National Audit Office

Briefing
for the House of Commons Energy and
Climate Change Select Committee

Electricity Balancing Services

MAY 2014

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Contents

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Summary

Introduction

1 The National Audit Office has prepared this briefing at the request of the Energy and Climate Change Committee. The briefing gives an overview of the statutory role of National Grid in ensuring electricity generation and supply remain in balance at all times, and of the regulation of this activity by the Gas and Electricity Markets Authority. It also explores the nature and costs of balancing activities, together with wider factors which may affect these over the next decade.

2 The briefing is structured as follows:

- Part One explains the need for balancing services, the way they operate, and how the costs of these services are recovered.
- Part Two sets out in greater detail the different kinds of balancing services available and the way in which they are used. It also examines how Ofgem incentivises National Grid to achieve good value for money in managing balancing activities.
- Part Three explores shorter term security of supply considerations, and a range of wider factors which might affect the provision and cost of balancing activities over the next decade. The latter include the growth of intermittent sources of generation and the development of an integrated EU-wide energy market.

3 This briefing was compiled on the basis of desk-based research of publicly available documents from Ofgem, National Grid, and Elexon; together with previous National Audit Office reports and briefings on the electricity landscape. It was supplemented by interviews with Ofgem staff, and a visit to National Grid's control centre at Wokingham.

Main features

4 Electricity cannot easily be stored. Generation and supply therefore have to remain balanced at all times in order to provide a reliable supply to consumers and prevent damage to infrastructure such as power lines, transformers and generation plant.

5 The government introduced a new electricity market structure for England and Wales (the New Electricity Trading Arrangements or NETA) in 2001. These arrangements were extended to Scotland in 2005 and renamed the British Electricity Trading and Transmission Arrangements (BETTA). The market is based on bilateral contracting between electricity generators and suppliers who aim to balance their individual contracted positions. However, some imbalances do always arise for a variety of reasons, and National Grid therefore fulfils a statutory residual role in ensuring that the system remains balanced.

6 National Grid's role in balancing the system is set out in primary legislation and regulated by the Gas and Electricity Markets Authority working through Ofgem. It is specified in detail in transmission licence conditions and a series of codes, including a Balancing and Settlement Code. Compliance with balancing requirements is included in individual generation and supply licences, and generators and suppliers may also negotiate or bid for the provision of certain types of balancing services. Where they do so, they generally receive an availability payment as well as a payment for the use of a service.

7 Balancing activity is based on half hour periods ('Settlement Periods'). Suppliers and generators contract with each other and provide details to National Grid of their contractual positions one hour before each settlement period. They also provide estimates of their likely actual generation and demand in that period, and what they would charge or be prepared to pay for altering their level of generation or demand ('bids and offers'). National Grid can then take any balancing actions necessary using these bids and offers and a range of other services available.

8 There are two types of balancing actions. Energy imbalance actions address overall mis-matches between generation and demand at a national level across the settlement period as a whole. System imbalance actions tackle local or regional constraints in the capacity of the transmission network, or short-term variations between demand and supply within a settlement period. Constraint actions can result in compensation ('constraint payments') for generators which lie behind a constraint barrier.

9 In 2013-14, the total cost of balancing services, including National Grid's own administrative costs and incentive payments, amounted to £1,002 million. National Grid initially recovers these costs through a Balancing Services Use of System (BSUoS) charge. This is levied at a uniform rate on generators and suppliers according to the amount of electricity they put into, or take out of the grid, adjusted for transmission losses. In 2013-14, typical BSUoS rates were between £1 and £3 per megawatt hour (or 0.1 to 0.3 pence per kilowatt hour).

10 National Grid's arm's length subsidiary, Elexon, subsequently analyses the prices of individual balancing actions. Elexon charges each generator and supplier according to the extent any imbalances in their own contracted positions contributed to the overall imbalance of the transmission system. This process is known as 'Cash Out'. Cash Out imbalance charges are designed to ensure that generators and suppliers have an incentive to balance their own positions in the market ahead of the settlement period.

11 National Grid has a range of individual balancing services available to address different circumstances. In 2013-14, more than 50 per cent of the total cost of balancing services related to frequency response and reserve generation. These are typically deployed where National Grid is faced with a short term mismatch between generation and demand. This could be due, for example, to a sudden loss in generating capacity arising from the failure ('outage') of a major power station. Around 40 per cent of total costs arose from instructions to generators to adjust their production because of local and regional constraints in network capacity.

12 The total cost of balancing services has increased significantly since 2010 largely due to the growth of constraint costs. This growth results mainly from the unavailability of some transmission assets due to the major programme of upgrades which is currently underway in Scotland and elsewhere. In addition, a small part of this growth is due to the introduction of the 'Connect and Manage' policy. Under this policy, National Grid is required to connect new generators before completing all relevant transmission network upgrades in that region to cope with the extra capacity.

13 Ofgem operates a Balancing Services Incentive Scheme to incentivise National Grid to act economically and efficiently in carrying out its balancing role. Under the scheme, National Grid is allowed to retain a share of savings where costs are below a target set by Ofgem, but has to bear a share of excess costs where the target is exceeded. Since 2005, costs have generally exceeded targets. From 2011-12, Ofgem has set initial cost targets for two year periods using a balancing cost model and forecast activity levels. Ofgem has then used the same model to adjust balancing cost targets to reflect actual levels of activity. For the 2011-12 to 2012-13 scheme, National Grid expenditure totalled £1,723 million against a target of £1,503 million, resulting in a £48 million net loss for National Grid. For 2013-14 to 2014-15, following validation and approval by Ofgem, National Grid has refined the balancing cost model used for target setting.

14 Ofgem's 2013 Electricity Capacity Assessment highlights that risks to security of supply are expected to increase appreciably until winter 2015-16 from near-zero levels. This is mainly due to a significant reduction in electricity supplies from coal and oil generation plant, coupled with limited investment in new plant. After 2015-16, Ofgem expects the position to improve due to a combination of reduced demand and new generation. From 2018-19 onwards, the introduction of the Capacity Market may help to address security of supply. In the short term, Ofgem has approved the availability of two new balancing services for National Grid to use to stimulate the development of demand side responses, or keep available power stations which might otherwise be closed or mothballed.

15 In 2012 Ofgem launched a review of the Cash Out provisions of the Balancing and Settlement Code. This followed concern that the existing Cash Out charges were not providing sufficient incentives for generators and suppliers to balance their contractual position in the market ahead of gate closure. Sharpening these incentives could potentially reduce the extent of balancing activities required and the costs associated with them. Ofgem is due to take a decision on the Cash Out review later this year.

16 The EU Third Energy Package aims to establish an open, integrated and competitive energy market across the EU. This involves the development of a 'Target Model' to facilitate efficient use of cross-border capacity and encourage harmonisation of European wholesale market arrangements. These developments may require further changes to balancing mechanism arrangements.

17 In response to the wide range of developments which might impact on market arrangements and balancing activities, in February 2013 the Authority launched an initiative to ensure that the trading arrangements deliver efficient operation of existing assets, appropriate incentives to maintain existing assets and invest in new capability, and effective and efficient integration with wider European markets to the benefit of British consumers. In February 2014, Ofgem announced that it was taking forward work on locational pricing and the Target Model, and that it would give further consideration to how to take forward other potential workstreams relating to managing intermittency, balancing services, and long-term market arrangements.

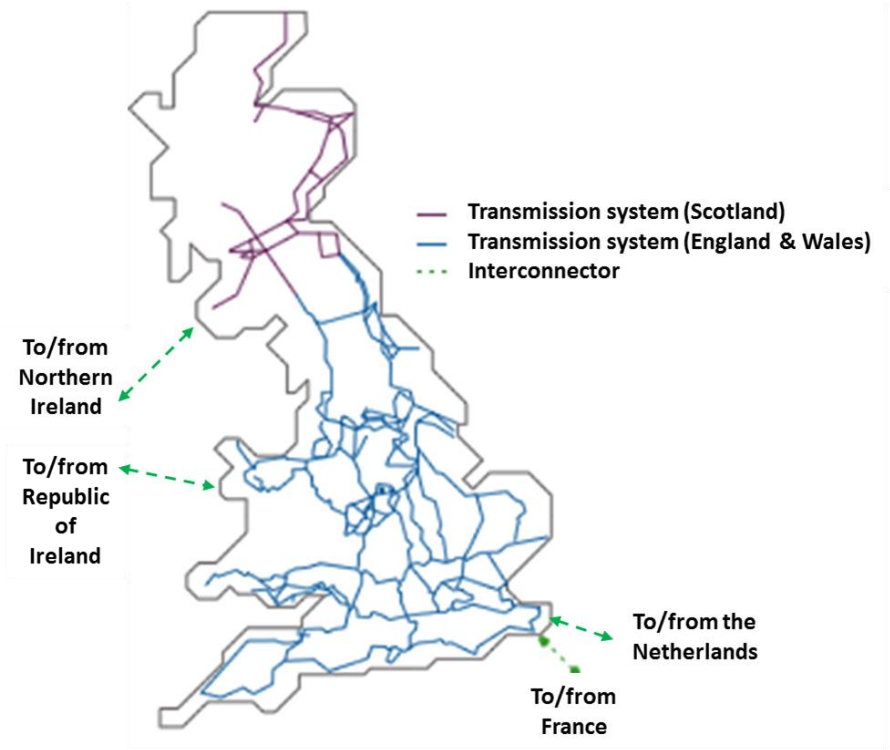
Issues for consideration

18 Questions which the Energy and Climate Change Committee might explore with Ofgem and National Grid include the following:

