E3G

GB power market reform – high level policy choices

Discussion paper

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October 2010

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Preface

This discussion paper has been written by E3G as part of a project funded by the European Climate Foundation.

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- Meg Gottstein and Richard Cowart the Regulatory Assistance Project (www.raponline.org)
- Mike Hogan and Matt Philips from the European Climate Foundation
- Rob Gross from the Centre for Energy Policy and Technology
- Claire Thornhill from the Climate Change Committee Secretariat
- Rachel Cary from the Green Alliance
- Philip Baker, Catherine Mitchell and Bridget Woodman from Exeter University
- Stephen Thomas from Greenwich University
- Ben Caldecott from Climate Change Capital

Context

The UK power market faces an unprecedented challenge. It is now widely accepted that it will be necessary to have largely decarbonised the power sector by around 2030 in order to set the UK on the path to meet 2050 greenhouse gas reduction targets for the economy as a whole. This in turn will involve the replacement of a large proportion of the existing power generation fleet with new, low carbon, technologies, in addition to radical improvements in the efficiency and responsiveness of energy usage.

This raises two major challenges:

- It is necessary to attract significant levels of investment and to do so in a way that ensures that the total cost of these investments (including financing costs), and their impact on energy prices, are acceptable, to investors, consumers and society as a whole, and
- Throughout this transition, maintain current levels of system security and the efficient operation of the power system.

The existing power market arrangements were not designed to cope with this situation and were implemented at a time in which:

- Limited new investment was required and the investment that was expected to emerge was in mature generation technologies which could be largely accommodated by existing network infrastructure.
- There was particular focus on the efficient use of existing assets which incur a high proportion of their costs when burning fossil fuels and whose output can be controlled to meet system stability requirements.
- The scope for demand response was restricted by the lack of information and control technology, and no market and regulatory rules were developed to recognise the contribution of end-use efficiency as an optimal system despatch/investment option.

It is therefore necessary to consider where the existing arrangements will fall short in delivering the required objectives and consequently where market reform is required.

Investment under current market arrangements

The value of investments in the power market has traditionally been driven by volatile commodity costs[1] and the extent to which these are reflected in power prices. Trading between market participants has developed to meet the conflicting need to hedge long term exposure to this underlying volatility whilst retaining sufficient flexibility to take advantage of movements in short term prices. The need to match supply and demand in real time, and the absence of large scale power storage, has meant that it has been necessary to centrally administer a market of last resort - the balancing mechanism - in which the cost/value of uncontracted demand/generation is centrally calculated and settled. These default prices represent the ultimate benchmark against which the value of forward contracts can be assessed. Any investment in new power plant, energy efficiency or demand response must therefore involve market participants taking a view that the full costs of the investment will be recovered as a result of prices in short term markets being sufficiently in excess of operating costs over the lifetime of the asset. If this is not the case, one or more market participants[2] will incur a potentially significant loss arising from the stranded investment.

The current market arrangements therefore involve high risks and require investors to take a view on the market, often far into the future. Business models have developed to manage these risks through seeking to increase scope and scale of operations across commodities, supply chain functions and internationally. The consequence of this is that a consolidated market structure of vertically integrated and predominantly international companies has emerged. Apart from concerns about the potential detrimental impacts on competition and innovation, the imperative to retain a strong credit rating means that it is not possible for these companies alone to leverage the amount of capital required to fund the necessary investment and new risk capital must be attracted to the market.

Businesses investing in the supply chain capacity for low carbon technologies are critical if high rates of learning and deployment are to be achieved. These companies face particularly severe uncertainty since they need to take a view on

[1] This largely relates to fossil fuel prices (particularly gas prices) although recently carbon prices have become increasingly significant.

[2] Depending on the nature of the bilateral contract arrangements involved and, therefore, which party retains the long term price risk.

the demand for their product well into the next decade and long before any investment decisions are taken by power market participants.

