PRICE RESPONSIVENESS OF DEMAND FOR NTS CAPACITY

OFFICE FOR GAS AND ELECTRICITY MARKETS

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INITIAL DRAFT

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IMPORTANT NOTICE

1. INTRODUCTION

CEPA in association with TPA Solutions (TPA) has been commissioned by Ofgem to develop a tariff and impact assessment model of changes in the structure of the gas National Transmission System (NTS) charges in Great Britain (GB).

A central part of our assignment is modelling the impact that changes in NTS charges could have on capacity booking patterns and strategies – the price responsiveness of demand for NTS capacity – of users of the NTS. This note outlines our initial thinking on price responsiveness of demand for NTS capacity and how that could be reflected in the proposed impact assessment modelling.

The rest of this note is structured as follows:

- Section 2 outlines how we would expect different users of the NTS to evaluate their requirements for capacity under a given pricing structure.
- In Section 3 we consider the GB gas market structure – today and in the future – and how market structure may influence the demand for NTS capacity given different supply and production sources.
- Section 4 provides our initial thinking on how we intend to model NTS user price responsiveness of demand.

2. PRICE RESPONSIVENESS OF DEMAND FOR ENTRY CAPACITY

In this section we consider what is meant by price responsiveness of demand for NTS entry capacity and its primary determinants.

2.1. General determinants of price responsiveness of demand

The demand for gas transmission capacity is a derived demand: users require NTS capacity to dispatch to the GB or neighbouring county wholesale gas markets (where there is cross-border interconnector capacity).

Users price responsiveness is, therefore, closely interlinked with wholesale market structure, the expected position of supply sources in the merit order and supply profiling / flow requirements given their reaction to, or role in setting, wholesale prices. The demand for NTS capacity may also be influenced by opportunities for trading in other markets in response to profitable trading opportunities (flow/dispatch optionality).

Consistent with economic theory, network users' willingness to make capacity commitments can also be expected to reflect their evaluation of NTS capacity scarcity, the extent to which they value capacity certainty (given supply arrangements) and the extent to which they value or anticipate short term capacity constraints and discounts (or premia). This will be driven in part by their contracts with customers.

There are, therefore, a number of possible determinants of price responsiveness of demand for NTS capacity as detailed in the subsections below.

2.1.1. Wholesale gas market structure

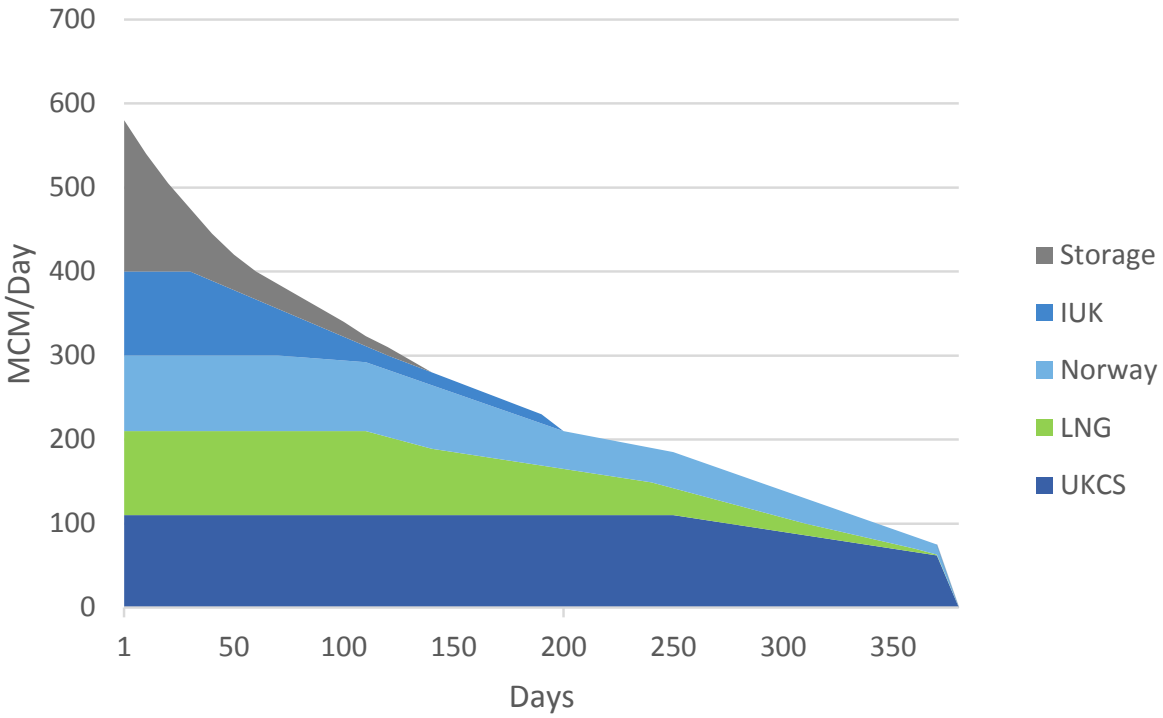
The structure of supply to the GB market has a major influence on the structure of demand for NTS capacity.

