Promoting choice and value
for all gas and electricity customers

Gas Security of Supply Report - Further measures design appendix

Ofgem report to Government supplementary appendices

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Overview:

In November 2011, the Secretary of State requested Ofgem assess the potential risk to medium and long term gas security of supply in Great Britain and appraise potential further measures in the gas market which could enhance security of supply. The Gas Security of Supply report responds to that request by:

1. Assessing the scale and nature of the risks to security of supply given developments in the global gas market;

2. Assessing the level of risk that remains after Ofgem's proposed reform of emergency gas cash-out arrangements;

3. Considering the range of potential measures in the UK gas market to mitigate risks that remain; and

4. Assessing the relative merits of each of these interventions, including the risks of market distortion, unintended consequences and initial views on cost-benefit comparisons. It also provides initial thoughts on how these interventions might be designed and implemented.

This annex to the report provides additional detail for the Government on potential intervention design options.

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Context

Since privatisation in the late 1980s, a competitive gas market in Great Britain has delivered secure supplies and witnessed high levels of investment. Since 2004, driven primarily by declining production on the UK Continental Shelf, Great Britain has been a net importer of gas and since then has relied increasingly on international gas markets. These international markets have so far been effective in supplying gas to Britain and investing in domestic infrastructure.

However, Ofgem has observed that there is some uncertainty over future developments in global gas markets. Some commentators have noted that gas markets may tighten over the coming years and opinion is divided over whether this situation will improve by the second half of this decade. Against this background, Ofgem has been looking to use the Significant Code Review (SCR) process to provide a greater incentive for firms to avoid a potential gas deficit in Great Britain.

In its Gas SCR draft decision document the Authority[1] stated its intention to pursue reforms to introduce capped emergency cash out. It added, however, that the capped approach could leave a gap in the emergency arrangements, leading - in the most extreme cases - to consumer disconnection. Ofgem noted that the Government might decide this risk was significant enough to merit further intervention in the gas market.

The Department of Energy and Climate Change (DECC) supported the Authority's conclusions and requested that Ofgem undertake a review of medium to long term security of supply and explore potential measures which could be undertaken.

[1] The Gas and Electricity Markets Authority (the Authority) exists to protect the interests of current and future gas and electricity consumers. Ofgem, the Office for Gas and Electricity Markets, was created by the Authority to support it discharge its duties. Everything undertaken by Ofgem is done in the name of the Authority, and the two terms are used interchangeably in this report.

Associated documents

Gas Security of Supply Report. November 2012.
http://www.ofgem.gov.uk/Markets/WhlMkts/monitoring-energy-security/gas-security-of-supply-report/Documents1/Gas%20SoS%20Report.pdf

Gas Security of Supply Report Risk and Resilence Appendix. November 2012.
http://www.ofgem.gov.uk/Markets/WhlMkts/monitoring-energy-security/gas-security-of-supply-report/Documents1/Gas%20SoS%20Report%20-%20Risk%20appendix.pdf

Redpoint Further Measures modelling report. November 2012.
http://www.ofgem.gov.uk/Markets/WhlMkts/monitoring-energy-security/gas-security-of-supply-report/Documents1/Redpoint%20further%20measures%20modelling%20report%20final.pdf

Proposed Final Decision - Gas Security of Supply Significant Code Review. July 2012. Reference number 111/12.
http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Documents1/120731_GasSCR_pfd.pdf

Impact Assessment for the Proposed Final Decision - Gas Security of Supply Significant Code Review. July 2012. Reference number 112/12.
http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Documents1/120731_GasSCR_IA.pdf

Draft Policy Decision - Gas Security of Supply Significant Code Review. November 2011. Reference number 145/11.
http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Documents1/Draft%20Policy%20Decision%20Gas%20Security%20of%20Supply%20Significant%20Code%20Review.pdf

Impact Assessment for the Draft Policy Decision - Gas Security of Supply Significant Code Review. November 2011. Reference number 146/11.
http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Documents1/Draft%20Impact%20Assessment%20Gas%20Security%20of%20Supply%20Significant%20Code%20Review.pdf

Project Discovery - Options for delivering secure and sustainable energy supplies. February 2010. Reference number 16/10.
http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=73&refer=Markets/WhlMkts/monitoring-energy-security/Discovery

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Appendix 4 – Descriptions of Further Measures

This appendix contains indicative designs of each of the options to show how they might work and how they could be implemented. Our views on design and key risks and benefits at this stage, before in-depth consideration and consultation of each of the options, are necessarily preliminary. In this appendix, we also summarise provisional analysis of each of the further measures including impacts on the probability of interruption, impacts on prices where relevant and some initial assessment of costs of the measures.

The provisional analysis of the further measures included in this appendix is based on assumptions that were used for the Counterfactual in the Gas SCR Proposed Final Decision document[2]. This is to allow like-for-like comparison between the measures and the Counterfactual.

The options considered in this appendix are:

- Information requirement
- Promoting standardisation of interruptible contracts
- Demand side response tender
- Back-up fuel requirements
- Financial reliability option
- Non specific service obligation on suppliers
- Service obligation on the system operator
- Storage obligation
- Semi-regulated storage
- Strategic stocks

[2] See: http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Documents1/120731_GasSCR_pfd.pdf

1. Information requirement

Option Overview

Option Assessment

1.1. The information requirement would focus on particular sections of the market where information asymmetries prevent all market participants from being aware of potential future market risks (eg on provision of information regarding interruptible contracts, liquefied natural gas (LNG) tanker destination or storage booking information). We would envisage further work with the industry to identify the kind of information that may be most useful, and the best way to present this to help market participants to ensure supply security. Once the nature of the information requirement is decided upon, holders of the relevant information would be required to allow the market to access the specified data. This system could also help promote new entry and competition from non-integrated players in the GB market.

Outline of the Option

1.2. Discussion with industry participants has revealed that information provision could be helpful in reducing asymmetries in the gas markets. This could lead to security of supply benefits or improve competition regarding security of supply measures which are already in place. Information requirements could be targeted at the supply side (eg provision of storage booking data) or at the demand side (eg requiring suppliers to inform the market of interruptible contracts they have in place).

1.3. Additional information availability may complement a number of the other options for further measures. Thus, the focus of design is intentionally left flexible until the most appropriate area on which to focus an information requirement can be determined.

Impact on Gas Security of Supply

1.4. The information requirement would be designed to assist the market allowing it to improve the way that it ensures an adequate level of security of supply is delivered. We would not envisage the information requirement to deliver a step change in security of supply in isolation but to support the market (or one of the other further measures options) in delivering the desired level of security. Thus the impacts of the option on security of supply have not been modelled.

Unintended Consequences

1.5. Theoretically, this measure could increase diversity of supply as market participants may be provided with more information. This may help them to identify opportunities to diversify supplies and ensure that, on a macro scale, provision of gas is more secure. The information provided may help to ‘level the playing field’ so that smaller suppliers could look to diversify supplies in a more cost effective manner.

1.6. There is a small risk that the option could place GB based companies (particularly large suppliers) at a competitive disadvantage to non-GB players (who will not be required to publicly share as much information) in the global gas market or that the exchange of information might otherwise impact competition. The nature of the information requirement will be important in this regard.

1.7. Another risk relates to the administrative burden associated with the information requirement. While this will depend on the exact nature of the information requirement, the level of burden should be considered and attempts made to ensure that this is not more onerous than necessary. The level of burden should be factored into considerations of whether any information requirement should be taken forward and compared with the perceived benefits when deciding whether to implement the information requirement.

Implementation Method

1.8. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply[3] and we envisage the implementation of an information requirement could be achieved through licence changes provided that the relevant information is held by licensees.

1.9. We estimate that development and implementation of the necessary licence changes would take two to three years to complete.

Interactions with the Electricity Market Reform Proposals

1.10. There is some concern that the Electricity Market Reform (EMR) proposals and gas cash-out reforms could act as contradictory incentives. One design of information requirement could be used to highlight if parties are conflicted under both regimes. For example, this could identify gas fired generators who have conflicting contracts in place under a capacity mechanism and under an interruptible contract with their supplier. This would provide the market with more certainty over how gas generation might act during a gas or electricity emergency.

European compliance issues

1.11. This could support the work currently being implemented as part of the regulation on energy market integrity and transparency (REMIT). Both measures improve information provision regarding the GB market.

Practicability

1.12. We would suggest a period of consultation with industry to determine what information would best benefit them in terms of delivering security of supply. It is likely that different stakeholders will have very different views on the kind of information that would be useful for them. The challenge will be to design an information requirement which provides most benefit to GB security of supply rather than being beneficial to one particular vested interest. Also, requesting information

[3] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

from industry in a useful and consistent format is never easy and there will be challenges with designing the information request appropriately.

Alternative option: Information provision to Ofgem

1.13. An alternative option is for the information request to be similar to voluntary information requests which have been issued by Ofgem on a number of occasions over the past two years. These requests, made to the 15 largest GB gas suppliers, request information on their winter supply and demand portfolios. These suppliers were asked to provide information based on a number of scenarios such as a 1 in 20 peak day. The SCR Draft Policy Decision document stated that this policy intervention could be made mandatory.

1.14. However, both the Draft Policy Decision and accompanying Impact Assessment raised a number of concerns over the measure. It was noted that the measure would not impact on market behaviour significantly and that collection of pre-winter contract information was not an accurate reflection of how the market may move during the season. Previous experience with information requests also suggests that it is very difficult to get meaningful information from the participants in the gas market in a consistent format.

1.15. If it was considered that this form of information provision should be re-introduced then the key design question would be how to revise this mechanism to make it more effective in terms of exactly what information we would require companies to provide. If it was decided to take this measure forward, we may want to target this form of information provision at obtaining information on how market players cover their demand requirements and whether there is a reliance on spot market purchases on the national balancing point (NBP) at an aggregated market level.

Design Considerations

- *Timing* - The pre-winter timing of the information collection has been criticised as not providing an accurate picture of gas contracting. Companies could also procure for the target date to demonstrate behaviour they believe to be desirable before amending their supply strategy following provision of the information. As a result, it may be preferable for data collection to be performed at random points or on an ongoing basis.

- *Use of the information* – An information requirement may not provide additional value if it is too similar to the information gathering exercise conducted for National Grid's Winter Outlook. Publication of the information might be more effective if done to either improve market processes or ensure that companies are reacting to the cash-out price signal (or meeting other obligations that it may be necessary to place upon the market). However there is still a question of whether this information would be most useful to Ofgem or to National Grid Gas (NGG). One option would be to provide this information (additional to the Winter Outlook information) to NGG so that it is able to better predict challenges for the coming winter.

- *Public or Private* – One of the key decisions will be whether we publicly announce the results of the information provided and legal issues around the publication of potentially sensitive/strategic data would need to be considered. Although industry might favour a system of warnings issued directly by Ofgem (in order to ensure they are able to maintain their competitiveness in a global gas market) it is unlikely that there would be public support for this approach. As such, it is likely that these assessments would have to be made publicly. One option would be to receive the information at a granular level, but to provide it to the market in an aggregated form. This would allow the market to interpret and act on this information as it wished. This should help to address issues around the impact that an information provision could have on the competitive position of market players.

- *Information Required* – To some extent this would have to be determined both through consultation with industry and with regard to the risks we are hoping to militate against. This may be one of the most time consuming aspects of developing this mechanism.

2. Promoting standardisation of interruptible contracts

Option Overview

Option Assessment

2.1. Promoting the standardisation of interruptible contracts could potentially support the negotiation of these types of contracts between suppliers and consumers. Standardisation could help to provide greater certainty to market participants, a facility for cross sector assessment and price discovery to demand side participants for example. The development of a market for commercial interruptible contracts may help to reduce the risk of firm outages during a gas defecit emergency (GDE). However, there would be no guarantee that this option would deliver a particular volume required to meet a security standard if introduced in isolation.

Outline of the Option

2.2. When negotiating interruptible contracts, suppliers could be required to offer terms or accept a request from customers for terms to be offered in a common format, or following a set of guidelines. However, suppliers and customers could be free to negotiate away from these guidelines or templates if they see value in doing so.

2.3. For example, a common contract framework may clearly define, but leave open to negotiation, variables such as: trigger for interruption, volume of gas offered, exercise/option fee, ramp down rate, cap on duration, cap on frequency, notice period for ramp down and penalties for non-compliance.

2.4. More standardised interruptible contracts could be more easily traded under normal market conditions. This would enable suppliers to interrupt customers in a more economically efficient order ahead of firm load shedding under a GDE.

Impact on Gas Security of Supply

2.5. Promoting the standardisation of interruptible contracts could help to support the Gas SCR in developing a market for interruptible contracts. We would not envisage the measure to deliver a step change in security of supply in isolation. Rather, it would provide some support for the DSR benefits envisaged under the Gas SCR. Thus the impacts of the option on security of supply have not been modelled.

Implementation Method

2.6. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply[4] and changes to the supply

[4] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

licence could be made here. Changes to the Uniform Network Code (UNC) would also need to be considered.

2.7. We estimate that discussion and agreement of the design of the measures to promote standardisation of interruptible contracts and implementation of the necessary licence changes would take between two to three years to complete depending on the nature of the measure.

Interactions with the Gas Significant Code Review

2.8. Promoting the standardisation of interruptible contracts would complement the incentives placed upon suppliers through the reforms proposed under the Gas SCR. These incentives should encourage suppliers to provide more suitable terms for interruptible contracts, which customers should be willing to sign. However, stakeholders have suggested that some non-economic barriers may remain to signing interruptible contracts. Increased standardisation may provide some assurance to customers that the nature of the terms that they are signing up to are consistent with those supported by the central body and may help to simplify the process and ease of comparison between suppliers.

Practicability

2.9. Promoting standardisation would place a low cost burden on the industry and would be relatively simple to implement. However, there could be some process/legal issues during the development of the contracts with different vested interest groups keen to design the contract guidelines or templates in a different manner, leading to greater complexity. This could prevent them from being as simple, transparent and comparable as intended.

Unintended Consequences

2.10. There is a low risk of unintended consequences associated with the promotion of standardisation of interruptible contracts alone. However, if the parameters of any contract guidelines or templates are defined too narrowly, this may curb innovation of interruptible terms.

2.11. In addition, if mechanisms to support this intervention were introduced (eg the trading of interruptible contracts or an obligation on suppliers to agree a certain volume of contracts) there could be a greater risk of unintended consequences.

3. Demand side response (DSR) tender

Option Overview

Option Assessment

3.1. A DSR tender could support the incentives introduced under the Gas SCR reforms by helping to deliver the potential for interruptible demand envisaged under the Gas SCR. This would reduce the risk of a GDE occurring and improve the economic efficiency of gas load reduction. The tender would be designed to secure a certain volume of interruptible demand availability needed to meet a defined requirement. To appropriately set this level of requirement the expected potential and interest from the demand side in such a tender would need to be taken account of.

Outline of the Option

3.2. We have developed the following indicative design to set out how the DSR tender might work:

- **Governance:** Run by National Grid Gas (NGG) who request supply reduction from tranches of consumers in order of the exercise price under a number of tranches (lowest exercise price tranche first).
- **Timing and Frequency:** Annually, held pre-winter for the winter ahead.
- **Cost assignment:** The costs of running the tender (including the option and exercise payouts and the administrative costs) would be paid for through the System operator's (SO's) price control and passed on to all users of the system through system charges.
- **Participation:** Large industrial and commercial (I&C) customers (not including large scale gas-fired generators) who can meet the specified entry requirements. Aggregators can also participate on their customers' behalf. There would be no obligation to participate. Customers may bid in part of their load rather than 100% load reduction.
- **Contract type:** Set number of tranches with administratively set exercise fee. Customers are able to bid in at the corresponding option fee that they would require as an ongoing payment in order to provide a demand side response with the set exercise fee as the trigger for interruption. NGG will set a required volume for each tranche of option and those who bid in the lowest option fees will be successful in entering into each tranche of the tender.
- **Required volume:** A required volume needs to be set for each tranche to deliver the specified security of supply level. The required volume would be determined by NGG. This would be achieved by identifying the gap between the level of security of supply being provided and that desired for firm demand customers, up to the maximum potential which is considered to exist within the market. This would take account of the potential interest amongst daily metered (DM) customers for entry into the tender. It may be possible for the volume requirement to be increased over time as competition to enter the tender increases.
- **Trigger:** Announcement of a gas balancing alert or other security of supply event. Under these circumstances reducing load in the order of customer's

bids is a tool for the SO (rather than being mandatory) if it is considered by them to be the most cost-effective option to avoid a GDE. NGG would firstly disconnect customers who had bid into the first tranche (i.e. lowest exercise price) in the order of their option price bids taking off the customers with the highest option prices first and would then disconnect customers from the subsequent tranches in the same order of bids.

