in price in the first year of all of the above price control periods. The RPI-X formulae give the price adjustments in each of the subsequent four years of the five-year price control period. In electricity distribution and transmission higher real prices have occurred because operating efficiency savings (which continue but at a slower rate than previously) are not sufficient to offset the effects of the extra capital expenditure on overall revenue requirements.[14] This situation reflects the fact that the ability for 'asset sweating' is much reduced relative to the early post-reform years. There are significant methodological issues with the ability of efficiency analysis to detect significant operating cost and capital cost inefficiencies when the underlying differences in inefficiencies between the firms are small. Doubtless improvements in the size of the datasets used for efficiency analysis, via the inclusion of international and panel data would help, but would not necessarily address the issue of the declining economic significance of measured efficiency differences and the unreliability of the methods applied to them (see Pollitt, 2005).

In terms of electricity distribution and transmission a significant part of the increase in capital expenditure is driven by low carbon investment, much of it not incentivised under the renewables support scheme (Renewables Obligations Certificates or ROCs) or the European Emissions Trading Scheme. For electricity distribution this amounts to £500m over the price control period (or around 25% of the increase) and for electricity

[14] For reference in GB, around 28% of the final price for electricity is for network services and 72% for generation and retailing costs (excluding taxes); in gas the network charges make up less than 20% of the final price of gas.

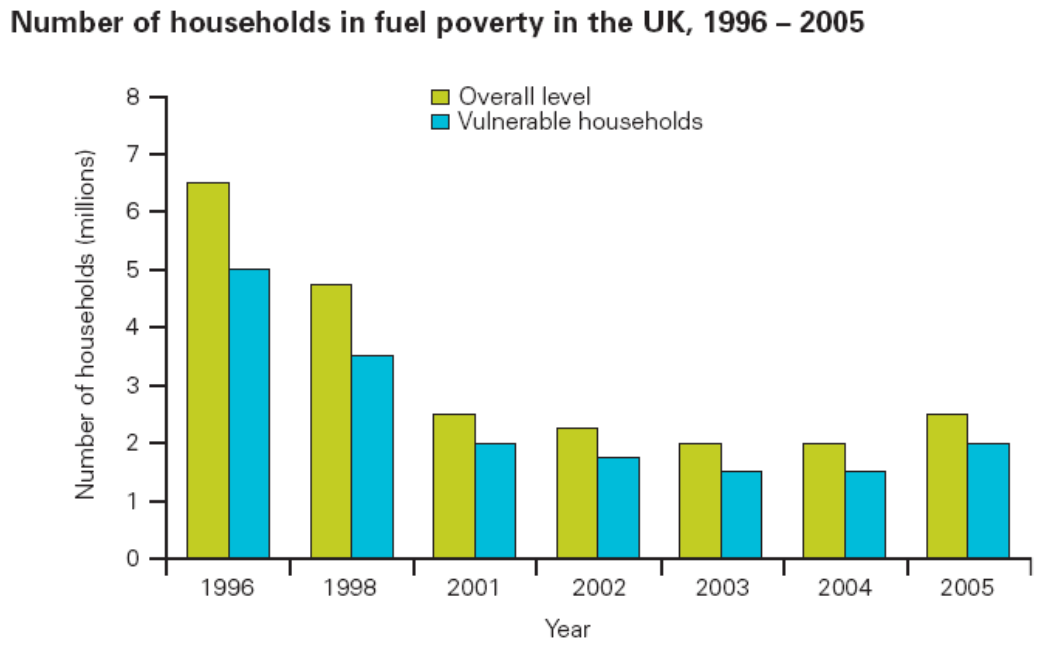
transmission there has been a separate allowance for £500m for renewable generation support in Scotland (under the Transmission Investment for Renewable Generation (TIRG) scheme) and scope for more if more renewable generation is connected.

If we assume that extra climate change inspired investment in GB is £200m per annum, by 2012 the price of distribution and transmission services might be 5% higher as a result of this extra expenditure.

More important in volume terms is the amount of investment required to renew and upgrade the existing network. Electricity transmission and distribution investment peaked in real terms in the late 1960s, this means rising and expensive replacement investment in the current price control period and this trend seems set to continue. Ensuring efficient re-investment in electricity networks is therefore much more of a priority than it was in the early years following the initial reforms because capital expenditure is a more significant share of total expenditure on networks than it was in the past (see Pollitt, 2005).

Rising commodity prices for gas and coal have contributed to substantial price rises for wholesale power since 2003 in GB. While our analysis of the trend in network services costs suggests these are going to rise in real terms, we have already seen substantial rises in wholesale power costs and in customer bills. Between March 2003 and September 2006, when prices peaked, the average household electricity and gas bill rose by £370 to £881. This contrasts with consistent falls in electricity and gas bills from 1995 to 2003. Such a large rise in the annual fuel bill has raised political questions and led to a significant increase in fuel poverty, defined as households which spend more than 10% of their income on fuel (primarily gas, but also electricity) to maintain a satisfactory heating level. From a low of 1.2 million the number of households defined as fuel poor rose to 1.5 million in 2005 (7% of all households) as energy prices rose (BERR, 2007a, p.10).

Figure 1:



Source: BERR (2007a, p.9)

While recent rises in electricity and gas bills are driven by supply and demand in fossil fuel commodity markets, the impact of environmental factors on the final price of electricity is increasing.

In 2006 around 6% of the price of electricity was related to supporting renewable low carbon generation (in spite of this only being 3.4% of electricity production in the UK, excluding hydro). This seems set to rise substantially. In addition the final price is influenced by the price of permits for CO2 in the EU Emissions Trading System.

