Literature review: principles of tariff setting and revenue recovery for network monopolies in the absence of significant network capacity constraints, including questions about long-term and short-term access pricing

FINAL REPORT FOR OFGEM

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SUMMARY

i. This Report presents the results of a high-level survey of relevant academic research, along with the experience of gas regulation in other jurisdictions, and network regulation in other sectors, that could be relevant to Ofgem's Gas Transmission Charging Review (GTCR). In conducting the survey, a number of contextual considerations relevant to the British gas market have been taken into account, including: the expectation that there will be sustained decreasing demand for gas transmission capacity on the network as a whole, and that, at the aggregate level, the transmission network can be generally characterized as having excess capacity at most times and points (although capacity constraints occasionally bind at some points on the network).

ii. In reviewing the results of the survey two particular points should be borne in mind. Firstly, that the capacity allocation and charging arrangements that have developed in the British gas market, particularly for entry capacity, are, in many respects, unique in the world. This has implications when considering the experience of gas allocation and charging arrangements in other jurisdictions. Secondly, while analytic work on charging can be important in terms of identifying issues and proposing principles for designing optimal charging schemes, in practice, because of the abstractions and unrealistic assumptions employed in analytical work, regulators need to develop charging arrangements in a pragmatic way having regard to specific contextual factors and the need to balance multiple pricing objectives. Accordingly, in reviewing current gas charging arrangements, there should not be an expectation that such arrangements will, or can, accord with theoretically 'optimal' access pricing.

iii. In regulated gas transportation activities a particular tension arises between the use of theoretically optimal (short-run) marginal cost pricing and ensuring the viability of gas transmission operators by allowing the recovery of their substantial fixed costs. Various options for addressing this tension have been examined in analytical work and applied in practice including: the use of a government subsidy to cover an operator's fixed costs; average cost pricing; non-uniform (differentiated) pricing approaches (such as Ramsey-Boiteux pricing); and non-linear pricing approaches (such as two-part tariffs). When choosing among these alternative approaches, regulators have often been confronted with a series of further tensions and trade-offs. These have included issues relating to the efficiency benefits of prices continuously adapting to reflect underlying costs (including capital costs) and the potential for price volatility (which can have implications for investments made by network operators and

network users). They have also included issues associated with: fairness and non-discrimination; participation, entry, and the development of competition in related markets; and with the complexity of any charging arrangements. The number of these trade-offs and tensions suggest that, in practice, a single set of charging arrangements is unlikely to satisfy all relevant pricing objectives simultaneously.

Potentially relevant insights from analytical work

iv. The survey suggests a number of insights from analytical work that might be relevant to the issues being considered as part of the GTCR.

- The current entry charging approach might be characterized as one where network users are offered a menu of two-part tariffs, and where users are being differentiated on a temporal basis. While this approach may be encouraging greater participation of low-valuation users in gas markets, the arrangements do not appear to be designed to make it rational for medium or certain high valuation customers to obtain access rights in long-term markets (and therefore pay a full capacity charge). Instead, under current arrangements, and particularly in the context of excess capacity, it may be rational for *most* users to acquire access rights in short-term markets, thereby avoiding the capacity charge and paying only the per unit (commodity) charge. More generally, because such differential charging is being applied to an *intermediate* input, rather than a final product, this could be giving rise to distortions in the related downstream markets (in so far as shippers who acquire access rights in advance and pay the full capacity charge are at a disadvantage to other shippers who acquire capacity in short-term markets at a discount).

- An important question to be addressed as part of the GTCR is the extent to which, under the current arrangements, the entry commodity charge deviating from marginal cost (such as to recover some proportion of fixed costs) results in distortions which are having appreciable effects on the utilization of the network, gas demand and allocative efficiency. Empirical evidence from the USA, particularly at the gas distribution level, suggests that the impact on allocative efficiency of such deviations may be significant. At the EU level, it has also been suggested that where a commodity charge does not reflect short-run marginal costs this may lead to inefficient usage of the network, and distortions of flows between different EU gas markets.

- Recent analysis has examined whether the relative split between the capacity and commodity components of a two-part tariff should vary over time, so as to provide incentives for the network firm to trade-off the costs of congestion against the costs of network expansion. While the analytical framework of this analysis is not directly comparable to the current GB conditions (i.e.: demand fluctuates and there are periods of network congestion), the analysis is potentially relevant insofar as it highlights the point that the relative size of the capacity and commodity components of a tariff can impact on the incentives of network users to utilize the network (in the short run) and the incentives of the network operator to expand capacity (over the long-term). The analysis also highlights how periodic adjustments to the relative split between the capacity and commodity charge can be a mechanism for managing the tension between (short-run) capacity utilization and (long-term) capacity investment. However, an implication of this analysis is that, in periods of excess capacity, the appropriate structure of tariffs is one where the commodity component should be low (to encourage greater utilization of the network) while the capacity component should be high (to reward the network operator for having invested to reduce congestion on the network). This structure is not immediately consistent with what is being observed in the gas transmission network in Britain.

- Some analytical work suggests advantages associated with allowing a gas transmission network operator to negotiate different capacity/commodity splits with specific types of network users. In particular, this is seen to allow the network operator to take account of the characteristics of the gas network user (i.e.: whether they are high or low load), and can stimulate participation in downstream activities. However, it is recognised that there may be substantial practical difficulties in applying such an approach within the UK's regulatory and legal framework. More generally, allowing the network operator to price discriminate in this way creates the potential to undermine competition between different network users at the retail level.

- Analysis of 'decoupling' policies in the USA may be potentially insightful for the issues being considered in the GTCR. Such policies have arisen in sectors where conservation policies are seeking to reduce demand for commodities (and therefore network services), and have involved the 'decoupling' of the level of allowed revenue that a network operator is allowed to earn, from the actual volume of

product delivered (i.e. the utility's revenues remain fixed even though sales volume may be fluctuating). Analysis of decoupling is potentially insightful in that: (i) it provides an alternative method through which the fixed (capacity) costs of the gas transmission network can be recovered; (ii) it suggests an approach that can allow for revenue recovery in the context of a permanent reduction in demand; and (iii) it can potentially address concerns about volatility in tariffs. However, it might be argued that the current charging arrangements are a form of 'decoupling' insofar as the commodity component of network user tariffs is periodically adjusted to account for any under-recovery of revenues from the capacity component and to allow the network operator with an opportunity to earn its allowed revenue.

- The use of auctions as a capacity allocation mechanism is a distinctive aspect of the current gas arrangements in Britain. Four points emerge from the survey of the relevant literature about the use of auctions as a capacity allocation mechanism which may be relevant to the GTCR. Firstly, under certain conditions, and in particular where capacity is constrained and there are a sufficient number of bidders, auctions can be an efficient mechanism for the allocation of gas capacity. Secondly, in contexts where demand is not growing, and there is no congestion on the network, the use of auctions may be disproportionately complex, and other capacity allocation methods may be more appropriate. Thirdly, in situations where either network capacity is not scarce, or there is insufficient competition among network users, auctions may not be appropriate. Finally, there is some scepticism in the academic literature regarding the usefulness of auctions as a mechanism for determining the long-term capacity needs of a network.

- Access-pricing frameworks often involve a trade-off between optimal access prices in a static sense, and those that are most appropriate in a dynamic context, particularly in terms of the impact that the level and structure and charges can have on infrastructure investments by network operators *and* network users. The potential magnitude of these impacts on investment can be significant, and studies of the telecoms industry have suggested that the dominant cost-based approach to access pricing may have had adverse effects on the incentives for entrants to invest in infrastructure (as well as denying the incumbent access provider the ability to recover costs).

- A central issue for the GTCR is the tension between setting charges which encourage short-term efficient utilization of the gas

transmission network, while also allowing for the recovery of past investments in the gas transmission network. Generally, speaking while the economics literature identifies the trade-offs involved, and the potential implications of different courses of action in terms of static and dynamic efficiency, it does not offer any concrete solutions to how this trade-off should be resolved in practice. However, some technical and policy reports have taken the view that, in contexts where there is no growth or congestion on a gas transmission network, tariffs should have a retrospective focus, and the primary concern should be allocating the historic costs of investments among network users in ways that accord with notions of fairness.

- The design of any charging structure can have significant impacts on the relative allocation of costs to different types of users, which in turn can impact on their profits. Charging structures based around allocating all fixed costs to capacity charges are seen to benefit high-load users (such as large industrial customers), and to be to the disadvantage of more seasonal or intermittent network users (such as residential consumers or peak generation facilities). While the wider academic literature implies that allocating all fixed capacity costs to capacity charges is appropriate, in practice, the relative split between the charges will often reflect other factors, including the impacts that this has on different types of users and on competition in related markets.

Insights from gas regulation in other jurisdictions

v. Although a number of countries around the world have liberalized and restructured their gas industries, the starting point for these processes, the trajectories followed, and the specific policies introduced have differed significantly, and this, along with other contextual differences, limits the relevance of regulatory arrangements in these other jurisdictions for the GTCR. Within this general caveat, the following insights may be of relevance to the GTCR:

- Charging arrangements for gas pipeline access in the USA has evolved from a structure based on a split of fixed costs among capacity and usage components, to an approach where all fixed costs are recovered through the demand (capacity) charge. This shift had two motivations: to promote competition among gas suppliers, and to encourage the more efficient use of the pipeline system (by better rationing capacity and making low-load shippers more selective about choosing this service as compared to storage). The shift in approach is seen to have

benefited large industrial customers and manufacturers (who typically have high-load factors) and to have been to the disadvantage of domestic and commercial customers (who have low annual load factors on average). While it is recognized that the charging approach does not yield efficient prices, it is seen to provide certain important benefits, including ensuring full-cost recovery, providing transparent and fair price signals to shippers and being procedurally simple.

- Of possible relevance to the GTCR is the analysis at the EU-level of alternative methods for dealing with any under (and over) recovery of revenues. The analysis in the Impact Assessment for the Harmonisation of Tariff Structures set out two main problems with an approach to cost recovery that involves adjustments to the commodity charge: (i) that it could lead to situations where the commodity charge significantly exceeds the actual variable costs, which could lead to inefficiency and welfare losses (although this was not quantified); (ii) that it could lead to distortions and inefficiencies in cross-border trading between interconnected markets. More generally, the analysis referred to the 'general principle' that commodity charges should reflect as far as possible actual variable costs, and that this indicated that fixed cost recovery mechanisms should focus on capacity charges.

- In terms of insights from the experience of European member states more generally, the survey reveals that there is currently considerable diversity in the charging structures applied across EU member states to allow for the recovery of the allowed revenues for gas transmission operators. In 10 EU member states no commodity-based charge is levied, and all revenues are recovered via a capacity charge. In those European countries where a commodity charge is applied, the split between capacity charges and commodity charges range from 70%:30% to 95%:5%.[1]

- Reviews of the structure of gas transmission tariffs, and how these interact with revenue recovery, have recently been undertaken in Ireland and New Zealand. In Ireland, the regulator, the CER, rejected any change to the split of capacity and commodity charges on the basis that moving network cost recovery away from capacity charges toward commodity charges results in 'peaky customers' contributing less to cost recovery, which was inappropriate given that the gas transmission network was conditioned on peak and not average

[1] With the notable exception of Romania where the capacity charge appears to be less than 10% and the commodity charge above 90%.

demand. In New Zealand, where the current approach involves the recovery of some fixed costs through the commodity charge, the approach has been assessed as 'no longer fit for purpose' in circumstances of tighter network capacity. Specifically, current prices are assessed as not being cost-reflective, and therefore provide incentives for the use of a pipeline that has limited available capacity.

Insights from other regulated sectors

vi. Despite some broad similarities between the different regulated network industries, there are considerable differences in the physical, technical and economic characteristics of these industries, including the charging mechanisms that are applied. While this means the experience of other industries are not likely to be directly applicable to the issues being addressed by the GTCR, the following points are potentially of some relevance:

- A wide range of charging structures and approaches are adopted for the use of transmission or transportation networks across network industries. There are also a range of methods for allocating capacity to transmission/ transportation networks including administrative methods, bilateral negotiations and open market-based processes. In general, auctions are not a major feature of capacity allocation in the transport or telecommunications industries (with the exception of spectrum auctions), and they feature to different degrees in the electricity industry (mainly for cross-border capacity to date). In this respect, the use of periodic, centralized capacity auctions for the allocation of gas transmission entry capacity in Britain is one of the most advanced examples of the use of auctions across the regulated sectors.

- In terms of the comparability of issues facing the gas and the other industries, certain telecommunications and postal services and electric services in some jurisdictions, are, like gas transportation, facing expectations of continuing decline in demand. Accordingly, the analysis of any changes to charging arrangements in relation to these services is potentially of some relevance to the GCTR. In relation to fixed line telecommunications services, where demand has steadily declined (as a result of mobile substitution), and underutilization is now a feature of large parts of this network, some analysis has proposed new approaches to regulating access prices for these services. One suggested approach combines the standard forward-looking long-run average incremental cost approach with a retail-

minus approach, and is seen to give the network operator greater flexibility in the context of the contraction of demand, while ensuring that it does not engage in a margin squeeze. In the postal services industry, which has also experienced non-temporary decreasing demand, analytical work has principally focused on the potential for introducing different forms of non-linear pricing, and has looked, in particular, at how the ability to differentiate among network users or to charge volume discounts can assist in ensuring the financial viability of the operator in the face of significant inter-modal substitution. In practice, in the UK, traditional price controls have been removed from most of Royal Mail's services with only monitoring and some margin-squeeze-related protections retained.

- While analysis of, and adaptions to, access pricing arrangements in the context of an expectation of non-temporary decreasing demand for network capacity in telecommunications and post is potentially insightful, two critical contextual points must be borne in mind. First, in both industries there is increasing competition between different network operators (mobile, fibre, cable in telecoms and bulk deliveries in post), and access pricing is of a two-way nature rather than a one-way nature. Second, there are high levels of vertical integration in both industries – albeit subject to some form of functional or operational separation – and so a major concern is how access prices set by the incumbent relate to the retail prices set by the incumbent (i.e. a price/margin squeeze).

- Perhaps the main point to take from these examples is that in the face of an expectation of non-temporary decreasing demand there has been an increased focus in both sectors on affording the network operator greater flexibility in the design of tariffs which will allow it to recover its fixed costs. However, in both examples, this greater flexibility is being given in a context where concerns about excessive pricing for transmission services is limited by the existence of network competition, a situation which is not immediately applicable in the British gas transmission industry.

- Finally, in some jurisdictions, notably the USA, but also parts of Australia and Canada, forecasts indicate a decreasing rate of growth in demand for electricity. To address this decline it has been suggested that there should be a fundamental change in the design of rates for electric utilities and that the rate design should be changed towards one based on SFV approach, such that the fixed charge covers the costs of investing, maintaining and operating the grid.

1. INTRODUCTION

1. This Report presents the results of a high-level review of relevant academic research, and of the experience of gas regulation in other jurisdictions, and network regulation in other sectors, that may be germane to Ofgem's Gas Transmission Charging Review (GTCR). Its purpose is exploratory in nature and it is designed to identify potentially relevant insights from recent work and experience, and to highlight how such insights could be of relevance to the GTCR. Accordingly, the review is not intended to be an exhaustive survey of the recent developments in the theory and practice of network charging arrangements, nor does it seek to critique the current arrangements, or present any conclusions as to the likely applicability of any specific approach for the future regulation of gas charging arrangements in Britain.

1.1 Background to the Review

2. It is our understanding that the GTCR is being conducted against a background of: (a) on-going market concern about the operation of the current charging arrangements, particularly in relation to entry[2] and (b) regulatory and legal changes which flow from developments at the EU-level.

3. Although there appears to be strong differences of opinion among industry participants as to the merits of the current entry capacity charging arrangements,[3] some specific concerns that have been expressed about these arrangements include that:

   - The current variable split between capacity and commodity components of the tariff is resulting in different tariffs being paid by different types of users (high load factor and low load factors users). This implies that one set of users are potentially contributing more to the recovery of network costs than other users.
   - Relative differences in the capacity/commodity split in Britain and neighbouring gas markets (particularly Belgium and the Netherlands) may be leading to distortions in cross-border flows of gas, insofar as cross-border trading is not being driven by differences in the cost of gas. In particular, there are concerns that the current arrangements

[2] See Ofgem (2010) and Ofgem (2013).
[3] While this trend is particularly evident for entry products, concerns have also been expressed about the relative capacity/commodity split in relation to exit products. See National Grid (2013).

can create incentives for shippers to export gas to continental Europe, and disincentives for shippers to import gas to Britain.

- The current charging arrangements are resulting in a situation where the variable commodity charge is being set at levels in excess of the marginal costs of network usage, and this is potentially creating (allocative) inefficiencies. Conversely, under the current charging arrangements, the fixed capacity charge is, in aggregate, potentially being set at a level below the long-run marginal cost of capacity, which may be dulling the incentives for network expansion (to the extent to which it is required), and therefore potentially impacting on dynamic efficiency.
- The charging arrangements may be creating downstream distortions in competition, insofar as those shippers who acquire capacity rights in short term markets at a discount are potentially put at a competitive advantage relative to those shippers who acquire rights in advance and do not receive a discount.
- The use of the commodity charge to recover any under or over recovery of revenues associated with the capacity charge is leading to greater volatility and unpredictability in gas charges which is undesirable for shippers.[4]

4. In relation to the legal and regulatory changes, these flow in particular from the EU's Third Package of Gas Regulation. Of particular relevance to the GTCR is the EU Framework Guideline on Harmonised Transmission Tariff Structures which requires, among other things, that at cross-border interconnection points any over or under recovery of revenue will have to be recovered through capacity products only, and that commodity charges should only be used to recover those costs which are associated with flows. Specifically, any over or under recovery of revenue at these interconnection points is to be recovered through an adjustment to the capacity charges in later years, meaning that the capacity charges are 'floating' rather than 'fixed' charges. In effect, this means that the price for capacity bought in previous years through a long-term auction, will, as a result of these changes, be determined in the year in which that capacity is used.

[4] Concern about the potential increase in uncertainty for shippers associated such a mechanism was noted by some commentators at the time when the policy was first introduced in 2004. See Transco (2004:2).