- How can Ofgem ensure that sharper Cash Out incentives from the Significant Code Review:
    - encourage generators and suppliers to balance their own positions before gate closure, thus reducing the call on National Grid to perform balancing activity after gate closure;
    - minimise the level of payments required under the capacity market; and
    - do not restrict market participation to major utilities?
- To what extent can National Grid's use of the two new balancing services tackle the risks to security of supply identified in Ofgem's 2013 capacity assessment?
- To what extent can implementation of the EU Third Package and the Target Model reduce balancing costs and mitigate risks to security of supply?
- To what extent will the 2013-21 regulatory settlements for Transmission Owners (RIIO-T1) address constraints on the movement of electricity around Great Britain?
- Is public information about constraint costs adequate, in the light of recent media publicity surrounding the scale of constraint cost payments to wind farms?
- How do you ensure that “Connect and Manage” is achieving its objectives without adding disproportionately to constraint costs?
- How do you ensure that the approach to regulating balancing costs gives strong incentives for efficiency, while eliminating costs considered to be outside of National Grid's control?
- Are current arrangements for balancing services as a whole fit for purpose in the light of current and future developments (including the growth of intermittent and embedded generation)?
- How is Ofgem proposing to take forward the various workstreams, other than locational pricing, identified by the Future Trading Arrangements initiative?

Part One: The British electricity balancing regime

Figure 1: The GB high voltage electricity transmission network



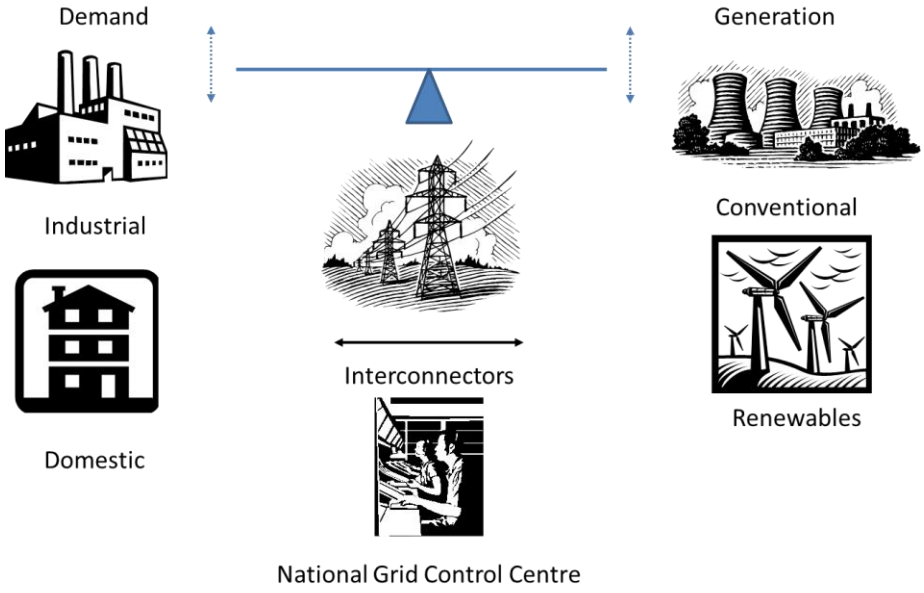
Source: National Audit Office

1.1 High voltage transmission networks transfer electricity generated at remote sites to areas of demand. Distribution networks carry electricity from the grid at lower voltages to population centres and industrial sites.

1.2 There are three high voltage transmission networks in Great Britain: National Grid's network in England and Wales, Scottish Hydro Electric's in north Scotland and Scottish Power's in south Scotland. Each company owns and maintains its network. In addition, National Grid has an overarching role as National Electricity Transmission System Operator (NETSO) for Great Britain.

1.3 Interconnectors link Britain to Northern Ireland and the Republic of Ireland (owned by the Irish networks), France and the Netherlands (owned by National Grid subsidiaries and the linked networks). Further links are planned with Belgium and Norway.

Figure 2: Balancing the GB transmission network



Source: National Audit Office

1.4 Electricity cannot be stored economically in large quantities. Therefore generation must always equal demand plus energy lost when electricity is transported (transmission losses). If it does not, the system's frequency moves away from the target frequency (50Hz) and the system becomes unstable.

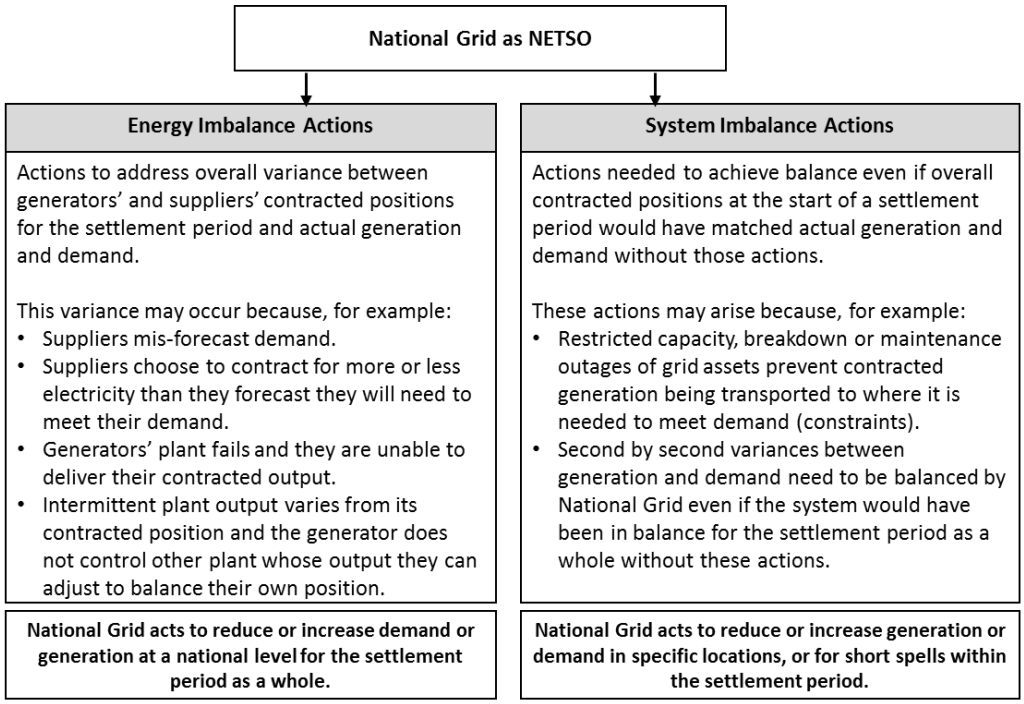
1.5 National Grid, in its capacity as National Electricity System Operator (NETSO), must ensure that electricity generation and demand are balanced across the GB transmission system on a second by second basis.

1.6 Each day is divided into 48 half hour periods, called settlement periods, for electricity balancing purposes. Each electricity supplier estimates how much electricity its customers will use during each settlement period, and enters into contracts with UK generators (or overseas generators and holders of interconnection capacity) to meet its requirements.

1.7 Generators with multiple plants will normally decide which plants to use based on their marginal operating costs. For example, if the wind is blowing they will prefer to use their wind farms, which have low operating costs, to meet as much contracted output as possible before turning to fossil fuel plant.

1.8 National Grid, as NETSO, can instruct generators to change their output, or take up offers from large users to reduce their demand, in order to balance the system. National Grid may also trade to change market-driven interconnector flows. These are balancing actions and their costs are balancing costs.