2.3 The Coming of Age of Climate Change Concern

So far the impact of climate change policies on electricity prices and the operation of electricity markets has been modest in the UK. Even by 2012 - the end of the current trading period of the European Emissions Trading System - the likely impact on electricity prices in the UK will be 10-15% on the basis of a continuation of existing policies.[15] The impact on the operation of the wholesale power market is also likely to be modest: all new large power stations will be CCGT with no nuclear, clean coal or carbon capture and storage (CCS) enabled plants likely to be on line by then. Wind generation is currently being built at a modest rate. Even though the requirements under the

[15] The share of renewables in total electricity supply is unlikely to be more than 6% at current trends. If this is assumed be at a cost of double the average cost of non-renewable generation (and current large hydro ignored – slightly over 1% of generation), this adds say 5% to the price. An EU ETS price of 20 euros per tonne of CO2, leads to around a 10% rise in electricity prices in the UK above baseline (see Carbon Trust, 2004).

Renewables Obligation Certificate (ROC) Scheme are that around 12% of electricity be produced from renewables by 2012, it seems very unlikely that this target can be met. In 2007 less wind capacity was added in the UK than in 2006 and this figure was less than 1% of total installed capacity on the system.[16]

However climate change concern is increasing. The influential Stern Review, published in 2006, has contributed to a strengthening of government policy and government attitudes in the UK. The Stern Review carefully discussed the value of doing something about climate change and reached the clear conclusion that significant expenditure of the order of 1% of GDP was justified by the economic value of avoiding the risk of significant climate change. This expenditure should be spent to achieve a CO2 emissions reduction of at least 60% on 1990 levels by 2050. 1% of GDP in the case of the UK is of the order £13bn in 2007. The electricity sector is capable of reducing its emissions by 80% by 2050 (Elders et al., 2006). Assuming other sectors collectively were to keep their emissions constant at no extra cost (which would be a good baseline performance) an 80% de-carbonisation of the electricity sector would reduce total emissions by 20% by 2050. This suggests that extra expenditure in the electricity supply industry of say £4bn p.a. (i.e. one third of the total extra expenditure) might be justified to meet climate change emissions reduction targets by 2050. Currently the actual amount of expenditure might be of the order of £1bn[17] (extra spending on renewables and networks), thus giving room for a significant increase.[18]

The Stern review has informed the Climate Change Bill (2007) which establishes the Office of Climate Change. This Office is charged with setting 5-year greenhouse gas emissions targets for the UK (-20% by 2020 and –60% by 2050) and ensuring that these are achieved. A raft of policies have been announced: including the phasing out of filament light bulbs by 2011, the requirement for all new homes to be zero emission by 2016 and the tendering process for a large scale demonstration CCS power plant and the commencement of a design approval process for a new generation of nuclear power plants. In addition the government is looking at a proposal to create a tidal barrage across the Severn Estuary, which would generate 5% of total electricity demand.[19] Meanwhile the European Union has announced a 20% reduction in CO2 and a target of 20% of all energy coming from renewable sources (this could be 35% for electricity), though the

[16] See Ofgem (2007b).
[17] This figure should include the extra expenditure on supporting renewables (currently around £500m), research and development (less than £100m) and on networks (say £100m) induced by climate change. The price impact of the EUETS represents a transfer from consumers to producers to reflect the carbon externality should not to be included, though the fuel switching that it induces does impose real costs (say £200m) but these are a relatively small fraction of the headline impact (which might be of the order of £2bn).
[18] Imagining how to spend this insurance money is quite easy. Elders et al. (2006) suggest that wind capacity alone in GB could be 60 GW by 2050 and generate up to 50% of our electricity. At a subsidy rate of £1500 per kW, this requires expenditure of £90 bn, which is £3bn over 30 years! Of course we might expect the required subsidy rate to fall due to learning and the economy to grow raising the available subsidy (which is a constant percentage of GDP).
[19] See BERR (2007b).

targets vary across countries.[20] The second trading period of the EU ETS began on 1 January 2008 with much lower quotas than in the first period and significantly higher prices for CO2 permits. At the municipal level, some local authorities have announced their own CO2 reduction targets. In some cases these have been more ambitious than national targets. For instance the Mayor of London has announced a commitment to 60% reduction in CO2 from London by 2025.[21]

The cumulative impact of these policies on the electricity market looks likely to be significant. There is likely to be pressure to build significantly more renewable generation capacity than in the past and for this to run on the system to save CO2. The impact of this on the operation of the wholesale market is potentially very significant. Large amounts of high fixed capital cost – low running cost plant creates price volatility in the balancing market and exposes un-hedged players to significant risks. This is in contrast to the benign effect of the entry of combined cycle gas turbine (CCGT) plants into the wholesale power market in the 1990s. CCGTs could be built quickly in response to market conditions, they were straightforward to finance and could be invested in on a merchant basis. One could argue that it was CCGT technology, which facilitated the emergence of a competitive market in the 1990s. Systems where hydro power was the price setting plant often had to accommodate wholesale price volatility (which they did in Norway and in New Zealand) or to employ a system of cost-based bidding in the power pool which they did in Chile. However such instability in hydro systems is seasonal rather than intra-day. It is possible that a deregulated market can accommodate the volatility introduced by renewables into pricing but it will require much more flexibility in demand side management (such as residential smart metering to control domestic loads).