1.2 Relevant contextual considerations

5. Against this background, this Report draws insights from three main areas: (1) relevant academic research; (2) the experience of gas regulation in other jurisdictions; and (3) the experience of the application of network regulation in other sectors. In conducting the survey of this work the following contextual considerations relevant to the British gas market have been taken into account:

    a. An expectation that over the medium to long-term there will be sustained decreasing demand for gas transmission capacity on the network as a whole.[5]

    b. That, at the aggregate level, the transmission network is generally characterized as having excess capacity at most times and points (although capacity constraints occasionally bind at some points on the network).

    c. That there has been a trend away from demand for long-term capacity rights, and shippers will continue to have a preference for acquiring capacity products in short-term markets at a discount. This trend can be observed in estimates of allowed entry revenues recovered from capacity charges which have decreased from around 80% in the period prior to 2008/09 to an estimated 30% in 2012/13.[6]

    d. That the gas entry flows on the GB transmission network are changing, and in particular, that there has been a shift away from gas entering the NTS from the UKCS at St Fergus, toward greater entry occurring at LNG points such as Milford Haven and Grain, and at Easington. One potential consequence of these changing entry patterns is the expectation that in the future, incremental capacity requests will more likely come from new connections (such as LNG connections) rather than expansions of existing connections.[7]

    e. That the current charging arrangements may be having an effect on cross-border gas flows, as a result of the fact that shippers are factoring into their decisions the relative level of commodity charge

[5] The Impact Assessment of the policy options on incremental capacity for EU gas transmission prepared by Frontier Economics (2013:7) records that, at the European level, the growth in gas demand has slowed and that some projections suggest that demand will peak in the next 10 to 20 years.
[6] See Brattle (2012:25).
[7] See Frontier Economics (2013:39).

when deciding where to deliver gas.

1.3 Preliminary observations

6. Before launching into the specifics of the survey, three preliminary points should be noted, each of which have implications for the conclusions drawn from the survey.

   - The first, and most obvious, point is that the capacity allocation and charging arrangements that have developed in the British gas market, particularly for entry capacity, are, in many respects, unique in the world. As discussed in more detail below, although market based arrangements to allocate gas capacity (such as auctions or open seasons) are used in other jurisdictions, and a number of countries apply a commodity (or usage) charge for gas transmission services, it is the combination of these two characteristics of the British gas market which make it somewhat distinctive, particularly the relationship between auction revenues and the magnitude of the commodity charge. The implication of this point is that the experience of gas allocation and charging arrangements in other jurisdictions – including those at the forefront of the liberalization process such as the USA – may be of only limited applicability and relevance to the issues being considered as part of the GTCR.

   - The second point relates to the relevance of the insights that may be derived from analytic work (i.e.: theory) on optimal access pricing approaches. While much of this work is important in terms of identifying issues and proposing principles and methods for designing optimal access pricing schemes, it also involves unreal assumptions (such as perfect information). In practice, regulators need to develop charging arrangements in a pragmatic way having regard to specific contextual factors which are not allowed for in the typically abstract models in which the principles of optimal pricing are analysed. It is, in part, for this reason that the access pricing principles favoured by most academic economists – such as Ramsey-Boiteux pricing or the Efficient Component Pricing Rule – are rarely applied in practice. The implication of this point is that, while the current arrangements for gas transmission charging may not accord with what might be considered an 'optimal' access pricing approach, this does not mean that they are inconsistent with the types of pragmatic approaches that regulators in other jurisdictions and sectors adopt in *practice* when

designing and applying charging arrangements for network infrastructure.[8]

- A third point is that the design of the structure of tariffs is of considerable importance, and can have significant implications for network operators and shippers businesses. In particular, the design of tariffs structures can have important distributional implications, insofar as these structures impact on different types of shippers in different ways. This, in turn, can have longer term implications for a shipper in terms of its operational decisions. More generally, as discussed below in section 3, empirical studies of the gas distribution industry in the USA suggest that the welfare losses associated with inefficient charging structures – particularly usage charges set in excess of marginal cost – can be significant, and, in one assessment, in the vicinity of $2.7 billion annually.

1.4 Report structure

7. The Report comprises four additional sections. Section 2 sets out some basic principles relating to efficient access pricing. While these principles may already be familiar to some readers of this Report, they nevertheless feature prominently in discussions and analysis of alternative charging arrangements and have been included for this reason. Section 3 considers what insights might be gleamed from analytical work that might be relevant to the issues being considered as part of the GTCR. In section 4, consideration is given to the experience of the regulation of the gas industry in other jurisdictions, and in particular, focuses on the design of charging arrangements in other liberalized markets, notably the USA, but also in Europe and elsewhere in the world. Finally, section 5 draws out some relevant insights from the approaches to regulation adopted in other network industries, particularly those where there is an expectation of decreasing demand for transmission/transportation capacity in the future.

[8] This point seems to be well-recognised by economic practitioners. For example, the influential 2002 Brattle Report on tariffs in the European Gas sector noted that "*No reasonably practical tariff system can perfectly reflect costs"* and that "*it is unreasonable to expect more than broad cost reflectivity, since the complexity of gas transmission and distribution, and the presence of fixed and sunk costs, rule out the exact measurement and allocation of costs to individual transactions*." Brattle (2002: 43)

2. THE BASIC PRINCIPLES OF EFFICIENT ACCESS PRICING

8. Although many readers of this Report will be familiar with the underlying core principles of optimal (one-way) access pricing, given the central importance of some of the concepts to the issues being considered as part of the GTCR (such as allocative efficiency and revenue recovery), it is worth restating them briefly here. The discussion in this section might be seen as setting the general scene for the GTCR by outlining the various possibilities for designing charging arrangements that have been proposed and used in the context of network industries.

2.1 The starting principle: marginal cost pricing

9. It is a longstanding principle of economic theory that, under certain assumptions, the optimal pricing approach is one where the price of access services is set equal to the (short-run) marginal cost of supplying access. Setting prices to marginal cost is the most efficient allocation of a firm's production because it is at this point that the total surplus is maximised, that is, the sum of consumer surplus and profit is at its greatest, and there are no unexploited gains from trade.[9]. Marginal cost pricing is sometimes referred to as 'first-best' pricing, because any deviations of price from marginal cost (in either direction, above or below) can only *reduce* total surplus. For this reason, marginal cost pricing is frequently considered to be the *starting* principle for the regulation of core network activities and the benchmark of efficiency.[10]

10. In practice, however, it is widely recognized that this 'first-best' principle of (short-run) marginal cost pricing is problematic when applied in the context of network industries, such as gas transmission. This is because even in an assumed static, single product setting, the core transmission networks are typically associated with high levels of fixed costs (which do not vary with output) and low levels of variable costs. It follows that, if the principle of marginal cost pricing is applied, this will result in revenues that do not cover fixed costs and the firm making a loss on production, which will ultimately make supply of the service unsustainable.[11] In

[9] Putting this the other way, an 'allocative inefficiency' is said to arise whenever the value placed on a additional unit of a product by consumers deviates from the opportunity cost associated with producing that additional unit.

[10] As Kahn (1971:65) observes: *"The central policy prescription of microeconomics is the equation of price and marginal cost. If economic theory is to have any relevance to public utility pricing, that is the point at which the inquiry must begin*".

[11] This potential has been recognized in the context of EU policy in the gas sector, where it has been noted that a short-term price of zero or close to zero raises issues of cost recovery, and over time, can incentivize shippers to make more use of the cheaper short-term bookings in the place of long-term bookings leading to a 'flight to short-term capacity'. See Brattle (2012:7)

simple terms, there is a tension across all of the network industries between the achievement of optimal allocative efficiency and ensuring that the regulated firm remains viable.

2.1 Deviations from marginal cost pricing to recover fixed costs

11. The tension between the achievement of allocative efficiency and allowing a network operator, such as a gas transmission operator, to obtain sufficient revenues to cover its fixed costs, has lead to the use, or analysis, of various options which, while allowing the network provider to recover its fixed costs, seek to minimize the distortion to efficiency. Among these, the following options have received the most attention:

    - The use of a subsidy to recover fixed costs, while allowing variable costs to be recovered by setting price equal to marginal cost. While this approach maximises allocative efficiently (by setting price equal to marginal cost) and allows the firm to remain viable, through the receipt of a subsidy equal to its fixed costs, there are a number of well-recognised disadvantages of the approach. Among these: (i) introducing a subsidy in one industry can create distortions in other sectors/industries of the economy; and (ii) regulators typically do not have the power to provide subsidies to regulated firms.

    - The use of average cost pricing, which involves the firm setting a single uniform price for all its output that is equal to average cost (i.e.: fixed and variable costs). This is sometimes referred to as 'second-best' pricing as, under certain assumptions, it can minimize the distortion to total welfare associated with deviating from marginal cost pricing, while also allowing the network operator to break-even. The principal problem with this approach is that the single uniform price per unit effectively embodies an equal mark-up to recover fixed costs over all units sold and therefore does not maximize total welfare. This means that even in the single product case, it is possible to improve total welfare by allowing the firm to adopt various alternative pricing approaches such as differential or non-linear pricing.

    - The use of non-uniform (differential) pricing. Under this approach, the firm can *differentiate* prices according to the preferences of different customers for the different product(s) supplied by the firm. Ramsey-Boiteux pricing is an example of such an approach, and in the single

product setting, involves applying a mark-up above marginal cost for different customer groups, which is inversely proportional to the elasticity of demand for the product by that particular group of consumers. As a result, per unit prices will vary among different groups of consumers: prices will be higher for consumer groups with less elastic demand, and lower for consumer groups with more elastic demand, despite the fact that the marginal cost of production is the same for both groups of consumers. Where feasible, this differential pricing approach represents an improvement on the average price approach, and increases the size of the total welfare. This is because the mark-up for different consumers of the product can be chosen in such a way as to allow the service provider to generate sufficient expected revenue across all of its users.[12]

- The use of non-linear pricing approaches. This approach, commonly used in the gas industry around the world, allows the firm to charge different per-unit prices to consumers, and in particular, where it can do so, to offer quantity discounts. The simple two-part tariff, based on a capacity charge to recover fixed costs (which do not vary with production) and a usage charge to recover variable costs, and other more elaborate forms of non-linear pricing, are examples of this general approach. The principal advantage of this approach is that by setting the usage (or commodity charge in the current context) equal to marginal cost this allows for allocative efficiency, while the levying of a fixed capacity charge allows for the recovery of any fixed costs associated with the network. Given the relevance of this approach to the GTCR, we consider this approach in greater detail below.

In practice, all of these options have been applied to the network industries, albeit to different degrees. The use of subsidies have long been a feature of the rail industry around the world, and Direct Support grants are currently provided to Network Rail in Britain to ensure full revenue recovery. The use of government subsidies has also been proposed by some stakeholders as being an approach that should be applied to gas transmission in other jurisdictions, such as Ireland.[13] Various forms of average cost pricing have been applied in practice, including in the telecommunications, postal and transport sectors, where a form of long-run average incremental cost pricing is applied (see

[12] Assuming different groups cannot engage in arbitrage or trade.
[13] See CER (2013:16). Specifically, the (unattributed) suggestion here was that in the event of a write down in the value of the assets of Bord Gáis Networks (BGN), or any such shortfall of revenues for BGN, that the Irish State should 'step in' and cover any capital shortfall. This suggestion was, however, rejected by the regulator.

discussion below). Ramsey-Boiteux pricing, while theoretically attractive, has rarely been applied in practice, in large part because of issues associated with fairness. Finally, non-linear pricing approaches, such as two-part tariffs, have long been applied in the network industries, particularly in relation to end-user tariffs across different sectors and jurisdictions.[14]

2.3 Efficient access prices for intermediate inputs

12. While the discussion in the previous section focused on optimal deviations from marginal cost pricing in a general way, additional issues arise in settings (such as the current one) where the service being provided is an intermediate product, or an input, and is not the final product being sold to end-users. An added complication here is that the access price may also be used to adjust for any distortions associated with related, downstream markets. For example, if the downstream market is assessed as being not competitive (i.e.: retailers are able to set prices above relevant marginal costs), then the optimal access price might be set at a level lower than the marginal cost of access in order to compensate for this inefficiency. However, this still leaves the difficulty of devising a mechanism to allow for the access provider to recover any fixed costs associated with the supply of the intermediate access product.

13. In circumstances where the regulator can fix both a vertically integrated firm's access price and retail price simultaneously, analytical work suggest that it is optimal for the regulator to apply Ramsey-Boiteux pricing principles as this will be the most efficient deviation from marginal cost pricing subject to the firm breaking even. However, various adjustments may need to be made to Ramsey-Boiteux pricing when applying it to intermediate inputs – such as gas transmission services. [15] Specifically, the optimal access price should comprise a mark-up over the marginal cost of access that reflects adjustments for the elasticities of demand for the respective products.[16] Again, while such an approach might be the most efficient approach to access pricing in theory, it is often

[14] This involves a user being levied a fixed or standing charge (levied on a quarterly/semi-annual/annual basis) as well as a per unit charge levied on each unit of the service consumed. For example, electricity customers may pay a flat monthly standing fee in addition to a charge per kWh of electricity that is consumed, and telecommunications customers may pay a fixed monthly access charge as well as paying for each call they make.

[15] That is, any deviation from marginal cost should account for both the own- and cross-price effects of the change in price for a service, which is done through the use of 'super-elasticities', which capture cross-price effects as well as own-price effects of a price change.

[16] See Laffont and Tirole (1994:1673) and Armstrong (2002).

resisted by regulators in practice. In part, this is because of the complexity in applying such an approach in practice, but also because of a perception among regulators that it will not be consistent with legal requirements in some jurisdictions that access prices be 'fair and non-discriminatory'.

14. In situations where the network operator is vertically integrated and also involved in the downstream activity, then the access price might be used as a mechanism for allowing the network operator to either; (a) recover the opportunity cost, or lost profit, associated with not supplying the retail output in circumstances where a downstream activity is being opened to competition; or (b) correct for any distortions in retail prices where such prices are set at a level different to costs because of historical or political reasons. This general approach to access pricing is known as the Efficient Component Pricing Rule (ECPR) and, in more recent applications, the Retail-Minus approach. Generally speaking this approach remains controversial and has been viewed with some scepticism in practice, although there are examples of the approach being used in the telecommunications industry, and in the water and wastewater industry (see discussion in section 5 below).

15. By far the most popular approach to access pricing for intermediate inputs in the network industries is to set prices on the basis of some estimate of the long-run incremental or marginal costs of operating a network which supplies the intermediate output.[17] In circumstances where the network activity is potentially contestable – such as in the telecommunications industry of for gas pipelines in some jurisdictions – an argument in support of setting prices on the basis of forward-looking estimates of long-run incremental cost is that it can send the correct 'make or buy' signals to entrants. Despite the widespread use of this approach in practice, theoretical work tends to be more ambivalent about the properties of the approach, noting that it will generally only be appropriate in certain circumstances, such as where the access price does not need to correct for distortions in the retail market.[18]

16. Given its widespread application, two characteristics of the application of long-run marginal or incremental cost approaches in practice are worthy

[17] In an early analysis, Cremer, Gasmi and Laffont (2003:16) show how prices based on long-run marginal cost will be the first-best policy for unidirectional flow gas networks in situations where the demand and cost conditions in all periods are identical, and where a line is congested. However, where there is also a need to balance an operator's budget, then the second best optimal allocation on a congested line, prices should be set at LRMC with a Ramsey mark up. Finally, they conclude that the first and second best optimal allocation involves a decentralized two-part tariff scheme.

[18] See Armstrong (2002).

of further discussion. Firstly, in most applications, in order to arrive at a per unit estimate of incremental cost, the total long-run incremental costs of providing a service over a year is typically divided by the (actual or forecasted) demand for that service. This results in an *average* estimate of the total long-run incremental cost per unit of output, and not a measure of the marginal cost of providing an extra unit of output (see discussion in paragraph 18 below). Secondly, when prices are based on estimates of the forward looking long-run incremental costs, regulators typically adopt a number of key assumptions including: (i) that the estimates should be based on the replacement (modern equivalent asset) cost for a hypothetical network operator and not the actual costs of the network operator; and (ii) that the network assets are optimized to meet demand, such that the costs measured are those that would arise if the hypothetical network operator employed the most efficient production methods and available technology to meet expected future demand.[19] An important implication of this approach, discussed in section 5 below, is that, in circumstances where assets prices are falling, or where demand is expected to decrease in the future, estimates of forward-looking long-run incremental cost will need to be adjusted to take account of the fact that an efficient hypothetical competitor would build a smaller network using cheaper materials and assets; the net result being lower estimates of long-run costs, and lower prices.

2.4 Long-run cost or short-run marginal cost pricing?

17. The issue of whether prices in network industries should be based on estimates of *long-run* marginal cost (LRMC) or *short-run* marginal cost (SRMC) is one that has long been debated in economics. In general terms, it has been argued that if a network system is optimally planned and operated – such as that capacity is continuously variable, forecasts of capacity are correct and the network is reliable – then there should be an equivalence between SRMC and LRMC, and prices can be set at this level. However, where these conditions are not satisfied, and there are periods of excess capacity, or capacity constraints, then only prices based on SRMC will ensure that optimal use is made of a network asset, such as a gas transmission line, at that point in time (i.e.: this will ensure that there is not too little or too much utilisation of the asset).[20] While there is broad agreement on the preceding point, the principal difficulty with this approach is two-fold:

[19] These assumptions have proven highly controversial in practice.

[20] In circumstances of excess capacity, prices based on LRMC will be too high and reduce the volume of sales, leading to inefficiently low utilization of the network at that point in time.

- First, as already noted, at times of spare capacity, pricing at SRMC does not allow for the recovery of sunk costs associated with the assets, and this potential for non-recovery can impact on the incentives for network operators to make investments which give rise to such a situation in the first place; that is, anticipating such an approach, network operators will not have incentives to invest in additional capacity which gives rise to SRMC pricing.[21] As discussed below, a separate issue arises in relation to cost recovery in circumstances where the situation of excess capacity is expected to be non-transitory (i.e.: permanent) in nature, where the main issue concerns the recovery of costs associated with historical investments.

- Second, because prices are continuously adjusted to available capacity, prices based on SRMC can be volatile. Specifically, prices can fluctuate according to how close the utilization of the specific asset (such as a gas transmission line) is to its capacity, with prices being very high at times when the asset is close to or at its capacity level, or very low (or zero) at times where there is excess capacity. This volatility in SRMC prices is seen to have implications for the decisions made by consumers and intermediate users of network assets (such as shippers), including in relation to their own investments in sunk assets.[22] It is to address this potential for volatility in SRMC prices, that some economists advocate the use of a LRMC pricing policy.[23]

18. The principal practical difficulty with LRMC-based pricing in most of the network industries, including in relation to gas transmission, is that investments in such industries are not continuous in nature but rather lumpy and indivisible. For example, large network expansions are often triggered by demand from a single network user for additional capacity on the network. If true long-run marginal cost pricing were applied then prices for this one user would include all of the additional costs associated with supplying that incremental unit of capacity. It is for this reason that, in practice, as already noted, some form of long-run *average* incremental cost concept is typically used, which divides the forecast of average long-run incremental costs of providing a service over a certain

[21] As Friedman and Weare (1993:63) note in the context of the electricity industry: *"Throughout much of the history of this industry, including currently, marginal cost pricing would not have raised enough revenue to cover the costs of providing service. No private firm would willingly agree to provide such service at marginal cost rate".*

[22] For example, in times of spare capacity a network user may make investments on the basis of a false expectation that SRMC prices will always remain low in the future. However, these investments may become uneconomic at times when capacity is tight, and SRMC prices are high.