The GB wholesale market currently has many different sources of supply, including beach supplies; interconnectors, LNG importation; and various forms of short, mid and long term storage. As illustrated in Figure 2.1 below, these sources are expected to be used at different times of the year as determined by the shape of the GB gas load duration curve.

For example, on peak days, more discretionary supplies – e.g. LNG spot – can be required but these supplies can also be flexible to flow to other markets. At other times of the year demand may be met with less discretionary supplies – e.g. baseload contracted LNG imports or beach supplies from dry or associated gas fields.

The concept of discretionary and non-discretionary sources of supply – the former having flow optionality – is an important feature of the structure of demand for NTS capacity and how that demand structure responds to changes in NTS tariff structures. As the structure of the GB market changes, the mix of discretionary and non-discretionary supplies will change, as will the structure of demand for NTS capacity.

Figure 2.1: Illustrative GB load duration curve



Source: CEPA and TPA

2.1.2. Scarcity of NTS capacity

The scarcity of entry capacity for the NTS in general and for individual Aggregated System Entry Points (ASEPs), will also be a determinant of price responsiveness of demand, in particular, incentives for long term and short term booking strategies. The possibility of entry capacity constraints can introduce opportunity costs for shippers and gas suppliers, including a loss of sale of gas at NBP, possible exposure to NTS imbalance charges and opportunity costs in related commodity markets (e.g. upstream oil production).

The value of a loss of sale, for example, is likely to be particularly important when capacity is constrained, especially at an important ASEP that can influence the NBP price.

The need to acquire capacity at that ASEP (rather than not flowing gas) will be a function of any contractual commitment (or own gas production) that can only be delivered via that ASEP. Many contractual commitments in the GB market today can be met at the NBP and do not dictate a particular route for gas supply, and shipper energy balancing exposure is also calculated nationally (again, this is where the differentiation between discretionary and non-discretionary sources of supply can become important). However, some associated gas sources require shippers to take gas at a particular ASEP (typically St. Fergus) in order, for example, to maintain upstream oil production.

Although the current outlook at most ASEPs is for adequate entry capacity barring unforeseen operational incidents the perceived risk (and value) of a capacity constraint at an ASEP – given

the potential opportunity cost of the value of the sales forgone should NTS capacity not be available – can still be expected to influence the structure of demand for different forms (e.g. long and short term) capacity and how responsive different users entry booking strategies for the NTS will be to price of alternative capacity products.

NTS capacity is relatively inexpensive in relation to the sunk costs upstream and downstream of the transmission system, and is a relatively low proportion of total gas value. Therefore, the risk of under purchasing entry capacity even in the context of adequate supply should in theory influence user decision making. The value of a particular booking strategy (for a given structure of NTS prices) must, therefore, be considered in the wider context of the value of capacity within the wholesale gas market.

2.1.3. Cross-border flows

As we explore in Section 3, the GB market is expected to increasingly be supplied by imported gas as production from the UK continental shelf declines.