The new low carbon electricity market envisaged by policy makers is still some way off. In the UK 9.2 GW of Wind Capacity (more than 3 times the current installed capacity) is in the planning process, awaiting approval from local planning authorities.[22] Such wind capacity will also require significant upgrading of the national transmission grid (which also requires local planning permission). Approval of the design of new nuclear power plants is only the start of the process of actually building a new nuclear power plant. It seems unlikely that a new plant will open for 10 years (5 years for approval, followed by 5 years to build). Carbon Capture and Storage is progressing with a demonstration plant competition underway in the UK and may yet prove to be highly significant, especially as a medium term solution.[23] However its true costs (particularly per tonne of CO2 actually captured) remain to be established in a real power station and its public acceptability (as a technological fix) is largely unknown, due to ignorance of how it works (see Reiner, 2008). Much is made of the scope for demand side reductions in energy use, with low

[20] See EU Commission (2008, p.41), which sets a draft target of 15% of final energy consumption in the UK coming from renewable sources. As electricity is less than 20% of *final* energy consumption, even if other sectors managed to achieve a highly ambitious 10% renewables target, electricity would be required to acheive around a 35% renewable share to meet the overall target (see DUKES Table 1.1.5). If biofuels for transport do not materialise then the figure could be much higher for electricity (say 47%).
[21] Greater London Authority (2007).
[22] http://www.bwea.com/ukwed/planning.asp. Accessed 8th March 2008.
[23] http://www.berr.gov.uk/energy/sources/sustainable/carbon-abatement-tech/ccs-demo/page40961.html

energy lightbulbs and smart metering clearly being targeted by government policy. However the significant behavioral change required will test public commitment to climate change policy. Zero carbon new homes will be a significant driver of change in terms proving of new technologies but the market for retrofitting existing homes with micro-generation sources or connection to district heating networks (which would significantly save on emissions from heating and electricity) has yet to established, but the theoretical potential is significant.[24]

The UK, like many other countries, has been through a period of significant uncertainty with respect to climate change policy. However there are now a number of significant commitments making progress into law. In particular a commitment to firm CO2 reduction targets and carbon budgeting, to be overseen by the Office of Climate Change[25]. This is the context that will shape much of the investment that will go into the electricity sector in the years to 2020 and beyond. Much uncertainty about the detailed content of policy remains but the general direction seems clear. It is also clear that the climate change related component of prices for energy will have to rise significantly.[26]

Of course it is still possible that we will see a retreat from these policy commitments, but that seems increasingly unlikely, especially in the context of EU wide agreements. This is because the reality of actual climate change and its effects on both the UK and on other countries seems likely only to intensify political pressure for action in the domestic electricity sector.

I think it is not going too far to suggest that the above three points constitute a strong case for saying that we need a substantial reexamination of the model of electricity regulation that has been so successful in the UK from 1991 to 2007. Climate change concern and its associated policy implications are so major that it would irresponsible not to ask whether our current regulatory model is fit for policy. This is because the current model existed in a world where the focus was on exploiting the efficiency gains that could be had from introducing competition, primarily facilitated by natural gas fired power stations in generation, and where independent regulators could deliver high values of X within price reviews from inefficient monopoly network owners via incentive regulation. Indeed Helm (2005) argues that the years since 1990 represent an unusual period of withdrawl of active political interest in the energy sector and that renewed political oversight and interference is now likely. Climate change will necessitate substantial institutional change in order to deliver a significant change in the carbon dioxide produced by the electricity sector. Of course it is not just regulation that is potentially at stake but also the ownership of electricity assets and the nature of how markets are organized in the electricity sector.

3. Premises of a new regulatory model

[24] A recent report (Wiltshire, 2006) established the theoretical potential for combined heat and power for commercial and residential buildings at 21.5 GWe at a 6% discount rate, dropping to less than 1 GW at a 9% discount rate.

[25] www.occ.gov.uk

[26] In order to correctly reflect the damage of CO2, Hope and Newbery (2007) suggest high and rising prices per tonne of CO2, which would currently imply a price in excess of $40 per tonne or perhaps twice the current price in the EU ETS. This would perhaps raise electricity prices by another 10%.

In arguing that there is a case for reexamination of the traditional model of energy regulation (in electricity and, where similar, gas), we need some starting points before we discuss the elements of the new model.

In this section I develop four premises on which any new regulatory system should be based. These are: first, that the lessons learned from the liberalization period should not be lost; second, that we need to focus on processes not just outcomes; third, that the economics of climate change should be a key driver; and fourth that managing uncertainty is the key to successful regulation.

3.1 The Lessons of the Liberalisation period

An examination of the key learnings from the period 1990-2007 suggests the following stylized facts about electricity markets (see Pollitt, 2008, for a fuller justification). *First*, competition reduces costs (and prices) significantly. It does this by encouraging efficient operation and least cost and timely investment. It also exposes pre-existing market power. *Second*, consumers do respond to price signals both by switching and by demand reduction. There also seems little reason why all consumers including residential consumers need centralized (and hence standardized) protection from wholesale market price fluctuations. Consumers have exhibited significant demand for fixed tariffs, which have emerged to allow those who wish to purchase insurance against price rises to do so. *Third*, markets do produce significant innovation. Thus we have seen significant retail innovation in terms of energy service management for large customers, innovative products for large and small customers (as noted above). We have also seen innovation in wholesale markets in terms of approaches to risk management and trading arrangements. *Fourth*, incentive regulation works and can be very powerful in driving down costs and improving standards. However incentive regulation should ensure that consumers benefit in a timely way from some of the improvements. *Fifth*, the vertical economies of joint operation between networks and competitive segments of the industry are not sufficient to outweigh the increased competitive pressure that comes from clear separation of the monopoly networks from the rest of the supply chain. This has been proved in electricity transmission, gas transmission and may be in process of being proved for gas distribution in the UK. *Sixth*, markets have proved adept at managing the short term risks associated with power markets, though there have been issues with the lack of liquidity in the market for long term contracts for power. The lack of liquidity in these markets may not be serious for residential consumers, who may not want long term contracts, but they are more significant for small supply companies who want to source power via long term contracts rather than make their own generation investments. Financial markets have also provided significant amounts of financing for power investments, much of it at low rates of interest. *Finally*, markets have been good at choosing between technologies on the basis of price, as for example demonstrated by the move to CCGT in the 1990s and the decline and renaissance of nuclear power investment in response to market prices. Although R+D expenditure has collapsed as a result of deregulation, a significant part of this reflected inefficiency in the expenditure before reform (Jamasb and Pollitt, 2005b). Equally, it has proved possible to correct for any reduction in R+D budgets by

incentivising private R+D expenditure decisions via the introduction of decentralized innovation funding incentives (see Pollitt and Bialek, 2007).