Investments in network infrastructure are regulated and regulators have generally approved investment on the basis that a system upgrade meets a known future need, thereby ensuring that new assets are unlikely to become stranded creating excess costs for future customers. In addition, the activities of the system operator are also governed by a regulated incentive mechanism where the focus of the regulator has also been to drive short term benefits to customers as opposed to considering the longer term balancing needs of the market.

However, the nature of a decarbonised 2030 power system is highly uncertain and likely to be very different from the system that we have today. In particular:

- The level and characteristics of system demand will be largely determined by two offsetting drivers which are a consequence of Government policy, namely the extent to which energy efficiency measures deliver demand reduction and the degree to which electric load has developed in heat and transport sectors.
- The generation mix will involve a large proportion of assets which have high capital costs but very low variable costs thereby leading to periods where short run system marginal prices are very low or, where output based subsidies are involved, negative.
- The availability of the majority of renewable technologies will be driven by natural resources rather than system need and the cost associated with making nuclear and CCS output flexible are likely to be high and would need to be a key element of the power plant design.
- The network infrastructure will need to expand to accommodate new plant and any new interconnections with Europe have the potential to drive convergence with the European market. In addition, deployment of 'smart' technologies may open up opportunities for the demand side of the market to play a more active role in system balancing.

It has been accepted for some time that the basic market arrangements are inadequate to drive the commercialisation of new technologies and a suite of innovation policies have been introduced to correct for this feature of electricity markets. These include the renewables obligation, to drive deployment of

renewables in line with the 2020 EU targets, a feed in tariff system for micro-generation, and a customer levy to fund demonstration carbon capture and storage projects. However, none of these instruments are linked to clear deployment targets beyond 2020 and the level of price support remains subject to ongoing change and uncertainty. Therefore, current policy consideration has not addressed the consequences of ongoing growth in low carbon generation and there is the need for an holistic review of the policy framework to ensure it can be integrated into the system in a cost effective manner. In particular, today's market arrangements fall short of creating the appropriate incentives for investment in a number of key respects:

- *Innovation policy:* The low carbon power system of the future will involve a number of technologies that are currently immature. Significant investment will be required in these technologies well before they are cost competitive and the absence of coherent long term deployment strategies will increase the risks associated with investment in R&D and the development of the necessary supply chain capacity

- *Investment in low-carbon generation*: The current market arrangements require investors in low-carbon generation to believe that market prices over the long-term will continue to be set by fossil fuel plant and will therefore reflect both carbon and gas (or coal) price[3]. Successful decarbonisation will therefore give rise to a number of problems. Firstly, a situation where low carbon plant receives significant earnings on the basis of prices set by a small residual volume of fossil fuel generation is problematic from both political and competition law perspectives. This is in addition to the political and market uncertainties that surround the absolute level of future carbon and gas prices. Moreover, the principle that generators will 'fight' for market share on the basis of short run marginal costs presents the prospect that for much of the time, prices could be very low or even negative and these circumstances will be particularly prevalent when renewable availability is high. This situation could only be sustained if these low price periods are offset by periods of extremely high prices which bring their own political and regulatory challenges. The risks on future project returns are therefore extremely

[3] This is even true to some degree for renewables receiving RO subsidy since they retain a significant degree of wholesale price exposure. Indeed, current market arrangements create a perverse incentive for investors in low- carbon generation to avoid displacing (or significantly reducing the operation of) fossil-fired generation at the margin, particularly when carbon prices are high - which in turn, limits the market space available for large-scale investments in renewable and other low-carbon resources

high and, if funding can be attracted, the financing costs will need to be very high to reflect this risk profile.

- *Long-term demand reduction:* The market has failed to develop a significant 'customer pull' for investments to improve energy efficiency and, under the current arrangements, deployment is largely driven by an administered obligation on suppliers in the domestic sector. These investments are not, therefore, made on an equivalent basis to generation investment and it is inevitable that a suboptimal mix of investment will emerge. Moreover, business models of energy suppliers have not evolved such the energy reduction products are viewed as core to future profit growth and they remain largely viewed an ancillary regulatory compliance activity that creates an additional cost to energy supply.