- **Gas-fired generation eligibility:** Given the current generation mix and the potential for the electricity generation mix to switch from gas to coal or distillate fired, many large scale gas-fired generators would make a commercial decision to reduce gas consumption as the wholesale gas price rises pre-emergency. As many gas-fired generators are supplied by the same company who own that generation, the proposed DSR payment reforms proposed under the Gas SCR are unlikely to impact these decisions as shippers would be paying themselves as customers of their gas. Under the proposed Gas SCR reforms, shippers, and in turn suppliers, would already have strong incentives to reduce gas demand from their gas-fired plant to reduce the risks of being short and to have additional gas available to sell to the market at prices which they would expect to be high. Therefore we do not believe that substantial additional demand side response would be provided by allowing large scale gas-fired generators to enter the tender. If the role of gas-fired generation increases in the future then the potential for gas-fired generation to provide additional DSR may also increase (although at the cost of electricity interruptions). Therefore the delivery body may want to revise this position in the future.

3.3. All eligible DM customers would have the opportunity to bid into a DSR tender[5]. In the event of a GBA (or other security of supply event), NGG would have the option to instruct the relevant tranche of customers to reduce load with tranches being instructed in order of the exercise price under that tranche (lowest first). Within one tranche there would be no defined order of load reduction. This should act as a buffer to firm load shedding and reduce the risk of entering into a GDE.

Impact on Gas Security of Supply

3.4. A key assumption of the Gas SCR modelling has been that two thirds of DM customers would respond to the incentives introduced through the proposed Gas SCR cash-out reforms by signing up to interruptible contracts with suppliers. This provides a significant benefit to security of gas supply under the modelling.

3.5. The basis for implementation of a DSR tender would be to support the proposed Gas SCR reforms. The tender would be used as a tool to complement the incentives being considered under the SCR. Therefore, the modelling results for the DSR tender do not differ materially compared to those observed for the Gas SCR reforms. Differences in modelling results are due only to the wholesale price levels at which the voluntary DSR services would be taken off the system which would be defined more rigidly by a DSR tender. The results below suggest that differences in

[5] With the full roll-out of automated meter read (AMR) advanced meters to all industrial and commercial customers by 2014, greater DSR potential may exist. This may require the use of aggregators who would also be eligible to participate in the DSR tenders if they could demonstrate the necessary eligibility requirements.

the probability of interruption, and the impacts on un-served energy, between the two, are too small to be statistically significant.

Probability of interruption

	Gas SCR mean[6]	DSR tender mean
Firm daily metered (DM) gas	1 in 128	1 in 129
Non daily metered (NDM) gas	1 in 167	1 in 167
Firm I&C electricity	1 in 75	1 in 75
Domestic and small and medium enterprises (SME) electricity	1 in 333	1 in 400

Un-served energy (and cost of un-served energy)

	Gas SCR mean (million therms per year, (£m))	DSR tender mean (million therms per year, (£m))
Firm DM gas	0.027 (0.5)	0.025 (0.4)
NDM gas	0.621 (12.4)	0.619 (12.4)
Firm I&C electricity	0.027 (1.6)	0.027 (1.6)
Domestic and SME electricity	0.003 (0.2)	0.004 (0.3)

Costs of the measure

3.6. The costs of the DSR tender will be made up of three components:

- The option fees that successful tender participants receive annually in return for the potential for them to be taken off the system by the SO under the tender.
- The exercise fees that will be paid to successful tender participants in the event that the SO reduces the supply of gas to that customer.
- The administrative costs of running the tender.

3.7. The design of the option set out above would require the exercise price to be set administratively for a number of tranches of customer. For the purposes of

[6] Note that the modelling of the Gas SCR security of supply benefits assumes that two thirds of daily metered volume will become commercially interruptible as a result of the Gas SCR reforms.

modelling we have set two tranches of tender to coincide with the two lower tranches of I&C customers (representing approximately two thirds of I&C customers) that were identified in the London Economics[7] study of value of lost load for different sectors of customers. The exercise price for each of these tranches is set at 75% of the average value of lost load (VoLL) for that customer tranche.

3.8. The model then determines the average option price that rational customers would bid to enter each tranche given the expected probability of disruption for successful tender participants, assuming that these customers are risk neutral. As an output, the model also provides data setting out the probability of customers in the tranches who are part of the tender being interrupted. From this information the costs can then be determined by taking the sum of the option prices for each tranche, combined with an average of the exercise fees that will be paid out as a result of the volume of interruption in any year. Results of the costs of the tender averaged over the three spot years modelled are provided below:

Customer tranche	DSR exercise price (£m/mcm)	Option fee (£m/mcm/yr)	Total option fees (£m)	Expected volume of interruption (mcm per year)	Total exercise fees (£m)	Average total cost /year (£m)
I&C Gas tranche 1	0.88	0.00076	3.23	5.28	4.63	7.86
I&C Gas tranche 2	1.84	0.00026	1.41	0.72	1.33	2.74
Total			4.65	6.01	5.96	**10.61**

3.9. While the costs of the DSR tender appear to be relatively small at only £10.61m/yr, it should be noted that only 6.01mcm/yr is exercised on average each year. Thus the actual cost/mcm of interruptible gas exercised is relatively high at £1.77m/mcm of gas exercised each year (equating to 481p/therm). However, initial analysis of the tender suggests that it may provide a relatively low cost method of providing additional certainty that the DSR levels envisaged under the Gas SCR reforms will emerge.

3.10. The administrative costs of setting up the tender are expected to be low compared to the option and exercise costs and thus are assumed to be negligible.[8]

<u>Impacts on price trends</u>

3.11. We do not expect that this option would have a significant impact on price trends ahead of pre-emergency tight system conditions (under which the DSR tender would be exercised), compared to prices with the Gas SCR reforms in place. Once

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[7] The London Economics report 'Estimating Value of Lost Load' can be found here: http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Documents1/London%20Economics,%20Estimating%20Value%20of%20Lost%20Load%20-%20Final%20Report%20to%20Ofgem.pdf

[8] An estimate of the costs of running the tender can be made by considering the costs to NGG of running the Short Term Operating Reserve tender. A recent assessment estimated these costs to be approximately £20,000 per annum.

the DSR under the tender is exercised we would expect lower demand on the gas system to dampen the wholesale price slightly. The extent of this effect will depend on the volume of gas required to be taken off the system. This effect would last until there is sufficient gas supply to restore any interrupted customers. Thus the tender could cause a slight reduction in volatility under very tight supply/demand conditions. The low likelihood of a significant amount of DSR being exercised under the tender would suggest that the impacts of this occurring would be small. We would not expect this to impact on forward price curves for example.

Challenges and potential unintended consequences

3.12. NGG has some reservations about a DSR tender. NGG highlight that the collective volume that customers may indicate that they would be able to offer in the event of an emergency may not actually be available in practice in the short amount of time required for demand reduction. This concern should be eased to some extent by working closely with NGG to define the eligibility requirements for entry into a tender. Penalties for non-compliance in the event of NGG calling on load to reduce demand may also need to be introduced.

3.13. There is a risk that the DSR tender could crowd out some of the demand side response that may otherwise emerge following introduction of the Gas SCR cash-out reforms. This could reduce economic efficiency and could also act as a limit on the level of additional security provided.

3.14. As the DSR tender is essentially a technology specific intervention, there is a risk that it could 'pick winners' at the expense of efficient delivery of an equivalent level of security of supply. Focusing on the demand side may help to encourage the emergence of low cost demand side response that may otherwise not be delivered. However, it should not be assumed that a DSR tender would necessarily be a lowest cost approach.

Key further considerations

Outstanding Design Requirements

- *Tender design and parameters:* We have set out an indicative design of the option as part of the modelling, including for example, exercise prices for two tranches of customer. However, in practice we would envisage a further piece of work with the industry to design the tender and develop the most effective set of parameters to ensure that the tender encourages the level of DSR required to meet a specified security of supply level at minimum expense.

- *The volume requirement:* The required volume is one particular parameter that would need to be agreed through further research. This should be set by NGG to meet the gap identified between the level of security of supply provided to firm gas load customers and that desired. This would need to take account of the potential and interest of the demand side in providing demand side response services in order to set an upper bound limit to the potential DSR that could be provided. Setting the volume requirement administratively could risk setting an inefficient level. Setting this level too high may lead to a lack of competition to enter the tender whereas setting the threshold too low could deliver an inefficient result. It may be necessary to have a relatively low volume requirement initially to stimulate competition, with the option to increase this requirement over time as competition emerges and customers have the opportunity to invest in back-up facilities. We would suggest further work to assess the potential for participation into the tender.

- *Paid as bid or clearing price:* Those successful in entering the tender could be paid the option price at the level that they bid or at the clearing price (i.e. the maximum successful bid). As all customers within a tranche have the same likelihood of having their load curtailed following the exercise of the tender by NGG, it may be more reflective to set the design as a clearing price. However, the relative merits of both approaches should be investigated further before confirming which would be more effective.

- *Number of tranches:* There is a balance to strike between having a larger number of tranches and increasing the complexity of the tender. More tranches would allow for greater granularity of exercise price and order of interruption essentially increasing efficiency of the auction. However this would also increase the complexity of the tender to consumers making it more difficult for them to identify the appropriate tranches to bid into.

- *Eligibility criteria:* Some basic eligibility criteria need to be set to ensure that customers entering the tender are able to provide a useful demand side response service to the SO at relatively short notice. To ensure safe and reliable exercising of the DSR contracts in order to provide the required security of supply benefits we would envisage a piece of work being taken forward together with NGG to ensure that the eligibility requirements are appropriate. As mentioned previously, penalties for non-compliance in the event of NGG calling on load to reduce demand may also need to be introduced.

- *Contractual arrangements:* The DSR tender would involve NGG contracting directly with customers to allow for NGG to direct load reductions ahead of an emergency (although see below in relation the limitations which are being considered in this regard). This may raise conflict with the contract that the customer will already have in place with a supplier. For example, some way of paying the supplier for the lost revenue resulting from the reduction in gas supplied to the disconnected customer may need to be developed. There are likely to be parallels with reforms to the emergency arrangements under the Gas SCR. The proposed Gas SCR arrangements should provide a useful straw man for how to tackle this issue.

Implementation Method

3.15. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply.[9] An obligation could be placed on NGG to run the tender through changes to licences and the UNC. NGG would not typically contract directly with customers so the detailed design would need to consider the involvement of shippers and suppliers (and any necessary changes to licences and codes in that respect) in the process. Additionally, NGG

[9] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

contracting directly with customers may raise conflicts relating to the contracts that suppliers already have in place with these customers.

3.16. We estimate that further policy development and implementation of the necessary codes and licences would take three to four years to complete.

Interactions with the Gas Significant Code Review

3.17. In line with the Gas SCR proposed final decision, firm customers who do not enter the tender would receive NDM VoLL if they are interrupted involuntarily by NGG. This may dampen the incentives on DM customers to participate in a tender given that they may be missing out on the £20/therm they would otherwise receive. However, those who are willing to provide DSR should have the incentive to do so given the ongoing option payments provided to them, which should reflect the lost opportunity cost of receiving VoLL in an extreme security of supply event. For many customers we would expect these benefits to outweigh the very small likelihood of receiving a demand side response payment as a result of being interrupted involuntarily as part of a GDE.

3.18. There is a risk that the DSR tender could crowd out some of the demand side response that may otherwise emerge following introduction of the SCR cash-out reforms thus reducing economic efficiency and the level of additional security provided.

Interactions with the electricity market

3.19. The design that we have set out above would not allow gas-fired generation to enter into the tender. However this is one area where further research and stakeholder engagement may suggest an alternative approach.

3.20. If gas-fired generators are allowed to enter into the DSR tender there may be important interactions with the electricity market. Gas-fired generators that participate in the electricity capacity mechanism under the EMR will face penalties if not available at specific times. This may restrict their ability or reduce their incentives to participate in a DSR tender as they may be unwilling to have their load reduced. These customers are likely to make an economic evaluation of the costs of non-compliance when determining at what level they would enter into the tender.

3.21. Whether or not gas-fired generators are allowed to enter the tender, there may be scenarios under which NGG instructs this generation off the system. If gas-fired generation is eligible to enter the tender then this may occur earlier (i.e. following the DSR exercise trigger). If not eligible then this would occur upon entry into firm load shedding. While reducing load from gas fired generation may benefit gas security of supply, the reduced generation capacity may lead to an electricity supply shortfall.

4. Back-up fuel requirements

Option Overview

Option Assessment

4.1. A number of gas-fired generators have the capability to switch from gas generation to another fuel type (the main alternative fuel being distillate fuel-oil). By keeping emergency alternative fuels on site these plants are able to interrupt their gas supply for a number of days during times of gas market tightness; instead burning the alternative fuel to generate power.

4.2. Under this option, gas-fired generation would be required to install distillate back-up (or some other form of alternative fuel) so that it could continue to run on alternative fuel thus reducing its demand for gas when supplies are tight without a consequent effect on electricity supply.

Design Considerations

- *Targeted parties* - The intervention could be targeted at only new-build gas generation, all gas-fired generation including those already in service or could be wider ranging and include all gas consumers above a certain volume. While the measure would be most effective if it targeted all major gas consumers, a number of sites, including many existing gas-fired generators would have significant practical and planning problems with fixing the required technology. Thus it may be necessary to only apply the requirement to new-build generators.

- *Technical requirements* - A requirement would need to define the speed at which the plant could switch to the back-up fuel and the duration for which it could continue to use back-up fuel without receiving gas.

- *Timing of the requirement* - It is likely that such a requirement would be tied to the winter period given that different types of oil are required during each period and it may be inefficient to continue this requirement into the summer months.

- *Type of fuel* – The majority of back-up facilities in place, both now and in the past, have used distillate fuel-oil as the back-up fuel. Therefore a back-up fuel requirement may specify this type of fuel as the back-up required to ensure consistency of back-up capability. However there could be an argument for leaving the decision of which type of fuel to use open to the generator. This may allow some parties to identify a more cost-efficient fuel for the design of their generator.

Impact on Gas Security of Supply

4.3. Gas-fired generators would be some of the first consumers to reduce their gas demand in the lead up to an emergency as a result of a commercial decision in response to rising prices. In addition, they would be some of the first taken off the system by NGG under firm load shedding within an emergency due to their level of consumption (NGG would firm load shed customers in roughly size order). Therefore, the installation of back-up facilities will not provide any significant additional security of supply to gas consumers (as gas-fired generators would have reduced its load whether or not the back-up facilities were in place). However, the back-up facilities would allow this generation to reduce its gas demand while still allowing the plant to generate electricity. Thus, back-up fuel requirements would provide an electricity rather than a gas security of supply benefit.

4.4. While the interactions between gas and electricity are an important consideration for this report, our initial analysis of further measures focuses on gas security of supply. The design of the model reflects this focus and, as such it was not felt prudent to model the back-up fuel requirements option given that it benefits electricity rather than gas security of supply. The option has been included in this report for completeness.

Implementation Method

4.5. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply[10]. Changes to the generator licence would be relevant here. Engagement with the Helath and Safety Executive (HSE) and the Environment Agency would also be needed. We estimate that further policy development and implementation of the necessary codes and licences would take three to four years to complete.

Interactions with the Gas SCR

4.6. In providing a requirement on gas generation to install back-up fuel, the amount of demand side response prepared to reduce gas demand ahead of an emergency should increase. However, stakeholders have suggested that the majority of gas-fired generators are self supplied and respond to prices in determining whether they should continue to consume gas and generate electricity. Therefore it is likely that these customers would make a commercial decision to come off the system in response to increasing gas prices in any case. In addition, gas generation would be amongst the first gas consumers to have their load reduced under firm load shedding by NGG. Thus implementing this option would not provide additional protection to firm load gas customers but would instead provide protection to electricity customers who may otherwise be disconnected as a result of gas generation coming off the system.