[23] See, in particular, the early contributions of Boiteux (1949).

period (such as year) by the forecast demand for that service over that period.[24] The net effect of this is that all network users who purchase the service in that period pay a common average price, and different users do not pay different marginal prices.

19. Finally, of relevance to the GTCR, is the conclusion of academic work as to the applicability of LRMC pricing in situations of sustained excess capacity or shrinking demand.[25] Specifically, the literature argues that, in these circumstances, the concept of LRMC is, by definition, meaningless and the appropriate cost concept is one of SRMC.[26] This follows from the reasoning that because there will no longer be situations in the future where capacity is constrained, there is no need to account for future capital costs in current prices.

20. However, as discussed in section 3 below, these academic conclusions abstract from the requirements that confront many (but not all) regulators to ensure that *historic* capital investments in network assets are recovered through current prices. Put slightly differently, in situations where the regulator is setting prices only on the basis of forward-looking estimates of long-run costs then it would be appropriate to set prices having regard to the expected future level of capital investment needed to satisfy future demand, which may be at a level close to SRMC (assuming there will always be excess capacity and there is no need for further network investment). However, where a regulator is required under a regulatory compact to set current prices in such a way so as to recover past investments, then this will require that prices deviate from SRMC in such a way so as to ensure that the network operator is able to recover the costs associated with past investments in the network assets. This approach will obviously entail some loss of (static) efficiency as prices will be higher than SRMC, but they potentially can lead to dynamic efficiency gains by enhancing the credibility of a regulatory system and therefore making others more confident that they will be able to recover the costs associated with their investments in network assets.

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[24] In an early analysis, Marcel Boiteux (a former Chairman of EdF) set out the reasoning for this approach as follows: *"[T]he need to keep rates steady (which has nothing to do with the marginal theory) makes long-term policy preferable to the instantaneous optimum use of investments; the underlying principle is to fix rates equivalent to what the differential costs would be if the plant were constantly at correct capacity, that is the rates equivalent to the development costs."*

[25] In situations where demand is growing, and/or where the network suffers from congestion, then the general view is that gas transmission tariffs should reflect the long-run costs. See Brattle (2002:6).

[26] For example, Brattle (2002:42) notes that in the absence of network congestion then the concept of long-run marginal cost is "*irrelevant".*

2.5 Summary: The trade-offs associated with access pricing

21. While discussion in this section might seem slightly removed from the specific issues that are being considered as part of the GTCR, the purpose of this section has been to set out some of the options discussed and proposed in theory, and applied in practice, for dealing with the various tensions and trade-offs that can arise when setting access prices in network industries. Among the issues and trade-offs identified include:

    - The trade-off between (static) efficiency and cost recovery when prices are set at short-run marginal cost.

    - The trade-off between the efficiency of ensuring that prices continuously adapt to reflect underlying costs (including capital costs) at any one point in time, and the potential for price volatility, which can have implications for investments made by network operators and network users.

    - The properties of different methods of deviating from marginal cost pricing while allowing for cost-recovery, such as Ramsey-Boiteux pricing and non-linear pricing, each of which raise their own issues and trade-offs (related to fairness and non-discrimination or participation).

22. From the discussion in this section, it is clear that a single instrument – the access price – can often be called upon to fulfill multiple objectives simultaneously, such as: allowing for efficient utilisaton of a network; ensuring cost recovery for a network operator; providing appropriate signals for investments by network operators *and* network users; and correcting for any distortions in related markets.[27] In practice, this creates a difficult balancing exercise and can require a regulator to balance and trade-off the objectives related to allocative efficiency against those of dynamic efficiency. [28] In addition, distributional issues can become

[27] As Laffont and Tirole (2000:99) observe in the context of telecommunications networks: *"[I]nterconnection charges must reflect multiple objectives. They must induce an efficient use of networks, encourage their owners to invest while minimizing cost, generate an efficient amount of entry into infrastructure and services, and do all this at reasonable regulatory cost".* Similarly, in the specific context, of tariffs for gas transmission networks in Europe, a report prepared by the Florence School of Regulation (2009) noted that: "*First, the transmission tariff should incetivize the efficient use of infrastructure and so facilitate the development of competition. Second, the transmission tariff should also give enough return to network investors so that they upgrade the network efficiently compared to their current and future uses not only for national infrastructures but also for cross-border pipelines."*

[28] The Impact Assessment for the Framework Guidelines on Transmission Tariffs makes this point explicit noting that there are "*tensions and trade-offs*" associated with the various policy

relevant; particularly the question of how the burden of cost recovery is allocated among different types of network users. More generally, the fact that a balance needs to be struck between sometimes competing objectives provides an explanation for why regulators sometimes adopt approaches which are pragmatic and do not necessarily accord with the strictures of economic theory.

objectives being pursued through the Gas Regulation, and that "*in general it will not be possible for a single set of tariffs to satisfy all of the objectives simultaneously."* See Brattle Group (2012:5).

3. POTENTIALLY RELEVANT INSIGHTS FROM ANALYTICAL WORK

23. Against this general background, in this section we consider what insights might be gleamed from relevant analytical work which may be of relevance to the issues being considered as part of the GTCR. Among the topics considered in this section include: the design and efficiency properties of different charging arrangements; revenue recovery in the context of excess capacity; interactions between the *level* of prices and the *structure* of prices; the properties of different methods for allocating capacity, including auctions; the interaction between different access charging approaches and investment; and the principles which might inform the allocation of costs among different network users.

3.1 The use of optional or self-selecting two-part tariffs

24. As indicated in section 2, in many jurisdictions, including Britain, a common structure of access prices in the gas industry is based around a two-part tariff. In principle, the fixed access (or capacity) element of the two-part tariff is intended to recover the fixed costs of the network (which do not vary with output), and the usage (or commodity) element is intended to recover the marginal costs (which do vary with output). This approach is therefore seen as a relatively simple method for setting optimal first-best prices and encouraging efficient utilization of the network, while, at the same time, allowing the firm to recover its fixed costs.[29]

25. In many jurisdictions, the approach applied in the gas industry has been one based around a *uniform* two-part tariff structure; where each user of the network pays the same capacity (or access) charge and faces the same schedule of marginal usage prices. However, as has long been recognized, this approach is based on the implicit assumption that all network users are identical, or near identical, in their preferences for the utility service. In reality, this assumption is unrealistic, and different users are likely to have different willingness to pay for network access. In short, the simple uniform two-part tariff approach may not be efficient where users have different preferences for the network service, particularly as it does not encourage participation by low frequency users who are not prepared to pay a high fixed access charge, and may therefore choose not to consume the product at all. For the network operator this gives rise to a potential tension between: (i) ensuring the efficient pricing and utilization of the

[29] Berg and Tschirhart (1988:106) observe that it suggests: "*we can have our cake and eat it too*".

network for those that do participate through the marginal usage price; and (ii) ensuring that the access price is not set too high as to deter participation by network users who are willing to pay an amount equal to marginal cost, or even an amount above marginal cost (which would contribute to the recovery of some portion of fixed costs) but lower than the combined uniform two-part tariff, to consume some units of product.

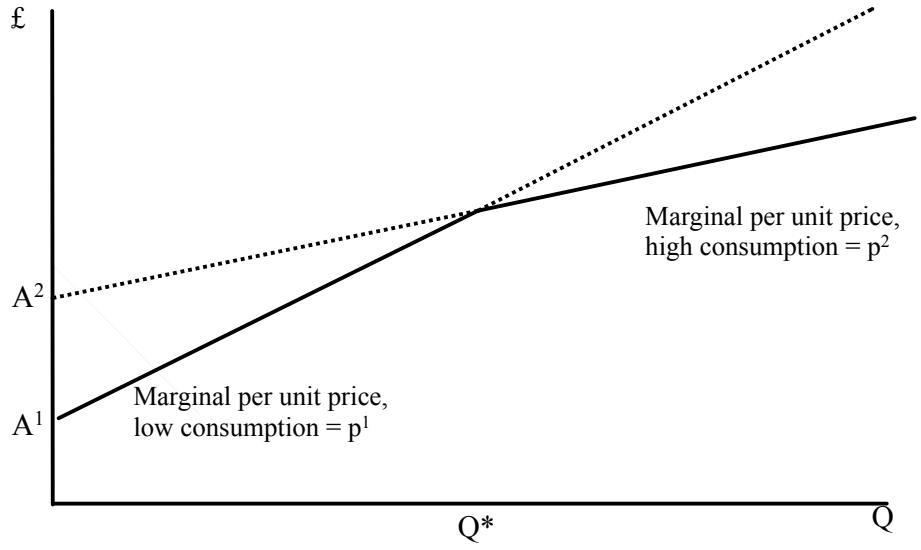
26. One way of addressing this tension is for the network operator to develop a 'schedule' or 'menu' of optional two-part tariffs, with different levels of access (capacity) charges and usage (commodity) prices.[30] For example, users might be offered a choice between a tariff with a low access (capacity) charge but a relatively higher per unit (commodity) charge to attract low usage users, and another tariff with a higher access (capacity) charge but relatively lower per unit (commodity) charge which should appeal to high usage users. This is seen to be more efficient than offering only a single uniform two-part tariff, as it allows for the inclusion in the market of low-usage users through a lower access charge (who ultimately contribute something to the fixed costs of the network). This is shown in figure 3.1 below, where users of a particular type (low or high usage) will always find it optimal to select the two-part tariff tailored to their preferences (represented by the solid line in figure 3.1). Users who consume less than Q* will choose the low access price (A^1) and the higher marginal per unit price (p^1), while users who consume more than Q* will choose a high access price (A^2) and a lower marginal per unit price (p^2). Ideally, the schedule or menu of two-part tariffs would be devised such that each network user faced an access price which was determined by the inverse elasticity rule (i.e.: Ramsey-Boiteux principles) and reflected its elasticity of participation, such that, the users who are highly elastic in relation to participation should face a lower access (capacity) fee but face a higher usage (commodity) charge and vice-versa.

27. The key finding of this analysis is that allowing a network operator to offer users a 'menu' or 'schedule' of two-part tariffs can increase total surplus, provided that consumers still have the option of choosing their original (regulated) tariff.[31] For such an approach to be effective, however, it is necessary that the network operator have relatively precise information about different customer valuations for the service, so that they are able to design a menu of two-part tariffs which induce network users to 'self-select' the tariff which is consistent with their preferences. That is, consumers of a particular class (low or high usage) must find it

[30] See Willig (1978) and Brown and Sibley (1986).
[31] See, generally, Vogelsang (1990).

optimal to select the two-part tariff tailored to their preferences.

Figure 3.1: Self-selecting optional two-part tariff



28. Despite its theoretical attractiveness, there are potentially some difficulties in applying this approach in practice. One difficulty, already noted, is that for such an approach to be effective it is necessary for the network operator to have precise information about the valuations of different user groups and customers. That is, the menu of two-part tariffs developed by the network operator should not create opportunities for high-value users to find it rational to choose a low-value access (capacity) price and a corresponding marginal usage price, including through the resale of capacity. Secondly, there can be issues associated with the legality of such an approach, insofar as it can be seen to be discriminating among different types of users of the network, each of whom can be charged different access charges for the network. Although this can potentially be addressed by providing that all tariff options remain available to all users (even though, in practice, they may not have an ability to choose these).[32] Thirdly, objections have sometimes been raised on the basis of distributional grounds.[33]

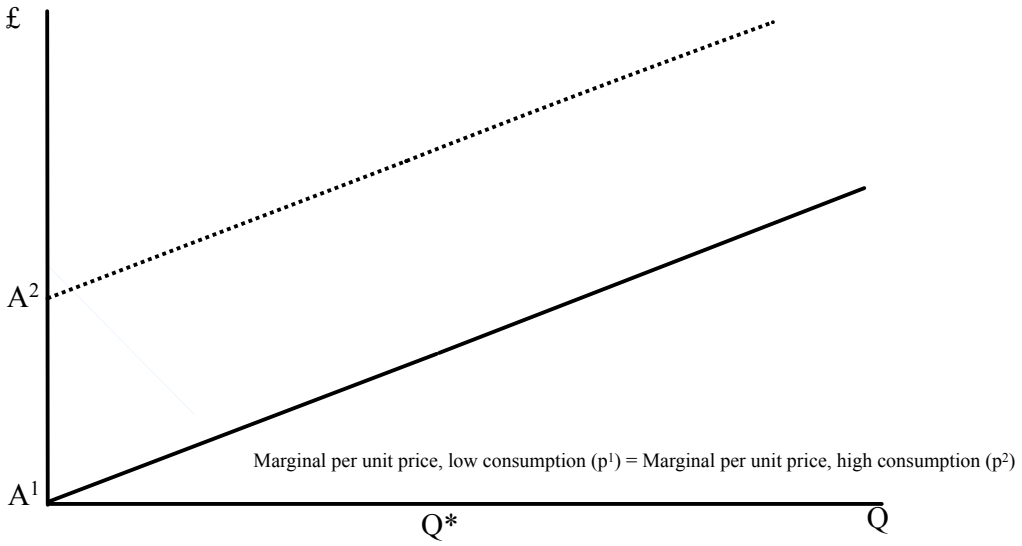
[32] See Panzar and Sidak (2006:285 and 292).

[33] Although there has been considerable work showing that, in certain circumstances, a menu of two-part tariffs could be developed which result in Pareto improvements. Willig (1978:58), for example, shows that, in the standard analysis, Pareto efficiency requires that the marginal price for the largest purchaser is equal to marginal cost. In circumstances where this is not the case, then it is always possible to add an additional nonlinear outlay schedule which Pareto dominates this schedule.

Potential relevance to the GTCR

29. Notwithstanding these points, this mechanism of offering a menu of two-part tariffs seems of some potential relevance to the GTCR. Indeed, it may be argued that a form of this approach is already being applied under the current arrangements where network users (shippers) are being offered a menu of different combinations of capacity (access) prices: those who acquire firm capacity rights a day ahead, or on the day, are paying a discounted or no capacity charge, while those who acquire firm capacity rights in advance pay the full charge. In effect, customer groups are being differentiated on a temporal basis with those who acquire rights in short term markets pay no capacity charge, and those who acquire rights in advance pay a full capacity charge. This is shown schematically as the solid dark line in figure 3.2 below, where all users (both high and low usage) will find it optimal to pay the discounted (zero) access price of A^1 and then face a common marginal per unit price ($p^1=p^2$).

Figure 3.2: Optional two-part tariff with different access prices, but the same marginal per unit price



30. While such arrangements might be rational in terms of encouraging participation of those who would not otherwise pay a high access (capacity) charge, they are not designed in such a way as to make it rational for medium or certain high valuation customers to seek long-term access rights (and therefore pay a full capacity charge). This is particularly the case given the levels of excess capacity on the network. In short, those that acquire capacity rights in the long-term, and therefore pay a high access (capacity) charge, are not compensated by a lower marginal or per unit charge. This is shown graphically by comparing

figures 3.1 and 3.2. While in figure 3.1 it is rational for a high value user to chose to pay a high access (capacity) price and face a lower per unit usage (commodity) charge, this is not the case in figure 3.2 where, under this arrangement, it would be rational in circumstances of excess capacity for *most* users to acquire capacity in short-term markets, avoid the capacity charge and simply pay the per unit (commodity) charge. This appears to be consistent with the 'flight to short-term capacity' in the GB context, where the only users that continue to acquire capacity in medium to long-term markets appear to be those that are either: risk averse; or face a high cost exposure in the absence of sufficient capacity.

31. The current arrangements raise another more general difficultly that is associated with the application of optional schedules of tariffs for *intermediate* inputs, such as gas transmission access. Most analysis of the properties of menus of two-part tariffs typically assumes that such a menu is applied to final consumers, in circumstances where the demand schedules of different users are *independent* from one another. However, the demand schedules of different intermediate users for inputs such as gas transmission access are typically *interdependent* meaning that the purchase decisions of one user (one shipper) can affect the purchases of other users (other shippers). This interdependence of the demand curves for firms (i.e.: shippers) that compete in the final product markets complicates the analysis of the welfare properties of optional two-part tariffs. As Panzar and Willig observe this is because "*[a] discount offered to one competitor puts its rivals at a cost disadvantage to that input*", the result being that firms which do not receive a discount on the input will, other things equal, achieve lower sales in the final product market, which in turn decreases their derived demand for the intermediate product.[34] This is seen to create a series of 'feedback effects' such as: a lower final market price; increases in the output of firms that receive discounts; and decreases in output, input purchases, and profits for firms that do not receive a discount.

32. All of these effects are seen to have profound implications for the efficiency of two-part tariffs in the context of intermediate products, and in particular, in these circumstances, it can no longer be assumed that *all* users will benefit from the introduction of a schedule of two-part tariffs (i.e.: there may not be a Pareto improvement). Put slightly differently, a general problem in allowing a network operator to price discriminate among different network users in this way is that it can undermine competition between network users at the retail level.

[34] See Panzar and Willig (2006:295).

3.2 Does the relative split of capacity and commodity charges matter?

33. The previous analysis suggests that two-part tariffs can offer a relatively simple solution to the problems associated with efficient pricing while allowing the network operator to recover efficient costs, and it is perhaps for this reason that they are so widely used in the gas industry. Two questions follow from this: (1) do network operators tend to establish two-part tariffs in this way in practice (i.e. is the fixed access (or capacity) element of the two-part tariff set to recover the fixed costs of the network and the usage (or commodity) element set to recover the marginal costs?); and (2) if they do not structure their two-part tariffs precisely in this way, does it matter in terms of economic efficiency? Put differently, to what extent does the commodity charge deviating from marginal cost (such as to recover some proportion of fixed costs) result in significant losses of allocative efficiency?

34. Recent research of gas distribution companies in the United States has examined this question carefully, and concluded that, in practice, network operators do not tend to set efficient two-part tariffs. In particular, these studies conclude that the usage (commodity) component of the tariff is often set in excess of marginal cost, and that the impacts of this divergence may be significant. Davis and Muehlegger (2010), for example, find that, in relation to gas distribution networks, while most industrial customers face usage (commodity) charges at levels close to marginal cost, this is not the case for residential and commercial customers, who typically face higher per unit (commodity) charges and lower fixed (access) charges. Similarly, Borenstein and Davis (2011) find that the structure of tariffs is inefficient, with usage charges for residential customers being above marginal cost. Both studies find that the per unit usage charge is set significantly above marginal cost – by between 30%-40% on average – in order to allow for the recovery of some fixed costs, and that this results in too little consumption of natural gas. Davis and Muehlegger estimate that this results in an annual welfare loss of $2.7 billion. Moreover, this tariff structure is seen to have distributional consequences, as high volume customers are paying a disproportionately large share of fixed costs. This can make it politically difficult for regulators to implement changes to the structure of rates which increase the fixed fees, and lower the usage fees, for residential and commercial customers.