Figure 3: Energy and System balancing actions

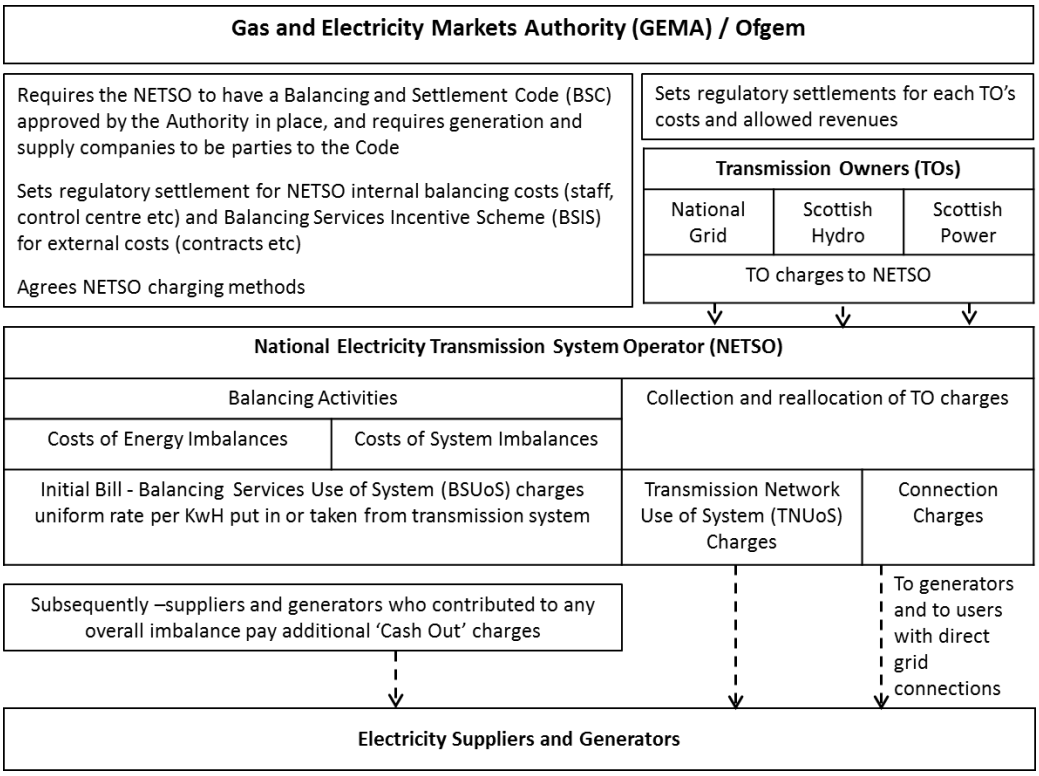


Source: National Audit Office

1.9 National Grid's balancing actions are of two types.

- **Energy imbalance** actions occur because the total amount of electricity contracted for by generators and suppliers ahead of a settlement period varies from actual demand over that period.
- **System imbalance** actions occur because:
    - grid constraints restrict the ability of a generator to meet its contracted output from its preferred plant. For example, the amount of electricity which can be carried from Scotland to England is limited by transmission capacity across the border. On windy days, output of Scottish generation plant may exceed this capacity and may need to be reduced while plant south of the constraint is called upon to balance the system. Other such constraints arise from damage to, or maintenance of, transmission network assets.
    - Minute to minute variances between demand and generation within a settlement period need balancing actions by National Grid, even if demand would have matched generation for the period as a whole without those actions.

Figure 4: Regulating balancing activity - overall context



Source: National Audit Office

1.10 The activities of transmission owners and National Grid's activities as NETSO are regulated by the Gas and Electricity Markets Authority.

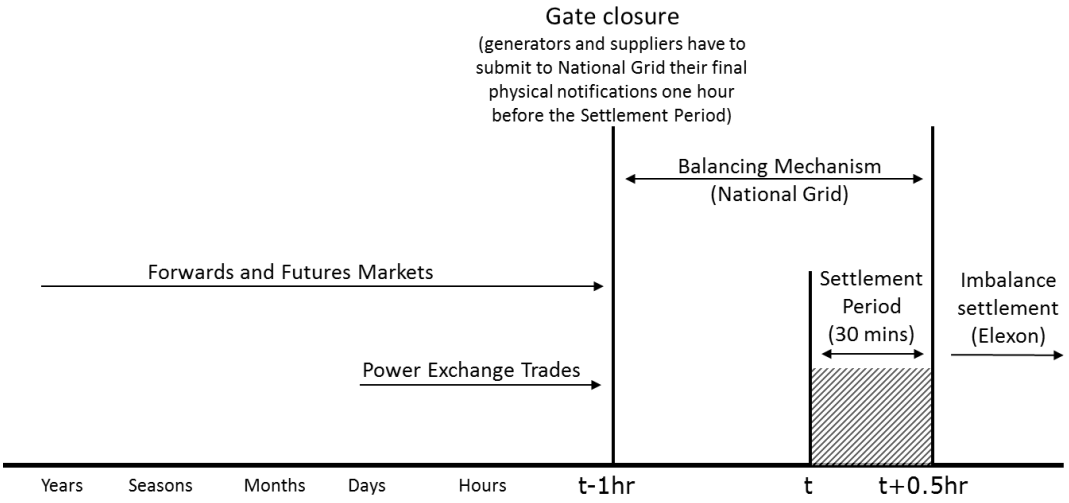
1.11 Under the transmission owners' regulatory settlements, each transmission owner prepares a business plan stating how it intends to deliver its outputs, including requirements for transmission investment, taking into account the short-term costs to the operation of the network and the longer-term value from strengthening it. These plans and their costs need to be approved by Ofgem.

1.12 National Grid as NETSO must maintain a Balancing and Settlement Code and a Connection and Use of System Code setting out how generators and suppliers should participate in balancing activities and how National Grid recovers its balancing costs from them.

1.13 The internal costs of National Grid's balancing activities are controlled under its regulatory settlement. National Grid recovers all its balancing costs through a Balancing Services Use of System (BSUoS) charge to generators and suppliers per kiloWatt hour generated or supplied.

1.14 Generators or suppliers pay or receive 'Cash Out' charges for any shortfall or surplus in the amount of electricity they put into or take out of the grid relative to their contracted position.

Figure 5: The balancing timeline



Source: Ofgem

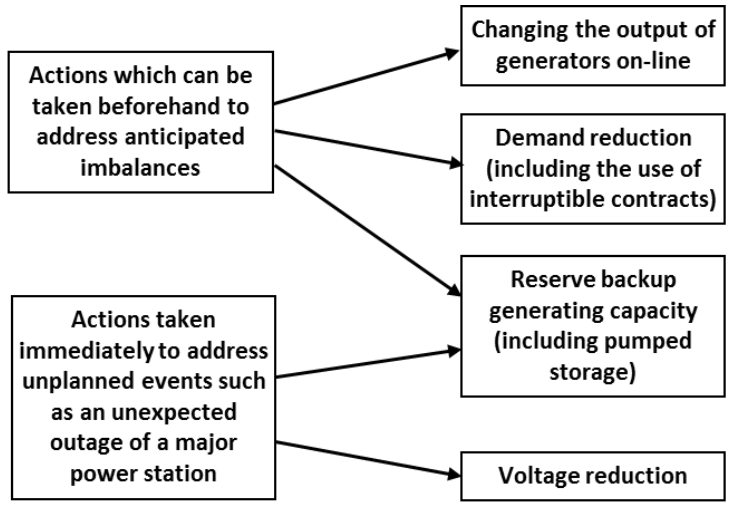
1.15 The British electricity trading arrangements aim to ensure the electricity system is balanced in the most efficient way, with generators and suppliers incentivised to balance their own positions. Where this is not possible or economic, National Grid fulfils a residual balancing role. Over 90 per cent of trades are arranged through bilateral contracting in forwards and futures markets. A further five per cent are negotiated within power exchanges operating over a period of up to 48 hours before real time. The net imbalance that National Grid has to address in its balancing services is typically around 2 per cent of total energy demand.

1.16 Electricity generators and suppliers have to provide initial physical notifications of their likely generation and demand before 11.00 am for the next operational day (05:00-05:00). This provides National Grid with some indication of the generation profile, and enables it to take early action to resolve any transmission constraints - for example, by entering into trades itself.

1.17 At 'gate closure' one hour before each half-hour period, generators and suppliers must provide final physical notifications of their expected generation and demand, together with their final contracted positions (which may not be the same). They may also submit 'bids' and 'offers' for the prices they would charge or pay for varying their generation or supply in the half-hour settlement period. A 'bid' is a proposal to reduce generation or increase demand, and an 'offer' is a proposal to increase generation or reduce demand. National Grid can call on these bids and offers to balance the system.

1.18 Elexon, a wholly owned arms-length subsidiary of National Grid, performs a formal regulatory role as the Balancing and Settlement Code Company. Following receipt of information from National Grid after the end of each settlement period on the balancing actions that were required, it analyses imbalance data to determine Cash Out charges.

Figure 6: Key balancing actions



Source: National Audit Office

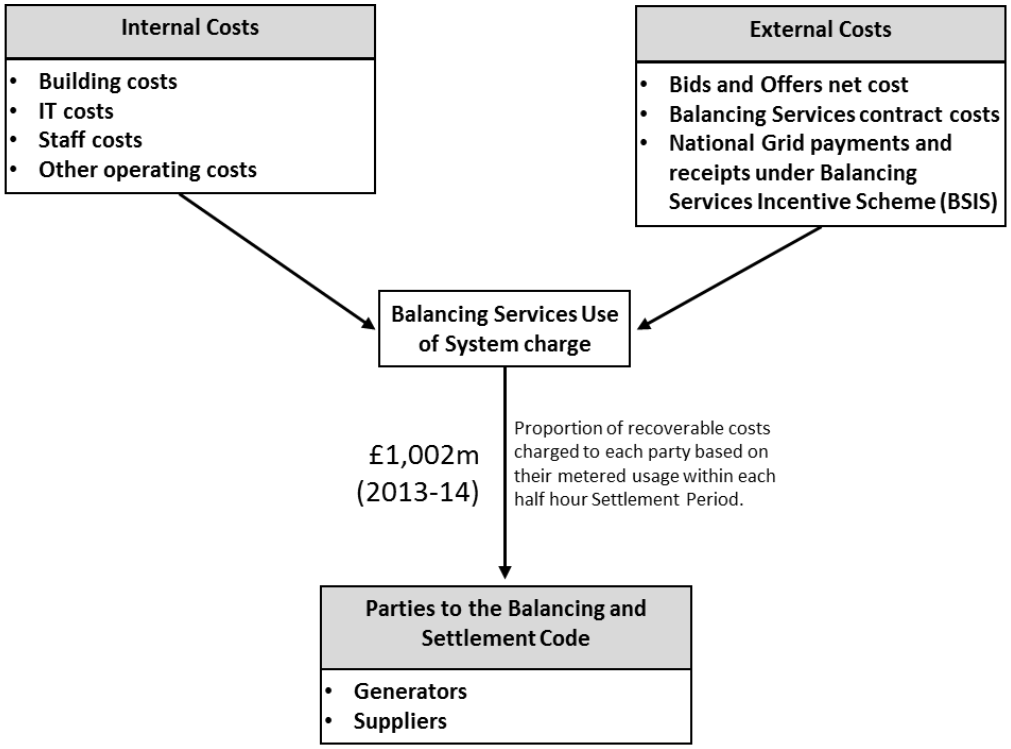
1.19 To ensure generation matches supply on a continuous basis, National Grid can take three types of action:

- **changing generation**: National Grid can call on power plants which are already generating to increase or decrease their output for limited periods of time through the balancing mechanism system of bids and offers. It also has contracts with generators for reserve generation which can be accessed very quickly. The latter include pumped storage – reserve hydro-electric power stations, which can generate power within seconds.