Interactions with the electricity market

4.7. While back-up requirements may not enhance gas security to a great extent due to the reasons set out above, it is more likely to enhance electricity market security.

[10] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

4.8. Back-up requirements would also help to mitigate potential conflicts that may be introduced between the Gas SCR capped cash-out reforms and the capacity mechanism proposals under the EMR. By allowing gas-fired generation to continue generating without requiring additional volumes of gas, these generators should be able to provide a demand side response by reducing gas supplies while still complying with obligations placed upon them under the capacity mechanism.

European compliance issues

4.9. Distillate oil back up should not be affected by the Electricity Market Reform's Emissions Performance Standard. The Industrial Emissions Directive (IED) would not prohibit the use of distillate oil back-up but there will be strict emissions limit values to comply with. We understand that in the event of a sudden interruption in the supply of gas, Ministers would be able to grant a derogation from these emission limits for a very short period of time. The IED is still pending transposition in the UK so this will need to be kept under review.

Practicability

4.10. Many gas-fired generators used to have distillate back-up attached. However, discussion with stakeholders has suggested that some of these plants have removed their distillate back-up facilities and that it is not common for new build gas generation to fix distillate back-up to their plant.

4.11. According to Poyry's March 2010 report into Security of Supply[11], there were 15 gas-fired generators with distillate back-up in GB at this time. The report also showed that of the nine plant committed to be built, only two were intended to have back-up facilities (Immingham 2 CHP & Langage). Much of the plant with distillate back-up is likely to be shutdown over the next 15 years or sooner as they have become increasingly uncompetitive as a result of environmental legislation.

4.12. Where back-up facilities are not already in place it may be a lengthy and costly process to attach this to existing plant. This may suggest that any requirement should only be made on new plant, however this raises the question of the value of the intervention.

4.13. In addition, there may be questions about the response time of plant with back-up fuel given the lead time in switching from one fuel to another. There is also a question around the duration for which the plant could continue to run on back-up fuel which would be dependent on the level of stock that the plant was required to hold in store.

Unintended Consequences

4.14. Given the costs and time required to install back-up facilities, as well as the difficulty in getting planning permission for the required infrastructure, the introduction of a back-up fuel requirement could have a negative effect on the extent

[11] Poyry's report can be found here: http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20markets/gas_markets/114-poyry-gb.pdf

to which gas plant is price competitive and thus could impact upon investment in this area. This could compound existing poor spark/dark spreads to further reduce the level of investment in gas generation.

4.15. Under a worst case scenario, costs and/or planning constraints could lead some existing generation to close earlier than it otherwise would, thus impacting negatively on electricity supply security.

4.16. In addition, there could be unintended consequences on competition associated with the option. If targeted only at new build generation then this would put new generators at a cost disadvantage compared to existing plant pushing them down the merit order. If targeted at all generators it should be noted that some plant already have distillate back-up attached and that this plant would be provided with a distinct competitive advantage over plant that was required to install it.

5. Financial reliability option

Option Overview

Option assessment

5.1. Financial reliability options should theoretically incentivise investment in forward gas supplies and/or infrastructure that may enhance security of supply. Reliability options could be beneficial if it is believed that the market is undervaluing the true cost of providing the peak supplies that consumers would be willing to pay for or if consumers are not able to express their long term risk preferences. By allowing the market to decide how best to meet the perceived shortfall in peak supply, it should be cheaper than an approach that mandates a particular technology type as the solution. Due to the difficulty of effectively monitoring a physically-backed regime this option would deliver financial contracts and, as such, would not guarantee physical delivery.

Outline of the option

5.2. We have developed the following indicative design to set out how the financial reliability option might work:

- **Security of supply level:** Contracts would be signed between suppliers and a countersigning party whereby suppliers would pay an ongoing reliability fee to the countersigning party. That party would then provide a payment back to the supplier in the event that the wholesale price rose above the defined trigger price. The volume covered under the option, and the strike price, would be defined to meet all firm load customers. However, rather than set a strict security of supply level that must not be breached, this provides an incentive on the market to hedge against the risk of this level being breached. It is possible however that the market may decide that it is more economic to allow the level to be breached rather than invest to avoid this occurring. Thus the option is more of a market-based incentive mechanism than a strictly defined security of supply level.
- **Governance:** NGG would be responsible for determining the volume requirement and strike price of the reliability option and for administering the scheme. In the event that the countersigning party failed to deliver the payouts to suppliers as a result of the strike price being exceeded (as a result of financial distress for example) the required funds would be recovered from other counter-signing parties.
- **Volume requirement:** NGG would calculate the volume of gas covered by the reliability options, defined as all firm load during peak periods. The methodology used to set this volume would be well defined to aid transparency. NGG would also set a strike price (representative of a tight market) for these options. The strike price would be set slightly below the lowest firm load customer VoLL. This would reflect the fact that those customers who enter into reliability contracts are being paid an ongoing option fee in return for a slightly lower exercise fee than they would otherwise require in the absence of these option payments.

- **Timing and frequency:** Tender process for yearlong gas option contracts run annually by a central body.
- **Participants:** Subject to meeting a set of entry requirements, including credit requirements for example, any party is able to bid into the process, whether or not they have a shipper licence.
- **Options contracts:** Successful participants in the tender process would receive an option payment based on the tender clearing price. When the reference market price rises above the strike price, the successful tenderers would have to pay back a sum of money to the supplier with whom they are contracted.
- **Cost assignment:** The cost of the option payments would be passed onto suppliers – based on peak demand of the supplier. Payments would be made from sellers of reliability contracts to suppliers in the event that the wholesale gas price exceeded the strike price.
- **Netting:** Netting is not included as part of our indicative design.

How the option would work

5.3. The option would be of a similar design to that initially proposed by the DECC for the electricity capacity market under its EMR proposals. NGG would follow a clear methodology to determine the volume of reliability options required based on an assessment of peak demand and the required level of supply security. A strike price would be set annually, representative of scarcity during peak periods. For our indicative design we assume that this would be set slightly below the lowest VoLL of any firm customer. The rationale for this is that prices approaching VoLL are indicative of an emerging scarcity situation. Also, this approach could provide an incentive for demand-side participation, with the annual fee paid to participants enabling them to make the necessary investments to reduce the short run cost of interruption.

5.4. Following this process, a tender would be held to procure (on behalf of customers) the required volume of reliability options. Under this tender, a party would bid in with the option fee that they required at the strike price set by NGG. Participants with a successful tender bid (sellers) would receive an option fee based on the tender clearing price but should the reference market price[12] rise above the strike price they would pay out a sum of money to suppliers. Any party could bid into the tender process – as such the mechanism would not have to be limited to shippers.

5.5. With the option payment incentive and with the risk of exposure under the payment from the counter-signing party to suppliers if the strike price is exceeded, sellers of reliability options would be incentivised to offset their exposure, for example by investing in forward physical supplies.

5.6. Option fees would be charged to suppliers, based on the projected market share of each supplier. This could be reconciled at the end of the year to reflect their true market share. Payouts generated under the mechanism would be distributed evenly amongst all suppliers through the same route[13].

[12] The reference market could be the On-the-day Commodity Market or the cash-out price.
[13] This approach would, in theory, incentivise suppliers to limit their demand during peak demand periods.

Impact on Gas Security of Supply

5.7. Modelling of the reliability option measure makes a number of assumptions about the response of the market to the incentives placed upon it. The option design used for the model sets the volume to cover all firm load gas customers. The strike price is set at 75% of the lowest VoLL of these firm load customers, equivalent to 1246 p/therm. In addition to the volume and strike price parameters, a key assumption is that the financial incentives placed on market participants will lead to an equivalent physical response if this is considered most appropriate[14]. Where the cost of the hedge is higher than the expected payout for exceeding the strike price however, the model assumes that no hedging action is taken but that contract counterparties will pay out the penalty for exceeding the strike price instead. The second simplifying assumption is that the physical response resulting from hedging actions will be delivered solely through additional short range storage (SRS).

Probability of interruption

	Gas SCR mean	Reliability option
Firm DM gas	1 in 128	1 in 188
NDM gas	1 in 167	1 in 273
Firm I&C electricity	1 in 75	1 in 125
Domestic electricity	1 in 333	1 in 750

Un-served energy (and cost of un-served energy)

	Gas SCR mean (millions therms per year, (£m))	Reliability option mean (millions therms per year, (£m))
Firm DM gas	0.027 (0.5)	0.016 (0.3)
NDM gas	0.621 (12.4)	0.469 (9.4)
Firm I&C electricity	0.027 (1.6)	0.012 (0.7)
Domestic electricity	0.003 (0.2)	0.000 (0.0)

[14] In reality, the financial incentives placed on parties may not lead to an exactly equivalent physical response. This could be the case for a number of reasons including market participants' approach to risk, financial rather than physical insurance investment, etc.

5.8. The modelling suggests that designing the option in this way would provide some benefit to all tranches of consumer. This results from the incentive on contract counterparties to avoid tight supply/demand margins which may cause the wholesale price to rise above the strike price, which would require payouts to be made from counterparties to suppliers. In order to avoid this, modelling suggests that the economically rational physical response provided will lead to the provision of 121 mcm of new SRS with deliverability of 10 mcm/day. The additional gas volume and deliverability provided would lead to the security of supply benefits shown.

Costs of the measure

5.9. The costs of this option will depend on the reaction of the market in providing physical back-up to hedge against exposure to payments required and on the nature of this response. This could be investment in physical response that could increase deliverability of gas, eg short range storage, or those that reduce price risk while not providing an increase in supply capability, such as additional long term gas supply contracts. In the modelling we have assumed for simplicity that this is short range storage.

5.10. Modelling of the option has assumed that all parties are risk neutral in their response to the measure and that counterparties will make an economically optimal decision of whether to invest in storage or take the risk of having to make the expected payments as a result of exceeding the strike price under the option.

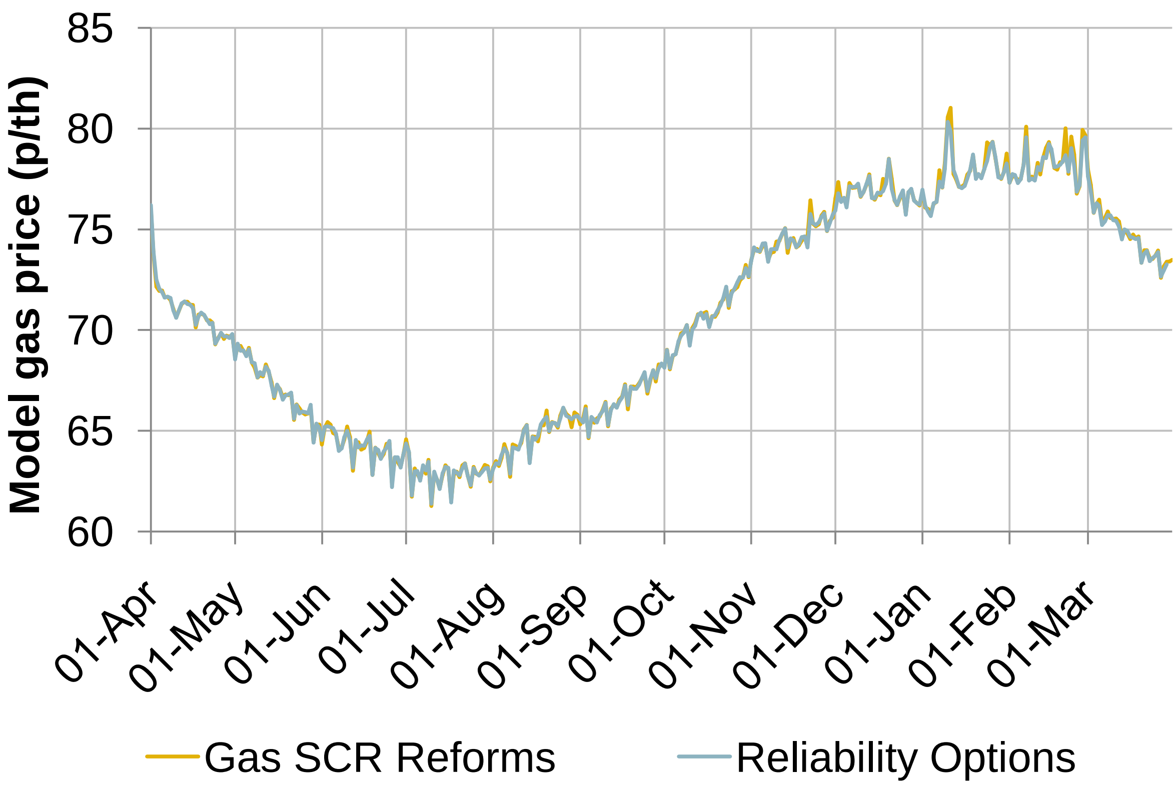
5.11. Based on these assumptions, the modelling suggests that the financial reliability option would lead to 121 mcm of additional salt cavern SRS with a deliverability of 10 mcm/day. Our cost estimates suggest that this would require a total capital expenditure (including the cushion gas required) of £116m. Estimates of annual operating costs for this type of storage range from £0.01/mcm to £0.06m/mcm. Thus an average operating cost for this volume of storage would be approximately £4.24m/yr.

5.12. The annual expected payout from sellers of reliability options to suppliers is £9.9m on average over the two spot years modelled. Assuming risk neutrality (and perfect foresight), we assume that the annual option fees are equal to this amount.

Volume covered (mcm)	Reliability option strike price (p/therm)	Volume of gas delivered by hedging (mcm)	Deliverability of gas delivered by hedging (mcm/day)	Capital costs of hedging storage (£m)	Operating costs of hedging storage (£m)	Expected annual option fee payment and counter party payouts (£m)
228.5	1246	121	10	116	4.24	9.9

Impact on prices

5.13. The graph below shows wholesale prices over the year 2020 averaged over the 1500 iterations modelled. This shows that at times of peak prices (where the wholesale price under the proposed SCR reforms is more likely to rise above the 1246p/therm strike price up to £20/therm VoLL) the reliability option leads to a slight dampening of peak prices over the year. This trend is particularly noticeable in the winter where peaks in prices are more likely to occur. However, the reduction in prices at this time may lead to a slight increase in average wholesale price over the summer period which may reflect the hedging actions of counter parties i.e. filling up the additional storage volume available.



Challenges and unintended consequences

5.14. Discussion of the option internally, and with stakeholders, has noted that a key challenge of the report is with defining and implementing it to ensure it delivers the desired incentives.

5.15. One particular challenge, and a potential area for unintended consequences is in setting the volume and strike price. Estimating the price risk preferences of customers is particularly difficult and subject to uncertainties and inaccuracies, for example due to the wide range of values of lost load estimates observed in the industry. Thus setting an appropriate strike price may be particularly challenging. If the strike price is set too low, the option may place a large financial cost on the industry which would be reflected by an unnecessary increase in consumer bills. The methodology that is used to set the strike price and volume will need to be well defined so that it is understandable for market participants.

5.16. As previously noted the financial incentives placed on market players under the mechanism may not be backed up with physical supplies of gas. This could be for a number of reasons including a miscalculation of the risk, which could lead to not building the appropriate level of physical response into investment. Alternatively, this could be because of possible involvement of financial speculators as contract counterparties who enter into contracts without backing this up with physical supplies. In addition, we note that many suppliers in the gas market are also shippers. Unless restrictions are placed on parties contracting with themselves under the design, the incentives to avoid the strike price may be undermined. Therefore, a purely financial reliability option may not necessarily be depended upon to achieve the required physical security of supply margin. Also, because these options are potentially risky instruments there could be a problem with the supply side not wanting to bid into the process. If they do bid into the process, the difficulty in valuing the option contracts could lead to uneconomic pricing of the option contracts.