35. At a more general level, and in contrast to these findings, it has been suggested, that because the demand for gas is very inelastic, the welfare losses associated with adopting an approach based on moving from a

two-part tariff approach to an approach based on uniform average revenue pricing may be small. On this basis, Brito and Rosellón (2011) argue that the efficiency gains associated with a two-part tariff may not justify the extra regulatory costs and difficulties associated with applying that pricing approach.[35]

Potential relevance to the GTCR

36. While these recent empirical studies have focused on the impacts that the structure of charges levied by gas distribution companies can have on final gas demand, and not how the structure of charges levied at the intermediate (transmission) level can impact on demand for access, the relevance of these studies for the GTCR is that they highlight the point that it cannot automatically be assumed that the current split between capacity and commodity charges is not creating distortions which may be having effects on the utilization of the network, gas demand and allocative efficiency. As discussed in section 5 below, the economic impacts of the relative allocation of fixed costs among capacity and commodity components was examined closely in the USA in the 1980's and 1990s', and, in the early 1990s, the US Federal Energy Regulatory Commission decided to restructure gas tariffs on the basis of concerns that the existing arrangements (which involved a 87/13 split) was creating economic distortions. Similarly, as discussed in section 5, a recent review of gas charging arrangements in New Zealand also found that the capacity/commodity split applied in that country was potentially causing distortions, and has proposed a move to a 100% capacity based charge for the recovery of fixed costs.

37. In Europe, the recommended position is that the commodity-related component of access prices should only reflect short-run marginal costs, so as to avoid distortions in the behavior of shippers in the commodity markets and network.[36] In making this recommendation, the influential EU THINK report on gas transmission networks notes that the current UK arrangements – in which the commodity charge is adjusted for any under-recovery of capacity revenues – is causing additional distortions in natural gas trade, as the commodity charge does not reflect the short-run marginal costs of the system.[37] However, the extent or magnitude of this potential distortion was not quantified.

38. In the context of the GTCR, another aspect of this issue concerns the

[35] See Brito and Rosellón (2011:537).
[36] See EU THINK (2012: v).
[37] See EU THINK (2012: 45).

impact that the current structure of transmission charges might be having on how the transmission network is used, and specifically the extent to which it is leading to usage that does not reflect underlying market signals. More specifically, the question here is whether the fact that the GB commodity charge is being marked up to recover some proportion of fixed costs, is leading to inefficient usage of the network, and distorting flows between different EU gas markets. The Impact Assessment for Framework Guidelines on Harmonised Tariff Structures captures this point:

"Capacity/commodity splits can also lead to lack of cost-reflectivity. The tariffs may not be sufficiently cost-reflective, if the commodity element of the tariff departs too far from the actual variable costs of the system. This could lead to inefficiencies. For example, a system user may have bought capacity, but decide not to flow gas cross-border if the commodity charge is more than the value of the cross-border trade. However, it would have been efficient to make the trade if its value is greater than the variable cost of transporting the gas."[38]

39. The magnitude of any distortion of cross-border flows is an empirical issue, but even in abstract terms, it is obvious that, to the extent that the difference between the per unit charges in Britain and neighboring countries are significantly different (for example, a 0% commodity charge in Belgium or Netherlands and 40% in Britain) this would feature in the decisions of a shipper, and could lead to cross-subsidies between types of users.[39]

3.3 Fluctuating capacity and commodity charges

40. The orthodox position in most economic analysis of efficient two part pricing is that the capacity charge should recover fixed costs, and any usage or commodity charge should be used to recover marginal costs. In the context of the supply of gas transmission services, where marginal costs are typically minimal and sometimes close to zero, this sometimes results in a tariff structure involving a 100% capacity charge, and a minimal or zero usage or commodity charge. [40]

41. As discussed above, while some analysis suggests that welfare can be

[38] Brattle (2012:21). See also ACER (2012:13).
[39] See Brattle (2012:17) for a fuller discussion of this point.
[40] David and Percebois (2004: 131) estimate that the relative burden of cost sharing is between 80% to 90% for fixed costs (such as capital depreciation) and 10% to 20% for variable costs (which vary with output).

improved by allowing network users to choose among different combinations of capacity/commodity charge levels (a menu of two-part tariffs), this analysis typically assumes that, once the schedule or menu of two part-tariffs is established, it will remain constant over time for each specific group of customers. Put differently, for each customer group, the relative split between capacity and commodity components of the tariff is generally assumed to remain constant over time, so that low-value network users will consistently face a low access price and a relative high usage charge each year, and this will continue to encourage them to choose this tariff.

42. A separate line of analysis has focused on whether the relative split between the capacity and commodity components of a two-part tariff should vary over time in such a way as to provide incentives for the network firm to trade-off the costs of congestion against the costs of network expansion.[41] In a highly insightful analysis, Vogelsang (2001) recognizes that it is the *level* of revenues/prices established under price regulation which appears to be of most importance in terms of incentivizing investment, but because the *structure* of tariffs impacts on the incentives for output expansion, this can also have implications for decisions relating to network utilization and capacity expansion.

43. Vogelsang's analysis identifies what he terms the 'conundrum' associated with transmission pricing.[42] In the short run, network operators seek to achieve capacity utilization, and this can be achieved through the use of sophisticated pricing allocation mechanisms (such as auctions) which capture the pricing of congestion at any one point in time. However, in settings where demand is fluctuating and where demand is inelastic, the resultant prices can lead to revenues which are not related to the underlying costs of capacity. In situations where congestion is severe, these arrangements can be highly profitable for a network operator and can reduce the incentives for investment in new capacity. Specifically, Vogelsang refers to a 'tension' in price regulation schemes between optimal capacity utilization (which requires that prices be flexible enough to allow for efficient utilization) while allowing the network operator to recover its capacity costs but also providing incentives for the network operator to invest when capacity utilization is getting high.

[41] Another line of work detailed in Cowan (2003) examines the optimal allocation of risk (resulting from changes in costs or demand etc.) between consumers and network operators in a two-part tariff framework, which involves various adjustments mechanisms.

[42] The analysis was focused on the electricity industry, however, it has general applicability, and has been extended to gas transmission.

44. The solution to this tension proposed by Vogelsang is to adapt the two-part tariff with time-fluctuating prices, such that the optimal capacity utilization is reached through the variable usage charge, while the incentive to invest is captured through a combination of revenues from the variable usage charge and the capacity charge. The main contribution of this analysis – and its relevance to the GTCR – is the suggestion that fixed capacity charges *be responsive* to changes in the variable commodity charge. For example, if, as a result of congestion, the revenue obtained from the usage component of the tariff increases, there should be a corresponding reduction in the fixed capacity charge (and revenues). Under this arrangement, although the relative contribution of revenues from the capacity and commodity components of the two-part tariff will vary from period to period (reflecting underlying network congestion), the firm will still recover an overall *level* of revenues consistent with its price cap constraint.

45. These within-period adjustments to the relative level of capacity and commodity charges, which allow the network operator to satisfy its price-cap constraint, are referred to as premia and penalties, and provide the relevant incentives for the firm to invest in capacity. Specifically, if there is too much congestion on the network, the variable charge increases (to ration demand) and the network operator will have to decrease its fixed fee across the board. This has the effect of penalizing the network operator for congestion on the network. Conversely, in situations where there is less than expected congestion and spare network capacity, the variable usage charges are lower (to encourage efficient utilization) and the fixed capacity charges increase, which generates a premium for the network operator. Because the prices stay within the averages established by the price constraint, the network operator can only generate extra profit by expanding the quantity sold (assuming prices exceed the costs of expansion), and this is seen to create an incentive to expand capacity.[43] In short, under this scheme, the fixed and variable components of the tariff are rebalanced in such a way so as to provide incentives for the network operator to expand the network.

46. Rosellón (2007) tests this proposal using data on electricity transmission networks in Mexico, and concludes that the rebalancing of the two-part tariff in a way outlined by Vogelsang could lead to adequate expansion of the network. More recent analysis by Hogan, Rosellón and Vogelsang (2010) and Neumann, Rosellón and Weigt (2011) confirm this result.

[43] Specifically, the transmitted volumes are used as weights for corresponding prices such that as network utilization and expansion increase, the profits of the network operator increase.

Indeed, Neumann, Rosellón and Weigt (2011) employ data from the EU gas market to show that a profit maximizing network operator will intertemporally rebalance the fixed (capacity) and variable (commodity) component of its two-part tariff to expand a congested pipeline, and that this will converge to a Ramsey-Boiteux equilibrium.

Potential relevance to the GTCR

47. While the analytical framework proposed by Vogelsang is developed within a context where demand fluctuates and there are periods of network congestion – characteristics which do not necessarily pertain to the current GB gas context – the analysis is potentially of relevance at a more general level for a number of reasons. Firstly, this is the first analysis to introduce the idea that the relative split between the variable usage (commodity) charge and the fixed (capacity) charge should be rebalanced over time, and that this rebalancing should occur within an overall price constraint. Second, the analysis correctly focuses on the issue of how the relative level of the capacity and commodity components of the tariff impacts on the incentives of network users to utilize the network (in the short run) and the incentives of the network operator to manage the network and expand capacity (over the long-term). Thirdly, and more generally, the analysis shows how periodic adjustments to the relative split between the capacity and commodity components of the two-part tariff can potentially be a mechanism for managing the tension between (short-run) capacity utilization and (long-term) capacity investment.

48. An implication of the analysis, which may have some direct relevance to the GTCR, is that it suggests that, in periods of excess network capacity, the appropriate structure of tariffs is one where the variable usage (commodity) charge should be low – to encourage greater utilization of the network – while the fixed capacity charge component should be high – to reward the network operator for having invested to reduce congestion on the network. This is not immediately consistent with what is being observed in the gas transmission network in Britain where there is generally excess capacity on the network, and yet the usage charge is relatively high and the capacity charge relatively low. However, this last point needs to be considered in the context of the type of price control that is applied and the expectation that demand for gas (and demand for network transmission capacity) in Britain will decrease in the future. In this context, it may be that a lower usage (commodity) charge will not necessarily encourage greater utilization, and therefore provide any

incentives for the network operator to expand capacity.[44]

3.4 Negotiations about the split between capacity and commodity charges

49. A related issue to those addressed in the previous sections concerns the efficiency properties of allowing a network operator to individually negotiate the structure of rates, including the relative split between capacity and commodity charges, with different network users. For example, a network operator might offer a uniform split of capacity and commodity charges to all users (say 100% capacity and no commodity charge), but have the ability to negotiate and agree to a different split between capacity and commodity components with specific types of users (say 75% capacity and 25% commodity).

50. This negotiated approach to the relative split between capacity and commodity components of a two-part tariff is one that has received some attention in the context of the gas industry in the United States. As discussed in section 4 below, since 1992, the Federal Energy Regulation Commission (FERC) has required gas pipeline operators to apply what is known as a Straight-Fixed-Variable (SFV) approach to access pricing which requires 100% of fixed costs to be recovered through the capacity component of the tariff, and only variable costs to be recovered through a usage (commodity) component of the tariff. However, since 1996, the FERC has also authorized pipelines to be able to negotiate rates with shippers that use different rate designs and to depart from cost-based rates. Such agreements can, for example, shift fixed costs from the reservation (capacity) charge to the usage (commodity) charge and are intended to allow pipelines additional flexibility when marketing pipeline capacity. The ability to negotiate rates has been seen by some state-based public utility regulators as particularly important in the context of the market for new-gas fired electric generation. Specifically, it has been argued that the original SFV requirements to allocate 100% of fixed costs to the reservation (capacity) charge might have discouraged the construction of such generators who typically only operate at low load factors. In addition, it has been submitted that the ability to negotiate

[44] More generally, the relationship between short run optimization and long run signals in the GB system is more complex, insofar as the short-term allocation mechanisms and long-term investment processes are to some extent distinct, such that even if you have a zero short run price there is still scope for a long run signal for investment. This is because (i) long term baselines are determined in the price control; (ii) long term incremental capacity is released through what is effectively an administered price mechanism that merely uses the same QSEC 'auction' mechanism as some of the shorter term products; and (iii) short term utilization occurs primarily through the zero reserve price daily product. A central issue this raises is whether the effective administered prices required to trigger long-term capacity release under the current arrangements are efficient.

rates is critical for power generators, and can lead to greater competition in the electricity market.[45]

51. However, some commentators have argued, more generally, that a negotiated approach for optional tariff offerings for intermediate inputs may not be appropriate. Panzar and Willig (2006), for example, argue that such agreements should be subject to the scrutiny of the ratemaking process. In part, this is because competitors who are not the subject of a negotiated service agreement relating to tariffs, may be at a disadvantage, and their views should be heard.[46]

Potential relevance to the GTCR

52. The main point of relevance of this discussion to the GTCR is simply that some US utility regulators are of the view that there can be advantages associated with allowing a gas transmission network operator to individually negotiate different capacity/commodity splits with specific types of network users. In short, it is suggested that a negotiated approach can be more flexible than a single one-size-fits-all split between the capacity or commodity components of a two-part tariff, or even a menu of two-part tariffs, and, by taking account of the characteristics of the gas network user (i.e.: whether they are high or low load), can be beneficial in terms of stimulating participation by different types of network users and potentially increase entry and competition in related markets (such as electricity generation).

53. However, as with the more general discussion of optional two-part tariffs discussed earlier, there are likely to be substantial practical difficulties in applying such an approach within the UK's regulatory and legal framework. Specifically, such an approach will likely be seen as highly discriminatory insofar as a specific tariff structure negotiated with a particular user in bilateral negotiations may not be made available to all network users. More generally, as noted above, allowing the network operator to price discriminate in this way can potentially undermine competition between different network users at the retail level.

3.5 'Decoupling' the level of revenues from the structure of tariffs

54. The linkages between a tariff structure that allows for the recovery of a level of revenues established under price regulation, and the incentives

[45] See Submission of Michigan Public Service Commission to FERC (2002).
[46] See Panzar and Willig (2006:298).

that such a tariff structure can create for usage of a network and consumption of a service is an issue that has recently been examined closely in the United States in the gas, water and electricity sectors. Specifically, this issue has arisen in the context of discussions of whether, in the face of policies directed at reducing demand for electricity, gas and water (i.e.: conservation policies), the level of allowed revenue that a network operator is allowed to earn should be 'decoupled' from the volume of gas, electricity or water delivered, and how this approach compares to a non-volumetric tariff structure (such as a 100% capacity charge) under which the recovery of costs are non volume based. [47]

55. In a nutshell, under a decoupling policy, the regulator fixes the authorized revenues that can be earned by the network utility in advance. If the utility's actual revenues are higher than this amount, because of a larger volume of sales than expected, the utility is required to pay a credit to customers. Conversely, if actual revenues are below those fixed by the regulator, the utility is able to charge a surcharge to customers for the difference. In short, the utility's (authorized) revenues remain fixed even though sales volume may be fluctuating. Revenue decoupling has proven popular in the USA, and as of January 2010, it was estimated that some 18 states had used such a policy in the gas industry and another 4 were considering such a policy.[48]

56. The principal advantage of revenue decoupling is that, in the context of conservation policies focused on reducing demand, it removes the incentive for a network operator to increase sales. In this respect, the mechanism has been seen to address previous tensions between energy conservation policies and the incentive of utilities to increase output. Revenue decoupling is also seen to provide other benefits such as smoothing variations in customer bills and making the utility's earnings more predictable.

57. A principal perceived disadvantage of revenue decoupling is that it can alter the incentives of the utility to engage in efforts to maintain or attract greater sales volumes (for example by increasing quality), [49] or to engage in efforts to attract new customers, as it is effectively guaranteed to be

[47] Brennan (2013:12) compares the two approaches noting: "*Decoupling involves separating a distribution utility's profits and revenues from use. It does not include charging for distribution through fixed fees for customers, which would be an efficient way to recover costs if costs were not based on the quantity of electricity delivered."*

[48] See DOE (2010:2).

[49] As Costello (2006:10) notes *"[A] utility disinterested in sales volumes is an oddity in the confines of corporate modus operandi, and, to some observers, a perversity that runs counter to the basic tenets of how markets work and private firms make money*".

allowed to recover its authorized revenue. Moreover, as Brennan (2013) notes, this approach challenges the central findings of regulatory economics that fixing profits or revenues will result in various distortions and inefficiencies, and that, to incentivize efficiency, prices should be divorced from costs for a certain period of time.[50] However, the US Department of Energy has argued against what they consider to be a common misconception that revenue decoupling guarantees a set level of *actual* profits, noting rather that it only allows a utility to recover its *authorized* revenues. Nevertheless, it is clear that even guaranteeing an operator its authorized revenues, irrespective of the level of sales, runs against the grain of most incentive-based regulatory principles, insofar as it results in the shifting of the revenue risk from operators to consumers.

58. Of relevance to the current analysis is the suggestion that revenue decoupling and the use of a two-part tariff which applies a 100% capacity charge (and 0% volumetric charge) are potentially substitutable policy measures. This reasoning has been applied by the Public Utility Commission in Ohio (PUCO) which shifted away from a policy based on revenue decoupling towards one that required that the Straight Fixed Variable (SFV) formula be applied.[51] According to the PUCO, the two approaches achieved the same outcome, but the SFV approach had the advantage of not requiring periodic adjustments to actual revenues. This reasoning is however disputed, and others have argued that the two approaches do not have the same outcome. In particular, it is argued that, unlike revenue decoupling, an SFV makes consumers indifferent to their own consumption as they pay the same fixed capacity charge irrespective of their usage.

Potential relevance to the GTCR

59. There are a number of potentially relevant insights from this discussion of the use of decoupling policies in the United States. Firstly, decoupling offers an alternative method to a two-part tariff, through which the fixed (capacity) costs of the gas transmission network can be recovered. In effect, both approaches seek to detach revenues from volumetric sales. While the SFV type rate design focuses on the *structure* of charges and seeks to recover all of the network costs through a capacity charge rather than through the usage charge, decoupling focuses on the overall *level* of revenues earned by the network operator and detaches the amount of

[50] Brennan (2013: 14) examines whether the analyses of price cap regulations may have missed something that can explain why guaranteeing profits may be valuable. However, he concludes that the economics of decoupling strongly suggest that it is motivated by political incentives rather than economic arguments.
[51] See DOE (2010:2).

revenue earned from the underlying utilization of the network.