A number of possible importation supply sources will be committed to supplying (importing) to the GB market (e.g. through long term contractual commitments) and has no option to flow elsewhere (i.e. to other markets). However, other sources of import supply will have flow optionality (e.g. certain forms of LNG).

Gas that has flow optionality will be traded on the basis of the relative value of the supplies in the GB and neighbouring / international gas markets. For these supply sources, the price responsiveness of demand for NTS capacity will be determined by how NTS charges affect the relative value of dispatch to GB as compared to neighbouring markets. This may be influenced by a number of factors including:

- how particular forms of NTS entry tariff (capacity vs. commodity) are treated in trading decisions (e.g. sunk cost or a commoditised cost);
- whether on the day a particular source of supply can expect to influence the wholesale spot price at the margin; and
- whether short term flow optionality is influenced by other trading factors than simply spot prices.[1]

Central concepts when considering the price responsiveness of demand for NTS capacity for importation supplies are, therefore, the differentiation between:

- committed (e.g. BBL);
- non-committed (e.g. interconnector) supplies; and

[1] For example, flows in summer may be influenced by expected trading opportunities in winter, available storage capacity and national supply obligations.

- the price formation processes which apply in GB and neighbouring markets which affect cross-border dispatch decisions.

The latter requires consideration of the supply and demand fundamentals of NBP and neighbouring European markets, influenced by the development of hub pricing in Europe, and how different forms of NTS charge affect dispatch decisions.

Across hubs, the price of gas, which is a homogenous good, should in theory tend towards uniformity, (allowances being made for transportation and other transaction costs), only in the absence of regulatory distortions, physical barriers to trade and other barriers that prevent competition and arbitrage activities. In a competitive context, arbitrage across the hubs should eliminate price differences apart from those due to transaction costs (such as NTS entry pricing and other transportation costs). This is often referred to by economists as the "relative law of one price" and the area within which the price of the homogenous good equalises, net of transaction costs, is referred to as a "geographic market".[2]

The influence of NTS charges on cross-border flows and price responsiveness of demand for NTS capacity will need to be considered within the framework of the law of one price and increasingly integrated European gas market (s). This particularly applies to shippers who hold interconnector capacity (and face decisions whether to export or import to the UK) and LNG supplies that can shape their dispatch decisions in response to spot rather than long term contractual considerations.

2.2. Summary

This section has begun to outline the key issues that we believe need to be considered when evaluating and modelling price responsiveness of demand for NTS capacity. We welcome feedback from the GTCR Technical Working Group on our initial thinking particularly the following issues and questions.

(1) Questions

- Have we identified the primary determinants of price responsiveness of demand for NTS capacity?
- What factors need to be accommodated in our modelling (see Section 4) to appropriately reflect the determinants of demand for NTS capacity?
- Have we identified the drivers of cross-border flows to and from the GB market and the role of transportation pricing in determining those flows?

[2] Petrovich, P (2013): 'European gas hubs: how strong is price correlation'