- **reducing demand**: large industrial plants can negotiate lower tariffs with energy suppliers in return for accepting that their electricity supply may be reduced or interrupted. National Grid can utilise such contracts to reduce demand.

- **voltage reduction**: National Grid can allow moderate voltage reductions for short periods of time. This has a slight effect on industry and consumers (including, for example, lights becoming slightly dimmer) but can simulate an additional generating capacity of up to 6GW, the equivalent of five nuclear generating stations of the size of Sizewell B. Voltage reductions can only be used as a short-term measure because consumers and business will respond over time by increasing demand (for example, by turning on more lights).

Figure 7: Balancing Services Use of System (BSUoS) charges



Source: National Audit Office

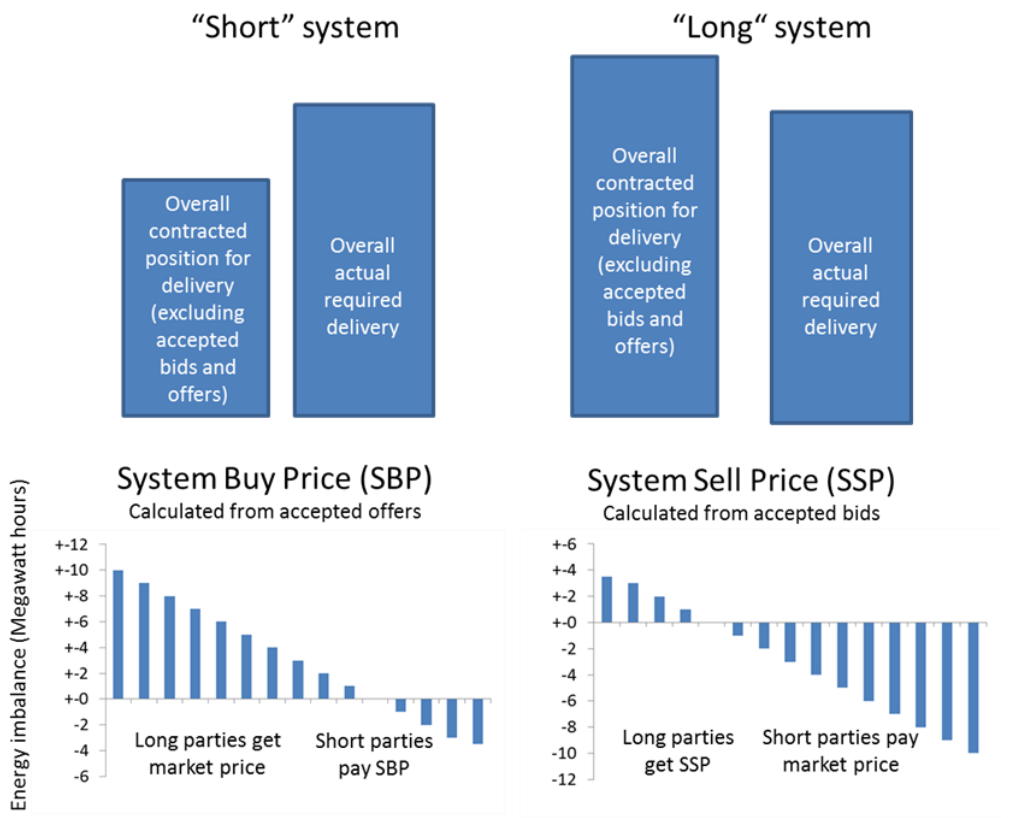
1.20 BSUoS charges allow National Grid to recover the costs of its balancing activity. Internal costs are the costs of National Grid's own balancing staff, accommodation and IT systems and are covered by its regulatory settlement. External costs are National Grid's costs in asking generators to change power delivery or asking users to change their use. National Grid is incentivised to incur external costs efficiently by a Balancing Services Incentive Scheme.

1.21 BSUoS charges are calculated for each half-hour settlement period. Figures can be revised over a period up to 14 months after each period as a result of Elexon's reconciliations of generation and supply.

1.22 BSUoS is charged per kilowatt hour and is the cost of balancing activity for a period divided by metered electricity volumes in and out of the grid during that period. Some balancing services available to National Grid may have an availability component as well as a use component. Availability costs are spread across the year.

1.23 The BSUoS rates can vary over different times of the day and year. The average BSUoS charge over the two-year period 2011-13 was £1.54 per MWh, with rates typically ranging between £1 and £3 per MWh (0.1 to 0.3p per kilowatt hour). The charge to each generator or supplier is their total generation or supply multiplied by the BSUoS rate.

Figure 8: Cash Out charges



Source: National Audit Office and Balancing and Settlement Code

1.24 The 'Cash Out' process penalises generators and suppliers to the extent that an imbalance in their own contracted position contributes to an overall imbalance for a settlement period.

1.25 If generators and suppliers as a whole contract to deliver less electricity overall than required, the system is 'short'. Generators or suppliers contributing to the shortfall by being short in their own contracted position pay a System Buy Price to Grid for each unit of their own imbalance. The System Buy Price is higher than the market price and the difference represents a 'penalty' for a short party relative to its position if it had achieved a balanced contractual position through the market.

1.26 If generators and suppliers contract to deliver more electricity in total than required, the system is 'long'. Generators or suppliers contributing to the surplus by being long in their own contracted position are paid a System Sell Price to Grid for each unit of their own imbalance. The System Sell Price is lower than the market price and the difference represents a 'penalty' for a long party relative to its position if it had achieved a balanced contractual position through the market.

1.27 Generators and suppliers out of balance in the opposite direction to the overall system pay or receive the prevailing market price for their shortfall or surplus. They are therefore not penalised for their imbalance relative to their position if they had achieved balance through the market.

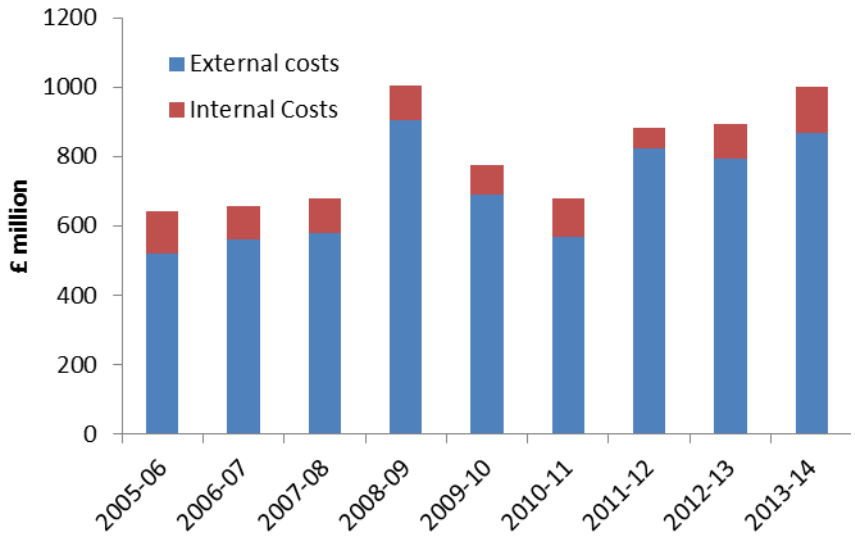
1.28 System Buy and System Sell prices are derived from bids and offers accepted by National Grid, and adjusted to reflect any availability payments which ensured those bids and offers were available to National Grid. Prices for bids or offers to perform system balancing actions are flagged by National Grid and are substituted in these calculations if they exceed the maximum or minimum cost of energy balancing actions. Otherwise actions taken because of the limitations of National Grid's own network could drive the prices paid by generators and suppliers who are out of balance. The System Buy and Sell prices are based on the average price of the most expensive 500MWh of bid or offer acceptances during the settlement period.

1.29 Any surplus from Cash Out charges is known as Residual Cashflow Realloaction Cashflow (RCRC), or colloquially as the 'Beer Fund'. The RCRC is distributed across generators and suppliers as a uniform amount per MWh delivered to or drawn from the transmission network.

1.30 Cash Out charges send important price signals to owners of existing generation plant and prospective investors in new plant. The System Buy Price, in particular, indicates the price which an owner of flexible plant could expect to receive when the supply of electricity is scarce.