5.17. Further, depending on the design of the option, and in particular whether a lead time is included ahead of the first year of delivery of the tender, there may be resulting impacts on industry investment. The idea of fixing a lead time would be to allow the market to make the necessary investment to adjust to the incentives put in place before the first tender is run. However, this lead time could lead to a converse approach in which investment that would otherwise be made is delayed to maximise the benefit resulting from the reliability option tender.

Key further considerations

Implementation method

5.18. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply.[15] The final design and operation of this mechanism could be implemented through changes to the UNC, and licences such as amendments to the NGG licence to run and administer the scheme although it would be necessary to consider whether any aspect of the design might require a basis in legislation.

5.19. In order for the market to react and deliver investment in physical infrastructure to meet any additional deliverability requirements the first tender may need to take place a number of years in advance of the first year of implementation. However, there may be inconsistencies with the provision of this initial lead time on the tender and the use of annual contracts.

5.20. Given the challenges surrounding development of this design option we would expect policy development and implementation of the necessary codes and licences to take four to five years. Any investment response of the market as a result of the incentives provided would take a further period of time dependent on the nature of the investment response.

[15] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

Interactions with the Gas Significant Code Review

5.21. The objective of reliability options is to prevent cash-out prices rising to £20/therm, under emergency or near-emergency conditions. This should be the case given that gas suppliers who have sold reliability options have no incentive for prices to rise above the option strike price since they have to pay the difference. The option strike price should place an incentive to avoid cash-out prices above the strike price (although this would not effectively cap prices as tender participants may judge hedging costs to be greater than the payouts that would be required for the strike price being exceeded in some instances), making it unlikely that cash-out prices would rise to the levels of domestic VoLL. However, where sellers of reliability options have not secured physical backing for their contracts, or if the tender is not designed appropriately (eg if the volume is not appropriately set) cash-out prices may rise above the reliability option strike prices more often than would otherwise be expected.

5.22. Allowing DSR to bid for the reliability option tenders would raise another interaction with the Gas SCR reforms. If the incentives being introduced under the Gas SCR reforms lead to the emergence of the expected level of DSR then a reliability option which is covered mostly by demand side response contracts may not be providing any additional security of supply but may come at an additional cost to the industry. We note that these costs are expected to be low given the fact that the response was already being provided and so this should push down the tender price.

Interactions with the Electricity Market Reform proposals

5.23. There is some concern that the EMR proposals and gas cash-out reforms could place contradicting incentives on gas-fired generators. These contradictory incentives could be exacerbated by the implementation of a reliability option. Hence, it would be important to ensure a co-ordinated approach to designing the electricity capacity mechanism and gas reliability options, and indeed any other forms of intervention in the gas market.

Other Design Considerations

- *Entry Requirements:* Potential entry requirements to the bidding process require further consideration. These requirements could limit the risk that speculators take part in (and potentially undermine) this mechanism. The design of entry requirements may need to consider the financial viability of market participants entering into the reliability contracts.

- *Contract Durations/Contract Lead Times:* To allow NGG to set the strike price and volume most accurately the reliability option contracts could be designed to last for one year. This should help to increase the efficiency of the reliability options. One risk of this approach may be that it does not allow the market time to invest in infrastructure that may be needed to hedge against the risks of the strike price being exceeded ahead of implementation of the reliability contracts. Options to deal with this risk would be to either introduce a lead time into implementation of the reliability options (eg four years) or to ramp up the volume being covered by the reliability options over a similar period of time.

- If there is a view that longer term contracting for peak supplies and investment in new infrastructure would not take place because investors believe it to be too risky, then we may wish to issue longer term contracts rather than annual contracts. However, there are risks associated with issuing longer term contracts since there is the possibility that the market could be foreclosed for future new providers of capacity and supplies. There is also a heightened risk of procuring the wrong volume of contracts given increasing uncertainty of demand further out. An alternative would be to progressively 'layer up' volumes year-by-year. This could be designed to allow the market to invest in any additional infrastructure needed to meet the reliability option requirements. However, it may be difficult to establish a transparent cleared price of the tender.

- *Netting:* If contracts are not hedged by investing in physical back-up then participation in the reliability option tenders is equivalent to selling 'naked' call options which are traditionally considered to be extremely risky instruments. This may reduce the level of participation. One way of addressing this problem would be to calculate pay-outs based on a 'netted' exposure i.e. sellers of reliability options would only be expected to pay-out on a volume net of their contracted position.

<u>Other Design Options</u>

- *Physical reliability options:* As noted above, for a number of reasons, purely financial reliability options may not deliver the desired physical insurance for consumers. One way of mitigating this risk would be to require physical back-up of any reliability contracts by the party entering into the contract with the supplier. However, in considering this option we have come across a number of practical issues. The most limiting of these is the burden on all parties entering into the contracts of needing to demonstrate physical back-up on an ongoing basis. For this reason in particular we do not believe the physical reliability option to be workable.

- *Summer/winter spread reliability option:* Another option that was considered was to fix the reliability option around the summer/winter spread. As with the indicative design set out above this would require regular payments to be made from suppliers to contract counterparties with a payback from counter parties to suppliers in the case that the summer/winter spread exceeds a defined margin. This could be used to incentivise seasonal sources of gas such as long range storage. However, we identified a number of significant challenges with an option designed in this way, such as defining how a strike price could be set and when (i.e. would this have to be performed ex post after the full winter) and considered that there were more direct methods of achieving this outcome.

6. Non-specific service obligation on suppliers

Option Overview

Option Assessment

6.1. This option would impose a licence condition on suppliers to ensure that they are meeting a certain security of supply standard. This would be tested in two ways. The first would be a regular demonstration to Ofgem that they have made sufficient provision (through whatever means and including financial provision to purchase gas on the spot market for example) to cover the demand from their customers in line with the security of supply level specified. Given that suppliers should already be meeting this standard, demonstrating this to Ofgem should not require a heavy administrative burden and Ofgem would expect to take a position on which forms of supply may be more physically secure at an individual company level. The provision of this information may be a useful tool for assessing where any security of supply risks may lie at a macro level however.

6.2. The second test would be applied ex post if the level of security of supply was ever breached (eg if local distribution zone (LDZ) isolation occurred thus leading to disconnection of domestic consumers protected under the Security of Supply Regulation (the Regulation)[16]). In this case, suppliers who were not meeting the requirements of the relevant customers could see enforcement action taken if they were found to be responsible for the licence condition breach (this would be indicated by their imbalance position at the time of the licence breach).

Outline of the option

6.3. We have developed the following indicative design to set out how the Non-Specific Service Obligation could work:

- **Security of supply level:** This would be set in line with the security of supply standard set out in the Regulation.
- **Governance:** Suppliers are subject to random spot checks to Ofgem (approximately annual) to present what provisions they have in place for ensuring that they can meet the demand required by the EU security of supply standard (in practice this largely means avoiding LDZ isolation and ensuring gas supply to any protected customers who are not connected to an LDZ). This can be met through any means including, for example, putting credit lines in place to be able to purchase necessary volumes of gas on the spot market. In the event that the specified security level is breached then those found to be responsible (assessed as those with a short imbalance position) would be subject to enforcement action.
- **Timing and frequency:** Annual spot checks with ex post enforcement following any breach of the supply standard.

[16] See: http://ec.europa.eu/energy/security/gas/gas_en.htm

- **Cost assignment:** Given that market participants have already indicated that this level is being met and that we would not take a position on supply sources that would be considered more physically firm, the costs associated are not expected to be significant. Ex post costs such as penalties for breaching the licence condition would be directed at those responsible.
- **Participation:** All suppliers.

Impact on Gas Security of Supply

6.4. This option as set out above is designed to ensure provision of gas to customers defined as protected under the Regulation. DECC's impact assessment on the Regulation suggested that this level is already being met. Our modelling supports this suggestion and stakeholders have also indicated that this level of supply security is being met. As the option would provide additional certainty of meeting a security of supply level which it is believed is already being provided for, benefits of the option in terms of security of supply cannot be modelled. Rather, decision makers may consider this option valuable if they believe that it will further reinforce the supply standard set out in the Regulation at a reasonable cost, for example by testing the financial robustness of gas supply strategies at an aggregated level and highlighting situations where there is an over-reliance on specific mechanisms such as short-term trading on the national balancing point (NBP).

Costs of the measure and impact on prices

6.5. We would expect the costs of this option to be low given the perception that the market is currently providing for this level of security of supply. The most significant cost for suppliers will be in preparing the data and documentation for the regular spot checks. Given that suppliers should already be taking steps to ensure that they are providing for this level of supply security, and given that Ofgem would not judge any one supply source to be more physically firm than another, we would not expect these costs to be large. If additional physical security is required to meet the specified standard then the costs associated will depend on the nature of any physical back-up that it encourages. This could be physical storage, demand side response or agreement of long term contracts.

Challenges and Unintended Consequences

6.6. Our indicative option would not raise any issues with distortion of gas supply purchasing practices of the industry. However, if the requirements for meeting the ex ante stress test are designed to be more onerous, the method of assessing whether the security of supply standard has been met could distort strategies for purchasing gas. While the measure would be non-specific in theory, there would need to be some evidence that this gas could be provided if called upon which may have an unintended impact on the type of gas purchased. For example storage could be disproportionately incentivised if it was unintentionally considered to be "more firm" than other sources of supply.

6.7. The option may benefit security of supply by encouraging suppliers to make a conscious assessment of the security of their own supplies of gas to meet the indicated level. However, given that the market has already indicated that the supply standard is being met, we would not expect this option to provide a substantial increase in security of supply. In the event that the standard is not being met, a supplier may be able to develop a strategy to suggest that they are meeting this security standard before unwinding some of these provisions thus not providing for the security standard that is set out. This could reduce the effectiveness of this intervention and would be very difficult to police. Using random spot checks rather than an annual assessment on a pre-agreed date would help to mitigate this risk to some extent.

Key further considerations

Implementation Method

6.8. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply.[17] This option would be implementable through a new licence condition on suppliers. However, we anticipate that this option would need to be considered in the context of Article 3 of the EU Gas Directive 2009/73.

6.9. We estimate that development and implementation of the necessary licence changes would take 2-3 years to complete.

Interactions with the Gas Significant Code Review

6.10. This mechanism works to ensure that companies put in place physical measures or lines of credit allowing them to purchase gas on the spot market to deliver the defined security of supply standard. A number of stakeholders have noted that a licence condition on suppliers would lead to greater scrutiny at board level of how a company is managing its supply risk.

6.11. One issue raised by stakeholders is that imposing a licence condition on suppliers which is enforceable ex post would not place any additional incentives on shippers who are already liable for high penalties for being short under the Gas SCR reforms. However, an ex post licence condition could provide additional reinforcement and plug some of the gaps remaining in these already strong incentives. In addition, as the condition would essentially be targeted at LDZ customers for whom shippers would only face capped liability of one day of VoLL rather than for the full duration of an LDZ outage, the licence condition may help to plug this gap.

Other Potential Designs

- *What condition to choose:* The option set out here would introduce a licence condition covering protected customers only (in effect those connected to the LDZ). This would be broadly reflective of the supply standard set out in the Regulation. Government may decide that it wishes to offer a higher level of protection against disconnection to large industrial and commercial users of gas, or that it wishes to provide greater security to electricity customers by protecting supply to gas fired generation. It could therefore decide to impose a higher standard within the licence condition which companies must meet.

[17] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

The additional requirements in the Regulation for increasing the supply standard would therefore need to be met.

- *Ex ante only:* Under the indicative design set out here, the licence condition would take the form of a regular assessment of suppliers' ability to meet the required standard with enforcement ex post if a supplier is found to be in breach of the standard. An alternative approach would be to have an ex ante assessment only. To ensure that this was able to deliver the desired security standard this would place more onerous requirements on suppliers. This design could have a number of challenges in terms of setting out exactly how the security standard should be delivered (i.e. percentage through physical supplies compared to risk capital provision), differentiation between small and large suppliers, and potential knock on impacts onto the gas supply mix.

- *Double counting issue:* With a more onerous ex ante requirement, the administering body would have to check the overall position to make sure that different suppliers were not relying on the same source of gas. This may be far from straightforward in some cases as many sellers rely on sourcing supplies from spot purchases made at the NBP. This might provide an additional reason to place a cap on the volume of NBP trades which count towards a company's final volume.

7. Service obligation on the System Operator (SO service obligation)

Option Overview

Option Assessment

7.1. The SO service obligation would place a requirement on NGG to procure options for additional gas supplies on behalf of the market to meet a defined security of supply level. NGG can achieve this through the method which it identifies as most economic but there is a requirement on it to ensure that any gas that it contracts for is physically firm.

7.2. Procurement would be through an annual tender with pre-season procurement of any shortfall in provision identified.

7.3. Given that the procured gas options would be a supply/demand balancing tool for NGG, the costs incurred by the SO in procuring these services would be recovered from shippers via neutrality charges.

Outline of the Option

7.4. We have developed the following indicative design to set out how the SO Service Obligation could work:

- **Security of supply level:** Requirement to procure options on gas supplies to meet any forecast short term gap (seven days) in provisions for peak delivery capacity left by the market. This would be set to meet the security of supply standard set out in the Regulation.
- **Governance:** NGG would be responsible for procuring options on gas supplies to meet this level. A licence condition on NGG would need to be introduced. There are a number of ways in which the obligation could be practically implemented. One option is to do this through an extension of NGG's operating margins.
- **Cost assignment:** Costs would be recovered from shippers through neutrality charges.
- **Timing and frequency:** Annual tender with pre-winter procurement for volume to meet any identified shortfall in provisions.
- **Participation:** NGG can procure gas from any source (including DSR) subject to a requirement to ensure that this gas is physically firm
- **Trigger:** Option for NGG to supply volume of gas immediately prior to LDZ isolation

Impact on Gas Security of Supply

7.5. DECC's impact assessment on the Regulation, our modelling under the Gas SCR reforms and stakeholder discussion have all suggested that GB is meeting the supply standard specified in the Regulation. As such, our modelling of the option would not suggest any material difference in gas security of supply if the option was designed to meet this level. However, this design of the option may still have merit if decision makers are keen to add further comfort by requiring NGG to assess this security of supply level. This could enhance security by allowing NGG to use its aggregated market position and take actions to plug any gaps. Alternatively, decision makers may envisage less comfortable periods for gas security of supply in the future (our risk analysis suggests that LNG supplies could tighten towards the middle of the decade for example) and may wish to put this measure in place to ensure that this does not result in the security level being breached.

7.6. Alternatively, decision makers may wish to set the service obligation to meet a different security of supply level. For example, they may wish to set the obligation to cover all firm gas customers (including I&C customers) in order to reduce the possibility of electricity customer disconnections as a result of firm load shedding of gas fired generation. We have modelled the impacts that this design of the option would have on security of supply in addition to an estimate of associated costs in the alternative designs section at the end of this annex.

Costs of the measure

7.7. The costs of this option will depend on the nature of the physical back-up that it encourages in the event that the SO needs to procure gas to meet the level set out in the obligation. This could be physical storage (likely to be short range storage), demand side response or agreement of long term contracts. Modelling suggests that the level covered by the indicative design described above is currently being met by the market. This suggests that under these conditions NGG would not need to take any procurement action. In this case, the costs of the option would only be a result of the administrative costs resulting from NGG needing to identify the gap in the level of security of supply being provided.

7.8. In the alternative designs section at the end of this annex we have set out the costs associated with designing the option to have a greater security of supply level.

Impact on prices

7.9. Whether the SO service obligation was designed to cover only protected customers or all firm load, ensuring that the gas was not released until the trigger event was reached (i.e. immediately prior to the security of supply level being broken) would be essential to avoid any unintended consequences on market functioning. In the case that the trigger point for release of the gas is reached, the reserved gas would become available on the on-the-day commodity market (OCM) at £20/therm to reflect the fact that this gas is needed to avoid disconnection of customers under which the cash-out price would rise to this level. Once purchased to avoid disconnection of customers this purchase would then set the system marginal buy (SMP^{BUY}) cash-out price at £20/therm. If designed in this way the supply of gas reserved for the obligation would act as a proxy for customer disconnection and so the option would have no impact on the wholesale price.