3. MARKET STRUCTURE

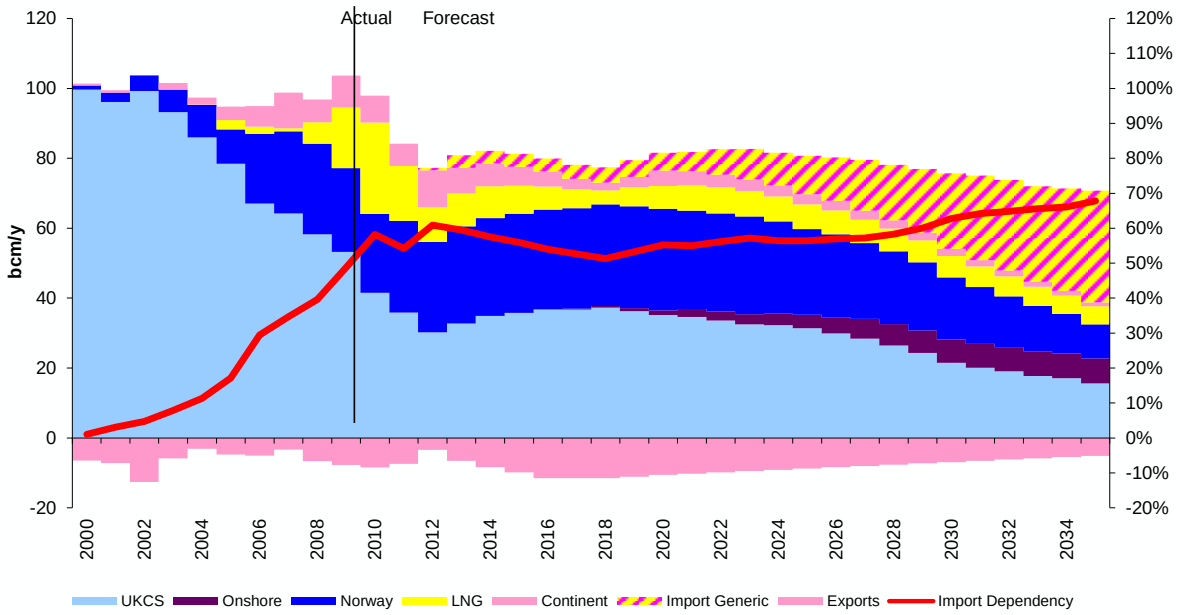
In this section we provide a brief overview of the GB gas market structure and, in particular, expected changes in the structure of supplies.

3.1. Future scenarios

Significant changes are expected in the structure of the GB gas market. Subdued gas demands are expected to lead to lower gas supply requirements and there is expected to be a continued decline of production from the UK Continental Shelf (UKCS). The UK is expected to have an increasing import dependency with gas storage expected to play an increasing role in meeting high demands and providing flexibility.

Figure 3.1 below illustrated National Grid's "Slow Progression" scenario from the 2013 Gas Ten Year Statement.

Figure 3.1: Annual gas supply – Slow Progression



Source: National Grid

Figure 3.1 illustrates:

- the declining trend in production from the UKCS (as a proportion of demand the contribution of UKCS increases slightly to 43% in 2020 before reducing to 22% in 2035); and
- the increasing importance of the combination of Norway, LNG and Continental import supplies (there is greater uncertainty of LNG and Continent supplies reflected in a minimum projected levels for both sources and an area described as 'generic' imports

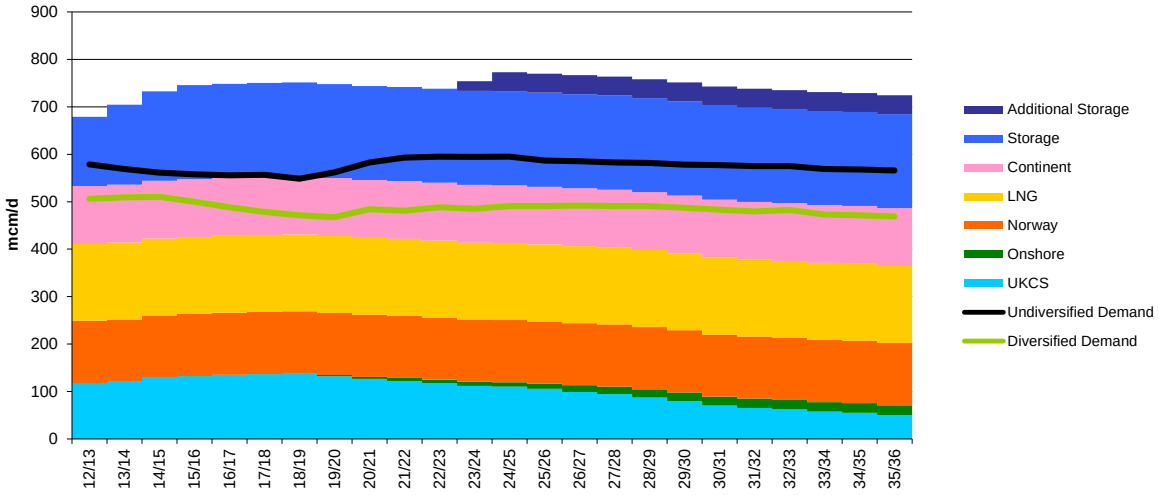
that represent supply that could flow from any combination of LNG and Continent sources).