Part Two: Balancing activities and efficiency incentives

Figure 9: Total costs of balancing services

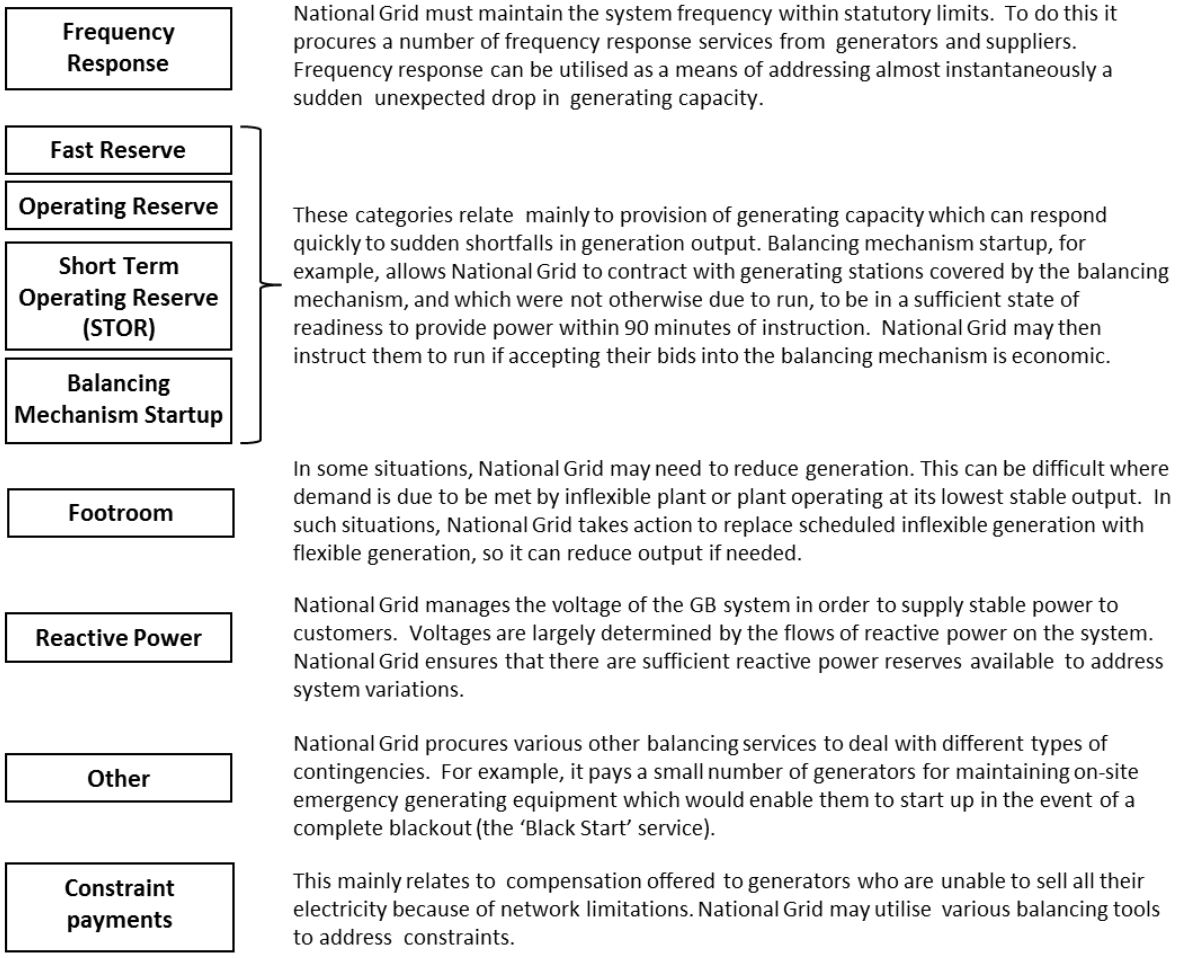


Source: Ofgem / National Grid

2.1 The graph shows the total costs of balancing services which are recovered through the Balancing Services Use of System (BSUoS) charges. The costs are broken down into external costs National Grid incur for the procurement and utilisation of balancing services, and its own internal costs (Figure 7).

2.2 Total balancing costs have shown a rising trend from £642 million in 2005-06 to £1,002 million in 2013-14. This overall trend is largely because of a rise in constraint costs (Figures 16 and 17).

Figure 10: Types of Balancing Services



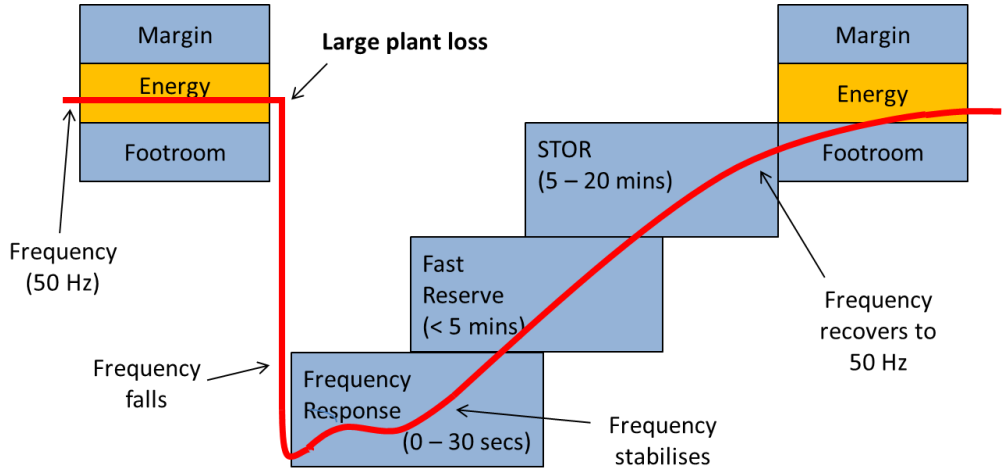
Source: National Audit Office

2.3 National Grid reports monthly on its use of balancing services under the above broad categories. In total, there are 22 individual balancing services available. A number of these would only rarely be used as they would be called on only in exceptional circumstances. They nevertheless provide additional assurance of the resilience of the balancing arrangements such as, for example, in a blackout situation.

2.4 National Grid procures its services through the balancing mechanism, tendered services and standard bilateral contracts. The prices paid and offered are published for most services. For many services, providers will receive both an availability payment and a utilisation payment.

2.5 Bids and offers are not shown separately in the above diagram as they can be utilised within a number of the services shown. In particular, a large proportion of constraint costs will relate to the acceptance of bids and offers.

Figure 11: Case study example of response to a major outage



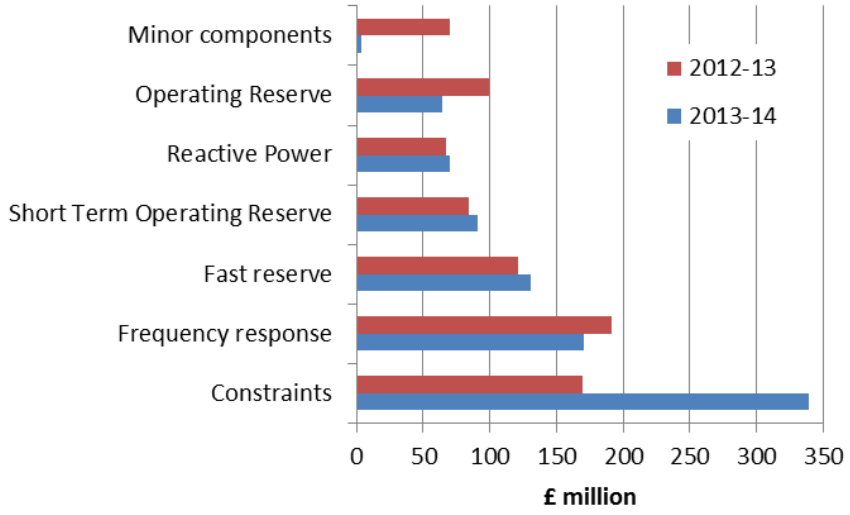
Source: National Audit Office / National Grid

2.6 National Grid typically uses a range of balancing actions to respond to an outage of a major power station:

- Frequency response control to stabilise voltage within statutory limits. This can be employed within seconds.
- Fast reserve generating contracts can be employed within minutes to provide extra generating capacity in order to begin to restore system frequency and meet energy imbalances. These contracts include, for example, pumped storage such as the Dinorwig plant in Snowdonia which can produce over 1.7GW of electricity with minimal notice.
- The Short-Term Operating Reserve (STOR) constitutes typically 3GW of reserve generating capacity or demand reduction which National Grid can employ within 5 to 20 minutes in a similar way to the fast reserve.

2.7 Additionally, as the system recovers, National Grid may utilise other balancing services such as bids and offers to restore the system to normality.

Figure 12: Cost of individual balancing services



Source: National Grid MBSS reports for March 2013 and March 2014

2.8 National Grid report on their utilisation of balancing services on a monthly basis. These reports include detailed information on individual services, together with summary analyses and projected outturns which are based on the categories set out in Figure 10 above.