Challenges and Unintended Consequences

7.10. There could be a risk that market players may believe that the gas procured by NGG may be released prior to the defined trigger point under public and political pressure. If this is the case, the option may reduce provisions made by market participants ahead of an emergency increasing the need for the intervention in the first place. This could lead to a continuous circle with greater intervention into the market being required to meet the same security of supply level.

7.11. It is possible that this design could be delivered through an extension of operating margins. If designed in this way, the option could remove gas from the market that would otherwise have been used to meet supplier provisions. This could lead to a doubling up of security of supply provisions with both suppliers as well as NGG looking to cover emergency events. The costs of this over-provision would then fall on customers. This can be avoided by ensuring that the option is designed so that NGG considers whether there is a gap in provisions and will only procure gas to meet any gap remaining. The costs of any actions would be passed back to all users of the system. However, this more drawn out process would raise timing issues as the position of the market may have developed by the time NGG has performed its gap analysis and procured gas to meet this gap.

7.12. While the option is intended to be non-technology specific, in requiring NGG to only procure gas which is physically firm, there is a risk that this may default to being met only through storage. This could be mitigated by working with NGG to carefully set out how physical backing could be defined including options for DSR provisions and other sources of supply/demand flexibility such as extended tank sizes at LNG terminals.

7.13. There is a balance to be struck between the amount of flexibility of the design and the costs associated with the procurement of gas. The design set out here is for annual procurement of gas so that the level of requirement can be assessed against expected conditions for the winter ahead. However, this short term procurement may result in higher costs than would be the case if NGG were able to contract for volumes of gas on a more long term basis.

7.14. If the option was designed with a security of supply level in excess of the security standard set out in the Regulation there would be a number of requirements that DECC would need to meet. These are set out in chapter 4 of the main report. In addition, if designed in this way then the risk of the option distorting market signals and negatively impacting on provisions of the market to meet the existing level of supply security would increase.

Key further considerations

Outstanding design requirements

7.15. While NGG would be able to meet the requirement through the method that it identifies as most economic rather than through one particular supply source type, it would need to ensure that the gas that it had procured was physically firm. This would require some method of determining which supply sources were considered to be firm and which were not.

7.16. In addition, the procurement of geographically distributed sources rather than one larger site may build additional redundancy provisions into the measure. Further development of the design may need to consider if and how this should be allowed for.

Implementation Method

7.17. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply.[18] However, we anticipate that this option would need to be considered in the context of Article 3 of the EU Gas Directive 2009/73. Licence conditions on NGG would be required to obligate it to procure the necessary capacity. Code changes to the UNC would also be needed. There is likely to be an interaction with the NGG Safety Case which would need to be considered.

7.18. The actual procurement of peak supply options at the start of winter (once the volume and other parameters are determined) would be conducted through a tender process in a similar manner to Operating Margins. This could include providers on both the supply and the demand side.

7.19. We estimate that further policy development and implementation of the necessary codes and licences would take three to four years to complete.

Interactions with the Gas Significant Code Review

7.20. The trigger point to allow NGG to utilise the procured volume of gas would be immediately prior to LDZ isolation. When NGG first releases this volume of gas the cash-out price would need to rise to VoLL if not already at this level to reflect the avoidance of disconnection of customers.

Interactions with the electricity market

7.21. The indicative design option set out here would be tied to the Regulation and so would only provide for protected gas customers (although this may require protection of all customers connected to an LDZ given the difficulty in isolating individual customers on an LDZ network). However an alternative would be the design that we have modelled. This would cover a gap in provision for all firm load customers for the amount of time taken for the market to react to some sudden shock which impacted on supply or demand. This could be defined as the time taken for LNG to react to the price spike observed, around seven days. The premise of this design option would be more to protect electricity generation to ensure that electricity customers were not disconnected as a result of gas supply disruptions. This would have the knock on effect of providing additional protection to all firm gas customers.

European compliance issues

7.22. The indicative design of the option would be set to cover the supply standard consistent with the Regulation and so it is unlikely that there would be any major compliance challenges to overcome. However, if a greater supply standard was set for the option (such as that specified under the modelling which would cover all firm gas load) then there could be a number of issues that would need to be considered. These include demonstrating the rationale for exceeding the level and potentially

[18] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

holding gas for internal use within GB beyond the supply standard. More information on these requirements is provided in chapter 4 of the main report.

Practicability

7.23. In principle, the procurement process by NGG under any of these options could be relatively straightforward, and similar to current Operating Margins processes. It would be important to ensure that any volume of gas was not being "double counted" in terms of the security of supply benefit it is providing. There would need to be a requirement and methodology for ensuring that all gas procured by NGG would be additional to that which had been procured by the market. This methodology would also need to ensure that gas was only being procured to meet any gap left by the market in meeting the specified security of supply level.

8. Storage obligation

Option Overview

Option assessment

8.1. A storage obligation could be used if it is believed that the market is not appropriately providing the level of security of supply that is desired. Alternatively this could be used if it is believed that the method through which the market is providing this may not be sufficiently secure (e.g. reliance on purchase of gas at the NBP). Requiring a level of gas to remain in storage could ensure that gas is available to cover a certain security level and that this gas is physically firm. This mechanism would oblige suppliers to store a certain volume of gas which could only be withdrawn in order to ensure provision to customers of a pre-defined security of supply standard. The emphasis of this approach would be on avoiding over-reliance of the market on spot gas purchases at the NBP by ensuring sufficient storage provisions to meet the defined security level. However, if it is found that the market is not appropriately providing for this level then the storage obligation could also provide effective long term incentives for investment in gas storage facilities.

8.2. It is worth noting that, unlike strategic storage, this option does not directly ensure that an additional source of supply is available to the market (a source in addition to commercial stocks), but rather regulates how stocks can be used (preventing stocks from falling too low). The option allows for the market to decide whether an additional storage facility would be necessary. If the market is already providing for the security of supply level specified through commercial booking of storage then it is not likely that the storage obligation will drive any new investment. However, the obligation may lead to physical gas being reserved in storage to meet the security level that would have otherwise been traded for different purposes. In this case, it is possible that this may drive new investment in order to have the same amount of gas available to the market for commercial use.

Outline of the Option

8.3. We have developed the following design to illustrate how the storage obligation could be set out:

- **Security of supply standard:** The obligation would be set consistent with the security of supply standard set out under the Regulation. Overall volume requirements over the winter would be set to cover the difference between seasonal normal demand and demand under exceptional temperatures occurring under a 30-day period once in 20 years. The on-the-day deliverability requirement would be set to cover the difference between seasonal normal demand and demand under exceptional temperatures occurring in a 7-day period once in 20 years.
- **Governance:** A central body (e.g. NGG) would continue to assess the level of supplies it believes are required to meet the security of supply standard specified in the Regulation. They would do this using a defined and transparent methodology which would be determined through further discussion with NGG and industry. It would then set a storage obligation on

all suppliers to ensure that this level is covered. The storage obligation would be weighted depending upon the protected customer portfolio of the supplier.

- **Timing and frequency:** The obligation would apply during each winter. A declining profile would be applied with the minimum levels of gas which each supplier must keep in store reducing over a winter period.
- **Participants:** The obligation would apply to suppliers. These suppliers would need to ensure that they have sufficient gas held in store to meet the defined level over the course of the winter.
- **Trigger:** Gas held to meet the obligation may only be released immediately prior to disconnection of customers protected under the obligation. In the case that the obligation needs to be broken to ensure supply to these customers the cash-out price will rise to £20/therm if it is not already at this level.
- **Cost assignment:** Suppliers would bear the costs of any additional actions needed to meet the security of supply level specified.

Design of the Option

8.4. Under our illustrated design the storage obligation would be set at a level consistent with the security standard set out in the Regulation. Under this design, gas would only be released when there is a shortfall in supply to protected customers (in effect mainly provision of gas to LDZ customers). At this stage, the cash-out price would rise to £20/therm. At this price level the gas would almost certainly contribute positively to the balance of GB consumption and supply rather than being exported.

8.5. Ofgem would determine a formula for how much gas each supplier would be obliged to store. The design set out here would require each supplier to have gas held in store to cover a level consistent with the security standard set out in the Regulation. The requirement would apply from a certain date at the beginning of winter and decline over the course of the winter. A level of deliverability would also be required for each day during winter[19].

8.6. The option could be introduced at a lower standard and then ramped up over time to ensure that the market has time to react through investment in storage so that sufficient commercial gas storage opportunity remains in the market.

Impact on Gas Security of Supply

8.7. The security of supply level specified in our indicative design is set to match that defined in the Regulation. Our modelling suggests that the market is currently providing for this level of supply security and that implementing the measure designed in this way would not have a material impact on the probability of disconnection. Rather, decision makers may want to implement the option designed in this way to provide additional certainty that this level of security is, and will

[19] The space requirement on each day would calculated to be equal to the sum of the daily difference between 1-50 NDM demand and seasonal normal temperature demands for each day for the remainder of the winter. The deliverability requirement on each day in winter would be calculated to be equal to the space requirement for that day divided by the remaining number of days in the winter (i.e. the deliverability requirement is constant for each day in winter).

continue to be, provided. For example, they may consider gas held in store in GB as more physically firm. Thus a storage obligation may provide additional comfort compared to provisions for supply of gas made through other means such as spot market purchases.

8.8. There are a number of alternative designs that could be implemented should decision makers wish. For example, the option could be designed to specify a different security standard to protect domestic customers under even more extreme conditions. We set out results from modelling the option to cover protected customers under more extreme conditions than that set out in the Regulation, and estimates of the costs associated with such an approach in the alternative design section at the end of this annex.

Costs of the measure

8.9. The costs of this option will depend on whether the level of the obligation restricts the commercial freedom of market players to trade gas held in storage, and whether this results in greater investment by storage developers to provide the same level of commercial availability. In the case that the obligation does have this impact on the market then it may result in lost arbitrage opportunity where suppliers may want to trade gas but cannot due to the obligation placed upon them. In some cases this impact of the obligation may be sufficient to encourage investment in additional storage. Under the indicative design set to cover the security of supply level specified under the Regulation, modelling suggested that the market is already providing for this level of security. Thus there is unlikely to be significant lost arbitrage opportunity or any additional investment in storage. To the extent that the obligation would not result in changes to supplier behaviour it would have no impact on security of supply. However at the same time the option would come at little cost (solely administrative costs).

Price impact

8.10. As with costs of the measure, the impact on prices will depend on the extent to which the storage obligation impacts on the actions of suppliers over the course of a winter. In the event that the market is already providing for the levels set out in the obligation then there will be no impact on prices as market participants will act as they would have done in the absence of the obligation. However, if behaviours change in order to meet the obligation over the course of a winter then this may impact upon prices. This impact will be dependent on how the profile of the obligation is designed over the course of a winter and how the market would otherwise act under the prevailing conditions. We illustrate how a storage obligation set at a greater level than our indicative design could affect prices in the alternative design section at the end of this annex.

Challenges and Unintended Consequences

8.11. A consequence of artificially making storage more scarce could be a reduction in the efficiency of how gas that is held in store is utilised. This is due to a volume of gas being reserved and unavailable for normal market trading for an event which has a low probability of occurring. This could lead to higher gas prices, on average, outside of an emergency.

8.12. Access to the gas should only be allowed if the specified security level is in imminent danger of being breached. Under the conditions that are likely to prevail at a time when the obligation is close to being breached there is likely to be political pressure to access gas held in store as a result of the high prices that are likely to exist. In addition there is some potential for ambiguity about how to define the point at which the security level is in 'imminent danger of being breached' This raises the risk that the market might believe that access would be permitted more readily in order to avert extremely high prices or disconnection of I&C customers who would otherwise not be supported under the obligation. This uncertainty might undermine the incentive to invest in other sources of flexibility. This could lead to less gas being procured by industry, and less commercially available gas in storage. If this gap emerged a higher level of obligation would have to be introduced to meet the same security of supply level.

8.13. Under the storage obligation there would be no incentive to hold off investment in storage whilst the policy was being introduced (as the obligation could only increase the amount of storage required). Thus, the option is unlikely to lead to an investment hiatus in gas storage facilities as a whole. However, depending upon the exact design of the obligation (e.g. if a certain deliverability of storage is encouraged) then this could favour certain types of storage at the expense of others. Further, if there was uncertainty about how a storage obligation was to be introduced this might impact investments in other sources of flexible gas.

Key further considerations

<u>Implementation Method</u>

8.14. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply[20] and changes to the supply licence could be considered here. However, we anticipate that this option would need to be considered in the context of Article 3 of the EU Gas Directive 2009/73.

8.15. Given the challenges surrounding development of this design option we would expect policy development and implementation of the necessary codes and licences to take four to five years. We would anticipate any storage investment as a result of the measure to require a further five to seven years.

<u>Interactions with the Gas Significant Code Review</u>

8.16. This option would be expected to enhance physical security of supply. By reducing the severity of an emergency it would also reduce shippers' exposure to high cash-out prices. If targeted solely at customers connected to the LDZ (rather than all firm load), and assuming that the market believes that the obligation will not be breached prior to this (due to political pressure for example), then the obligation should not interfere with the incentives placed on the industry to provide physical insurance against a GDE occurring.

[20] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

European compliance issues

8.17. European legislation allows Member States to introduce Public Service Obligations (PSOs) which may relate to security of supply. Implementation must be considered in that context.

8.18. Our indicative design of this measure is consistent with the supply standard required in the Regulation[21]. If, however, this standard is to be increased, the additional requirements set out in the Regulation in that respect would need to be met.

Other Design Considerations

- *Transaction Costs* - There is already an active primary and secondary market for storage capacity, but if transaction costs were deemed to be onerous for small suppliers then one option to address this concern would be to exempt suppliers below a certain size from the obligation. Another alternative would be to allow the obligation to be tradable (through a system analogous to the Renewable Obligation Certificates) in order to reduce transaction costs. However both of these options come with a number of challenges, particularly with diluting the obligation thus reducing its effectiveness as well as the introduction of additional complexity and a reduction in transparency.

- *Type of storage facility* - There is a question about which storage facilities would be applicable under the obligation. The design set out here requires suppliers to meet the obligation through access to GB storage facilities. This is to provide additional certainty that this gas will be available despite any EU infrastructure or political developments in the event of an emergency. There is also an outstanding question of whether access to LNG terminals should be applicable under the obligation.

- *Other design variants:*

  i) A 'very-strong' version of this policy would be to intentionally set the level of the obligation above the level of storage that the market was expected to deliver (or to allow it to be fulfilled only by additional storage facilities), i.e. to directly drive investment. Some have suggested that given the lumpy nature of storage investment, this approach might risk 'cliff edges'. This is where the obligation makes additional investment in storage and purchasing of gas necessary at a time when this additional investment is unnecessarily expensive or does not allow the market to take advantage of periods when storage and gas to hold in store is cheap.

  ii) A 'semi-strong' version of this policy would be to adjust the access rules such that the gas could be released prior to LDZ isolation and at a price below VoLL. This could help address concerns about the credibility of the access costs, but would make the measure less targeted at benefiting domestic (and other LDZ) customers.

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[21] Regulation (EU) 994/2010

iii) A ‘weak’ version of this policy would be to only set a required fullness level at the start of winter. This is an approach which is taken in the design of storage obligations in a number of EU countries. This would address concerns about the credibility of the access rules, but would also remove much of the benefit of the policy in terms of ensuring a specified level of gas in store to meet a defined security of supply level.

9. Semi-regulated storage

Option Overview

Option assessment

9.1. The value of storage capacity can be volatile and unpredictable. This can make financing new storage facilities challenging. If we believe that the market is undervaluing security of supply, is providing a sub-optimal level or diversity of capacity, or that volatile returns to storage facilities (combined with other characteristics of the storage market) inefficiently discourage investment in storage, then a regulated or semi-regulated approach to new storage investment may be justified. The additional storage would increase security of supply as well as contributing to the day-to-day operation of the market by offering an additional source of flexible gas and potentially reducing seasonal price spreads. As it will be important for facilities inside this regime to contribute to the competitiveness of the gas market, they would therefore need to offer third-party access.

9.2. One option for providing semi-regulated returns to storage investors is to underwrite new storage investment projects with a 'cap and floor' regime. Ofgem is developing a 'cap and floor' regime for electricity interconnectors which provides an example of how such a regime could be implemented. More detail is provided at the end of this section.