60. Secondly, the decoupling approach is one that can allow for revenue recovery in the context of a permanent reduction in demand. In the context of the GTCR, this provides an alternative method by which the required revenues of the network operator can be recovered, without having to constantly adapt the structure of charges. In effect, in the current context, and assuming that there was reasonable certainty that demand would be permanently reduced, the allowed revenues could be decoupled from the actual utilization and sales on the transmission network. This has the advantage of providing financial stability to a network operator in the context of decreasing demand. However, for the reasons noted above, such an approach is likely to be in contrast to the general sentiment against profit or revenue guarantees embodied in UK style price cap regulation.

61. Thirdly, revenue decoupling can potentially address concerns expressed by some shippers about the volatility in tariffs. Although this has been noted as a benefit in the context of gas distribution in the United States, in the current context it will depend on the frequency by which network users are required to pay a surcharge or receive a credit for any variation between the authorized level of revenues and the actual level of revenues. Indeed, it might be argued that the current arrangements are a form of 'decoupling' insofar as the commodity component of network user tariffs is periodically adjusted to account for any under (or over) recovery of revenues from the capacity component so as to provide the network operator with an opportunity to earn a set level of authorized/allowed revenue.

62. Finally, the discussion of decoupling serves as a reminder of a more general issue of the linkage between the level of usage (commodity) charge and demand. Specifically, it highlights the point that, in circumstances where demand is decreasing, and the majority of network costs are fixed (i.e.: indifferent to level of output), then lower levels of demand will reduce the revenue earned through the usage (commodity) component, which in turn, can create financial difficulties for the network operator. In response, this can lead to spiraling charges as the network operator seeks to recover such lost revenues by increasing the commodity component, which further exacerbates the demand reduction. In short, commodity charges will rise because cost recovery is spread over an ever-decreasing customer base.

3.6 The use of auctions as a capacity allocation mechanism

63. An important, and differentiating, aspect of the gas charging arrangements in Britain is the use of auctions for the allocation of gas entry capacity. In principle, the use of a series of rolling capacity auctions held at different points in time is intended to fulfill a number of purposes, including:

    - Efficiently rationing existing gas capacity demand over time, such that those who value it the most will acquire such capacity.

    - Allowing for efficient investment in incremental capacity at specific entry points through the use of the Incremental Capacity Entry Release methodology.[52]

    - Providing a market-based mechanism which can allow the network operator to recover the capital costs associated with the network.

    - Sending longer term signals to the network operator as to the need for any capacity expansions and investments at particular points in the network.

64. Before getting into the specifics of what economic research says about the use of auction arrangements to fulfill each of these objectives, it is useful to briefly recall that there are a number of different potential methods for capacity allocation in network industries. The characteristics of three methods in particular are noted in the literature:

    - administrative methods, such as where capacity allocation occurs on a first-come-first-served basis, or some form of 'grandfathering' of rights occurs;

    - bilateral negotiations between the network operator and a network user, which can often involve longer term commitments being agreed between the two parties; and

    - auction-type allocation mechanisms, including open season type arrangements.

[52] The Impact Assessment of the policy options on incremental capacity for EU gas transmission prepared by Frontier Economics (2013:9) noted that such an integrated auction approach – involving the allocation of both existing capacity and potentially incremental capacity – is unlikely to be acceptable in continental Europe.

65. For a range of reasons, the first approach is generally seen as inefficient as it does not typically take account of market signals (such as willingness to pay) when determining how capacity is allocated. The economic effects of the administrative approach are seen to be particularly problematic where congestion occurs on a network, as it may lead to the crowding-out of shippers who may have a high value for network access but are unable to obtain capacity rights. In addition, such an approach can stifle development in downstream markets, where a small number of large shippers have enduring rights to access the transmission network, and there are no liquid secondary markets or issues associated with market power. However, in situations where there is no, or limited, physical or contractual congestion then a 'first-come-first-served' approach is seen by some to be preferable because of its simplicity (see discussion below). [53]

66. As discussed in section 4 below, the use of bilateral negotiations is widely adopted in the United States for the allocation of gas transmission capacity. However, such an approach is increasingly seen as unsuitable in EU jurisdictions, largely because of issues associated with discrimination in the allocation of primary capacity (the potential for an incumbent network operator to favour its downstream affiliate), and because of the absence of liquid secondary trading markets. This is seen to impede the efficient use of the network in the short-term. In part, for these reasons, the Capacity Allocation Mechanisms Network Code requires that TSOs in EU member states provide a booking platform for the allocation of primary capacity by auction, and for the trading of secondary capacity.[54]

67. There are a number of perceived benefits associated with the introduction of auctions for capacity in gas markets:

    - They provide for an efficient and non-discriminatory allocation of capacity over the long and short term, and the value of capacity reflects the underlying valuation of capacity placed on it by different shippers.

    - That the ability to acquire capacity rights in the short-term promotes greater flexibility, and allows shippers to adjust their positions in order to balance their accounts in close to real time.[55]

[53] See Brattle (2002:10).
[54] Auctions (in the form of open seasons) have also been proposed for the allocation of capacity rights for major international gas pipelines, such as the Nabucco pipelines. See Pickl and Wirl (2011:2143).
[55] See Vazquez and Hallack (2013:484) who discuss how the allocation processes used in the EU could be enhanced through the use of short-term auctions which include the allocation of linepack.

- That capacity auctions can provide important price signals to the network operator about areas of congestion in the short-term and over the long-term. If the price signal is strong enough, and persistent, this can indicate to the network operator that there is a need to either reinforce or expand existing capacity at specific points, or undertake construction of new capacity in order to meet future demand.

- That such auctions can stimulate competition among shippers to forecast the future level of congestion at specific entry points, which over the long-term can improve the future forecasting of which parts of a network will be congested.[56] Specifically, the prices bid by shippers are seen to implicitly reveal private information about the future value that the shipper places on capacity at that point on the network, and which can entail some estimate by the shipper of the expected level of utilization and congestion of the network at that point.

68. At the same time it is recognized that a number of issues can potentially arise in the use of auctions to allocate capacity:

- One issue, which was recognized in early conceptual analysis of the use of auctions, concerns the issue of what to do with any under or over recovery of revenues associated with the auction process.[57] In Britain, the current charging scheme, whereby any under-recovery in revenues from entry auctions can be recovered from adjustments to the commodity charge was introduced in October 2004.[58]

- Another issue is the importance of the specific design of auctions to their overall effectiveness, including in terms of the type of auction adopted, the amount of capacity reserved for the spot market etc.[59] It is our understanding that there was some criticism in the early days of the use of gas capacity auctions in Britain, which related to the

[56] See Brattle (2002:11).
[57] McDaniel (2003:34) notes that the issue of how to use auction revenues has been a recurring topic in both the gas and airline industries.
[58] See Transco (2004). The introduction of an NTS TO commodity charge was seen as less distortionary than the alternative of making adjustments to NTS exit capacity charges on the basis that: (i) it would apply to all firm and interruptible gas flows; (ii) would not impact on the SO incentive scheme; and (iii) would not affect locational signals.
[59] See Klemperer (2002) on this general point, while McDaniel (2003:33) discusses the relevant design aspects for auctions in network industries. For a recent analysis of alternative auctions designs for the gas industry see NERA (2012).

specifics of auction design.[60]

- For auctions to be effective as an allocation mechanism it is necessary that there is sufficient competition among network users for entry capacity.[61] In situations where there is not a sufficient amount of competition among network users for entry capacity, the use of auctions is not appropriate as it raises the potential for collusion, and in these circumstances, it is unlikely that the clearance price which emerges will reflect the underlying short-run scarcity price of capacity.[62]

- There can be potential conflicts and tensions between the different objectives being pursued through auctions. In particular, there can be a tension between the objective of allowing the network operator to use the information provided by auctions to better predict capacity upgrades, and the objective of ensuring that there is sufficient competition in gas spot markets.[63]

69. As noted above, one of the perceived benefits of the use of long-term auctions is in providing market 'signals' regarding the future need for investments in network capacity. A long-standing question this raises is the reliance that should be placed on such signals, and how they fit into the wider scheme of network planning undertaken by the network operator. A number of studies have suggested that such information provides useful 'supplementary' information for formal planning processes, and the signals received through auctions should receive considerable weight in the network operator's planning process.[64]

70. Early academic analyses of this issue were sceptical about the appropriateness of using auctions to decide and fund network investments for gas transmission.[65] McDaniel (2003) argues that private information can give producers a strategic incentive to misrepresent their true levels of demand, and that this can result in either over or under

[60] See Brattle (2002:80).
[61] See Stern and Turvey (2003:2) on this point.
[62] See McDaniel and Neuhoff (2002:26).
[63] See the analysis in McDaniel and Neuhoff (2002b:2) who highlight the different perspectives of producers and shippers when participating in auctions, and the incentives this can create to withhold relevant private information. They suggest that a significant drawback of long-term auctions may be the investment bias and withholding of private information.
[64] See Brattle (2002:91). In a report for Ofgem on the market design for natural gas, LECG (2011: 23) notes that *"Explicit auctions for long-term capacity can also provide a good signal of capacity investment requirements. … A high price for capacity signals the need for investment to relieve the constraint."*
[65] In particular, see McDaniel and Neuhoff (2002:1) and Stern and Turvey (2003:7).

investment relative to the social optimum. Stern and Turvey (2003) argue that in some circumstances auctions can provide the correct signals for short-term allocation but may not be appropriate for long-term investment decisions.[66] More generally, Helm (2003) argues that auctions cannot determine optimal investment in energy networks, and can only play limited role in identifying future needs.[67] Newbery (2003) also expresses concern about the use of auctions to guide investment decisions in contexts where bidders are uncertain about the ability of regulators to commit to future actions.[68] Yarrow (2003) appears to provide a lone voice in support of the use of auctions as a mechanism for establishing future gas capacity needs, pointing to the fact that the use of auctions to reveal information is deregulatory in its intent, and that this allows for the development of the transportation system to be driven more by market processes (including the demand side) and less by monopolistic planning processes.[69] Notwithstanding this view, the general conclusion of a survey on this issue was that the usefulness of auctions as a mechanism to determine the long-term capacity needs of a network is limited:[70]

"Nevertheless, our view—and the general conclusion arising from the papers in this issue—is that auctions can have some role in providing long-term as well as short-term information on capacity requirements for network companies and regulators but that this role is limited. This is also the position that Ofgem appears to have reached for the UK gas industry, although Ofgem appears to be willing to adopt a larger role than most (but not all) of our contributors would recommend."

71. At a more practical level there is also a question about the extent to which such auctions *actually do* provide clear signals regarding the need for

[66] Specifically, they argue that that there might be a bias toward underprovision of new capacity in circumstances where any new incremental capacity expansion reduces the price that can be charged for all capacity, and therefore involve lost revenues on existing capacity.

[67] Helm argues that one clear role for auctions is in allocating existing capacity, and that as long as auctions are confined to this task there is little controversy. He argues strongly against the position that auctions could in some way *replace* the traditional CAPEX planning approach to determining investment. In short, Helm notes that the auction can provide information which *tests* a CAPEX plan, but that the determination of the CAPEX plan rests with the network operator and not the auction.

[68] In particular, the terms on which future capacity will be supplied and therefore the future value of capacity. Like Helm (2003), Newbery (2003:32) concludes: "*Long-term capacity auctions by themselves are either not credible or not sufficient as a mechanism to secure adequate investment in network capacity, particularly where this capacity is critical for the efficient and secure operation of the system. Nevertheless, auctions can work well for allocating existing capacity where there are a sufficient number of potential bidders, and particularly well where there are liquid spot markets that give indications of scarcity values and allow arbitrage.*"

[69] See Yarrow (2003: 18). See also Stern and Turvey (2003:4).

[70] See Stern and Turvey (2003:7).

future incremental capacity investments. According to one 2005 study, at that point in time, Transco did not feel that it had received clear enough signals from the long-term entry capacity auctions to justify investments above the baseline for a control period.[71] Consequently, at that time, it was recorded that supply forecasts were based primarily on information contained in various industry consultation processes and information obtained from commercial sources.[72]

72. A question also arises about the value of auction mechanisms in settings where there is expected to be an absence of network congestion in the future (as is the expectation in Britain). As already noted, in these circumstances it has been argued that the costs associated with using auctions to allocate capacity are likely to outweigh the benefits, and therefore auctions may not be necessary.[73] This is because in a transparent market the absence of congestion should be evident to all parties.

Potential relevance to the GTCR

73. It is apparent from the preceding discussion that the issue of the appropriateness of auctions as a capacity allocation mechanism raises a whole series of issues that likely extend beyond the issues that will be considered as part of the GTCR. However, given the link that now exists between the revenues obtained from the capacity auctions and any subsequent adjustments to the level of the commodity charge under the current charging arrangements, it is perhaps inevitable that the issue of the purposes and design of the auction arrangements may have to be addressed.

74. Four points in particular emerge from the discussion about the appropriateness of auctions as a capacity allocation mechanism which may be relevant to the GTCR:

    - First, there seems to be widespread agreement among commentators that, under certain conditions, in particular where capacity is constrained and there is a sufficient number of bidders, auctions can be an effective and efficient mechanism for the allocation of capacity for gas transmission networks.[74]

[71] See Energy Charter Secretariat (2005:7).
[72] See Energy Charter Secretariat (2005:25).
[73] See McDaniel and Neuhoff (2002:1) and Brattle (2002:67).
[74] In an early analysis of the use of (short-term) auctions for the GB network, McDaniel and Neuhoff (2002:26) conclude that: "*the current auction improves upon the previous methods*

- Second, a number of analyses make the high-level claim that, in contexts where demand is not growing, and there is no congestion on the network, the use of auctions may be disproportionately complex and it may be more appropriate to adopt other capacity allocation methods which are based on estimates of marginal cost. The 2002 Brattle Report made this conclusion clear:

  "We conclude that auctions are not useful if there is no capacity scarcity. Without scarcity the auction price will always be the reserve price if there is one, or zero if there is no reserve price and in that case an auction therefore simply adds needless complication."

  Similarly, an academic paper published in the same year, made this point regarding the appropriateness of auction mechanisms for gas transmission:[75]

  "Auctioning transmission access is only appropriate if the network constraints are significant, such that the transaction costs incurred by all parties for setting up a mechanism of property rights are below the costs incurred for constraint resolution by capacity expansion or constraint resolution by spot market interventions of the transmission operator."

- Thirdly, it has been argued that two prerequisites need to be fulfilled for the repeated use of auctions for entry capacity in gas: first, as noted, the existence of scarcity for network capacity; and second, sufficient competition among network users.[76] To the extent to which conditions are not satisfied (and we note that some commentators claim that, at some entry points in the UK, competition is limited), auctions may no longer be appropriate.

- Finally, there is considerable scepticism in the academic literature regarding the usefulness of auctions as a mechanism for determining the long-term capacity needs of a network. Many commentators observe that, at best, the signals provided through auctions of long-term capacity are limited and can provide a 'test' of proposals for

historically used in Great Britain to allocate entry rights. We add, however, that this might not be the case if there were not a reasonable amount of competition in production and supply markets. Also, if there were no significant transmission constraints, then the assignment of access rights via auction would be unnecessary."

[75] McDaniel and Neuhoff (2002:1)

[76] See McDaniel (2003:35).

long-term capacity that have been developed through traditional planning processes.[77]

3.7 Access frameworks and investment

75. In the last section, we focused on the issue of whether different capacity allocation mechanisms, such as auctions, can provide credible and reliable signals to determine future capacity investment. At a more general level, this touches on a wider question about the extent to which any access framework – encompassing both the allocation mechanism, and the level and structure of access charges – impacts on the incentives for investment, both for network operators and network users.[78]

76. In all network industries, the relationship between an access framework and investment incentives is complex, and the interaction between the levels of access prices and investment is not fully understood even in simple settings.[79] In large part this complexity derives from the fact it is the *expectations* of network operators and network users as to the level of future access prices that will impact on the investment decisions they make now. As is well recognized, how investors (both network operators and users) form expectations as to future regulatory treatment is more complicated in the network industries than it is in other industries because of the typically large and irreversible nature of the investments in these industries. In this respect it is argued that commitments by a regulator to an access pricing arrangement can be critical to influencing investment levels.[80]

77. The anticipated regulatory approach to access pricing can influence both the extent, and timing, of any investments made by network operators and network users. This can create a dilemma for a regulator: access prices must not deter firms from making timely investments, but also must not deter entry and the development of competition in related markets. Specifically, if access prices are set too low there may be inefficient entry in downstream markets and network users may make investments in assets on the basis of an expectation that prices will always be that low. In addition, the network operator may have limited

[77] However, note in relation to the allocation of Incremental Capacity, this might be characterized as a hybrid auction and administered mechanism, insofar as it involves a user commitment at an administered price covering 50% of the NPV of the required incremental investment.
[78] See generally on this point, Valletti (2003:659) and Gans and Williams (1998).
[79] See discussion in Guthrie (2006:965).
[80] See Gans and Williams (1998).

incentives to make further investments in capacity. Conversely, if access prices are set too high then this might deter entry by new downstream competitors, or limit their investments in sunk assets.

78. Of particular relevance to the GTCR is how the relative allocation of fixed costs between usage and capacity charges can also potentially impact on the incentives for network operators and network users to make sunk investments in assets. For network users, the relative split between capacity and commodity charges can impact their decisions on whether or not to invest in related markets (see discussion in section 3.4 above regarding participation by peak electricity generators in the USA). The incentives of network operators to invest are also potentially impacted by the structure of tariffs applied. In situations where all fixed costs are recovered through capacity charges the risks for a network operator associated with an investment are arguably lower than where fixed costs are recovered through usage charges. Gans and Williams (1998:6) capture the essence of this point as follows:[81]

"The determination of fixed charges has always been a contentious issue in regulation. In the past, its choice has been seen as arbitrary - essentially, redistributing income from access seeker to provider - without any real efficiency consequences. However, from the point of view of market participants, the level of fixed charges is a contentious issue. This is because providers realise that it affects the overall return on their investments and access seekers realise it influences their incentives to enter markets and compete with incumbents. We contend that the use of fixed charges can have a key role in determining investment incentives. …. To have an effect on investment, regulation must modify incentives. A higher fixed access charge raises the incentives of firms to invest. However, it cannot be too high or seekers might have an incentive to duplicate the facility. For providers and seekers, therefore, a formula that determines their expected access charge will form a critical part of their perceived returns from their actions."