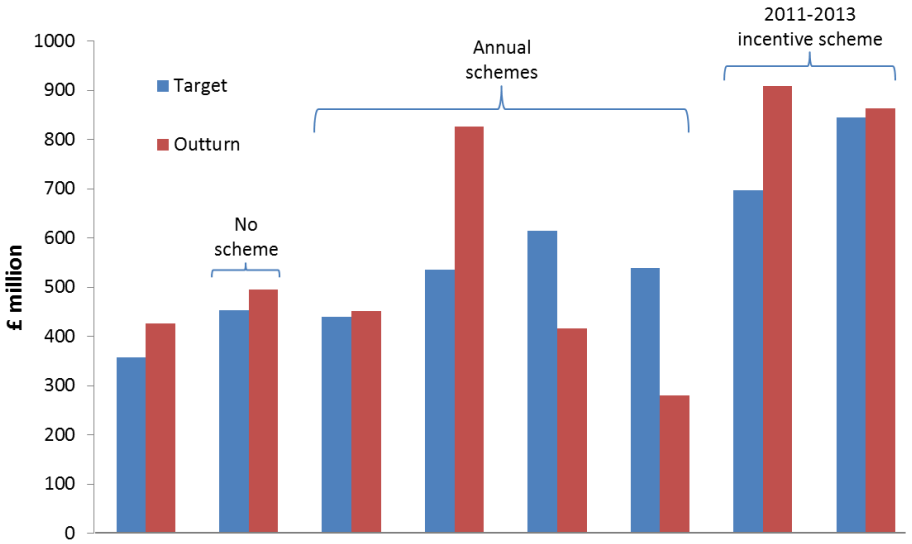
2.9 In 2013-14, the key measures National Grid utilises in balancing the system were:

- frequency response and reserves (more than 50 per cent of total costs);
- actions to deal with constraints (around 40 per cent of total costs); and
- reactive power (around 8 per cent of total costs).

As the above graph shows, expenditure particularly on constraint costs can vary substantially in different years (see Figure 16 below).

2.10 Frequency response and reserves are generally used to deal with a sudden unexpected imbalance, such as created by the failure of a major power station. Constraint actions are undertaken to deal with geographical imbalances between generation and network capacity.

Figure 13: Balancing Services Incentive Scheme - past performance



	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-13
Payment to/from NG	-£4.0m	None	-£1.2m	-£15m	£15m	£15m	-£49m
Performance	In range	N/A	In range	Floor hit	Cap hit	Cap hit	In range

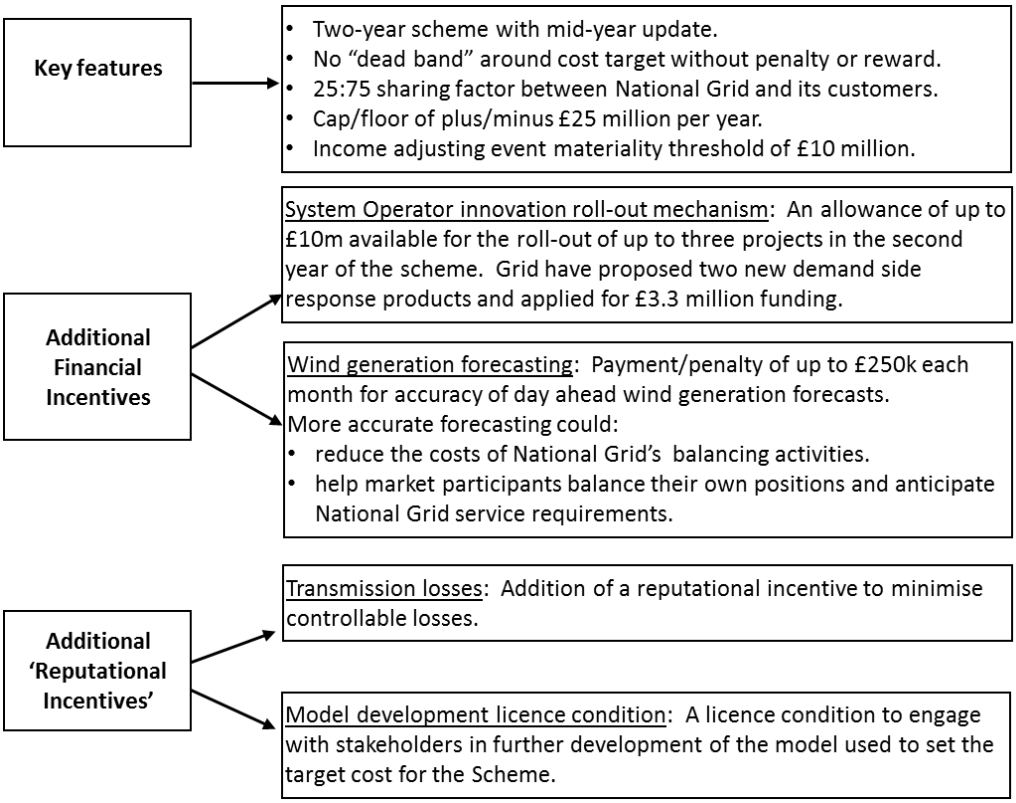
Source: Ofgem

2.11 Ofgem operates a Balancing Services Incentive Scheme (BSIS) to incentivise National Grid to act economically and efficiently in performing its balancing role. Under the scheme, the cost or benefit of over or underspends relative to target is shared between National Grid and its customers. This is subject to a cap on the total profit or loss National Grid is subject to, and until 2013 to a narrow dead band range around the target within which National Grid was not entitled to or liable for any share of profits or losses. Ofgem determines the parameters of the scheme, including the target setting approach, after consultation with stakeholders. Since 2011, targets have been based on a model of balancing costs. Model inputs which Grid can control are fixed in advance for two years, whilst those beyond its control reflect actual outturn values.

2.12 Since 2005, outturn costs have generally exceeded targets. Until 2011, National Grid's profits or losses from balancing activities were capped at £15 million per year.

2.13 Under the 2011-13 scheme, National Grid was liable for 25 per cent of any overspend relative to the scheme target, and conversely was permitted to retain 25 per cent of any underspend, subject to a cap of £50 million in total costs or profits over the two year period. National Grid's expenditure over the two years was £1,723 million against a target of £1,503 million. Under provisions for income adjusting events, National Grid applied to exclude over £200 million of expenditure from performance against the scheme target. Ofgem allowed the exclusion of £28 million of this, resulting in a £48.7 million net loss for National Grid.

Figure 14: Balancing Services Incentive Scheme - the 2013-15 scheme



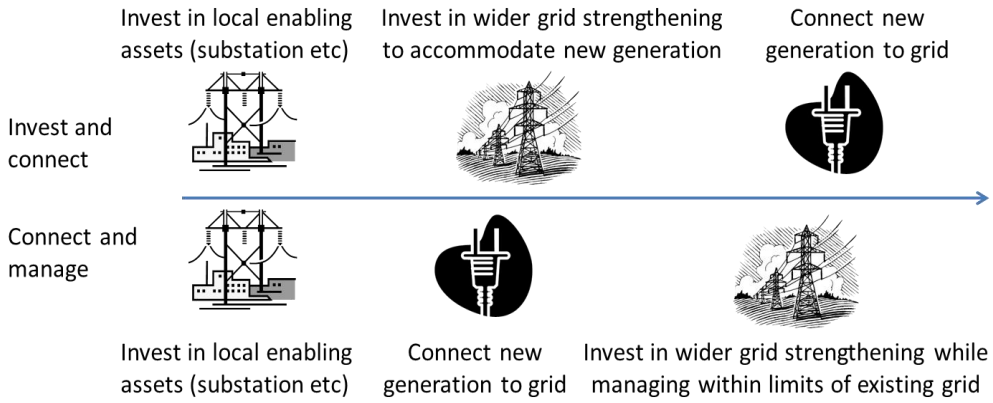
Source: National Audit Office / Ofgem

2.14 For 2013-15, Ofgem has developed a new incentive scheme incorporating:

- Improvements to the target modelling approach.
- Removal of the dead band either side of the target within which National Grid was not entitled to or liable for any share of profits or losses.
- Introduction of new financial incentives for innovation and accurate forecasting of wind generation.
- Introduction of new 'reputational incentives' to minimise transmission losses and further improve the model used to set targets for balancing costs.

Part Three: Future challenges and proposals

Figure 15: Connecting new generation to the Grid



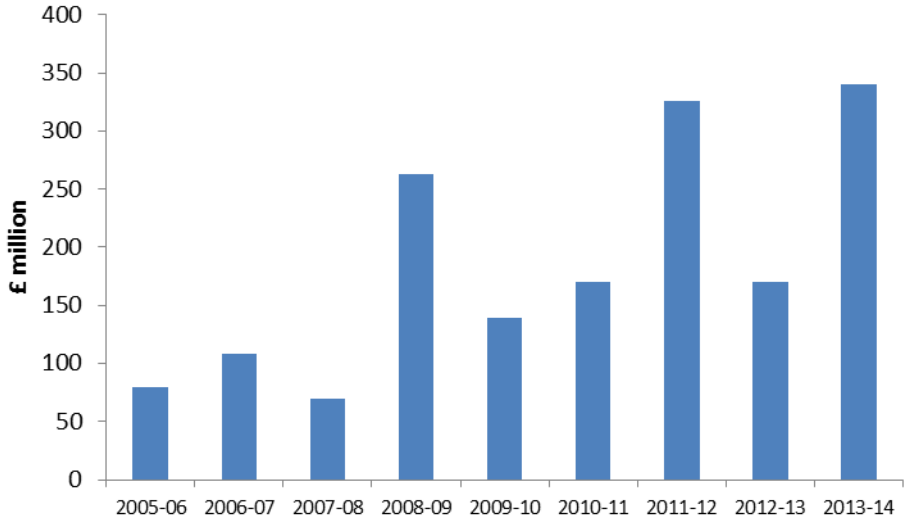
Source: National Audit Office

3.1 Until 2009, in its role as NETSO, National Grid operated an 'Invest and Connect' regime under licence conditions requiring it to comply with the transmission Security and Quality of Supply Standard. Under that standard, National Grid could not offer generators connections until transmission owners had completed both local 'enabling works' to establish a grid connection and 'wider works' to allow the grid as a whole to handle the export of the additional electricity generated. This helped minimise constraint costs, but often meant lengthy connection times for new plant.