Outline of the Option

9.3. There are many options for the design of a regulated or semi-regulated returns approach to storage. We have developed the following indicative design to set out how the semi-regulated regime could work. We note that this option will need further consideration and development working closely with policy makers and industry in the event that it is taken forwards:

- **Security of supply benefits:** By encouraging the development of storage facilities it will help contribute to a reliable and diverse mix of gas sources for the GB market.
- **Governance:** NGG would assess how much storage capacity to procure under a set of specific and transparent rules, taking into account the amount of risk that would be socialised (the costs) as well as the benefits that additional storage could bring. Ofgem would ensure that the 'cap and floor' levels are set appropriately given this level of storage requirement.
- **Timing and frequency:** An assessment of the value of additional storage would occur annually.
- **Participants:** The semi-regulated returns regime would be targeted at seasonal storage facilities. Any developer of a seasonal storage facility would be eligible to participate.
- **Cash flow assignment:** Payments triggered as a result of revenues breaching the 'cap and floor' could be passed to or from consumers, respectively, via NGG.
- **New or existing facilities:** The regime would be open to all facilities, new and existing. However, the following attributes of the regime would limit it to those developers who can provide a facility with the required attributes and

may make it less attractive to existing storage facilities and those with third party access exemptions:

- 'cap and floor' levels are likely to fall over the life of a project as capital is repaid,
- the regime would only apply for the economic life of a facility,
- the facilities would have to offer third-party access, and
- the key driver of the 'cap and floor' levels would be space.

How the option would work

9.4. A 'cap and floor' regime for revenues means that if revenues for a facility were to fall below a certain level (the 'floor') it would be topped-up and if revenues exceeded a certain level (the 'cap') the excess would be returned to consumers. The revenue uplift/payback would be applied on an annual basis. This cap and floor would only impact the holders of the storage assets and would not impact on the returns that a party holding capacity in the storage facility could extract.

9.5. The 'cap and floor' would be set in way to help make new storage facilities more financeable[22], by reducing investment risks[23] and stabilising cash flows whilst still providing incentives to ensure the facility is built at least cost and is fully utilised. The cap protects the interests of consumers. This means that some of the risks associated with developing storage facility would be socialised.

9.6. For example, the 'cap and floor' could be set at a level to help cover certain operating costs, depreciation and a return on initial capital expenditure[24] over the economic life of a facility. Since these costs are likely to fall over the life of the asset (for example, as under project Nemo, as the asset depreciates over time the required return to the asset will fall) it follows that the level of the 'cap and floor' will likewise fall over time. Therefore, this regime is likely to be more attractive to new facilities than for existing facilities as existing facilities may limit their returns through application of the cap without the floor helping to support returns to the same extent as for new facilities.

9.7. The cap and floor regime would be designed to encourage the development of additional seasonal storage. While other forms of storage would not be prevented from entering the tender under the regime we would not expect the design of the regime to appeal as strongly to these other forms of storage. A central body would assess how much storage capacity to procure, taking into account the amount of risk that would be socialised (the potential costs) as well as the benefits that additional storage could bring.

9.8. A competitive tendering process is one approach to ensure that eligible facilities are built at least cost, for example a key assessment criteria could be how low a level of a 'cap and floor' a developer would be prepared to accept. However, if it was concluded that there were insufficient bidders to be confident that costs would

[22] In particular it could make raising debt finance easier.
[23] Through limiting the downside risk they are exposed to.
[24] The regulatory asset value (RAV).

be minimised then additional measures may be needed to ensure that only efficient costs feed into the 'cap and floor' levels[25].

Impact on Gas Security of Supply

9.9. The semi-regulated storage option assumes that one additional long range storage site will be built. Under the Counterfaqctual we assume that this site will have a volume capacity of two bcm and a deliverability of 25 mcm per day. The modelling suggests that the addition of this facility will deliver the following security of supply benefits:

	Gas SCR mean	Semi-regulated storage mean
Firm DM gas	1 in 128	1 in 500
NDM gas	1 in 167	1 in 500
Firm I&C electricity	1 in 75	1 in 188
Domestic electricity	1 in 333	1 in 3000

Un-served energy (and cost of un-served energy)

	Gas SCR mean (millions therms per year, (£m))	Semi-regulated storage mean (millions therms per year, (£m))
Firm DM gas	0.027 (0.5)	0.007 (0.1)
NDM gas	0.621 (12.4)	0.288 (5.8)
Firm I&C electricity	0.027 (1.6)	0.007 (0.4)
Domestic electricity	0.003 (0.2)	0.000 (0.0)

9.10. Modelling suggests that the addition of another long range storage facility as a result of the semi-regulated storage option could have a significant beneficial impact on security of supply across all customer types. This is due mainly to the additional deliverability that is available from the facility in the event of a supply disruption. While the additional volume capacity is also a factor, this is less important in providing security under a short, sharp shock scenario but may help to mitigate risk associated with a prolonged extreme cold winter event.

[25] For example, through benchmarking of costs or through tenders for the capital works.

Costs of the measure

9.11. The costs of this option will be a result of the additional long range storage investment delivered. The way in which this cost is distributed will be dependent on the cap and floor arrangements in place to support the storage. Direct costs to consumers will result from the times where the floor is required to support returns to investors. The remainder of the costs will be met by private investment and recouped through market mechanisms.

9.12. The regulated storage option specified here was designed to deliver two bcm of long range storage volume with a deliverability of 25 mcm/day. Our cost estimates suggest that the total capital expenditure required for a depleted gas field to deliver these specifications would be around £1440m including the required cushion gas volume. Our estimates of operating costs for depleted gas fields vary from £0.01m/mcm to £0.02 m/mcm. Therefore an average estimate of operating costs would be around £30m/yr.

9.13. As an illustrative calculation to investigate the potential cost to consumers of a cap-and-floor regime, based on the facility described above, we made a simple estimate of the annual profit floor needed to be equivalent to a floor on return of 6% (paired with a 10% cap) at around £120m. We found that the modelled profit for the facility fell below this level in over 90% of simulations, and that on average a 'top-up' payment to the facility owner of around £90m/year was required. This should be treated as indicative only, with further analysis required, in particular due to the simplistic cash flow modelling, and the fact that storage profits are likely to be conservative in the market modelling as specific facilities are not fully optimised.

Challenges and Unintended Consequences

9.14. The greater the amount of storage which is developed as a result of this regime the more market returns to such storage facilities may be depressed. This may make it more likely that revenues breach the 'floor' level, and may increase the reliance on the semi-regulated storage regime to support further investment.

9.15. Since gas is a tradable commodity it will be important to ensure that such an option creates a significant benefit in terms of security of supply and reduces the risk of benefits being 'leaked away'. This may result from crowding out other sources of supply to the GB market, being exported, or through reducing the incentive to invest in other infrastructure or demand-side response for example.

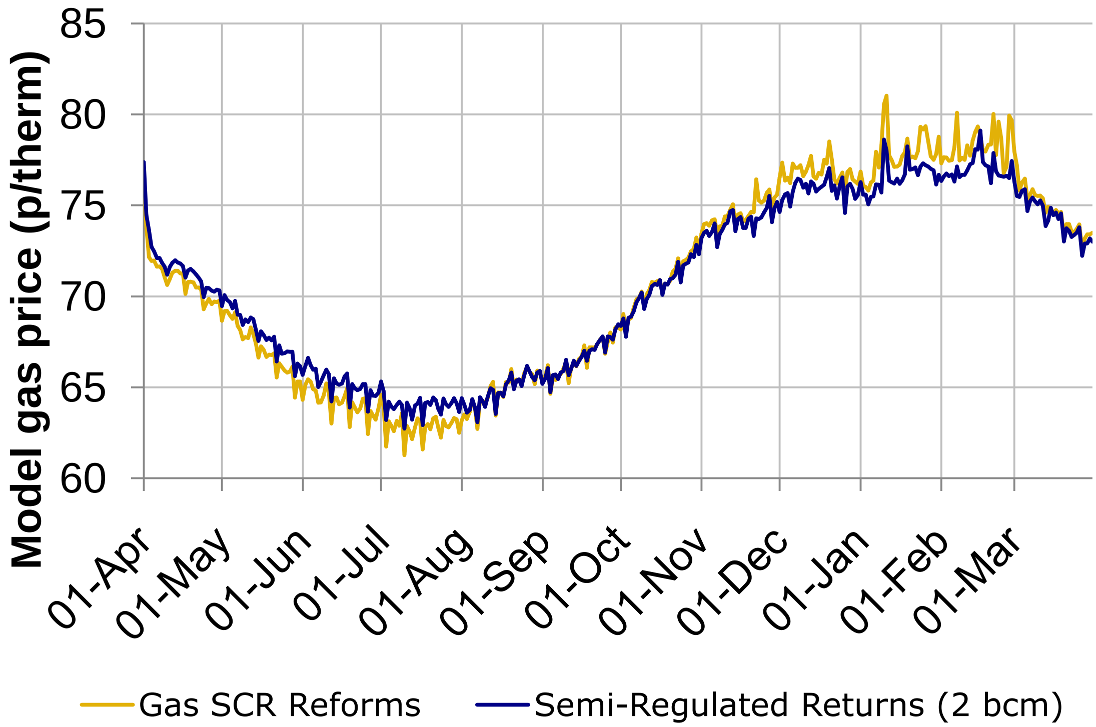
9.16. This, combined with a requirement to auction storage rights with a low defined reserve price, could also help to address any risk that storage investment made under the regime would be under-utilised.

9.17. There may be regulatory uncertainty as to how much storage the central body applying the cap and floor regime would support. Moreover, care will need to be taken to ensure that the current challenges with investment in seasonal storage are not exacerbated as a result of uncertainty while the regime was being introduced. Under a worst case, an additional facility supported under the regime could impact on the potential returns of existing seasonal facilities and lead to their premature closure. The risk of this could be addressed by giving the option of applying for this support to facilities that are already in operation or under construction.

9.18. The availability of an additional gas facility could have a significant impact on the rest of the market and this needs to be carefully considered. The additional facility may have a significant impact on summer/winter spreads, and on more short term volatility. Uncertainty regarding the design of the option and during construction could delay or reverse the investment decisions of those considering the development of additional short and medium range infrastructure. This may reduce the security of supply and price benefits that the long range facility could otherwise deliver.

Impact on prices

9.19. The graph below shows the modelled results, averaged over 1500 runs and taken from the spot year 2020, of the impact on price of having an additional long range storage facility as a result of the support provided under the semi-regulated returns option. The figure shows that prices are depressed in the winter as a result of the additional volume of gas available through storage. However prices increase in the summer as a result of additional injection of gas into the new storage facility. The overall effect is to reduce the summer-winter spread by approximately 1-1.5 p/therm, with a net reduction on the total market wholesale cost of gas of approximately £20m[26]. The modelled impact in 2030 is much lower, largely due to the lower assumed level of demand.



[26]The wholesale cost impact is calculated as an average across modelled simulations excluding occasions where there is an interruption to firm gas supply.

Key further considerations

Implementation Method

9.20. The 'cap and floor' regime would be open to new and existing storage facilities that comply with certain requirements including volume and deliverability parameters. If these requirements are placed on storage operators directly, this would require changes to the Gas Act 1986 as storage operators are not currently licensed[27].

9.21. A party would be required to scrutinise accounts and administer any payments required as a result of revenues breaching the 'cap and floor' levels. NGG could be a candidate for this and the obligation to administer the cash-flows could be a licence condition.

9.22. Given the challenges surrounding development of this design option we would expect policy development and implementation of the necessary codes and licences to take four to five years. We anticipate that the storage facility would then require a further five to seven years to build.

Interactions with the Gas Significant Code Review

9.23. This option would be expected to reduce seasonal variation in prices, short term volatility and contribute to physical security of supply. Consequently, this could reduce the impacts of the incentives being introduced through the Gas SCR cash-out reforms.

European compliance issues

9.24. European legislation allows member states to promote infrastructure investment[28] and to introduce measures to enhance security of supply including through the use of economic incentives[29]. This measure would help support the development of additional storage capacity and would contribute to meeting the 'N-1' infrastructure and supply standards in the Regulation[30] although we note that this may be considered an additional obligation imposed for reasons of security of gas supply in which case care would need to be taken to ensure that the additional requirements in this respect in the Regulation could be met. One requirement is to demonstrate that the measure does not have a harmful impact on the security of supply of other Member States. We would not expect this option to harm the security of supply of other Member States.

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[27] Alternatively, there are specific provision in the Gas Act which enable the Authority to apply to the Secretary of State for an order (which would have to be given through a statutory instrument) providing for activities to become licensable activities. Such activities must be "connected with" the current licensed activities essentially. The order would set out the licence conditions for the newly licensed activities.
[28] See for example recitals 7 and 14 of Regulation (EU) 994/2010
[29] See for example Articles 3.2 and 3.7 Directive 2009/73/EC
[30] Regulation (EU) 994/2010

Other Design Considerations

- *Scope:* There is a key question as to whether it will be a legal necessity (or indeed desirable) to allow all storage facilities (existing and new) to opt into the 'cap and floor' regime. Since:

    - 'cap and floor' levels are likely to fall over the life of a project as capital is repaid,
    - the regime would only apply for the economic life of a facility,
    - the facilities would have to offer third-party access[31], and
    - the key requirement for entering the regime would be volume.

  this regime may be less attractive to existing facilities (as the cap and floor levels would be unlikely to support their revenue to the extent required), salt caverns, or those with third-party access exemptions. If these facilities were to opt into the regime the potential cost of them may be smaller than for new long-range facilities.

- *Practicality:* This option as described is focussed at encouraging investment in seasonal storage facilities. However, a key difficulty would be in determining exactly the characteristics that a storage facility would need to demonstrate to be eligible. It would also be challenging to set appropriate caps and floors.

- *Revenue 'top-up' limits:* If there were concerns that such a mechanism might lead to excessive and inefficient amounts of additional storage being procured, then one option would be to limit how much revenues could be topped up. This limit could be based on the estimated wider benefits the storage facility brings as a result of enhanced security of supply[32].

- *Detailed Design issues:* Further design issues include:

    - the extent of the costs that feed into the level of the 'cap and floor',
    - where 'sharing factors' should be applied to revenues exceeding or falling below the 'cap and floor' levels,
    - whether setting a floor without a cap is more appropriate. Arguably the case for this might be strongest if there was a limit to the amount that storage revenues could be topped up, on average, each year,
    - how long the cap and collar might last (for example, the economic or technical life of the project),
    - whether there might be 're-openers' to the level of the cap and floor and if so how they might be triggered, and
    - the frequency with which transfers of money are made.

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[31] The Gas Act 1986 already requires the owner of a storage facility to provide third party access unless it benefits from either a minor facilities exemption or an exemption under section 19B Gas Act 1986. It would be necessary to design the option so that a facility benefitting from the cap and collar model did not also have a third party access exemption. We do not at this stage consider this to be insurmountable albeit that certain consequential amendments to the Gas Act are likely to be required.

[32] For example, if the estimated benefit of a certain storage facility in terms of reducing expected energy un-served were £50m p.a. then any top ups could be limited to (on average) £50m p.a. This would mean that storage would only be developed if the positive externality exceeded the potential cost being underwritten by consumers.

Cap and floor example: The development of a 'cap and floor' regime for electricity interconnectors

9.25. Under a merchant regime[33], the developer would apply for an exemption from EU legislation and interconnector revenues would depend on price differentials between the two markets it connects and so is volatile from year-to-year. The unpredictable revenue streams, the fact that the European Commission sees exemptions as exceptions, and their subsequent decision to impose a cap on returns on the Britned[34] interconnector, created the need for the development of a new regulatory regime for interconnector investment. This would also bring GB closer to other European countries where interconnection is built under a fully regulated model.