Potential relevance to the GTCR

79. The relevance of the above discussion to the GTCR is perhaps more general in nature than some of the other issues addressed in the Report. Specifically, the main point is that an access-pricing framework often involves a trade-off between optimal access prices in a static sense, and

[81] Gans and Williams (1999:6).

those that are most appropriate in a dynamic context.[82] Put slightly differently, while there is considerable focus on how the level and structure of access prices can impact on the efficiency of network utilization at any one point in time, there is relatively limited analysis of how an access pricing framework impacts on the incentives of network operators and network users to make longer term decisions about the level of their own investments. However, as the influential EU THINK report recognizes, both the *level* and *structure* of gas transmission tariffs can have a strong impact on infrastructure investments.[83]

80. While this point is a general one, the magnitude of the economic impacts associated with not taking these considerations into account in practice can potentially be significant. Studies of the telecoms industry, for example, have suggested that the dominant cost-based approach to regulating access pricing in telecommunications adopted in many jurisdictions – whereby prices are set on the basis of estimates of forward-looking long-run (average) incremental cost – have resulted in prices at too low a level, and that this has had adverse effects on the incentives for entrants to invest in infrastructure (as well as denying the incumbent access provider the ability to recover costs).[84]

3.8 Efficient pricing in a context of permanent excess capacity

81. While there is a considerable body of economic research which addresses the issue of the optimal design of charging arrangements in contexts where there are temporary periods of excess capacity or congestion – for example, the work on peak load pricing which examines the properties of pricing arrangements where the periods of excess capacity and tight capacity are temporary and predictable – there is very little work that examines pricing arrangements in a context where there is an expectation of a *permanent* reduction in the demand for capacity. This is perhaps for the simple reason that, up until relatively recently, most of the network industries have experienced continual and sustained growth.

82. At a general level, however, it has long been recognized that the expectation of sustained decreases in long-run demand for capacity is a

[82] See Valletti (2003:663) who captures the essence of this trade–off: *"Access regulation based on simple cost recovery rules, while encouraging efficient utilization of assets, risks discouraging investments."*
[83] See EU THINK report (2012:iii).
[84] See Hausman (2000a:191) and Pindyck (2007) who discuss the recovery of costs in the context of USA telecommunications regulation. Kahn, Tardiff and Weisman (1999:360), and Sidak and Spulber (1998:411) discuss the effects it can have for entrants to invest in their own facilities and take risks.

'cause of great concern' for regulatory policymakers. The principal tension that has been identified is that between encouraging the efficient utilization of the network, which implies that prices should be set on the basis of SRMC, and the need to ensure that the network operator recovers sufficient revenues to cover the past expenditures in capital assets. This last point is of particular relevance in the network industries, given that the recovery of capital costs can be spread over a period of 20 to 30 years.

83. There does not appear to be a simple way of resolving this tension in practice, as it effectively involves a trade-off between static efficiency and wider dynamic efficiency. Under some regulatory regimes, the issue can potentially be addressed through a 'revaluation' or 'reoptimisation' of the asset base. Put simply, the costs that can be recovered through user prices can be tailored to the current expectations of future demand, where allowable costs include only the capital costs associated with a network sized to satisfy the forecast of demand (rather than the capital costs associated with an existing network). Such an approach underpins the logic of 'used and useful' doctrine in the United States, and also the approach that has been adopted in the telecommunications industry in many jurisdictions (see discussion in section 5 below).

84. However, this process of basing current prices on a re-optimised network which is needed to satisfy current demand is likely to raise a number of issues in practice. In particular, under the arrangements applied in the UK and elsewhere, where cost recovery in the gas industry has been based on a historical regulatory asset base (RAB) approach, this could be viewed as a breach of the regulatory compact. As noted above, this can have wider impacts on dynamic efficiency insofar as it reduces the credibility of a regulatory regime, which can lead to an increased perception of risk and a higher cost of capital for investments in other network industries.

Potential relevance to the GTCR

85. The tension that has been identified between setting charges which encourage short-term efficient utilization of the gas transmission network, while also allowing for the recovery of past investments in the gas transmission network, is central to the GTCR. While the wider economics literature identifies the trade-offs involved, and the potential implications of different courses of action in terms of static and dynamic efficiency, it does not offer any concrete solutions to how this trade-off should be resolved in practice.

86. As discussed below in section 5, this issue is also emerging in other network sectors in some jurisdictions – for example in relation to fixed telecoms networks – and here there have been a range of suggestions, including that forward looking long-run average incremental cost estimates be adjusted to account for whether assets can be re-used in the future or not. In contrast, in the gas industry, some technical reports have suggested that whether the charging arrangements are forward-looking or backward-looking should be based on whether of not the network system is expected to be growing or in decline. The influential 2002 Report on the European gas market by the Brattle group set out this reasoning in the following way:[85]

"- With growth or congestion, capacity is scarce and tariffs face the primary challenge of ensuring efficient allocation. The relevant cost concept is prospective, related to scarcity value and the marginal cost of construction (long-run marginal cost).

– With no growth or congestion, the primary role of the price mechanism is to allocate the fixed costs of previous investments among system users. The relevant cost concept is retrospective, related to the allocation of costs already incurred (average cost). It emphasises cost allocation methodologies designed to correspond to intuitive notions of fairness.

– In both cases tariffs must ensure that pipelines expect to recover their costs (including a fair return on investments). However, in the first case a large part of fixed cost recovery can come from scarcity/congestion charges (and the relatively small remainder from an additional component of the total tariff)."

87. Specifically, the Brattle Report recommends that *"with no growth or congestion, the primary concern is allocating the costs of previous network investments among system users*" and that tariffs should have a retrospective focus which encompasses methods for allocating costs which corresponds to *"intuitive notions of fairness*".[86]

3.9 The relative burden of cost recovery: distributional issues

88. This last point leads into a brief discussion of what the relevant literature says about how the relative burden of cost recovery should be spread among different users of a network. As a general principle, it is argued that the share of the burden of cost recovery should be related to the extent to which a particular user triggers costs in a network. Put slightly

[85] See Brattle (2002:5).
[86] Brattle (2002:37).

differently, those users who utilize the capacity the most, and require it to be available at all times (including peak times), should contribute more than those users who do not require capacity to be available at all times and largely make use of the network in off-peak periods. This is the general reasoning behind peak-load pricing, which differentiates customer charges between high and low demand periods (charging a higher price to 'peak' consumers than to 'off-peak' consumers) and is intended to reflect the different marginal costs associated with supplying the service at different points in time.[87]

89. As discussed in section 4 below, in Ireland, this line of reasoning has been applied in the context of the setting of gas transmission tariffs. Specifically, on the view that the costs imposed on the gas transmission system are dictated by customer peaks, and not customers' average usage, the Irish regulator has deemed a high capacity/low commodity split appropriate for the recovery of gas transmission costs.[88] Nevertheless, as the New Zealand gas transmission network operator has noted, in practice the split between fixed and variable charges in cost recovery is often driven by other (often political) factors, and in particular, the potential for high fixed charges to deter connections.

90. More generally, as indicated above, perceived issues of 'fairness' can be important in determining the appropriate allocation of costs among system users. The notion of fairness is clearly multifaceted and involves some form of value judgment. In the context of the design of charging arrangements, the notion of fairness has been interpreted in different ways. Some commentators suggest any allocation method should consider the '*extent and nature of system use by customers*.'[89] Others have argued that the relevant notion of fairness should capture the idea of a 'reference transaction', and in particular that the fairness of a particular action should be assessed by comparison of the extent to which it deviates from a relevant precedent. In this context, a reference transaction might involve a certain reference price and a positive reference profit to the firm, which the parties determined before each party made any sunk investments, and therefore feel entitled to.[90] The reference transaction

[87] See Steiner (1957:585) for an early exposition of the standard model of peak-load pricing. Also see the survey by Crew, Fernando and Kleindorfer (1995).
[88] See CER (2013:25).
[89] See Brattle (2002:37).
[90] See Kahneman, Knetsch and Thaler (1986:S296) who note, for example, that it might be considered fair to allow firms to raise prices as necessary to maintain its profits at the reference level. However, it would be unfair for the firm to use its market power to raise prices and thereby alter the terms of reference transaction to the direct expense of consumers. See also QCA (2013:4).

can be used as a basis to assess whether a specific price, or level of profits, are consistent with a network users' reference price and at the same time consistent with a network operators reference profit. Put slightly differently, whether an action is considered to be 'fair' or not is assessed as changes *relative* to the reference state rather than in absolute terms.[91]

Relevance to GTCR

91. The design of any charging structure can have significant impacts on the relative allocation of costs across different types of users, which in turn can impact on their profits. As discussed in the next section, charging structures based around allocating all fixed costs to capacity charges are seen to benefit high-load users (such as large industrial customers), and to disadvantage more seasonal or intermittent network users (such as residential consumers or peak electricity generation facilities). Conversely, the allocation of some fixed costs to usage (commodity) charges is seen to allocate a proportionally larger amount of costs to high-load customers, and a lower proportion of network costs to low-load customers. The main point is the recognition that while the orthodox view implies that allocating all fixed capacity costs to capacity charges is appropriate, in practice, the relative split between the charges will often take account of other factors, including the impacts that this has on different types of users, and in the achievement of other policy objectives (such as the connection of peak or renewable electricity generation).

92. A separate issue which has arisen under the current GB gas transmission charging arrangements is whether certain types of shippers may be contributing to fixed capacity costs through two mechanisms. In particular, there is a concern that some shippers who acquired capacity rights through long-term auctions in the past and paid a non-discounted price, also now face a higher commodity charge which reflects a contribution to fixed costs as well.

[91] See, generally, Kahneman, Knetsch and Thaler (1986:S297).

4. POTENTIALLY RELEVANT INSIGHTS FROM OTHER JURISDICTIONS

93. Over the past three decades numerous countries around the world have introduced policies to restructure their gas industries, and in particular to introduce competition at different stages of the supply chain.[92] While this might suggest that some of the issues being considered as part of the GTCR might also have arisen in other jurisdictions, it is important to be mindful that the starting point and trajectories of restructuring processes have differed considerably across countries. Such difference can be seen in the nature and pace of restructuring policies, particularly among EU member states, and in the different policy contexts in which such restructuring has occurred. For example, in Europe, a major policy objective of restructuring policies has been the development of a single European gas commodity market. In jurisdictions, such as Britain, Argentina and Australia, the restructuring of the gas industry has occurred alongside wider policies of privatization and corporatization, including policies directed at the introduction of competition into specific activities in the natural gas supply chain. In the USA, where the majority of companies involved in the production, transportation and supply of gas were privately owned, the reforms have been principally designed to facilitate open access to transmission networks. Jurisdictions also differ in other, more general aspects. There is, for example, considerable diversity in the industrial structures for the production and supply of gas across different jurisdictions, particularly the extent of indigenous gas reserves and the relative reliance on imports and the extent to which there is the potential for pipeline competition.

94. In sum, although a number of countries around the world have liberalized and restructured their gas industries, the starting points, the trajectories followed, and the specific policies introduced differ significantly, and this, along with other contextual differences, limits the potential for precise comparisons across jurisdictions.

4.1 Approach to charging in the USA

General attributes of long-term and short-term capacity trading arrangements

95. Perhaps the closest comparator country to Britain in many ways is the United States. Both jurisdictions embarked on processes of restructuring

[92] Examples include the USA, EU member states, Argentina, Australia, Canada, Chile, Colombia, Mexico and New Zealand.

at around the same time, and both are considered to have mature and competitive gas commodity markets. However, as is well recognized, there are some important differences between the two jurisdictions. Most relevant among these is the preference in the United States for transmission rights for specific pipelines to be acquired through long-term contracts. Short-term adjustments to positions then involve bilateral transactions between network operators, marketers and network users in secondary markets.[93] These transactions typically occur through trading platforms established at various (physical) market hubs, which are points where various pipelines interconnect with one another.

96. An important aspect of the US arrangements, and one that differs from Britain and the wider EU, is that the allocation process for long-term capacity rights is fundamentally based around bilateral contracts signed between pipeline operators and shippers, and there is no formal centralized organized market to facilitate these trades. One consequence of these arrangements is that investments in pipeline infrastructure are typically driven by long-term contracts.

97. Against this background, there are two insights from the US experience of gas transmission pipeline regulation which are of potential relevance. The first concerns the shift in the charging structure for pipeline access from a structure based on a split of fixed costs among capacity and usage components, to an approach where all fixed costs are recovered through the demand (capacity) charge. The second insight relates to the changing treatment of new incremental capacity projects.

The structure of gas transportation charges in the US

98. In the US, the initial distribution of capacity rights occurs through the sale of contracts to shippers at prices that are regulated by the FERC.[94] If a pipeline operator has market power, the FERC determines the structure of charges based on the so-called Straight-Fixed-Variable (SFV) approach, which requires that 100% of fixed costs are allocated to a demand (capacity) charge, and that the usage (commodity) charge recovers only the variable or operational costs.[95] Interruptible charges range between a maximum and minimum; maximum charges recover variable costs and

[93] These adjustments allow shippers to react to short-term changes in demand and supply and to take advantage of price swings in natural gas prices.
[94] Unless they can charge market based rates meaning that they can, with regulatory approval, set their own tariffs. Applicants must satisfy the FERC that they do not have significant market power, and could not therefore profitably raise prices above competitive levels for a significant period of time. Despite this potential, there has been minimal use of 'market-based-rates' to date, and FERC remains active in rate setting for transmission charges.
[95] See FERC Order 636 (1992).

some proportion of fixed costs, while minimum charges only recover variable costs. As discussed below, charges for newly constructed pipelines are also regulated by the FERC on the basis of two approaches – 'rolled-in' rates (i.e.: socializing costs) and 'incremental' rates.

99. Prior to the introduction of the SFV approach in 1992, the approach mandated by FERC for rate structures was based on the so-called 'Modified Fixed-Variable' (MFV) approach. This allowed for some proportion of fixed costs, such as taxes and a return on equity, to be recovered through variable usage charges. This approach typically involved the recovery of 87% of fixed costs through the capacity charge, and 13% through a volume charge.[96] The rationale for this approach is set out by Stosser (1992) as follows:

"MFV was adopted in 1983 in order to promote the production of sales gas by devising bundled city-gate sales rates. It was thought that by shifting certain fixed costs (in particular, return on equity) from the demand component to the commodity component, a pipeline would have an incentive to both obtain and market gas at reasonable prices because the return on its investment would be directly related to the volume of gas sold."

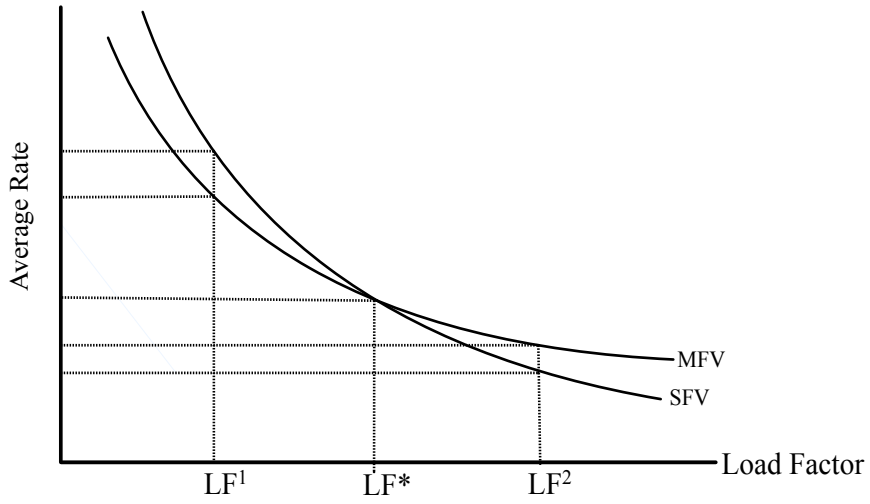
100. According to the US Department of Energy, the shift away from the MFV approach to the SFV approach in 1992 was motivated by two factors: first, to promote competition among gas suppliers by eliminating distortions in the previous approach; and second, to encourage the more efficient use of the pipeline system.[97] In relation to the latter point, it was reasoned that increasing the capacity charge may assist in rationing capacity because the higher unit cost would make shippers more selective about choosing this service, and this would potentially encourage low-load shippers to make greater use of storage facilities.

101. This shift was, however, not without controversy and was opposed by consumer groups and local distribution companies on the basis that it would increase costs for low-load factor customers. The potential distributional effect of the shift in pipeline rates is shown in figure 4.1 below.[98] In this diagram, average rates decrease under both charging approaches in response to an increase in the load factor. However, the rate of decline is greater for the MFV approach (which is equivalent to a

[96] According to David and Percebois (2004) between 1973 and 1989 an approach known as the 'United Method' was applied which involved the recovery of only 25% of fixed costs through the demand (capacity) charge and 75% of fixed costs and any variable costs through a usage (commodity) charge.
[97] See EIA (1995:7).
[98] This figure has been adapted from EIA (1995:8).

87%/13% capacity/commodity split) than it is under the SFV approach (which is a 100%/0% capacity/commodity split). At a particular load point (LF*), the two rate structures result in the same average rate, however at points before LF* (LF <LF*), such as LF^1, shippers with lower load factors face higher average charges under the SFV approach than the MFV approach. Conversely, at load factors greater than LF*, such as LF^2, those customers with low-load factors face lower average charges than under the SFV approach.

Figure 4.1: The impact of the SFV and MFV rate structures on high and low load factor users



Source: EIA (1995:8).

102. Of particular relevance to the GTCR is the impact of this shift from a structure of charges based on a split of fixed costs among capacity and usage components of a two-part tariff, to an approach where all fixed costs are recovered through the demand (capacity) charge. As might be expected, one impact of this change was an increase in the unit cost of gas for low-load factor customers,[99] and a reduction in the unit cost of gas for high-load factor customers. This is seen to have benefited large industrial customers and manufacturers (who typically have high-load factors) and to have penalized domestic customers (who have low annual load factors on average).[100] More specifically, analysis by the US Department of Energy has concluded that:[101]

[99] Typically shippers who face a seasonal demand profile, and are required to purchase capacity up to their maximum daily output year round, even though they use this capacity for only short period.
[100] See David and Percebois (2004:132).
[101] See EIA (1994) and EIA (1995).

- Customers who had relatively stable rates of gas consumption patterns benefitted more from the shift to SFV rates, than customers who had more variable rates of consumption.

- The change in the rate design was a principal driver between the widening of the gap between the rates paid by low-load factor customers (residential consumers) and high-load factor customers (large industrial plants). As a consequence, low-load factor customers benefitted less from the change in rate structure.

103. What can be said about the economic and market impacts of the shift towards the SFV approach? Some commentators have suggested that the SFV approach does not yield efficient prices for pipeline transportation, but it nevertheless ensures full-cost recovery and provides transparent and fair price signals to shippers.[102] In particular, a perceived advantage of the approach is that it involves a more simple and transparent tariff-making process. In addition, because the same methodology is applied to setting rates across all pipelines, this allows shippers to easily compare the tariffs being offered by different pipelines and make decisions on this basis.