- *System balancing:* There is a range of potential future providers of balancing services (e.g. generation, demand response, storage) and it is likely that some combination of all of these will be required. However, they each have distinct cost characteristics and are at various stages of technological development. The current arrangements require that investors take a long term view of both short run prices and future system operator contracting strategy. The huge uncertainties involved make these extremely high risk investments for established technologies, let alone for those that are immature and require further development. It is therefore likely that the current arrangements will lead to a dependence on existing fossil generation plant remaining on the system to provide these services.

- *Networks investments:* Significant network developments involve long lead times and expenditure needs to be justified by the Regulator against a highly uncertain future system need. In the absence of a clear strategic vision for the future system, it is therefore likely that the transmission infrastructure will tend to impose a constraint on the ability of low carbon generation to export power to the system as network upgrades lag the rate of new generation build. Moreover, the failure to fully integrate demand side investments in the appraisal of network developments is likely to result in an over-reliance in developing new network capacity.

- *International integration:* The costs of reducing carbon emissions and maintaining system stability across Europe are likely to be much reduced with an effective single European energy market in which low carbon and

system stability resources are shared between member states. Moreover, the UK has to potential to benefit significantly from the ability to export renewable energy given the extent of the indigenous resources. However, the current market arrangements are based on the principle that national demand will be matched by national supply and any exchange with neighbouring countries will be limited. This will increase the costs of decarbonising the national electricity system in addition to foregoing export opportunities.

The need for market reform

It is apparent from the deficiencies described above that the current market arrangements are incapable of driving the transition to decarbonisation at the required rate – if at all – and market reform is therefore needed.

There are a number of key benefits that will arise from a well designed package of reforms. Firstly, there is the potential to re-balance risks between investors and the customers of the future, who will directly benefit from the investments, such that investment financing costs are reduced. The overall costs of the transition to decarbonisation will be strongly affected by investment financing costs and reducing these costs will deliver significant benefits. In addition, it will:

- Open up the market to a broad range of potential investors, which is highly desirable given the extent of the investment required.
- Reinforce the ability of the Green Investment Bank to leverage private finance by reducing overall investment risks.

Secondly, there is the opportunity to ensure that competition is focussed on those areas that directly benefit customers and, therefore, that investments arise through companies seeking market opportunities rather than as a result of de-facto negotiations with Government for subsidy or over what are acceptable levels of consumer prices.

Finally, a well designed package of market reform measures will lay the foundations for delivering broad public acceptance for the transition to decarbonisation by creating a clear relationship between market interventions and customer benefits. Ensuring that these policies do not conflict with those that address social inequities, and that the market remains competitive and avoids the perception of profiteering, is also important in this regard.

However, realisation of these objectives requires that market reform be introduced with a clear set of design requirements.

Market reform design specification

The GB power market must be designed such that it is largely decarbonised by 2030 through promoting investment and innovation at the least cost[4] to consumers and the economy in three key and equally important areas:

- Low carbon resource technologies
    - Including both generation and demand reduction through energy efficiency
- Security and stability services
    - Provided by both supply side and demand side resources
- Network infrastructure

Significant investment will be required throughout the value chain, from early stage R&D through to wide-scale deployment of technologies and infrastructure, and the market must therefore remain attractive to a wide range of potential investors. Investment decisions will be made on the basis of future expectations of both sales volume and margin. However, the clear identification of a future volume opportunity is particularly important since this initiates the competitive process whereby investors seek to develop or purchase the cheapest technology to meet this future market need. Price is a less reliable driver for this market response since it will either be the consequence of future competitive actions or, where it involves an administered subsidy, it is vulnerable to changes in policy.