The 2013 Future Energy Scenarios document which produced this Slow Progression scenario, highlights that the levels of LNG supplies are dependent on: existing and future UK LNG contracts or upstream partnerships; global availability of spot LNG; and global gas supply and demand fundamentals.[3]

Continental imports to the UK are also subject to uncertainty given they depend on flows of pipeline gas from Russia, Central Asia and North Africa. Continent supplies may also be influenced by: existing and new supply contracts or upstream partnerships; UK and Continental gas price differentials; energy supply and demand fundamentals in Europe; and the process of market liberalisation in Europe.

Storage is expected to play an important role in meeting peak demands. Figure 3.2 shows peak day gas supply for the Slow Progression scenario assuming the contribution from UKCS (including onshore gas sources) and imports are at or near maximum supply/capacity and storage at maximum deliverability.

Figure 3.2: Peak day gas supply: Slow Progression



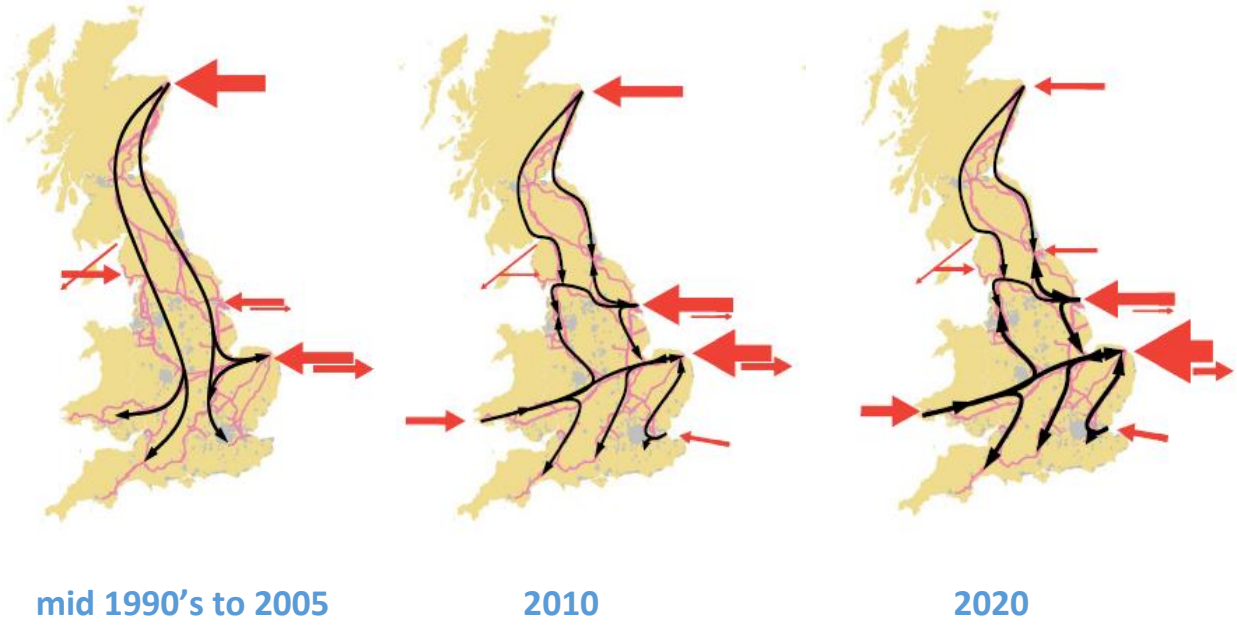
Source: National Grid

3.2. Flow patterns and demand for NTS capacity

The forecast changes in the structure of supply to the GB market are also likely to impact on the way gas flows across the transmission network (see Figure 3.3) and, therefore, the structure of demand for NTS capacity.