3.2 Focus on processes of regulation not just outcomes

Currently independent regulators and those who review their performance are very focused on measures related to the outcomes of regulation. Historically, Ofgem has been much concerned about the degree of competition in the generation market as measured by the market shares of the leading generating companies, the degree of competition in the residential market as measured by the retail switching rate and loss of incumbent market share. In relation to regulation of networks Ofgem has been very concerned about the size of X, within the RPI-X formula, in its price control reviews, with higher values of X (subject to the condition that there are also high levels of investment) being associated with better outcomes for consumers, i.e. that lower regulated charges are better.

Most of the above mentioned measures have no real meaning for an economic regulator, when looked at across time. On generation market shares, this can fluctuate but it is possible to have a very competitive market with higher concentration ratios than currently exhibited (in particular via integration of the UK national market within a bigger regional European market). It is not clear where Ofgem can go with this measure in the future. This is also true of its measures of retail market competition. Lower rates of switching may reflect more competitive offers by incumbents and less exploitation of incumbent customers. A clear parallel with telecoms exists here, where the incumbent in the UK, BT, the former incumbent monopolist, still has a significant share (of its traditional fixed line market) but is faced with an increasingly competitive market (see Ofcom, 2007). I am not saying that energy regulators are not aware of the measurement issues here, but that they have an issue in how they present useful metrics of performance.

Ofgem has successfully achieved a competitive market in wholesale and retail power (though it is currently investigating the latter). This suggests that higher level monitoring and investigation can increasingly be left to the general competition authorities, who are able to apply sophisticated and proportionate regulation of competition, reflecting best practice across competition cases. There are two major advantages of general competition regulators over sector specific regulators. First, they are able to take a view on competition relative to other markets, particularly those that are not regulated. This ensures a degree of consistency in the approach to promoting competition, which trades off the costs and benefits of regulatory action. Second, where the problems are severe they can propose much tougher remedies including fines and structural reforms. Indeed arguably the GB electricity generation market and the GB gas supply industry only made significant progress following competition authority interventions, in spite of years of prior pressure from their sectoral regulators. Earlier referral to the competition authorities in both cases would have yielded benefits for consumers. Indeed an encouraging sign, in this vein, is that competition within the central European electricity market may be significantly facilitated by the activity of the European competition inquiry into the competitiveness of the energy sector (European Commission, 2007), initiated on the basis of EU competition law.

Instead climate change policies will pose new competitive challenges. Driven by rising prices for energy from gas and coal based technologies, incumbent network operators may face entry from private networks (which may want to connect up a few electricity and/or heat customers in a locality to a low carbon energy source) and requests to connect distributed generation. Thus ensuring that free entry and exit of new players and individuals, who wish to self-generate, should become an increasing focus of sector specific regulation (as this involves ongoing detailed assessment of connection rules and individual requests to connect/disconnect). These new entrants may wish to sign customers up to long term contracts for electricity, energy services and /or heat. Such contracts will need monitoring, at least initially, for unfair terms clauses and for mis-selling.

In the incentive regulation of networks, X will be driven by new investments. This means that independent regulators, like Ofgem, need to focus on the process by which it is decided that new investments are necessary. Reliance on an investment plan submitted by an incumbent network, audited by consultants, to determine both whether the investments are necessary and are least cost no longer seems appropriate, especially given the likely scale of the new investment. Indeed it may never have been appropriate, but may have been a reasonable shortcut when the investments being considered were less debatable and less significant. We look at this in more detail in section 4.1.

Underlying all of the above, is the context that prices will be rising and hence judging Ofgem's success on the basis of price will be increasingly difficult. Higher prices might well be justified if they deliver more CO2 reduction, more quickly. Thus a focus on both more sophisticated measures of the impact of regulation on social welfare and on the process by which regulatory decisions are arrived at seems appropriate. Indeed as some of the original studies of the impact of UK electricity market and regulatory reforms make clear the social welfare impact is not merely about price per se (see Newbery and Pollitt, 1997, and Domah and Pollitt, 2001).

Beyond price, regulators will also need to decide on the quality of energy supply and local environmental impact that consumers are willing to pay for. This cannot be the decided as the outcome of a submission from the regulated companies. It will require an informed discussion between buyers and suppliers of network services and also be informed by the opinions of customers (expressed via willingness to pay surveys). One key element of this better informed process will be the system of penalties for over or under performance in the area of quality of service.