For the GB power market to be attractive to the full range of investors, it is therefore necessary to ensure that:

- There is a clear and credible long term sales volume opportunity against which potential investments can be assessed, and
- There are low barriers to entry which maximise the number of potential providers of the technologies/services thereby bringing competitive pressures to bear on costs throughout the supply chain

The long term sales volume opportunity must be clearly defined for each area:

- Low carbon resource technologies:

[4] Where the costs referred to here are those that give rise to direct financial impacts for businesses and consumers. It is recognised that there are aspects of total cost which are not currently allocated on a polluter pays basis (e.g. the full spectrum of environmental costs, water and land usage). Costs minimisation also involves the optimal use of resources in operational timescales.

- Ensure that a sufficiently high proportion of the overall electricity demand for energy and capacity is effectively reserved for low carbon technologies in line with overall decarbonisation and reliability objectives, such that it is not susceptible to competition from high carbon alternatives
- Within the overall low-carbon market, reserve volume sub-segments:
  - For delivery of energy efficiency measures and other low-carbon demand-side resources[5] that ensure that cost-effective investment in demand reduction is prioritised over investment in large scale generation,
  - To drive innovation in renewables, to ensure that the 2020 targets are met (incentives to develop the supply chain capacity to deliver these targets require ongoing growth opportunities after 2020), and in other technologies that have the potential to become cost competitive and where there are industrial policy advantages in taking a national lead.
  - To preserve an appropriate balance of technology and fuel supply risk consistent with delivering long term security of supply
- Define long term system access rights for low-carbon resource technologies including costs and terms for compensation during periods of system congestion or re-sale during periods of outage.

- Security and stability services:
  - The required categories of services (capacity, speed of response, location, etc.) must be established by the system operator along with forward projections of need for each service that are consistent with delivering pre-defined levels of system security and stability
  - Long term markets must be established based on the system operator's projections of need, which allow price discovery over timescales consistent with making the necessary investments
  - Energy efficiency and other low-carbon demand-side resources must have equal access compared to supply-side generation. This

[5] Including demand response and distributed (on-site) generation

requires, in particular, that the appropriate information and communication technology is available on the network

- The system operator must be regulated to ensure the efficiency of both the long term markets and any short term markets/pools created to deliver operational optimisation of assets, including congestion management and transmission access rules.

- Network infrastructure:
  - The key objectives of network regulation must be to deliver the necessary network infrastructure that will enable the:
    - Target low carbon resource volumes to be met at least overall cost
    - System operator to minimise the long term costs of security and stability in line with its regulatory incentives. This includes investments to relieve congestion and to ensure that the appropriate information and communication technology is available to allow full participation of demand-side measures (including micro-generation). It is important that the business separation between system operation and transmission operation is such that investments in network assets are treated on an equivalent basis to other potential providers of security and stability services.

The following approaches are required to maximise the number of potential providers of the technologies/services:

- Reduce investment costs by rebalancing risks between investors and consumers such that investors are not exposed to those risks they are not best placed to manage. In particular, the future volatility of short run marginal prices should not materially affect project returns. This will ensure that the market is opened up to investments from a broad range of investors and that the provision of technologies/services in the three key areas is not restricted, either directly or indirectly, to those parties with particular advantages in managing short-run wholesale price risk.

- Ensure that potential producers based outside GB are able to provide the technologies/services on equitable terms with GB based providers (and that providers based in GB are able to sell these services into overseas

markets). Also, regulatory mechanisms must ensure that the provision of services from overseas markets is considered as an equivalent means to reduce overall costs.

Other key design requirements are:

- The change from the current market must be delivered such that there are no incentives to delay investment projects whilst changes are being decided and implemented by guaranteeing that investors will not be better off as a result of changes in market arrangements through delaying an investment decision.

- Existing assets should not receive an unexpected increase in future profits arising as a result of market reform. Conversely, it is necessary to satisfactorily resolve unexpected losses arising from the stranding of historic investments.

- Market reform must not give rise to a disproportionate increase in cost burden to vulnerable customer groups[6].

- The overall market framework must provide transparency of policy objectives to promote a clear understanding of public value and deliver confidence in the enduring nature of regulatory arrangements.

- The process by which future refinements to the policy framework is made by Government must be well understood.