104. However, others have pointed out that the FERC's policy of ensuring cost recovery has resulted in some economic inefficiencies.[103] In particular, the SFV approach is seen to neglect factors which are relevant to efficient pricing such as: the price elasticity of demand; the marginal cost of capacity and throughput, and demand and supply changes. This, it has been suggested, may be leading to sub-optimal decisions by shippers about their usage of the network. Perhaps more critically, the SFV approach is seen to not allow pipeline operators the flexibility to charge rates that respond to underlying demand. For example, it has been suggested that many low-load customers find it too expensive to purchase capacity rights which are based on 100% load factor. As a result, these users must rely on acquiring shorter-term firm and interruptible contracts in the secondary market, or purchase small firm capacity contracts from the pipeline operator.

105. These concerns are mitigated to some degree by various measures

[102] See Juris (1998:34).
[103] See Juris (1998:38) for an excellent discussion of these points.

that have been introduced by the FERC.[104] These include an ability of pipeline operators to enter into negotiated tariff agreements, or to offer discount tariff plans or multipart tariffs to low-load shippers. More generally, if pipeline operators can demonstrate that they do not have market power, they are able to customize their rate structures and charges. In such circumstances, three alternative charging arrangements are permitted: market-based rates which places no restriction on rates charged; incentive rates which allow for the sharing of any efficiency gains; and negotiated rates that are determined between a pipeline operator and a shipper, and which provide for recourse to the default regulated rate.

Recovery of costs associated with incremental investments in gas pipelines

106. Another area where there has been a policy change in the United States which may be relevant to issues being considered as part of the GTCR, concerns the interaction between the recovery of costs associated with pipeline expansions and the structure of rates. Specifically, the issue concerns whether the costs associated with a pipeline expansion should be borne solely by the new customers (so-called incremental rates) or whether the costs associated with providing a new service can be spread across both new and existing customers (so-called rolled in rates).

107. In simple terms, incremental pricing places all of the costs of pipeline expansion on the parties causing the expansion. This means that the rates paid by new shippers are determined by the costs incurred in the creation of the new capacity, while the rates for existing pipeline users are unaffected by the expansion. This can be contrasted with 'rolled-in' pricing which spreads the costs of pipeline expansion over all customers, new and old. Incremental pricing results in a situation where new shippers may be paying a price above or below existing users of the pipeline, while with rolled in pricing each user (including new users) pays the same rate.

108. Prior to 1999, the policy was largely in favour of rolled-in pricing in circumstances when the cost impacts of the new facilities would not affect existing customers by more than 5% and some system benefits would occur. However, after 1999, the policy changed and a threshold test was introduced, whereby a project could proceed without

[104] This includes the removal in 2000 of the price-cap on secondary trading which required that the price paid by a replacement shipper did not exceed that paid by the releasing shipper. See FERC Order 637 (1999).

contribution from existing customers.[105] In addition, applicants no longer needed to present evidence showing demand for the new capacity (prior to this change the FERC would accept evidence that 25% of proposed capacity was covered by long-term, 10-year binding contracts).

109. The effect of this policy change has generally meant that all new projects are priced incrementally, and that the shippers triggering the expansion will have to pay the full costs of the project.[106] This policy shift was triggered by a number of concerns, including that:[107]

- under the rolled-in rates approach, existing customers were paying for network expansions but were not receiving proportionate system-wide benefits

- pipeline users who held long-term service contracts were potentially exposed to subsequent price increases as a result of this policy.

- the subsidies which existed under the rolled-in arrangements could be leading to uneconomic expansion, and discouraging entry by new pipeline companies.

110. In terms of the relevance of this discussion to the GTCR, it highlights a general issue that can arise in situations where capacity rights are acquired under different allocation and charging systems. In the USA, one issue that has arisen is the 'blurring' of the difference between what 'old' customers can do with their capacity rights, and what 'new' customers under an incremental contract can do.[108]Moreover, the difficulties of cost allocation may be accentuated in contexts where incremental capacity expansions occur within a meshed, existing network (common in the UK) as compared to when a brand new pipeline is built. These issues may become more relevant in Britain if, as some commentators suggest, new incremental investments in gas transmission capacity come from new connections (such as LNG plants) rather than as a result of expansions to the existing transmission network.[109]

[105] See FERC (1999b).
[106] Although the costs for some projects can be rolled-in in certain circumstances, such as where the expansion is needed to improve service to existing customers etc, or there is no pipeline to pipeline competition.
[107] Generally, see Tye and Garcia (2007) on these points.
[108] See Tye and Garcia (2007:41).
[109] Under the current charging arrangement, users requiring new incremental capacity investments must make a commitment equal to 50% of the NPV of the expansion.

4.2 Approaches to charging in Europe

111. The issue of the appropriate or optimal approach to capacity allocation and charging is an issue that has received considerable attention in Europe in recent years, particularly following the introduction of the third energy package and as part of the EU Gas Target Model process.[110] In many respects, the analysis of charging and allocation arrangements at the EU wide level lag-behind the developments that have already occurred in Britain, and therefore are of limited direct relevance to the issues being considered as part of the GTCR. Nevertheless, it is useful to briefly consider the reasoning behind the policy decisions that have been made at the EU level in relation to capacity allocation and transmission charging arrangements.

112. One key area where there appears to have been some difference of opinion among commentators is the role of long-term contracting as a method for capacity allocation, and as a means of underpinning network investments. In Europe, a long-standing concern has been that long-term capacity contracts are potentially inimical to the development of competitive markets, as they can lead to so-called 'contractual congestion' and result in market foreclosure in circumstances where capacity cannot be transferred to third parties.[111] This potential is being addressed through various Network Codes related to Congestion Management. In relation to network investments, while many commentators have seen long-term contracting as critical to network investment, others have been less sanguine about the usefulness of long-term contracts, and market mechanisms such as Open Seasons, preferring to rely more heavily on regulatory mechanisms to determine new infrastructure capacities.[112]

113. In relation to gas charging arrangements, a number of objectives of any transmission tariff structure have been derived from the Third Energy Package, including objectives relating to: the facilitation of trade and competition; the avoidance of cross-subsidies and undue discrimination among users; cost reflectivity; promotion of efficient investments; and transparency. However, as the *Impact Assessment on the Framework Guidelines on Harmonized Transmission Tariffs* (the 'Impact Assessment') recognized it will not, in general, be possible to satisfy all of these objectives simultaneously, and trade-offs between policy objectives will therefore be necessary.

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[110] See Vasquez, Hallack and Glachant (2012) for a discussion of the different versions of the Target Model.
[111] See Ascari (2011:10) on this point.
[112] See Vasquez, Hallack and Glachant (2012:10) and Glachant (2011).

114. The Framework Guidelines on Harmonized Transmission Tariffs has as an objective the harmonization of the capacity/commodity split across Europe. In practical terms this means that, at entry and exit points of interconnection between Member States,[113] there will be a requirement to apply a common charging methodology such that the majority of fixed charges are recovered through a capacity charge, and any commodity charges will be used to recover certain variable and operational costs. To correct for any over or under recovery of allowed revenues associated with the sale of capacity – which will be allocated via auctions – a capacity recovery mechanism will be introduced. This will have the effect of varying the price of the annual capacity product, such that the price paid for capacity that was acquired in previous years through a long-term auction will be set in the year in which that capacity is used (i.e.: the price will be floating rather than fixed).

115. Prior to this position being adopted, the Impact Assessment set out and assessed three possibilities for dealing with the under (and over) recovery of revenues:[114]

- First, any under (or over) recovery of revenues at a particular entry or exit point could be addressed by increasing (decreasing) the tariff at that entry point in subsequent years.[115] However, one problem with this approach was that it could lead to spiraling increases in capacity charges over subsequent years (i.e.: the increase in the capacity prices could lead to a further reductions in the recovery of revenues in subsequent years and so on).

- Second, the under recovery of revenue could be addressed through a general uplift on a pro-rata basis across all entry and exit points. A reservation with this approach is that spreading costs in this way could reduce cost-reflectivity.

- Third, the under recovery of revenue could be addressed through adjustments to the commodity charge, as currently occurs in Britain. However, the Impact Assessment refers to the reasoning presented in the THINK study (cited earlier at paragraph 37), noting that such an

[113] Member State NRAs are able to use a different revenue recovery mechanism for points that do not involve interconnection.
[114] See Brattle (2012:21).
[115] It is our understanding that this possibility was originally considered in the aftermath of the original GB auctions for the same year, however there was a concern was that participants would factor the potential recovery into their bids and this would result in very high prices.

approach can cause additional distortions insofar as the commodity charge no longer reflects marginal costs.

116. The analysis in the Impact Assessment set out the main problems with an approach to cost recovery which occurs through adjustments to the commodity charge.[116] Specifically, they considered that it could lead to a situation where the variable charge significantly exceeds the actual variable costs, which could lead to inefficiency and welfare losses (although this was not quantified). In addition, it could lead to inefficiencies in situations where a shipper who held a capacity right decided not to ship gas because of the high commodity charge, notwithstanding the fact that a price difference between two interconnected markets would make it profitable to do so.

117. In conclusion, the authors of the Impact Assessment referred to the 'general principle' that commodity charges should reflect as far as possible actual variable costs, and that this indicated that cost recovery mechanisms should focus on capacity charges. In addition, the Impact Assessment concluded that any under-recovery of revenues should be recovered via an uplift on capacity charges from a broad group of users – across all entry and exit points – and not at specific points of interconnection. This is seen to avoid situations where cross-border trade would be distorted.

4.3 Charging arrangements in EU Member States

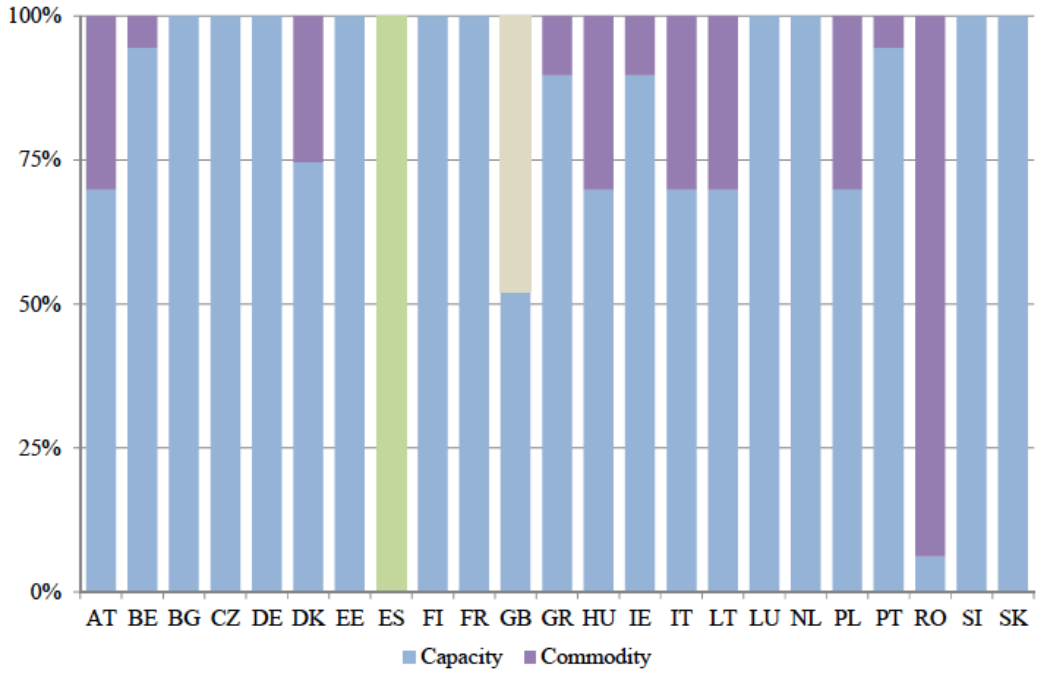
118. There is currently considerable diversity in the charging structures applied across EU member states to allow for the recovery of the allowed revenues for gas transmission operators.[117] Figure 4.2 below, reproduced from the Impact Assessment shows the relative split between capacity and commodity charges in gas transmission tariffs across EU member states. Two points emerge from this figure. First, in 10 EU member states no commodity-based charge is levied, and all revenues are recovered via a capacity charge. Second, in those European countries where a commodity charge is applied, the split between capacity charges and commodity charges range from 70%:30% to 95%:5% (with the notable exception of Romania where the capacity charge appears to be less than 10% and the commodity charge above 90%).

119. In the cross-border context, this diversity in the relative split between capacity and commodity components of gas transmission tariffs

[116] See Brattle (2012:57).
[117] See KEMA (2009:10) and Brattle (2012:17).

is seen as problematic for a number of reasons.[118] Firstly, as it results in different types of users (low-load and high-load) paying different tariffs, this can distort international trade routes. Secondly, where there is a lack of cost reflectivity in the tariffs charged by a network operator at one interconnection point – perhaps in response to a need to raise prices to allow for an under-recovery of revenue at another point – this can create a 'contagion effect' and undermine cost reflectivity in the reference prices of neighbouring network operators. Thirdly, it can distort competition, and in some circumstances, give an unfair advantage to domestic producers.

Figure 4.2: Relative split between capacity and commodity components of gas transmission tariffs



Source: Reproduced from Brattle (2012:17).

Other potentially relevant insights from other EU member states

120. Although there is a general policy desire at the EU policy level to encourage greater short-term capacity allocation mechanisms, issues associated with revenue recovery and the so-called 'flight to short-term capacity', have also apparently arisen in Germany. Specifically, according to some reports,[119] under the current arrangements, the reserve price for day-ahead capacity in auctions is set at zero, and this has resulted in a

[118] See Brattle (2012: 17).
[119] See Brattle (2012:26).

situation where the prices for the majority of short-term capacity sold do not rise above zero. This is attributed to the fact that network users are moving away from long-term capacity products, and acquiring capacity on a daily basis for free. This is seen to put shippers who acquired capacity on a long-term basis at a disadvantage. In addition, it is claimed that there is a loss in investment signals as a result of this substitution of short-term for long-term capacity products. Further, in order to address the under recovery of revenues it has been suggested that the prices for other auctions may need to rise.

121. Finally, the general issue of the structure of gas transmission tariffs, and how this interacts with revenue recovery, has recently been examined by the Irish energy regulator (the CER).[120] The context is one in which there has been a significant reduction in primary booking of capacity by electricity generators and large industrial and commercial customers. The specific focus has been on secondary capacity allocation mechanisms at exit points, but the analysis of the regulator touches on a number of issues that are similar to those that are emerging as part of the GTCR. Firstly, consideration was given to the issue of how to balance pricing flexibility for short-term capacity products, and how this interacts with network utilization and revenue recovery. Secondly, a number of respondents to a consultation on these issues queried whether the current rate structure – based on a 90%/10% capacity/commodity split – was appropriate, and indeed whether the commodity element of the charge should increase to either 25% or 40% on the basis of forecasts of an increase in annual power sector gas demand.

122. The CER rejected any change to the split of capacity and commodity charges on the basis that moving network cost recovery away from capacity charges toward commodity charges results in 'peaky customers' contributing less to cost recovery, which was inappropriate given that the gas transmission network was conditioned on peak and not average demand.[121] In addition, the decision referred to the fact that this was consistent with the Draft ACER Framework Guidelines which state that the collection of revenues shall primarily be based on capacity charges.

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[120] See CER (2013).

[121] Specifically, the CER reasoned that: *"Those customers who are not peaky would end up paying more overall gas transmission charges because peaky customers would not have to pay the same level of capacity charges as they would under a higher capacity proportion in the split. The costs imposed on the gas transmission system by flat and peaky customers are fundamentally dictated in both instances by the customers' peaks, not their average usage. Therefore, a high capacity element, as is currently the case, is deemed to be the appropriate split for recovery of gas transmission costs."* CER (2013:25).

4.4 Capacity allocation and charging arrangements in other jurisdictions

123. Outside the jurisdictions already discussed a range of approaches to capacity allocation and cost recovery are adopted in the gas transmission industry, although most are based on the use of some form of two-part tariff. In some jurisdictions, such as Argentina, the form of price regulation is enshrined in law and does not give network operators any flexibility to alter the structure or level of prices, such as the relative capacity/commodity split.[122] This rigidity is seen by some to potentially give rise to a structure of prices which is consistently non-proportional to marginal costs.

124. The issue of the different properties of capacity allocation methods has recently been examined in Australia,[123] where the vast majority of gas is transported on the basis of long-term gas capacity contracts, which underpin pipeline investment, and short-term trading occurs through bilateral secondary capacity agreements. However, a review was recently launched in response to concerns about inefficiencies caused by significant periods of unutilized capacity that has been contracted under long-term agreements to gas retailers and large industrial customers (i.e.: contractual congestion). In particular, there was a concern about the limited trading in short-term capacity, and how this may be caused by the absence of a transparent and responsive market for trading unused pipeline capacity. This situation is seen to make trading costly and complex, with the result that pipeline operators are more interested in negotiating long-term contracts for significant volumes than entering into short-term trading with shippers for smaller volumes of capacity. The overall conclusion of the review was that the transmission capacity markets have limited transparency, and in particular, that the lack of publicly accessible information makes it very difficult for current and potential market participants to engage in secondary capacity trading. More generally, this lack of transparency was seen as acting as a barrier to entry, to limit competition and the utilisation of transmission pipeline infrastructure. The potential relevance of this review to the GTCR is that active consideration was given during this process to international best practice for the allocation of capacity, including the use of auctions.[124]

[122] For a recent analysis of Argentina, see Casarin (2014:115)
[123] See SCER (2013).
[124] See Brattle (2013) and SCER (2013).

Although the use of voluntary and mandatory market based trading platforms for the sale of capacity were potential options considered, they were ultimately rejected in favour of an approach based on improved information and standardization of contractual terms and conditions. This approach was preferred, in part, on the basis that it was seen to be a 'low-cost' option.

125. Finally, the issue of the appropriate split between capacity and commodity components for gas transmission tariffs has recently been reviewed in New Zealand. The charging approach there is based on a two-part tariff with a fixed access charge (known as a fixed capacity reservation fee) to recover fixed costs and a variable delivery charge (known as a variable throughput fee) to recover any variable costs. As was the case in the USA, the approach to the relative split of capacity and commodity charges has changed over time. Up until 1996, the approach was to allocate 100% of fixed costs to the capacity charge and only variable costs to the commodity charge. After 1997, the approach changed to shift the recovery of some fixed costs onto the commodity charge, with a corresponding reduction in the capacity charge. According to the network operator, *given the excess supply conditions* on the network, the system worked well. However it is now '*no longer fit for purpose*'.

126. The preferred approach now is based on a two-part tariff with a fixed access charge (known as a fixed capacity reservation fee) to recover all fixed costs and a variable delivery charge (known as a variable throughput fee) to recover any variable costs. The principal driver of this change is a perception that current prices are not cost-reflective and that this provides an incentive to increase use of a particular (Northern) pipeline which has limited available capacity.[125] More generally, the network operator expresses the principle that "*the recovery of fixed and sunk costs should be set in such a way that actions taken by gas consumers do not alter the charges they face"*.[126]

[125] See Vector (2012:5).
[126] Vector (2012:13).