3.3 The economics of climate change should be a key policy driver

It seems clear that electricity sector will be the lead sector in the medium term response to CO2 emissions in the UK, closely followed by improvements in the use of heat. In 2006, combustion for fuel for heat constituted 31% of CO2 emissions, just behind power station emissions which were 33% of the total. Focussing on fuel sources, in 2005 coal combustion accounted for 27% of CO2 emissions, while natural gas combustion was

36% of CO2 emissions.[27] An economic regulator for energy, committed to economically efficient achievement of policy goals, potentially has a key role to play in this. Climate change policy should be all about ensuring the efficient internalization of the externality created by CO2 (and other greenhouse gases or GHGs) emissions. Clearly an economic regulator like Ofgem should consistently price CO2 across all of its regulatory interventions and do this consistently with other government policies. This has the potential to be a powerful institutional component of sensible policy trade-offs in government. A key problem will be the unwillingness, at least initially, for governments across Europe to simply let the price of CO2 rise to the level required to fully decentralize CO2 reductions. This makes sense at the level of the fact that the CO2 price in such a market would reflect all of the institutional barriers to low carbon investment – e.g. blockages in the planning process and uncertainties in the financial markets. Using a combination of prices and other policies would therefore seem sensible. However this suggests that large government inspired initiatives will be forthcoming e.g. trialing of smart metering and heat networks and subsidized investments in CCS and tidal barrages. Such initiatives are likely to be inconvenient in terms of necessitating adjustment of the rest of the electricity system to accommodate them. However Ofgem's role should be to ensure that the competitions to enact government initiatives should be competitive and the costs of accommodating them should be minimized, i.e. the independent regulator should ensure that politically motivated investments in demonstration projects occur at least cost to the energy system.

3.4 Managing uncertainty is the key to successful regulation of the sector

The electricity sector is going to be faced with significant climate change inspired risks over the coming decade. These risks will primarily be around the exact course of national and international government policy towards climate change. Such risks must be faced. The role of the energy regulator should be to manage these risks as carefully as possible in order to minimize their impact on the cost and price of electricity. The primary way this will be done is via the weighted average cost of capital applied in price reviews or to specific regulator approved investments. Recent price reviews in GB have reflected an improving environment for infrastructure financing and a low degree of regulatory risk. In 2004 the electricity distribution price control assumed a 4.8% post tax rate of return (Ofgem, 2004); in 2006 the electricity and gas transmission price control review assumed a 4.4% post tax rate of return (Ofgem, 2006); in late 2007 the gas distribution price control review assumed a post tax rate of return of around 4.3% (Ofgem, 2007c).

Some risks should be eliminated, others can be managed, some risks should be transferred to the private sector and others to the public sector. Thus revenue guarantees of the type embedded in price control reviews are a way of eliminating the revenue risk facing companies. An example of regulatory risk management would be allowing for the reopening of price reviews in the light of new information about government climate change policy requirements. An example of risk transfer to the private sector would be to deregulate parts of the value chain in response to market evolution (a recent example

[27] See www.defra.gov.uk. For information transport CO2 emissions were 24% of the total is 2006, while petroleum was the source of 31% of emissions in 2005.

being the introduction of competition in metering in GB). An example of risk transfer to the government would be for the government to take responsibility for delivering certain targets (e.g. in the area of domestic energy efficiency measures). The precise allocation of risk would require some careful experimentation to test which risks are best allocated where. Efficient risk management would also require the evidence on the feasibility and cost of new technologies, which comes from large scale trials. It would also require a phased approach to achieving the targets being set by the Office of Climate Change that coordinates the timing of regulatory reviews, the announcement of policy initiatives and dates for the achievement of targets.

This is important as it will reduce the capital cost, by avoiding unnecessary investments, and reduce the required rate of return, both of which will together drive the cost of climate change concern policy.

A key example of this would be in the financing of existing networks. It is possible to simultaneously guarantee the revenue stream of existing investments and encourage competition in the area of new investments. Thus one might want to be very careful to reassure existing network owners that their sunk investments are protected while working to create competition between distributed generation, demand reduction investments and new network investment.

4. The elements of a new model of economic regulation

In the light of the above drivers of change and the premises for a new regulatory model, I explore what the key elements of a new model of economic regulation might consist of. In doing so I draw on the latest research on regulatory experiences and on the challenges posed by climate change concern. I will discuss three elements of the new model in turn: new processes of regulation; new models of competition and the issues raised by a focus on climate change.

4.1 New regulatory processes

In section 3.2 I suggested that economic regulation needed to focus on processes rather than outcomes. This was because old measures of the outcome of regulation now have little meaning and that what matters is the way that investment requirements are decided and incentivised. A key way to do this is shift responsibility for deciding on network investment requirements on to the buyers and sellers of network services. The central idea is that decisions on investments in capacity and quality should be negotiated between the parties in the industry. The regulator would still be formally responsible for approving any network investment plan within the context of regulatory price control review – assuming that they had not be deemed to be excluded from monopoly regulation. The regulator would move from being the key decision maker to being the auditor of decisions agreed between the buyers and sellers. The regulator might continue to provide independent assessment of the scope for efficiency improvement or the social value of particular investments. This is a variant of a ‘negotiated settlements’ approach practiced in North America (Doucet and Littlechild, 2006) or of the ‘constructive

engagement' approach introduced by the Civil Aviation Authority for the regulation of airports in the UK (CAA, 2005).

Negotiated settlements have several theoretical (and practical) advantages. First, they shift much of the risk for getting decisions wrong on to the companies or consumer representatives involved in the negotiations. This is especially true when buyers of network services have to say how much quantity and quality they are prepared to pay for. Clearly getting this wrong may impact negatively or positively on their profitability of the companies, yet it is also true they should be in the best position to predict future demand requirements. Second, they will tend to better allocate risk between the consumers and the regulated companies relative to a regulator imposed solution. This is because if the regulator has to predict what the investment requirements are, they will tend to be conservative and be likely to leave the consumer with costs of overinvestment or underinvestment, socialized within network tariffs. Third, negotiated settlements will produce innovations in regulatory processes as the transaction costs of regulation are determined by the parties to the negotiation. Companies will seek to reduce these costs by suggesting how negotiated outcomes might be arrived at, at less cost. Fourth, negotiated settlements will be better at making more informed trade-offs between quality and cost as these will be jointly negotiated by the companies rather than, as they usually are, treated separately by the regulator. Finally, negotiated settlements are likely to produce more innovative regulatory outcomes as private companies are good at drawing up contracts between them which efficiently allocate risk and reward.