[6] Additional measures would be required to proactively ensure that the existing legal requirement to eliminate fuel poverty by 2016 is delivered and these measures are not considered in this paper.

High level policy choices

The design specification outlined in the previous section sets out a list of the key outcomes that the reformed power market must deliver. Various design options will achieve these requirements with differing levels of effectiveness and it is therefore necessary to identify the key high level policy choices that will set the basic framework for detailed market design.

The underlying market process will deliver a wide range of possible outcomes. It is possible for policy interventions to impose constraints on these outcomes and ensure that certain key outcomes are delivered. There are a number of such interventions in the current policy framework[7]. The key ones are:

- CO_2 emissions capped at EU level through the EU ETS
- Renewable energy targets out to 2020
- Targets to deploy energy efficiency measures in the domestic sector (currently out to 2012)
- Technical parameters to maintain system stability

It is possible to consider a greater level of prescription and possible candidates include:

- Limits on CO_2 emissions from the GB power sector consistent with the overall decarbonisation objective
- Renewable generation targets beyond 2020
- Constraints on the energy mix to insulate customers from price or security of supply shocks arising from significant single source technology or commodity cost risk factors.
- System reliability requirements based on fixed capacity margin or expected level of unserved energy
- Prescribed location of future network investment to match low-carbon generation resource potential
- Long-term targets to deploy energy efficiency measures
- Long-term requirement for system stability services, such as short term operating reserves

The careful introduction of each of these changes has the potential to reduce future market uncertainty for those investments that are critical to the delivery of key policy objectives. In addition to reducing investment risk and cost, such

[7] Those relating to EU ETS and RES targets are not specific to the GB power sector and therefore do not provide true certainty of outcome in this market.

interventions might deliver wider benefits to the UK economy such as industrial development in new green technologies. However, fixing market outcomes does create the risk that future customers will have to bear additional costs if the resulting investments become stranded by the emergence of lower cost alternatives.

The first key choice for market reform is therefore to identify the set of future market variables that Government wishes to fix on the basis that the benefits outweigh the potential future costs.

In order to ensure that these priority outcomes are indeed delivered, it is also necessary to allocate delivery responsibility to a central agent or market participants. The current market involves a mix of approaches with the system operator charged with maintaining systems stability whilst obligations to deliver renewables and deployment of energy efficiency measures are placed on suppliers.