9.26. Project NEMO[35] is a proposed interconnector between Great Britain and Belgium, and is the pilot project for the development of a new regulatory regime for interconnector investment which is based on a 'cap and floor' approach. A 'cap and floor' regime can help increase the financeability of an interconnector project. It reduces the downside risk faced by developers, whilst the cap protects the interests of consumers and complies with European legislation. The new regime has undergone extensive development and consultation and in late 2012 we intend to consult on our minded to position for the design of all aspects of the regime with a view to publishing a final decision in 2013. It is anticipated that the NEMO link will start commercial operation around 2018. This regime will co-exist alongside the exempt 'merchant' route.

9.27. The 'cap and floor' levels set the maximum and minimum levels of net[36] revenue the developer can earn in a given year. These levels are based on the forecast levels of initial capital expenditure and operating costs on an ex-ante basis, i.e. prior to construction of the assets[37]. An ex-post assessment is likely to be used for capital expenditure to ensure only the economic and efficient costs incurred in building the asset feed into the 'cap and floor' levels[38].

[33] Exempt from the relevant requirements of European legislation, e.g. around use of revenues
[34] Britned is a 1GW interconnector between GB and Belgium which became operational in April 2011
[35] Further details can be found at:
http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=99&refer=Europe
[36] Gross congestion revenues less market related costs, e.g. firmness
[37] Similar to onshore regulation
[38] This may result in the 'cap and floor' levels being adjusted upwards or downwards

10. Strategic stocks

Option Overview

Option Assessment

10.1. Strategic stocks would provide an additional source of supply in additional to commercial supplies. This strategic gas could only be released immediately prior to breach of a specified security of supply level. The stocks would be procured by a central body and held outside of the market to avoid that the risk of crowding-out other supply sources or demand-side response.

Outline of the Option

10.2. We have developed the following to illustrate how the option could be designed:

- **Level of Security of Supply:** This would be set to meet the security of supply standard specified in the Regulation.
- **Governance:** A central body would be required to administer the level of storage required (NGG), to procure the facility and the gas required and administer payments (NGG) and to control the operation of the facility/facilities (the storage operator upon the instruction of NGG).
- **Timing and Frequency:** An assessment of the need for emergency stocks would be undertaken annually. Gas to meet the storage requirement would be procured annually ahead of winter and then released at the end of winter.
- **Trigger:** The emergency stocks could only be released immediately prior to disconnection of customers protected under the security of supply standard. Upon release of this gas the SMP_{BUY} cash-out price would rise to £20/therm if it was not already at this level.
- **Participants:** Any storage developer would be eligible to participate in the tender for the new storage facility/facilities.

Design of the Option

10.3. This option is designed to meet the supply standard specified under the Regulation. NGG would determine the volume of strategic stocks required consistent with the supply standard. NGG would also be responsible for procuring and managing the additional facility. In order to ensure that this option led to an increase in capacity, these emergency volumes would need to be stored in one or more new storage facilities[39].

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[39] There may be a benefit in having a number of facilities in different physical locations and with different network connections to provide enhanced security of supply though greater diversity.

10.4. The costs of holding this gas would be socialised. This could be achieved through amendments to NGG's price control process, and could be targeted upon those who maintain high gas use during peak demand periods

10.5. The stocks would only be released if the alternative was LDZ isolation (or disconnection of a protected customer not connected to the LDZ). The release of this gas would be priced into the cash-out mechanism at £20/therm.

Impact on Gas Security of Supply

10.6. The security of supply level specified in our indicative design is set to match that defined in the Regulation for a full winter period. Our modelling suggests that the market is currently providing for this level of supply security. Thus, implementing this design would be academic and, in theory, not lead to the introduction of a new facility. Rather, decision makers may want to implement the option and introduce a new facility to provide additional certainty that this level of security is, and will continue to be, provided. This may be the case if they wish to protect against geopolitical risks that are hard to quantify or if they have concerns about the physical firmness of gas in the market. This may lead to a belief that the costs associated with a centrally held body of gas to be justified by the physical firmness provided for the targeted customers.

10.7. Alternatively, decision makers may wish to set the level of the strategic stocks to meet a different security of supply level. For example, they may wish to design the level of stocks to cover all firm load in order to reduce the possibility of electricity customer disconnections as a result of firm load shedding of gas fired generation for example. We have modelled this alternative design to consider the improvement in security of supply that would be achieved as well as estimating the associated costs. This analysis is provided in the alternative designs section at the end of this annex.

Costs of the measure

10.8. The costs associated with this measure would be the costs of developing the additional infrastructure and procuring the additional gas. As suggested previously, our modelling suggests that the level of security of supply set under our indicative design of the option is being met by the market. Thus it is not possible to theoretically size a storage facility to meet a gap in provision for this security of supply standard. We have modelled an alternative design of the option under which all firm load is covered by the volume and deliverability requirements of the emergency stocks. We provide an estimate of the costs associated with the storage facility that would be needed to meet this level in the alternative designs section at the end of this annex.

Impact on prices

10.9. Whether the strategic stocks option was designed to cover only protected customers or all firm load, ensuring that the gas was not released until the trigger event was reached (i.e. immediately prior to the security of supply level being broken) would be essential to avoid any unintended consequences on market functioning. Upon release of the stocks the cash-out price would rise to VoLL (£20/therm) if it was not already at this level to reflect the avoidance of disconnecting customers. If designed in this way the release of this gas would act as a proxy for customer disconnection and so the option would have no impact on the wholesale price.

Challenges and Unintended Consequences

10.10. A key issue under this option is how the trigger point for release of the stocks is defined and how credible it is that the gas would only be released when this trigger point was reached. A strict definition of the trigger point to allow the gas to be released only immediately ahead of LDZ isolation would be the simplest method of determining the trigger point. However, allowing release of gas some days before this point may prevent LDZ isolation that would occur if the release of gas was left until it was too late to provide any response.

10.11. However the trigger point is defined, if market participants believe that the stocks could be used earlier and at lower prices, then this could risk reducing the incentive to invest in other sources of flexibility such as other storage facilities. Strategies to reduce the ability of policy makers and those controlling the release of the stocks to access the gas ahead of the defined trigger point (for example by placing them in primary legislation) might help to address these concerns.

Key further considerations

Implementation Method

10.12. Ofgem currently has the broad vires to introduce licence conditions where requisite or expedient for protecting security of supply[40] and changes to the NGG's licence (in terms of governance) could be considered here. However, we anticipate that this option would need to be considered in the context of Article 3 of the EU Gas Directive 2009/73[41].

10.13. If any requirements are placed on storage operators directly, this would require changes to the Gas Act 1986 as storage operators are not currently licensed [42].

10.14. Given the challenges surrounding development of this design option we would expect policy development and implementation of the necessary codes and licences to take four to five years. We anticipate that the storage facility would then require a further five to seven years to build.

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[40] Section 7B(4)(a) and Section 4AA(1A)(b) Gas Act 1986

[41] *"Having full regard to the relevant provisions of the Treaty, in particular Article 86 thereof, Member States may impose on undertakings operating in the gas sector, in the general economic interest, public service obligations which may relate to security, including security of supply, regularity, quality and price of supplies and environmental protection, including energy efficiency, energy from renewable sources and climate protection. Such obligations shall be clearly defined transparent, non-discriminatory, verifiable and shall guarantee equality of access for natural gas undertakings of the Community to national consumers..."*

[42] Alternatively, there are specific provision in the Gas Act which enable the Authority to apply to the Secretary of State for an order (which would have to be given through a statutory instrument) providing for activities to become licensable activities. Such activities must be "connected with" the current licensed activities essentially. The order would set out the licence conditions for the newly licensed activities.

Interactions with the Gas Significant Code Review

10.15. It is important to ensure that strategic stocks would not undermine the current Gas SCR proposals by crowding out other sources of supply or demand-side response. Therefore, the strategic stocks should only be made available immediately prior to LDZ isolation (or firm customer disconnection under the alternative design) and priced at capped VoLL. This will mean that shippers will be indifferent between accessing these stocks and paying the cash-out charge.

Interactions with the Electricity Market Reform Proposals

10.16. If designed to protect all firm customers as under the alternative design set out later in this document, this option would help to enhance security of supply for all firm gas customers. This would include those gas-fired power generators who may otherwise be subject to firm load shedding in a GDE. This would have the impact of enhancing the security of supply of electricity consumers, including domestic consumers.

European and other legal compliance issues

10.17. European legislation allows member states to promote infrastructure investment[43] and to introduce measures to enhance security of supply[44]. The European Commission has also recognised the concept of strategic stocks in its Third Package interpretative note on storage but that such measures must be taken under strict conditions[45]. This measure would help support the development of additional storage capacity and would contribute to meeting the 'N-1' infrastructure and supply standards in the Regulation. This measure would help support the development of additional storage capacity and would contribute to meeting the 'N-1' infrastructure and supply standards in the Regulation[46]. However, we note that this may be considered an additional obligation imposed for reasons of security of supply. As such, care would need to be taken to ensure that the additional requirements in the Regulation could be met.

Other Design Considerations

- *Scope:* One option would be to extend the scope of what sources would be eligible. For example, if they could demonstrate that they could bring about a net addition on reliable supplies upstream fields could be a candidate. However, similarly to removing gas from the market to place in store, we note that this design could lead to these sites withholding production of gas from the market thus impacting on market functioning.

- *Access terms:* In order to make the access arrangements for this gas more credible, access charges below capped VoLL could be considered. For example, the central body could tender options on tranches of volumes of this

[43] See for example recitals 7 and 14 of Regulation (EU) 994/2010
[44] See for example Articles 3.2 and 3.7 Directive 2009/73/EC
[45] See the interpretative note on directive 2009/73/ec concerning common rules for the internal market in natural gas
[46] Regulation (EU) 994/2010

gas to be released at different prices (such as £2/therm, £5/therm, etc.) to market participants. Those who are successful in their bid for options could then access the gas once the relevant price was reached thus reducing the possibility that supply/demand conditions would tighten further. However, such an approach risks undermining the original intention of the policy to hold gas in store to protect certain customers and may risk crowding out other sources of flexibility.

- *Practicality:* A key challenge will be to establish the level of stocks required, procuring them efficiently, and managing them. In addition, some method of ensuring that the facilities are able to operate appropriately given their likely infrequent use.

Appendix 5: Alternative security of supply level design modelling

Introduction

11.1. In the previous section we set out our indicative designs for the further measures options. Where there is the possibility to target these options at a specific set of consumers we have maintained consistency by setting this level at protected customers defined under the Regulation.

11.2. However, we have noted that, for a number of reasons, decision makers may wish to define a different level of supply security. For example they may wish to provide further protection to domestic consumers under more extreme situations than that set out in the Regulation. Alternatively, they may wish to protect all firm load, perhaps with the objective of increasing supply security to electricity consumers. It is important to note that as set out in Article 8 of the Regulation any increase in the supply standard requires the Member State to meet a number of requirements and provide evidence of these to the EU Commission. These requirements are set out in chapter 4 of the main report.

11.3. In the previous section we indicated that, for a number of options, defining the security of supply level as that set out in the Regulation would not suggest a gap in the level of supply security currently being provided. Thus it would not be possible to size those further measures defined in this way to meet any gap. Therefore, the options as designed in this manner would not suggest any reduction in the probability of gas consumer disconnections. However, decision makers may still wish to introduce the measures to provide additional certainty that this level of supply security is being met.

11.4. In the following section we set out a number of alternative designs for the SO SO service obligation, storage obligation and strategic stocks options. Designing the options in this way has allowed us to model the impact that they may have on the probability of supply disruption and their costs.

11.5. We have also set out an alternative design of the semi-regulated returns option under which we have modelled the results if support was to be provided for a four bcm rather than two bcm storage facility. This roughly corresponds to the level of storage recommended by the Energy and Climate Change Select Committee in 2011[47]. In this report the Committee recommended doubling of the storage levels currently in place by 2020 which equates to roughly four bcm of additional storage.

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[47] This was recommended in their report titled '*The UK's Energy Supply: Security or Independence?*'[47] published in 2011

Service obligation on the System Operator (SO service obligation)

11.6. An alternative design of the service obligation to that set out previously would be to define the level of security of supply to meet all firm load customers. The SO would then be responsible for procuring gas to meet any gap between this level and that being covered by the market. The results of this modelling are provided below[48].

11.7. The SO service obligation as modelled was designed to increase supply security to all firm gas customers (including I&C customers) for a period of seven days[49] under an extreme winter scenario and with a major infrastructure outage (the whole of Bacton terminal consistent with DECC's N-1 calculation). It was assumed that the SO would secure additional storage in order to meet the volume and deliverability requirements. This led to an additional 150 mcm of storage volume with a deliverability of 22 mcm/day. However, in practice, the obligation may not specify that additional requirements would have to be met through storage. It may also not specify that the SO would have to procure new storage rather than booking any spare deliverability in existing facilities (e.g. DSR, meeting the obligation through options on gas supplies in multiple storage sites, etc).

Probability of interruption

	Gas SCR mean	SO Service Obligation mean
Firm DM gas	1 in 128	1 in 409
NDM gas	1 in 167	1 in 409
Firm I&C electricity	1 in 75	1 in 180
Domestic electricity	1 in 333	1 in 900

[48]We note that, when sized to cover all firm gas load, this approach would have similarities with the top-up regime that was removed in 2004; the main difference being that the SO service obligation would be a market wide mechanism and may not restrict NGG to storage booking to meet its obligation. In addition, unlike top-up arrangements all gas procured by the SO would need to be additional to that provided by the market to meet any gap in provisions for the required security of supply level.
[49] This was considered to be a proxy for the time taken for LNG to react to the high prices in GB and divert to the GB market

Un-served energy (and costs of un-served energy)

	Gas SCR mean (millions therms per year, (£m))	SO service obligation mean (millions therms per year, (£m))
Firm DM gas	0.027 (0.5)	0.009 (0.1)
NDM gas	0.621 (12.4)	0.191 (3.8)
Firm I&C electricity	0.027 (1.6)	0.010 (0.6)
Domestic electricity	0.003 (0.2)	0.001 (0.1)

11.8. The results show that there is a significant increase in security of supply as a result of the measure. In addition to providing additional security to NDM gas customers, the design of the option to cover all firm load also provides protection to large I&C gas customers and electricity customers as a result of the protection provided to large gas fired generators.

Costs of the measure

11.9. We have estimated the costs of the measure as designed here by assuming that the SO meets the obligation by procuring gas leading to investment in an additional salt cavern storage facility with 150 mcm of volume capability and 22 mcm of deliverability.

11.10. Our cost estimates suggest that the capital costs of this storage facility would be £200m including the costs of cushion gas initially required. Research suggests that annual operating costs of the facility would range from £0.01 – 0.06 m/mcm. An average of the total operating costs is therefore £5.25m/yr which does not include the costs of any additional gas required.

11.11. A rough estimate can be made of the costs of the gas needed to keep gas in store. Using the methodology and price differentials set out in Ofgem's conclusion in its 'Review of Top Up Arrangements in Gas'[50] gives an estimate of £17-112m for the direct costs and £170m for the indirect costs of the 150 mcm of gas that would need to purchased. We note however that the methodology used to derive these costs were very simplified, that the price differentials may have changed significantly since these estimates were made and that the design of the option as a market wide mechanism may result in different costs to those observed under top-up

[50] See: http://www.ofgem.gov.uk/Networks/ad/Documents1/The%20Review%20of%20Top%20Up%20Arrangements%20in%20Gas%20-%20Conclusions%20Document.pdf

arrangements. Thus more work would need to be performed to develop more accurate cost estimates.

11.12. The administrative costs of the obligation are expected to be low compared to the capital and operating costs and thus are assumed as negligible[51].

[51] An estimate of the costs of administrating the obligation can be made by considering the costs to NGG of running the Short Term Operating Reserve tender. A recent assessment estimated these costs to be approximately £20,000 per annum.

Storage obligation

11.13. In order to assess the potential impacts of implementing a storage obligation we have modelled an alternative design to that set out previously. This would meet a higher security standard than that implied in the Regulation by providing protection to protected customers under even more extreme conditions than that required. The storage obligation was modelled as a minimum level profile throughout the winter. This obligated suppliers to meet the difference between the gas demand of LDZ connected customers (equivalent to covering those considered as protected under the Regulation) under seasonal normal[52] and extreme winter conditions (1-in-50) through access to storage. This is designed to reduce the risk that these customers are not cut off if a winter turns out to be significantly worse than was expected by the market. Even under this more onerous obligation, modelling has suggested that it is only infrequently that the storage obligation would restrict the market from trading gas held in store as it usually would do under commercial conditions.