Evidence on the operation of such approaches is growing. Stephen Littlechild has published a series of papers looking at their operation in North and South America. His examples are interesting because the arrangements examined have been introduced in parallel with market liberalization.

It seems clear that for transmission investments (and gas distribution) it is reasonably easy to envisage ways in which such an approach would work. Ownership unbundling (in England and Wales at least)[28] of electricity and gas networks ensures that the seller – National Grid – faces an array of significant buyers – the generators and gas suppliers.

Doucet and Littlechild (2006) show how negotiated settlements were introduced to determine the price of oil and gas pipeline services in Canada. An important advance was the setting of a regulatory weighted average cost of capital (WACC) each year, which could be used in the negotiations, thus eliminating a potential source of disagreement between the buyers and sellers. Littlechild and Skerk (2007) detail the important Argentine experience with voting rules for deciding whether new electricity transmission investments were to be undertaken. The UK would seem well suited to moving towards a negotiated settlements approach in electricity and gas transmission given the existing ownership structure.

[28] Scottish electricity transmission network ownership, though not system operation, remains part of integrated companies.

A key question is the extent to which negotiations could be used to determine electricity distribution investments. Here integration between the distribution network owners and generators and suppliers is potentially a problem. There might also be issues to do with coordination across negotiations as the same parties negotiate the investment plan for each network area. However the prospects for progress seem encouraging. Littlechild and Ponzano (2007) discuss the development of a 'sub-transmission' (high voltage distribution – mainly 132 KV, but also some 66 KV)[29] plan in Buenos Aires Province (the area around Buenos Aires) involving negotiations between 200+ buyers and the local sub-transmission company. They find that negotiations did result in the agreement of a ten-year plan for a range of sizes of investment. The process did not involve large transaction costs (as many of the smaller players let larger parties with aligned interests negotiate on their behalf).

Littlechild (2007) also reports on the role of the consumer advocate in Florida who with small annual budget successfully negotiated significant packages of price reductions for utility customers using his public profile and the threat of referral to the Public Utilities Commission for price review in the absence of agreement. This consumer advocate could have an important role in European countries, such as the UK, in the area of proposing social tariffs, offered by energy retailers to poor consumers. A powerful and informed consumer voice is likely to be more important as electricity and gas prices rise.

Closer to home, Ofgem has recently had very positive experience with setting gas distribution prices (where gas networks are unbundled), with active contributions from the largest gas supplier who provided constructive input into the regulation with the aim of keeping the gas distribution charged to its customers down.

It is worth discussing some of what has happened during the constructive engagement process used by the regulator, the CAA, at Heathrow and Gatwick airports (see Bush, 2007 and CAA, 2008a, b). This has recently ended. However there has been substantial agreement between the airlines and the airport owners.[30] In particular there has been agreement about the incentive scheme to be placed on the airport owner, BAA, for the delivery of new investment and the automatic traffic growth triggers for new investment. There has also been agreement on levels of service to be provided by the airports and the penalties and risk sharing for non-delivery. The CAA reports that the process has been slow to get going and that airlines have been critical of it – perhaps because it was a new form of regulation. However it has built substantially on the existing Airport Consultative Committees, which existed at each airport prior to the current price control review. This suggests that negotiated settlements can work in the UK and can build on existing informal processes of consultation between buyers and sellers of network services. Indeed one could go further and suggest that the fact that the process has been useful in an industry with an incumbent monopolist with a very poor reputation and a group of

[29] In the UK both of these voltages are operated by distribution network companies.
[30] CAA (2008b, p.v): 'The CAA considers that, as a result of such engagement, its price control decisions are significantly better informed by a broader and deeper understanding of airlines' views, along with BAA's own responses to its users' requirements.'

very diverse (in terms of size and quality preferences) purchasers in the airlines suggests much more scope for the success of constructive engagement in electricity and gas.[31]

4.2 New Models of Competition

As Box 1 highlights, promoting effective competition is central to the acheivement of Ofgem's mandate. I believe that in the context of electricity and gas markets this has to interpreted more widely in the future, beyond whether there is significant competition between existing large energy suppliers. As we noted in 3.1 competition has had important successes in the era of deregulation of electricity markets. However as we pointed out in 3.2 the current measures of competition seem less relevant in the coming era than they did in the past.

As we have already suggested, in section 3.2, that where competition has matured responsibility for monitoring how competitive the overall market is should be shifted to the Office of Fair Trading and the Competition Commission.

Ofgem needs to focus on how vulnerable customers are being treated within the competitive market. These are the consumers about whom it should be concerned. Richer consumers in competitive markets who choose not to switch should not be the primary concern of independent regulators.

The discussion of negotiated settlements in section 4.1 highlighted their benefit in choosing which investments were necessary. However clear lessons also exist from Argentina on the key role of competition in the tendering process for investments, decided by negotiation, in network services. Argentina had an excellent experience with this in electricity transmission, with active bidding for contracts (Littlechild and Skerk, 2007). The tender price was then used as the basis of the charges to be paid for the investment (akin to including it in the rate base). In an age when investment is set to increase sharply, competition in the tendering process for new investments, and the passing of any benefits from the tendering process on to consumers will be a big issue. There is much more scope for encouraging competition in the tendering market and then using these prices within price control reviews. Argentina engaged in competitive tendering in sub-transmission on investment blocks down to $2m (Littlechild and Ponzano, 2007).