5. POTENTIALLY RELEVANT INSIGHTS FROM OTHER SECTORS

127. Although there are some broad similarities between the different regulated network industries – particularly the fact that they all involve one stage in the supply chain, typically transportation, which exhibits decreasing average costs – there are also considerable differences in the physical, technical and economic characteristics of these industries. In addition, different regulatory strategies and approaches have been applied in the different network industries, including in relation to capacity allocation and charging mechanisms. These factors suggest limitations on the extent to which the application of regulation in other network industries can provide insights for the GTCR.

128. Against this background, we briefly examine three issues of potential relevance to the GTCR: (i) the charging structures that are adopted in other network sectors; (ii) the capacity allocation mechanisms that are adopted, and in particular the use of auctions, in other network sectors; and (iii) how issues associated with non-temporary decreasing demand have been addressed in other network sectors, particularly in relation to fixed telecommunications and postal services.

5.1 Charging structures in other network industries

129. A central issue of the GTCR is the appropriateness of the current charging structure, and in particular the relative split between capacity and commodity components of the gas transmission tariff. Looking across other network industries, it is apparent that a wide range of charging structures and approaches are adopted for the use of transmission or transportation networks. Although it has not been possible in the time available to conduct a comprehensive survey of the charging structures adopted across different network industries, the following points can be noted:

- In the electricity sector, the charging structures applied for the use of the transmission network are typically based around charges that are levied on some measure of capacity, although commodity charges can also be levied in some circumstances.[127] This charging structure has lead to complaints by some intermittent forms of generation – such as

[127] Such as where losses also feature as part of the transmission tariff charging arrangements, see CEPA (2011:20).

renewables – that they are required to pay for capacity which is often not utilized.

- Given the scope of unbundling policies that have been applied in many fixed-line telecommunications industries, there are a wide range of products that are now offered to network users (including wholesale access, unbundled local loop access, sub-loop access etc). Generally, charges for products such as access to the local loop or wholesale access are levied on a monthly basis on a per service unit basis (i.e.: per loop or line), while origination and termination services tend to be priced on a 'per minute' charge basis. All of these prices tend to be based on estimates of forward looking long-run average incremental cost (FL-LRAIC). In relation to mobile networks, where access charges are levied between network operators, they are generally levied on a per minute charge basis, which in some jurisdictions is regulated and also based on estimates of FL-LRAIC.

- Funding in the rail sector comprises a mix of sources including revenue generated from variable access charges, revenue from fixed access charges and network grants. Network grants are paid by the Department of Transport and Transport Scotland, on a pound for pound basis, in lieu of some fixed track access charges.[128] Different charging structures apply to different users of the train access network, such as franchised passenger operators (who face a combination of variable and fixed charges, including fixed track access charges and station charges); freight operators (who face a mix of variable charges, including some which vary according to the type of commodity transported); open access passenger operators (who can face variable usage, capacity and electrification charges) and charter passenger operators (who have historically faced variable usage charges based on the type of equipment used). Further differentiation exists in terms of the capacity charges levied (where, historically, passenger services capacity charges were levied on the basis of service group while freight capacity charges were levied across the network on a flat rate basis) and in how variable freight charges are levied (which vary by the type of commodity transported, such as coal for the ESI, iron ore or spent nuclear fuel).

- In the water and wastewater sector, there is only a limited number of examples of access being sought between network operators and

[128] In 2011-12, it was estimated that some 78% of Network Rail's income was derived from the combination of the fixed track access charge (payable by franchised passenger operators) and grant income, both of which are fixed and therefore invariant to changes in traffic.

network users as, in many jurisdictions, the activities of water and wastewater supply tend to remain vertically integrated. In England and Wales, up until recently, the price for access was determined according to what was known as the 'Costs Principle'. This was a form of retail-minus pricing (see discussion in section 2) and was based on subtracting from the retail price what was known as 'ARROW costs', which are defined as "*costs that are Avoided or Reduced; or any amount that is Recoverable in some Other Way*". This approach proved highly controversial – there was limited access granted on the basis of this approach – and the regulator has proposed that a 'cost-based' approach be applied to network charging in the future.

5.2 Capacity allocation mechanisms

130. As with the discussion of charging structures in the preceding section, there is a wide range of capacity allocation measures that are adopted across the network industries for transmission or transportation networks. Once again, in the time available, it has not been possible to conduct a comprehensive survey of these different approaches, but it is worth noting that in some industries, such as telecommunications and water, the primary method through which transportation or transmission capacity is allocated is typically through negotiation and agreement between the network operator and the network user rather than through any centralized capacity allocation process.

131. Of particular relevance to the GTCR would be any use, or experience, of auctions as a method for allocating primary capacity in the other network industries. Generally speaking, however, the use of auctions to allocate capacity in network industries is not widespread. There are however, some examples.

- In telecommunications, auctions are increasingly used as a method of allocating radio spectrum, which is necessary for mobile communications networks, but is also a scarce resource used for a range of different purposes.[129] In addition to the competitive mechanisms used for the initial allocation of spectrum, in some jurisdictions, there is the possibility of secondary trading in spectrum, whereby existing holders of spectrum rights transfer all, or some, of

[129] Historically, mobile telephone spectrum was typically allocated using non-market/administrative mechanisms, such as 'beauty contests'. This approach was used to award second-generation (2G) spectrum licences in the UK. However, see Klemperer (2002:829) on problems with the 3G telecom auctions in some European countries.

their spectrum entitlements.

- Different types of capacity auction arrangements are used in the electricity industry. Firstly, auctions are used as a mechanism for allocating cross-border interconnector capacity in Europe, particularly between Germany and the Netherlands, but also between France and England.[130] Secondly, auctions are a feature of electricity systems designed around nodal pricing arrangements, such as in many states in the US, where market participants can acquire financial transmission rights in advance of the actual use of the transmission networks.[131] Such rights are typically auctioned by an Independent System Operator in annual, monthly or seasonal auctions and entitle the holder to access a proportion of any congestion revenues accumulated on a network,[132] thus allowing participants to hedge their exposure to the presence of network congestion.[133]

- Finally, in the transport industries there has been a long-standing interest in the use of auctions for capacity allocation. In relation to the auctioning of airport slots there has been interest in both the US and the EU, but this has met with significant resistance from airlines and other bodies (including in the EU, some EU member states), and the predominant method for allocating capacity is based on either some form of bilateral slot trading or lease arrangement, or through the 'grandfathering' of rights.[134] In the rail industry, the predominant form of allocation of capacity rights is administrative and, for passenger services, is determined through franchise arrangements. There is, however, some increasing academic and policy interest in the use of market-based auction mechanisms to allocate train paths in both the UK and the US, although it is recognized that this may be unrealistic in the short-term.[135]

132. In sum, there is a range of different methods for allocating capacity to transmission/transportation networks across the different regulated industries, including administrative methods, bilateral negotiations and

[130] See Newbery (2003:28) for an analysis of these auctions.
[131] Generally on transmission rights, see Joskow and Tirole (2000:450).
[132] Congestion revenues arise because of differences between the nodal payments by load to the system operator and the nodal payments made by the system operator to generation. See generally Hogan (1992:211).
[133] In theory, the effect of FTRs is to make the holders of such rights indifferent to the presence of congestion, as the FTR is intended to reimburse to the holder the same amount by which the short-term price of transmission has been increased as a result of network congestion. See Hogan (2000).
[134] See UK Parliament (2012) and Cave (2013:88).
[135] See Cave (2013:89) and Harrod (2013:176).

open market-based processes. As a general observation, auctions are not a major feature of capacity allocation in the transport or telecommunications industries (with the exception of spectrum auctions), and feature to different degrees in the electricity industry (mainly for cross-border capacity to date in the EU). In this context, it appears that the use of periodic, centralized capacity auctions for the allocation of gas transmission entry capacity in Britain is one of the most advanced examples of the use of auctions across the regulated sectors.

5.3 Decreasing demand for gas transmission capacity

133. One of the interesting contextual factors in which the GTCR is being conducted is the widespread expectation that demand for gas transmission capacity will, in aggregate, steadily decline over the medium to long-term, and that this will have the effect of reducing the number of instances where the gas transmission network is capacity constrained. Put slightly differently, there is a general expectation that, in the future, there will be spare capacity available at most entry points on the National Transmission System. An important question this raises for the GTCR is how this expectation interacts with the design of the charging arrangements and. more specifically, how the issues of efficiency and cost-recovery are balanced.

134. Across the other network industries, there are three other cases where demand is expected to decline for transmission/transportation services, and which can potentially provide some insights for the GTCR as to how the charging arrangements might need to adapt.

Decreasing demand and excess capacity for fixed telecommunications networks

135. A first case is fixed line telecommunications services where, in many jurisdictions, there has been a steady decline in market penetration in recent years, in large part as a result of the increasing penetration of mobile networks. In addition, it has been argued that many fixed networks that carry voice and data services can be characterized as having had excess capacity over the past decade.[136] As a consequence of these points it is now suggested that underutilization is a feature of large parts of this network in some jurisdictions, particularly for the local-loop component (which is not used to transmit mobile services).[137] This

[136] See Jahn and Prüfer (2008).
[137] See Briglauer and Vogelsang (2011:103).

situation had lead some commentators to argue that a 'new approach' to regulating fixed telecommunications access prices is required in contexts where there is a non-temporary decrease in demand.

136. In a recent analysis, Briglauer and Vogelsang (2011) suggest that the use of the standard pricing approach – based on forward-looking estimates of long-run average incremental cost (FL-LRAIC) – will be inappropriate in the context of non-temporary decreasing demand. Specifically, because such an approach is based on *average* costs and economies of scale (decreasing long run average costs), it will lead to increases in access prices, which will have a spiraling feedback effect. This will result in allocative inefficiencies.

137. A number of possible pricing options – many of which we discussed in section 2 – are considered by Briglauer and Vogelsang in this context, including:[138]

- *Access prices set at short-run marginal cost (SRMC)*. This is acknowledged to be the (static) efficient cost standard given the excess capacities, but would not allow sufficient margins to cover the network operator's fixed and sunk outlays and could lead to the stranding of some assets. However, SRMC pricing will provide efficient long-term investment signals for the network operator in this context where demand is contracting.

- *Access prices set at SRMC plus a mark-up to recover fixed costs*. This could be based on Ramsey-Boiteux principles, but in practice the mark-up would have to be significant, and the complexity involved in the exercise raises the potential for regulatory misjudgement and arbitrariness.

- *Capacity based access charges*. This would involve the replacement of per minute charges with monthly prices that are set on the basis of the incremental cost of capacity. This could include two-part tariffs with a variable component capturing the usage costs, and a fixed component to recover the underlying fixed costs.[139]

- *Retail-minus pricing (the margin rule ECPR).* Given the assumption that retail markets are competitive, this approach may be appropriate in

[138] See Briglauer and Vogelsang (2011:103-106).
[139] However, in the context of network competition, such an approach is seen to potentially be anti-competitive as the fixed capacity charge which is based on average costs will be larger for smaller sized operators. See Briglauer and Vogelsang (2011:105).

the context of a mature industry. The attractiveness of this approach is that it can allow the network operator to recover all necessary costs, while allowing for reductions in retail (and wholesale) prices without resulting in a margin squeeze.

138. The conclusion of the Briglauer and Vogelsang analysis is that the pricing approach should combine the standard FL-LRAIC method with the retail-minus method. More specifically, in situations where demand is expanding, the option that would be chosen by a network operator would be the standard FL-LRAIC, however in times where the market is contracting the chosen approach would be retail-minus with a maximum price ceiling of FL-LRAIC. This, it is argued, will give the network operator the flexibility to lower prices below FL-LRAIC, while limiting its ability to engage in a price squeeze of competitors.

139. Other suggestions for addressing a non-temporary decrease in demand in the telecommunications industry focus on adapting the FL-LRAIC approach. Some analysts emphasise that the FL-LRAIC approach is conceptually based on the assumption of an expanding market, where additional capacity is being installed. However, this is no longer true of the standard copper fixed line network, because of substitution to other networks (mobile, cable and fibre).[140] True forward-looking costs in circumstances of future excess capacity are therefore likely to be considerably lower. Other commentators argue that, in times of substitution from copper to fibre networks, the appropriate cost standard should be adjusted so as to no longer take account of sunk capital expenditure (in copper) on the basis that it is not 'decision relevant' anymore (i.e.: no one would invest in a copper asset).[141] They argue that applying standard LRIC pricing in this context would lead to an over-recovery of costs. In these circumstances, it is argued that the appropriate access price should lie between short-run incremental cost and long-run incremental costs, and that the assets used in the estimation of long-run costs be valued according to whether they can be reused in new fibre networks or they cannot be reused.[142]

140. While the analysis of how to adapt access pricing frameworks in telecommunications in the context of an expectation of non-temporary decreasing demand is potentially insightful, three critical contextual points must be borne in mind. First, in telecommunications there is

[140] See Neumann and Vogelsang (2013:3).
[141] See WIK-Consult (2011).
[142] See Cave, Fournier and Shutova (2012:162) citing analysis by WIK-Consult (2011).

increasing competition between different network platforms (mobile, fibre, cable), and access pricing is of a two-way nature rather than a one-way nature as in gas transportation. Secondly, many incumbent fixed line operators are still vertically integrated – albeit subject to some form of functional or operational separation – and so a major concern is how access prices set by the incumbent relate to the retail prices set by the incumbent (i.e. avoiding a price/margin squeeze). Thirdly, the approach to the estimation of access prices in telecommunications has traditionally been based on forward-looking estimates of costs applying an operational capital maintenance (OCM) rather than a financial capital maintenance (FCM) approach. In a nutshell, this means that the value of the underlying assets is not based on historic costs and investments made by the network operator, but is re-valued periodically on the basis of what is operationally required.

Decreasing demand for postal network services

141. Another network industry which has experienced non-temporary decreasing demand that is expected to continue in the foreseeable future is the postal services industry. This situation is largely the result of declines in mail volumes as a result of fierce inter-modal competition – principally from electronic forms of communication but also from bulk mailers. In the postal sector, the cost recovery issues include both how to finance historic investments in assets, as well as how to finance ongoing universal service obligations (USOs), which typically require certain coverage and quality standards be maintained (i.e.: number of deliveries/collections), as well as that prices be affordable and uniform across a specific jurisdiction.

142. The issue of how to design appropriate charging arrangements in these circumstances has received some attention recently both in analytical work and in policy analysis. In more analytical work, the analysis has principally focused on the potential for introducing different forms of non-linear pricing in the postal sector. One particular area of focus has been on whether the ability to charge volume discounts can assist in the financial viability of the operator in the face of inter-modal substitution (to digital forms of communication).[143] Some authors have proposed a charging approach which combines Ramsey-Boiteux type segmentation with volume discounts.[144]

143. In the UK, the volume of mail delivered has decreased by 25%

[143] See Crew and Kleindorfer (2012).
[144] See Borsenberg, Cremer, De Donder, Lécou and Joram (2012).

since 2006, as a result of customer substitution to digital forms of communication, which is seen to potentially threaten the viability of the services, and in particular the USO. As was the case in relation to fixed telecommunications, these reductions in demand are potentially giving rise to a situation of increasing average unit costs and higher prices, which has a negative feedback effect on demand. In Ofcom's analysis the risk is that the postal sector could become locked into *"an inexorable spiral of decline".*

144. In 2012, after taking over responsibility for postal services, Ofcom recorded that, in light of the trend of non-temporary declining demand, the traditional approach to regulation had failed in the postal sector. In particular, it noted that the existing price control approach did not give Royal Mail the flexibility it needed to respond to changes in its market environment. In conclusion, Ofcom proposed to remove traditional price controls for most of Royal Mail's services and to give the operator greater pricing flexibility, including giving it the choice as to the most appropriate way to raise revenues to address the financial situation associated with the universal service. Specifically, in granting Royal Mail this flexibility, Ofcom noted: *"In this uncertain time, when the position of post in relation to electronic substitutes is unclear, Royal Mail is in a better position to determine the impact of price rises of different products on overall demand and, hence, revenues."*[145]

145. The specific elements of the new regulatory framework applied included:

- a monitoring regime, with the threat of re-regulation if efficiency gains were not achieved;
- measures to ensure that the basic universal service product was available to all, and remained affordable; and
- various measures and safeguards to ensure that competition, particularly access competition, remained viable and continued to develop.

146. In relation to access markets, it was recognized that Royal Mail needed to be able to recover its costs and therefore additional measures were introduced that included not regulating the price of access, so as to allow Royal Mail the freedom to set prices in a way which covered the costs of the network. Given intermodal competition, the risk of excessive pricing under this arrangement was seen to be minimal, however, there

[145] Ofcom (2012a).

was a potential risk of Royal Mail engaging in a margin squeeze. To address this, the new pricing flexibility of Royal Mail became subject to a margin squeeze test, so as to ensure that the difference between the access prices and the retail price is sufficient to allow competition to develop.[146]

147. Perhaps the main point to take from these discussions of alternative regulatory strategies to address decreasing demand in post and telecommunications is that, in the face of non-temporary reductions in demand for network capacity there has been an increased focus in both sectors on affording the network operator greater flexibility in the design of tariffs which will allow it to recover its fixed costs. However, in both examples, this greater flexibility is being given in a context where concerns about excessive pricing for transmission services is limited by the existence of network competition, a situation which is not immediately applicable in the British gas transmission industry

Decreasing growth in demand for electricity

148. Finally, in some jurisdictions, notably the USA, but also parts of Australia and Canada, there are concerns about the impacts of a decreasing rate of growth in demand for electricity consumption.[147] In the USA, for example, it has been estimated that growth in electricity will be below 1% (around 0.7% to 0.9%) in the years to come. Faruqui (2013) identifies five factors which he considers are leading to this low rate of growth in the USA, including: changes in consumer psychology; energy efficiency measures; changes to regulations and codes in response to environmental concerns; an increase in distributed generation (particularly solar power); and a rise in consumer switching to alternative fuels arising from the development and exploitation of shale oil and gas reserves.

149. Within this context it has been suggested that there should be a fundamental change in the design of rates for electric utilities (particularly in the context of distribution companies). Specifically, it is suggested that the rate design should be changed towards one based on SFV approach, such that the fixed charge covers the costs of investing, maintaining and operating the grid.[148] This will require that the fixed charge for many customers will have to increase, and it is recognized that this will raise difficult issues for both regulators and consumers,

[146] See Ofcom (2012b: para 10:87)
[147] See, generally, Faruqui (2013) on this issue.
[148] See Faruqui (2013:9).

especially as small consumers may see their bills increase as a result of this change.

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