Probability of interruption

	Gas SCR mean	Storage obligation mean
Firm DM gas	1 in 128	1 in 167
NDM gas	1 in 167	1 in 281
Firm I&C electricity	1 in 75	1 in 92
Domestic electricity	1 in 333	1 in 450

Un-served energy (and costs of un-served energy)

	Gas SCR mean (millions therms per year, (£m))	Storage obligation mean (millions therms per year, (£m))
Firm DM gas	0.027 (0.5)	0.017 (0.3)
NDM gas	0.621 (12.4)	0.208 (4.2)
Firm I&C electricity	0.027 (1.6)	0.017 (1.0)
Domestic electricity	0.003 (0.2)	0.002 (0.2)

[52] Assuming seasonal normal temperatures

11.14. Results show that the option provides a noticeable increase in security of supply to NDM gas customers for whom the option is designed to protect. This is a result of the infrequent occasions where the gas in storage under the obligation is required to prevent these customers from being disconnected. In theory the option could lead to an increase or decrease in security of supply to firm I&C gas customers depending on the supply and demand dynamics over the course of a winter. The requirement to have a certain amount of gas in store at points over the winter could ensure that there is more gas available for I&C gas customers at times of system stress. In contrast, the requirement not to fall below the required obligation could prevent gas from being supplied to I&C gas customers where it would otherwise be available. This could lead to interruptions of firm I&C gas demand, and as a consequence of interruptions of gas fired generators, electricity load. Under the assumptions included in the modelling, this option provides a small increase in the supply security of electricity and firm gas load however.

Costs of the measure

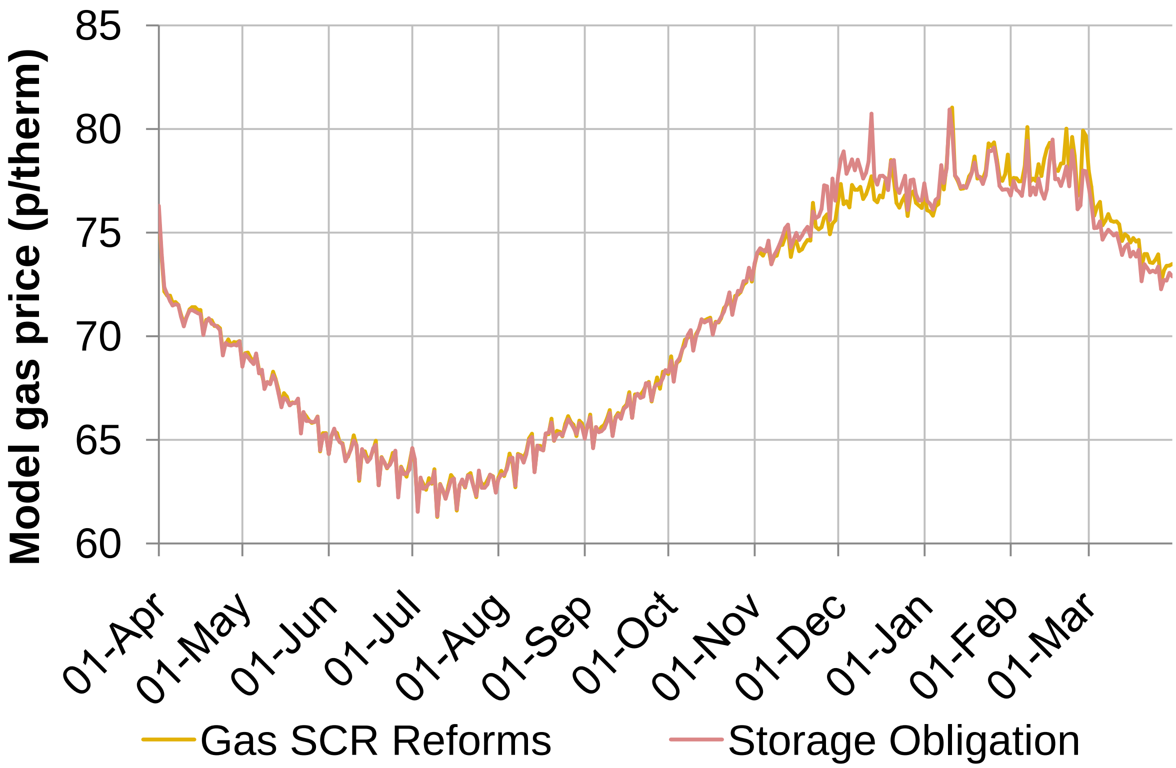
11.15. Under the alternative design there would be some cases where the market was not able to access gas held in store to maximise profit at high prices as a result of the minimum level of storage defined under the option. As an output of the model we have estimated the size of a storage facility that would mitigate this impact and allow the market to trade freely while still retaining sufficient gas in storage to meet the obligation. This suggests the investment response that may be delivered through setting the obligation at this level. Modelling estimates additional investment to provide 42 mcm of salt cavern gas storage volume with a deliverability of 3.5 mcm/day. Our estimates suggest that this investment would have a capital cost of £40m, including cushion gas required initially. Estimates of operating costs for this type of storage range from £0.01-0.06 m/mcm. Therefore, on average, the annual operating cost for this size of storage investment would be approximately £1.47m/yr.

Impact on prices

11.16. The graph below shows the average impact on prices over the 1500 runs for modelling results in the example spot year 2020[53]. This shows that the storage obligation can have an impact on the wholesale price over the course of a winter in which it would be active. On average the obligation would have an upwards impact on prices at the start of winter. This can be explained by the limiting requirement that the obligation places on the market so that storage facilities are not able to deliver the amount of gas that they otherwise would in the absence of the obligation. Towards the end of winter this impact is reversed with the obligation generally reducing prices. This results from release of additional gas that may otherwise not have been available as the obligation level falls through the winter. This places downward pressure on the wholesale price. As the obligation may only be breached to prevent disconnection of protected customers, and as the cash-out price would already have risen to £20/therm in the event that firm gas customers were disconnected under the proposed Gas SCR reforms, there would not be any impact

[53] For more information on how the model functions please see page 12 of Redpoint's Modelling Analysis which accompanies this document.

on price as a consequence of the obligation being breached when compared with the Counterfactual in which cash out reform has been implemented.



Strategic stocks

11.17. Similarly to the SO service obligation, an alternative design of the strategic stocks option would be to set the security of supply level to provide additional protection to all firm customers (and thus electricity customers) under extreme conditions. We have modelled this alternative design to consider the improvement in security of supply that would be achieved. Under this option, the strategic stocks option would be designed to cover the same deliverability parameters as modelled for the SO service obligation (i.e. all firm load under extreme winter conditions and with an outage of a major piece of infrastructure). However, this would be required for a full winter rather than for a seven day period only. This would provide further security of supply certainty under such an extreme event as a protracted N-1 failure under a prolonged extreme winter with tight global markets unable to react to high GB prices.

11.18. The modelling suggests that there would be no firm supply disruptions lasting for a period of more than seven days under the Gas SCR capped cash-out Counterfactual. This suggests that strategic storage would only protect against extreme events not covered by the modelling, which although unlikely are still conceivable. Thus, the impact on supply security as modelled would be the same as that observed for the SO service obligation option. Rather, the design of the option as set out here should only be pursued if decision makers were keen to ensure that GB was able to meet provision of gas to all firm load customers in its gas supplies over a full extreme winter period and with a prolonged 'N-1 outage'.

Probability of interruption

	Gas SCR mean	Strategic stocks mean
Firm DM gas	1 in 128	1 in 409
NDM gas	1 in 167	1 in 409
Firm I&C electricity	1 in 75	1 in 180
Domestic electricity	1 in 333	1 in 900

Un-served energy (and costs of un-served energy)

	Gas SCR mean (millions therms per year, (£m))	Strategic stocks mean (millions therms per year, (£m))
Firm DM gas	0.027 (0.5)	0.009 (0.1)
NDM gas	0.621 (12.4)	0.191 (3.8)
Firm I&C electricity	0.027 (1.6)	0.010 (0.6)
Domestic electricity	0.003 (0.2)	0.001 (0.1)

Costs of the measure

11.19. The costs of this option will be a result of the additional long range storage built and the gas that would need to be procured at the start of winter compared to the value of the gas at the end of winter. In order to deliver the security of supply level specified under the alternative design a long range depleted gas field storage facility with a volume of 1780 mcm and a deliverability of 22 mcm/day would be required. Our cost estimates suggest that the total capital expenditure required would be £1276m including the initial cushion gas requirements. Our annual operating cost estimates for this type of storage range from £0.01-0.02m/mcm. Thus an average estimate of the operating costs would be £26.7m/yr. However this does not include an estimate of the costs and value of the gas required.

Semi-regulated storage (4 bcm facility)

11.20. The design of the option that we set out in the analysis above was designed to encourage investment in an additional 2 bcm long range storage facility. We have also modelled the impacts of a design which encouraged investment in 4 bcm of additional long range storage. This roughly corresponds to the level of storage recommended by the Energy and Climate Change Select Committee in 2011[54]. In this report the Committee recommended doubling of the storage levels currently in place by 2020 which equates to roughly 4 bcm of additional storage.

Probability of interruption

	Gas SCR mean	Semi-regulated returns (4 bcm) mean
Firm DM gas	1 in 128	1 in 750
NDM gas	1 in 167	1 in 1000
Firm I&C electricity	1 in 75	1 in 600
Domestic electricity	1 in 333	1 in 1500

Un-served energy (and cost of un-served energy)

	Gas SCR mean (millions therms per year, (£m))	Semi-regulated storage (4 bcm) mean (millions therms per year, (£m))
Firm DM gas	0.027 (0.5)	0.003 (0.1)
NDM gas	0.621 (12.4)	0.029 (0.6)
Firm I&C electricity	0.027 (1.6)	0.003 (0.2)
Domestic electricity	0.003 (0.2)	0.000 (0.0)

11.21. Modelling suggests that the addition of a 4 bcm long range storage facility as a result of the semi-regulated storage option could have a significant beneficial

[54] See their report titled '*The UK's Energy Supply: Security or Independence?'*[54] published in 2011

impact on security of supply across all customer types. This is due mainly to the additional deliverability that is available in the event of a supply disruption. While the additional volume capacity is also a factor, this is less important in providing security under a short, sharp shock scenario.[55] The effect is similar as that observed with the two bcm facility but is generally more effective as we would expect with a larger facility.

Costs of the measure

11.22. As with the two bcm version of this option, the costs will be a result of the additional long range storage investment delivered. The way in which this cost is distributed will be dependent on the cap and floor arrangements in place to support the storage. Direct costs to consumers will result from the times where the floor is required to support returns to investors. The remainder of the costs will be met by private investment and recouped through market mechanisms.

11.23. The regulated storage option specified here was designed to deliver 4 bcm of long range storage volume with a deliverability of 50 mcm/day. Our cost estimates suggest that the total capital expenditure required for a depleted gas field to deliver these specifications would be around £2884m including the required cushion gas volume. Our estimates of operating costs for depleted gas fields vary from £0.01m/mcm to 0.02 m/mcm. Therefore an average estimate of operating costs would be around £60m/yr.

11.24. As an illustrative calculation to investigate the potential cost to consumers of a ‘cap-and-floor’ regime, based on the facility described above, we made a simple estimate of the annual profit floor needed to be equivalent to a floor on returns of 6% (paired with a 10% cap) at around £246m. We found that the modelled profit for the facility fell below this level in over 95% of simulations, and that on average a ‘top-up’ payment to the facility owner of around £210m/year was required. This should be treated as indicative only, with further analysis required, in particular due to the simplistic cash flow modelling, and the fact that storage profits are likely to be conservative in the market modelling as specific facilities are not fully optimised.

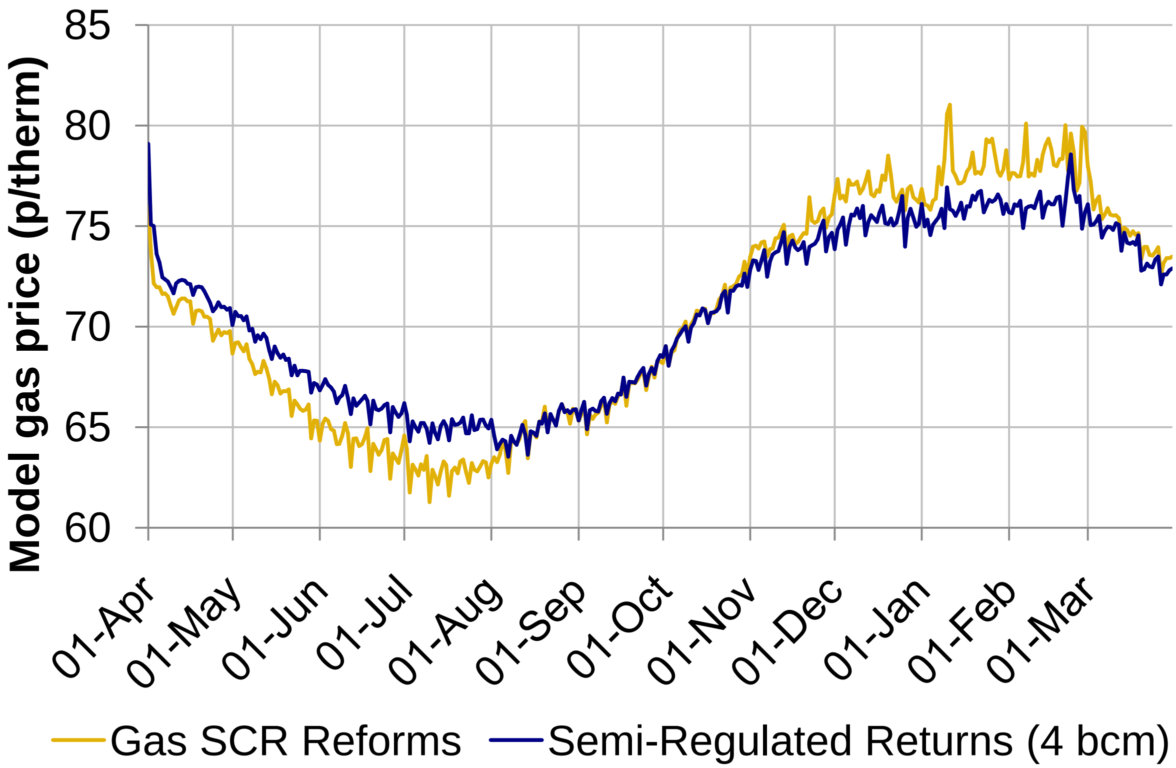
Challenges and Unintended Consequences

11.25. The nature of the challenges and unintended consequences associated with the four bcm semi-regulated returns option will be the same as the two bcm option. However, given the greater volume and deliverability capabilities of the facility the potential impacts of any unintended consequences may be greater.

[55] Upon comparing the results of the 4 bcm design with that of the 2 bcm design it can be noted that the 4 bcm option seems to provide less protection to domestic electricity customers. However this is more a result of the nature of the model. Given that the model is run 1500 times for each spot year, probabilities of 1/1500 or 1/3000 (the results of the 4 bcm and 2 bcm option for domestic electricity respectively) have a high margin for error. Thus the differences between the two probabilities would, in fact be outside the margin of significance.

Impact on prices

11.26. The chart below shows the modelled results (averaged over 1500 runs and taken from the spot year 2020) of the impact on price of having an additional long range storage facility as a result of the support provided under the semi-regulated returns option. The figure shows the same characteristics as for the two bcm option but with a slightly larger magnitude of impact. The figure shows that prices are depressed in the winter as a result of the additional volume of gas available through storage. However prices increase in the summer as a result of additional injection of gas into the new storage facility. The overall effect is to reduce the summer-winter spread by approximately 2.5p/therm to 2.9 p/therm, with a net reduction on the total market wholesale cost of gas of approximately £71m[56] on average over the spot years modelled.



[56]The wholesale cost impact is calculated as an average across modelled simulations excluding occasions where there is an interruption to firm gas supply.