Ofgem should also examine the barriers to new entry into generation, energy services and heat networks. Competition between grid supplied electricity, microgeneration and heat networks is something that may emerge in the future (Patterson, 2007) and be an important disciplining force on incumbent companies. A clear comparison exists here with fixed line telecoms where new technology has emerged to create new networks and also to install parallel lines.

[31] BAA and its role in the market for airport services has been the subject of a Competition Commission investigation since March 2007.

Such a radical view of the possible evolution of competition suggests that serious consideration be given to the ownership unbundling of electricity distribution networks from generation and retail, as this may be a key way to facilitate the entry of energy service companies and heat networks, as well as facilitating negotiated settlements. This again would parallel developments in telecoms where BT has recently formally separated its retail and lines business, as part of an agreement with the regulator Ofcom, via the creation of a lines business, Openreach.[32]

4.3 The issues raised by a focus on climate change

A focus on the issue of climate change by the energy regulator has a number of important implications for the way economic regulation of energy is conducted. While all these issues we go on to discuss are important, some of them could be addressed by agencies outside of the economic regulator, however my observation is that they are not receiving sufficient focus within economic regulation at the moment due to a lack of mandate or powers in this area.

My starting point is as in 3.3: from the perspective of an economic regulator climate change policy is all about ensuring the efficient internalization of the externality created by CO2 emissions. It should not be confused with energy security concerns or industrial policy objectives for domestic technologies. My view is that independent regulatory agencies such as Ofgem can play a key role in focusing regulatory incentives on the effective internalization of environmental externalities.

Several new directions for regulation suggest themselves in the light of this and the areas of work for the energy regulator that suggest themselves. Each of these areas is currently a small work area within an independent regulatory agency, such as Ofgem. However each has the potential to become extremely significant.

4.3.1 Effective internalization of externalities

There is a need for serious independent investigation of whether major low carbon investments in electricity and heat are worthwhile given that international schemes (such as EU ETS) may not provide sufficient incentives to meet national objectives. In Europe the key issue is the extent to which the EU ETS will deliver. The EU ETS raises an important discount rate issue, which we highlight below.

Table 2 shows that the choice of the two low carbon investments varies according to the discount rate chosen. Both investments take 2 years to make and pay off equally over 8 years. However Investment 1 involves higher up front construction costs but lower running costs relative to Investment 2.

[32] See http://www.ofcom.org.uk/telecoms/btundertakings/otherdocs/overview.pdf

Table 2: The choice between two investments with identical energy and emissions reduction benefits.

Scenario:Two alternative investments; Carbon Reduction of Two Investments Identical										
Context Decentralised project										
	Costs									
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Investment 1	500	500								
Investment 2	245	245	100	100	100	100	100	100	100	100
NPV 1, 10%		£867.77								
NPV 2, 10%		£866.11								
NPV 1, 2%		£970.78								
NPV 2, 2%		£1,179.78								
	Benefits									
	0	0	197	197	197	197	197	197	197	197
NPV, 10%		£868.58								
	0	0	138	138	138	138	138	138	138	138
NPV, 2%		£971.66								
		Extra Investment Cost of 10% discount rate:					£209.00	22%		
		Extra carbon price cost of 10% discount rate:					£415.42	43%		

At a 10% discount rate Investment 2 has a lower net present value and should be chosen. However at a 2% discount rate the net present value of Investment 1 is substantially less than Investment 2. Weitzman (2008) argues that we should use 2% social discount rates or less for climate change investments given the catastrophe risk associated with CO2 emissions. However if we actually use a market rate of 10%, the choice of investment will be changed between two investments with equal climate change mitigation effect. The cost of this investment is 22% higher when discounted at the 2% social discount rate. If we leave it to the EU ETS to provide the incentive for the low carbon investment, the effect of discount rates is quite striking. In the table the Benefits streams indicate the annual payoffs required to generate a net present value equivalent to the discounted costs at the two discount rates. If all private investors in low carbon investments require a 10% return as opposed to a 2% return, the price in the EU ETS of CO2 will be 43% higher. Given that this will translate into higher energy prices this raises important questions about the discount rate to be used in climate change investments and its implications.

It is highly likely that the government will and should examine a number of investments which make sense on the basis of social discount rates in climate change risk reduction but which are very challenging to fit these into the existing electricity market. One can think of nuclear power, the Severn barrage and large scale domestic heat networks as possibilities. An economic regulator should be in the business of evaluating these schemes and suggesting how to ensure they are built at least cost and how any required financial support is best raised from electricity consumers.

4.3.2 Demand is as important as supply

There is a need to focus on demand management as being as important as sources of generation (especially in the first instance). The European Union has ambitious targets on energy efficiency (a 20% reduction in energy usage by 2020). Low hanging fruit exists in the area of demand side management. Some of this can be identified in the UK: low energy light bulbs might cut total demand by 2-3%; LED street-lighting by 0.7% of total demand. Other measures such as staying on British Summer Time all year may be worthwhile. There is also the issue of raising electricity prices (in Denmark the tax on domestic electricity use is 100%) to support demand reduction investments. If the demand side invests to save CO2 how can it share some of the benefits if they are not fully reflected in the price of electricity? More work needs to be done on the potential for smart metering to reduce demand and/or to shift it in order to increase economic efficiency in the power sector. In the US regulatory agencies often oversee substantial demand side management programmes (e.g. in California) aimed at overcoming the market failures which exist in this part of the market. These incentivise electricity companies to achieve demand reductions via allowing them to finance demand reducing investments in their regulated charges.