3.2 In May 2009, to speed up grid access, National Grid introduced a temporary 'Connect and Manage' policy with Ofgem's approval. The policy was made permanent by the government in August 2010. Under Connect and Manage, transmission owners must offer generators applying a connection date once local enabling works are complete. If wider works are also needed, the transmission owner must seek a derogation from the normal requirement to complete them before offering a connection. National Grid as NETSO can challenge derogation requests on the basis of system security, running an economic and efficient network, and adverse impact on other network users.

3.3 Because there is a natural lag between investment decisions and generator build, the Connect and Manage regime did not start having a notable impact until relatively recently. In the future, the impact of the Connect and Manage regime on balancing costs (and constraint costs in particular) may increase as more, and larger, generators connect under it.

Figure 16: The growth of constraint costs



Source: National Audit Office / Ofgem

3.4 Constraint costs have risen in recent years. Constraint costs for 2013-14 were £340 million compared with levels around or below £100 million for the three years 2005-06 to 2007-08. Figures can vary significantly between years, and high constraint figures in some years relate primarily to major transmission upgrade works which require some grid capacity to be disconnected during construction.

3.5 National Grid estimate that in financial years 2011-12 and 2012-13 Connect and Manage accounted for only 1 per cent and 3 per cent of constraint costs respectively, but accounted for 16 per cent of constraint costs in calendar year 2013.

3.6 The transmission investment programme from 2013 to 2021 is expected to significantly reduce network constraints. But this work, like previous work on the network, may itself increase constraint costs for several years while key parts of the transmission infrastructure are out of use as part of the upgrade programme. A Network Access Policy has been developed by Ofgem under the latest regulatory settlements for transmission owners. It is intended to promote coordination of outages to reduce constraint costs.

3.7 To help control constraint costs, the Department (with support from Ofgem) introduced a new licence condition in October 2012 (the Transmission Constraint Licence Condition), preventing generators of all types from submitting excessive bids for reducing their output. There has been a decrease in the price paid to wind farms to reduce their generation following the introduction of this condition. Some smaller generators who do not require a licence are not subject to this condition.

Figure 17: Constraint costs attributable to wind power

Source: Ofgem

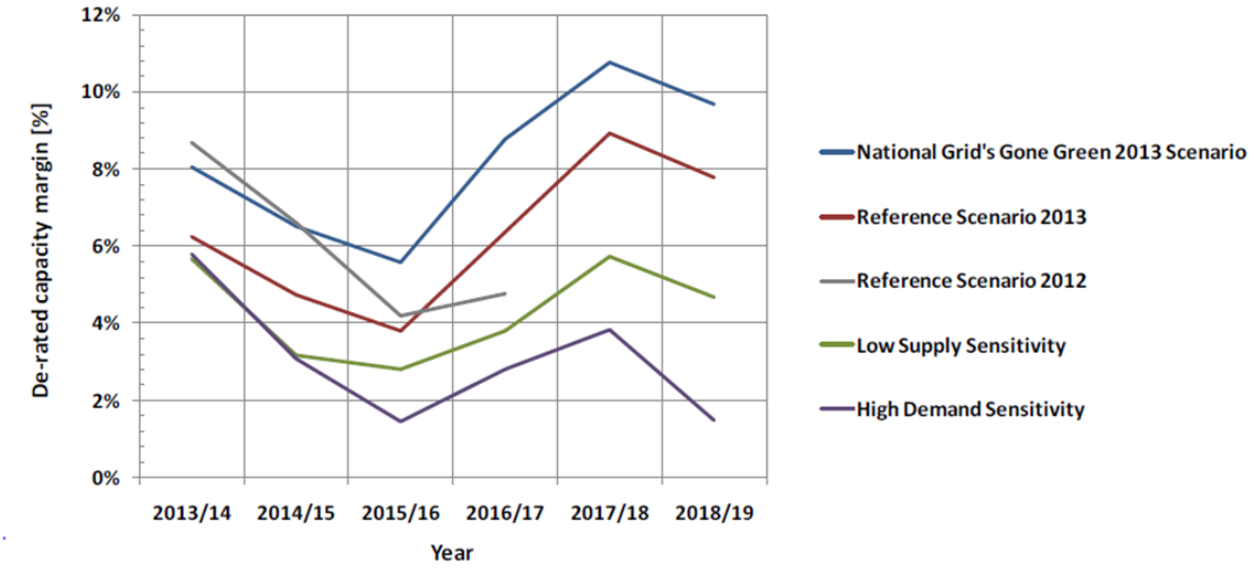
3.8 The marginal cost of generation from renewables such as wind and solar power is low since plants do not consume costly fuels. Moreover, many renewable generation plants receive both the wholesale market price and renewable obligation certificates for each unit of electricity they generate. Renewable generators will therefore want to export as much power into the grid as wind and sun conditions allow. If National Grid curtails their output to meet balancing requirements, generators will seek to recover their costs through their bids into the balancing mechanism.

3.9 In some cases, National Grid may have few options to resolve a constraint. There may, for example, be few generators (or users available to reduce demand) in the area where action is needed to relieve an excess of generation over demand. In these circumstances, National Grid may need to accept relatively high bids from renewable generators.

3.10 Curtailing wind power in a constrained location may also incur costs in increasing generation on the other side of the constraint. These costs are included in the chart above as part of the 'Other generators' category.

3.11 More generally, the growth of other forms of small-scale generation, such as small-scale wind farms and solar photovoltaics, which is 'embedded' within local distribution networks, may also increase the difficulty of forecasting net demand and the challenges of balancing generation and demand at both a national and local level.

Figure 18: Security of supply projections



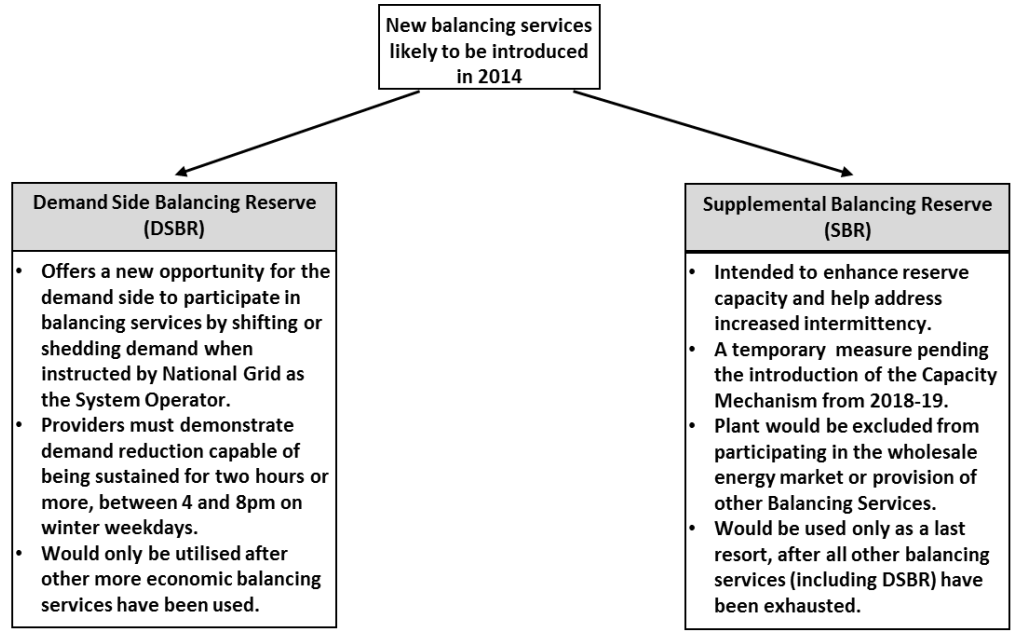
Source: Ofgem, Electricity Capacity Assessment, 2013

3.12 Concern over security of supply has increased in recent years and the Energy Act 2011 requires Ofgem to provide the Secretary of State with an "Electricity Capacity Assessment" by 1st September each year. These reports are compiled with the help of National Grid, to whom all the modelling and data analysis was delegated.

3.13 Ofgem's latest Electricity Capacity Assessment report (June 2013) emphasises the difficulties involved in projecting the future security of supply outlook (in particular, the uncertainties associated with demand side reductions). The report presents sensitivity analysis around key uncertainties associated with demand, installed generation and interconnector flows. It highlights that risks to security of supply are increasing as the excess of generating capacity over supply (the 'capacity margin') may fall to around 4 per cent by the winter of 2015-16 in the reference scenario. Ofgem estimates that this may increase the risk of disconnection of customers from around 1 in 47 years in winter 2013-14 to 1 in 12 years in 2015-16, and to around 1 in 4 years in 2015-16 if demand reductions anticipated in the reference case fail to materialise.