[3] National Grid (2013): 'Future Energy Scenarios', p. 109

Figure 3.3: Changing Gas Flow Patterns in GB (Source: National Grid)



Source: National Grid

The flow patterns and expected scenarios for peak day supplies may be expected to influence factors such as the scarcity of entry capacity at individual ASEPs and the probability of constraints emerging at the ASEP. They will also change the structure of wholesale price formation and, therefore, the value of opportunities foregone for different users of the NTS should there be constraints on accessing entry capacity.

3.3. Summary

This section has provided a brief review of GB market structure and expected flow patterns in response to changes in expected supply sources.

We welcome feedback from the GTCR Technical Working Group on the implications that need to be taken from expected these changes in market structure in modelling price responsiveness of demand for NTS capacity.

(2) Questions

- How should a modelling framework for price responsiveness of demand for NTS capacity take account of expected changes in market structure?
- How does structure of demand and the *price responsiveness of demand* change as market structure changes?
- Which long term planning scenario (e.g. Slow Progression or Gone Green) should be used in the modelling?

4. MODELLING METHODOLOGY

This section provides our developing thinking on modelling the price responsiveness of demand for NTS capacity.

4.1. Modelling framework

We propose to develop a scenario based modelling framework of the demand for NTS capacity and the responsiveness of demand for different forms of capacity product in response to changes in the structure and level of NTS prices.

This will involve modelling entry capacity product bookings under profit maximising expectations of capacity scarcity and NTS prices through a staged modelling process which determines shipper booking behaviour.

4.1.1. Stage 1 - Supply and demand modelling

As a first step, we propose to identify a supply and demand scenario for each gas day in the impact assessment modelling. These will be based on the long term planning scenarios in National Grid's Ten Year Statement.[4] We will establish a merit order of GB supplies, and associated flow patterns for each ASEP on the network, by determining a dispatch schedule with a marginal source of gas that clears the spot market.

A central part of this initial stage in the modelling will be identifying the position of different import supplies in the merit order, including cross-border flows (see Figure 4.1). Cross-border flows, in the absence of long term contractual commitments, can be expected to be influenced by whether they are a price taker or price maker in the wholesale market:

- If a price taker, then NTS charges may influence flow direction, given relative wholesale prices in neighbouring markets and resulting profit margins of dispatch to the GB market as compared to neighbouring markets.
- If a price maker, the wholesale price may rise to attract the required import supplies and clear the GB market. The incidence of NTS charges – and how they are treated by shippers – will in this scenario influence the wholesale price level.

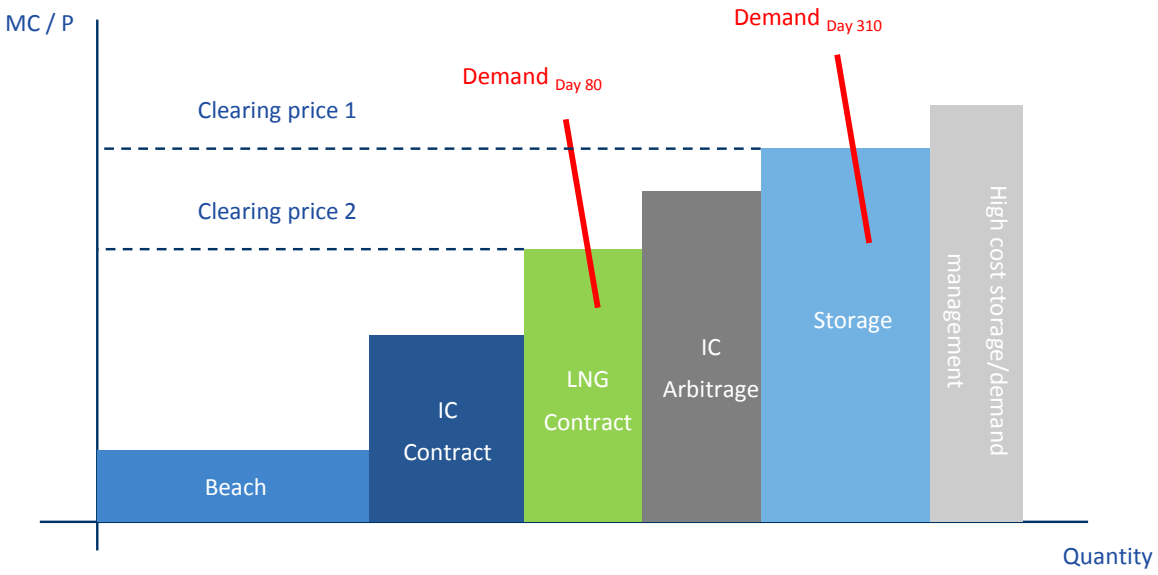
We plan to model these dispatch decisions to understand the impact NTS charges may have (subject to contractual commitments) on cross-border flows and, therefore, cross-border supplies' demand for NTS capacity.