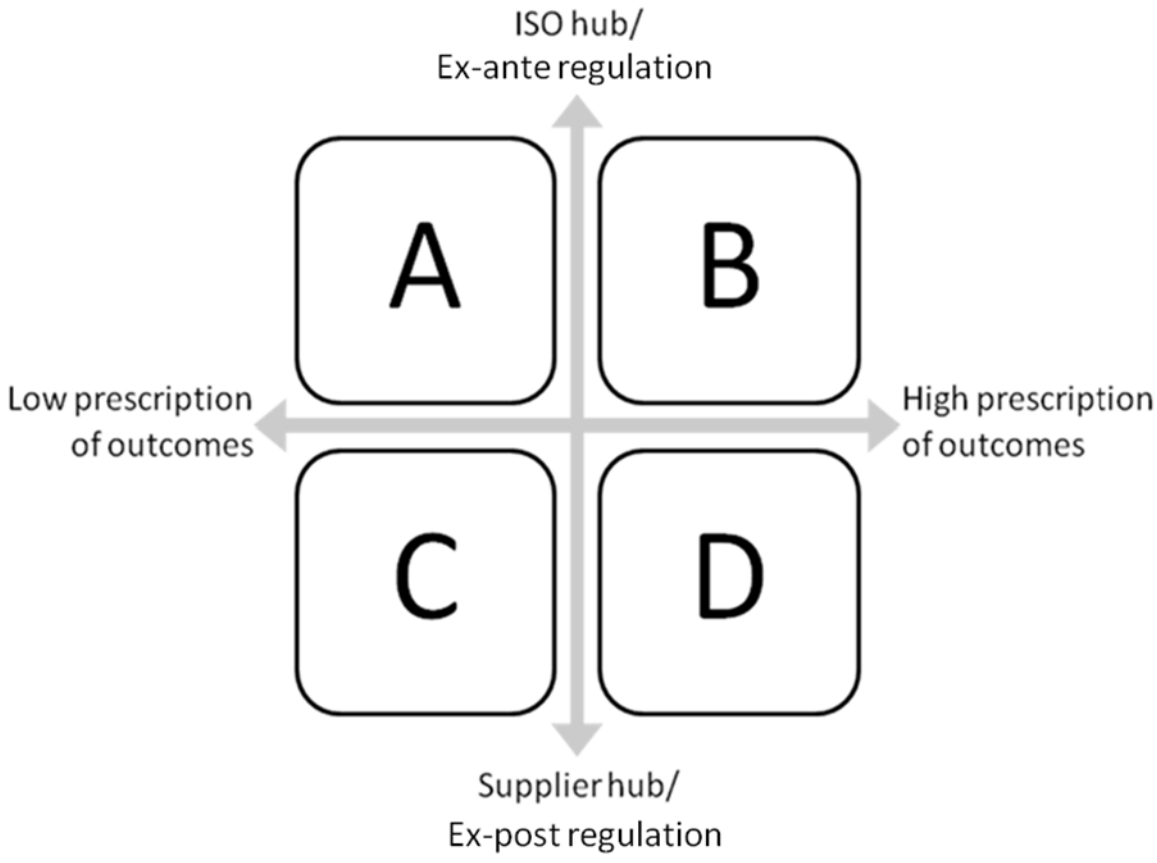
This decision will have a major impact on the business models for market participants. As they become subject to more obligations, the business and risk management processes become more complex. Market participants have the potential to manage these risks through a combination of trading and sub-contracting; however, it is likely that risks will be most effectively managed through achieving scale advantages and, where possible, reducing competitive pressures that might prevent these costs from being easily passed through to customers.

On the other hand, delivering obligations through a central agent requires strong ex-ante regulation and the establishment of centrally designed (and probably compulsory) markets through which the agent can deliver the obligations cost effectively. The nature of the integrated power system requires that system stability must be delivered centrally as is the case in the current market. This is achieved through a combination of bi-lateral markets for ancillary services and a centrally administered and compulsory balancing mechanism. Creating new obligations on a central agent are therefore likely to require the creation of additional centrally designed markets (e.g. forward capacity markets to deliver a capacity margin, auctions of renewable power acquired through feed-in-tariffs). However, the key challenge is to develop an

appropriate set of incentive mechanisms administered by the Regulator that ensure that the agent acts to minimise overall costs.

Although it is possible to envisage obligations being placed on a range of central agents or market participants, it is convenient to compare an 'ISO hub' model, where obligations are placed on an Independent System Operator, with a 'Supplier hub' model, where obligations are placed on Suppliers. In both cases, it is expected that the costs of meeting the obligations will be passed through to customers; however, in the ISO hub model, these costs will be controlled by direct ex-ante regulation, whilst in the supplier hub model cost control relies on suppliers seeking relative cost advantages in the competitive retail market along with ex-post regulation of their behaviour in this market to ensure competitive conditions prevail.

The key policy choices described above are illustrated in the following diagram:



There are risks and costs associated with each of these quadrants. For example, increasing the number of future outcomes that are prescribed will tend to reduce investment costs for key investments but will also increase the risk that

future customers will have to bear the cost of stranded assets. Implementing these targets through obligations on a central agent will tend to promote new entry and competition in the market but will require ex-ante incentive mechanisms and, potentially, the introduction and administration of new centralised trading arrangements. Implementing the targets through supplier obligations relies on strong ex-post regulation of competition in the retail markets in the situation where the business imperative will drive towards an increasingly consolidated market.

This high level choice will define the basic market framework within which detailed market mechanisms can be selected to meet the specification outlined above. The design specification therefore provides a check-list that can be used to assess the detailed design and indicate which of the high level choices outlined above will deliver the most successful market framework.