3.14 In recognition of the risks to security of supply, the Government is introducing a capacity market mechanism, with auctions to award generators the right to receive payments for having capacity available. National Grid will estimate the amount of capacity required, with DECC making the final decision on the target amount for each auction. The government is intending to hold the first capacity market auction in 2014 for 2018-19. The Capacity Market might potentially reduce the scale of balancing activity required by ensuring more extensive reserve capacity is available at four hours notice.

Figure 19: New Balancing Services



Source: National Audit Offce

3.15 In view of the significant concern about potential shortfalls in capacity over the next few winters National Grid has developed two new balancing services which have been approved for use by Ofgem. These services will only be procured if margins tighten to the extent that additional reserves are required and their procurement can be economically justified. They are seen as short-term measures pending the development of the Capacity Market. The services are:

- Demand Side Balancing Reserve, which aims to create new opportunities for demand side response providers, suppliers, or aggregators acting on their behalf to participate in balancing services; and
- Supplemental Balancing Reserve, which is targeted at holding power stations in reserve that would otherwise be closed or mothballed. It would only be available to generating plants which will not participate in the wholesale market or balancing services for the duration of their contracts.

3.16 Ofgem has approved National Grid's use of these new services and is now developing proposals for how they will be funded so as to achieve value for money for energy consumers. It has forecast that these services could cost an average domestic consumer less than £1 a year and an average SME around £7 a year, while the impact on industrial consumers is likely to be higher as they tend to consume more electricity. These figures are only an approximation as actual costs would only be known after National Grid has run a tender.

Figure 20: The Electricity Balancing Significant Code Review

Overall rationale and objective:

Ofgem considers that cash-out prices currently provide insufficient incentives for generators and suppliers to meet demand when the system is tight, or to invest to avoid scarcity. This reduces security of supply and potentially inflates consumer bills. The objective of the review was to improve the efficiency of cash-out prices.

Key recommendations:

- **Make cash-out prices 'marginal' by basing them on the most expensive action the SO takes to balance the system rather than an average as now;**
- **Include a cost for customer disconnections and voltage control into the cash-out price calculations, and introduce payments for disconnections to domestic consumers and small businesses;**
- **Improve the way reserve costs – in particular, the costs of STOR – are priced by reflecting the value such reserve services provide to consumers at times of system stress; and**
- **Move to a single cash-out price for each settlement period to simplify procedures and reduce unnecessary imbalance costs.**

Potential impacts:

- **Increase imbalance charges particularly at times of system stress.**
- **Incentivise generators and suppliers to ensure they fulfil their contracted positions.**
- **Might reduce the need for the System Operator to take action to balance the system, and hence would reduce balancing costs.**

Source: National Audit Office

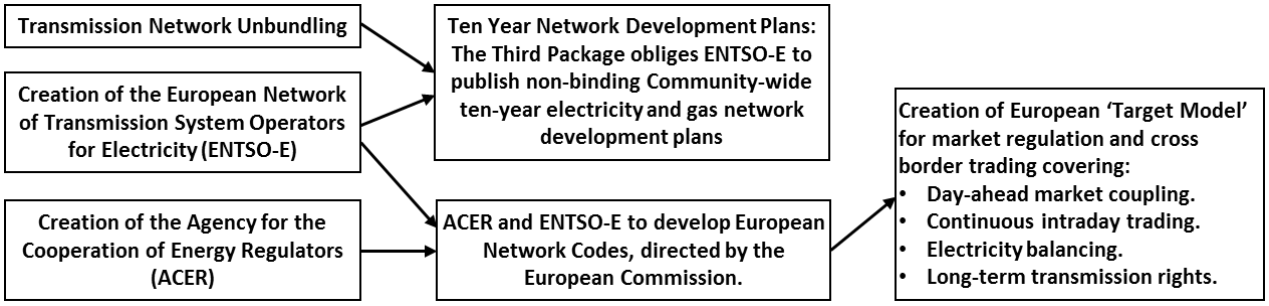
3.17 The Significant Code Review was formally launched in August 2012, following concerns that imbalance charges ('Cash Out') were not providing sufficient incentives for generators and suppliers to meet demand when the system is tight, or to invest to avoid scarcity.

3.18 Sharpening incentives on generators and suppliers could improve efficiency in balancing and reduce the associated costs.

3.19 More efficient Cash Out price signals are also likely to provide incentives to invest in or retain flexible capacity (such as flexible generation, demand response and storage). Flexible capacity will increasingly be important for security of supply in a system with a large share of intermittent generation

3.20 Ofgem published its draft decision in July 2013 and consulted on this until October 2013, It is aiming to publish its final policy decision in spring 2014. Its key recommendations are set out above.

Figure 21: EU harmonisation of wholesale markets and balancing arrangements



Source: National Audit Office

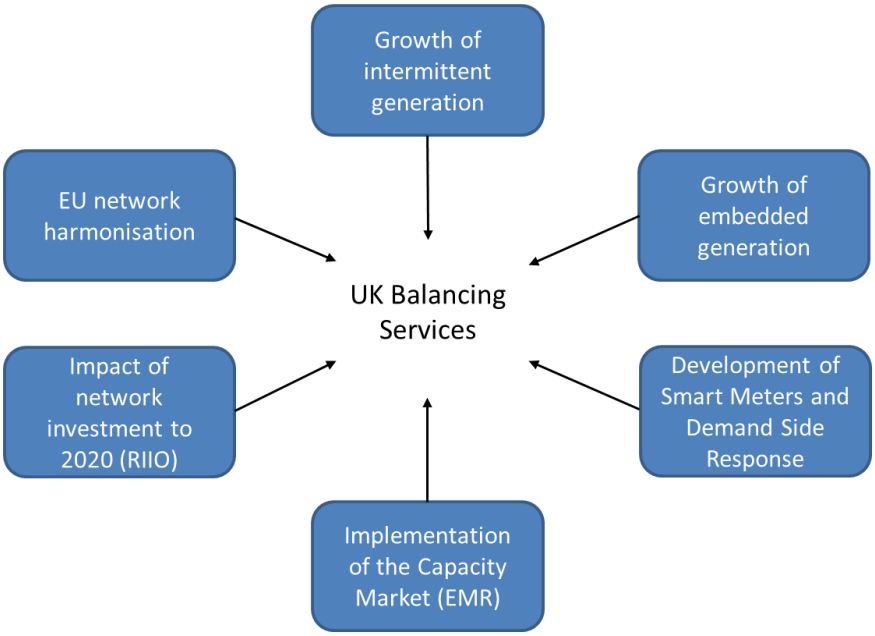
3.21 The EU Third Energy Package aims to establish an open, integrated and competitive energy market across the EU. The Target Model establishes common rules to facilitate efficient use of cross-border capacity and encourage harmonisation of European wholesale market and balancing arrangements. The main features of the Target Model are:

- **Day-ahead market coupling and continuous intraday trading**: This will mean that the GB day-ahead price will be calculated at the same time and same way as prices in neighbouring markets. Intraday trading will also help generators and suppliers to balance their positions as the accuracy of their forecast generation and demand improves closer to real time.
- **Electricity balancing**: The Target Model includes a framework for developing cross-border balancing markets. This would increase National Grid's ability to procure cheaper balancing resources from overseas. The potential for balancing resources to be effectively shared and traded between countries can enhance security of supply, improve the levels of competition in balancing markets and reduce the costs of system operation.
- **Long-term transmission rights**: The Target Model mandates the development of cross-border markets for long term rights to access capacity on interconnectors. These changes could benefit GB market participants and reduce balancing costs through providing access to wider markets.

3.22 Progress in implementing the Third Package has been slow and it is unlikely that the creation of a single integrated market will be achieved in 2014 as was intended. However, European Network Codes which will establish the European Target Model are being developed and are expected to be agreed in 2014-15.

3.23 National Grid already has arrangements in place with Réseau de transport d'électricité (RTE, the French system operator) for some cross border balancing services. It achieves this through System Operator to System Operator trading.

Figure 22: Determining the future of balancing services



Source: National Audit Office

3.24 A wide range of factors might impact on UK balancing activity over the next decade, and their impact on the costs of balancing is unclear due to the extra complexity and uncertainty involved in the operation of the system.

3.25 In recognition of this, in February 2013 Ofgem launched a 'Future Trading Arrangements' consultation to ensure that, in the face of key changes in the industry, the trading arrangements deliver efficient operation of existing assets, appropriate incentives to maintain existing assets and invest in new capability, and effective and efficient integration with wider European markets to the benefit of GB consumers.

3.26 Following the initial consultation, Ofgem established a 'Future Trading Arrangements Forum'. During 2013, the Forum identified four priority workstreams for consideration. In February 2014, Ofgem announced it would take forward the first of these (locational pricing[1] and how this related to the EU harmonisation proposals), and that it would give further consideration to how to take forward the other three workstreams - managing intermittency; ancillary services, wider balancing and reserve review; and long-term market arrangements.

[1] Locational pricing is a feature of transmission charging, and is based on the principle that generators located further away from major centres of demand should pay a greater share of network costs than generators located close to those centres.

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