Modelling the dispatch should also facilitate modelling of the allocation of economic rents in the modelled wholesale market. This will be important for evaluating the opportunity cost/value of a forgone sale to a particular supply source should there be a constraint on NTS

[4] http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas-Ten-Year-Statement/

entry capacity at an individual ASEP (as described below, this is central to our proposed approach to modelling a shipper booking strategy for the NTS (see Stage 2)).

Figure 4.1: Illustrative merit order of supplies by cost[5]



Source: CEPA and TPA

4.1.2. Stage 2 - Shipper booking strategy

Demand to flow gas on the NTS for each gas day will be determined through the supply and demand scenario modelling described in Stage 1. In this second stage the model will determine a shippers booking strategy given a gas day flow requirement. This will involve modelling the expected cost or value of NTS capacity from the perspective of different supply sources wishing to flow to or from the GB market.

We expect to consider:

- dry gas fields;
- associated gas fields;
- LNG;
- storage;
- interconnector (committed import) pipeline; and
- interconnector (arbitrage) pipeline.

We will establish the cost or value of a constraint from the perspective of various types of supply who may decide to rely fully or in part on the availability of shorter-term NTS capacity at an ASEP. Having established this value we can then step back to reconsider the merits of

[5] The merit order "stack" is derived for each day on the load duration curve.

acquiring longer-term capacity by estimating the probability of constraints subsequently emerging and taking account of other relevant factors.

The expected value/cost of a constraint at an ASEP will then be input into a profit maximisation decision (given a structure of LT and ST capacity and commodity prices) to determine whether short or long term capacity may be booked with or without:

- short term capacity discounts;
- fixed or floating ST and LT capacity product tariffs; and
- inflation indexation applied to capacity prices.

In the absence of detailed network modelling we will need to make a relatively simple assessment of the probability of constraints emerging.

Although constraints can take various forms and arise for a variety of reasons, we are primarily concerned with a "commercial" constraint in which the shipper is no longer able to purchase ST capacity at reserve price levels – for example because there is more shipper demand for ST capacity than the TSO is obliged (or able) to make available for sale. This could arise where all obligated capacity has already been sold at that ASEP (or moved elsewhere by substitution).

In determining the booking strategy of individual supply sources, the model may also need to consider the option value of purchasing LT capacity. We are still considering how this may be accommodated in our modelling framework, but expect it to be based on similar opportunity cost considerations as we propose to use to establish the value of NTS capacity given the risks of a short term capacity constraint.

4.1.3. Stage 3 – Constrain modelling for known capacity bookings

Stages 1 and 2 will have determined a modelled booking strategy of demand for NTS capacity under a supply scenario for the gas year. We will then constrain this modelling scenario to reflect known capacity bookings by ASEP.

4.2. Summary

This section has provided an introduction to how we currently propose to approach modelling price responsiveness of demand for NTS capacity. We welcome feedback on our initial thinking and modelling assumptions.

(3) Questions

- What are the Technical Working Group's views on our proposed approach for modelling price responsiveness of demand for NTS capacity?
- Have we identified the range of different supply sources that need to be included in the modelling?
- What are your views on the proposed approach to modelling the value of NTS capacity under the probability of a constraint?