4.3.3 Support new entrants

New entrants into low carbon production and energy management need to be encouraged and concerns about the inaction of incumbents in providing network access or import/export services addressed. We need to recognize the possibility that existing incumbents may not be best placed to deliver the de-carbonisation of the electricity sector. There are a number of reasons for this: they require legitimacy in spending the large amounts of capital investment that will be required; more locally based companies may be more effective an engaging the public in demand reduction or the uptake of micro-generation; new business models may be more appropriate, such as those focused on energy service management, rather than ownership of hard assets.

It should also be pointed out that the public sector has traditionally been important in the rapid roll out of intrusive networks with initially poor returns (even when run efficiently). While few would advocate a return to public ownership of energy networks (where these have been privatised), history does suggest interesting reasons for increased government ownership in the electricity and gas sectors e.g. to do with cost of private financing and the political sensitivity of siting assets (see Foreman-Peck, 2003 and Gleaser, 2001). Public *operation* of the underlying assets is no longer necessary as the *financing* advantages of public ownership can be achieved via a public-private partnership. If the historical reasons for public ownership are mirrored today then it is quite possible therefore that we will see significant public-private partnerships emerge in the electricity sector in the coming years. Indeed it is highly unlikely that any subsidized roll out of a new technology, such as heat networks would not have public sector involvement. Such facilities based competition might involve competition from water companies. Private energy services companies based around smart control of heating and lighting and joint provision of security or IT services might also have a role to play in the future. Independent regulators, such as Ofgem, should have a key role in facilitating the entry of new players into the market, especially where these have strong political backing.

4.3.4 Engage with local initiatives

There is a need to engage with local initiatives as these are start up projects that need regulatory assistance and have the potential to be important market drivers in the future. This relates to the previous point about encouraging new entrants. The regulatory agency needs to have the capacity to support local initiatives to get off the ground. These are potentially very significant in terms of climate change mitigation, but also in terms of supporting the legitimacy of political support for the whole of climate change policy. Local initiatives have the capacity to be popular and to engage individuals in environmentally friendly action at low cost, by for instance being effective ways of targeting subsidy.

In the UK, some small examples of local initiatives currently exist: some community enterprises in Scotland and local authority heat schemes in places such as Woking (see London Energy Partnership, 2007). However the capacity exists for significant take off in this area, with the London Energy Savings Partnership in place to help deliver London's ambitious target for reducing CO2 by setting up local energy service companies. London Energy Partnership (2007) identifies 7 current schemes, with more in planning.

4.3.5 Plan for large-scale trials

There needs to be planning for large scale trials of new technologies in electricity production and demand management. Most current local initiatives are small, too small to make a real difference to the UK's overall CO2 targets. However they are important examples of social entrepreneurship and give rise to demonstration effects. What is clear is that we will need much larger scale trials to demonstrate the least cost way of reducing CO2 emissions, given that divergence of approaches is, at least initially, desirable. These trials will need to take place at the level of medium sized cities and might involve, for example, the setting up a heat network, smart metering in every home and/or the establishment of a well funded local energy service company (ESCO). Several requirements to begin moving in this direction are set out EU Directive (06/32) on Energy End-Use Efficiency and Energy Services and supported by the UK government's response (DEFRA, 2007).

Some of these trials, and their associated technologies, would require the development of regulations for heat networks and ESCOs. These are currently not subject to specific regulation in the UK. They would also require powers to deal with the incumbent local monopolies, such that the value of their property rights is protected, but their ability to block the successful implementation of trials is removed.

5 Conclusions

I have argued that the future of electricity (and related gas) regulation involves new processes for doing economic regulation, a wider interpretation of the requirement to

promote competition and a clear shift of emphasis to the effective internalization of the environmental externality of greenhouse gas emissions.

This is not to say that independent regulators, such as Ofgem, have not been extremely effective in delivering their mandates to date. It is to say that that mandates (and their interpretation and power to deliver them) born of an era of electricity (and gas) deregulation following inefficient state intervention in the operation of the industry and prior to the era of climate change concern need to be reconsidered and, as necessary, challenged. It is therefore encouraging that Ofgem has recently recognized this by announcing a major review of its system of RPI-X price control. This 'RPI at 20' review explicitly asks whether a system that has worked well for 20 years is fit for purpose going forward (Buchanan, 2008).

In the specific context of the UK I offer a couple of concluding sets of observations for national government and energy companies.

While much can be done within Ofgem's existing mandate, it does seem to be the case that Ofgem's mandate and hence its powers do need some clarification (see also Sustainable Development Commission, 2007). I have argued that the current primary focus on the promotion of competition is no longer appropriate for a specialist energy regulator like Ofgem. This is not to say that competition is no longer important. It is to say that other issues require relatively more attention and that a significant part of the current competition agenda can be handled by the general competition authorities. I think that something like the *promotion of economic efficiency in the delivery of energy services*, better captures all of the trade-offs between supply and demand, production costs and price, and environmental and financial costs that need to be covered by Ofgem. The UK government needs to clarify CO2 targets for the electricity (and heat) sector in particular and there may be a role for government in some of the public-private partnerships that would be seem to be necessary to deliver some socially valuable CO2 reducing investments. Helm (2005) and Maugis and Nuttall (2008) go further and argue for the need a new UK energy policy – which would also include to nuclear policy and primary energy supply security - based around concentrating the existing, dispersed, civil service and ministerial effort either in a single agency (Helm) or under a single minister (Maugis and Nuttall).

For companies there are two pieces of good news. First, fair rates of return can be guaranteed on existing investments and low risk investors can focus on established network investments. At worst, policy towards climate change will give rise to the need to allow for stranded asset recovery (as was the case with electricity deregulation in the presence of private monopolies). Second, investment requirements are rising. Yago et al. (2008) estimate that environmentally inspired investments will add £28bn of investment to 2020 in the GB electricity sector above the base case. This implies opportunities for incumbents and entrants alike in the presence of a level playing field.

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