

# IED Investments: Initial Consultation

17th November 2014

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## **I. Introduction**

Welcome to our consultation on the options available for the National Transmission System (“NTS”) compressor fleet to make it compliant with the Industrial Emissions Directive (“IED”). We are now at the critical halfway stage in the development of the fleet strategy.

As the sole owner and operator of gas transmission infrastructure in GB, gas passes through National Grid’s NTS on its way to consumers. We work with other companies to ensure that gas is available where and when needed. Gas producers supply gas to our NTS through reception terminals. Gas from LNG importation terminals is injected into the NTS after quality checks and gas that has been held in storage can also be reintroduced into the system. Gas is owned by gas suppliers; however, we are responsible for this gas whilst it is being transported. It is our compressor stations that keep the gas flowing through the system.

6 months ago in May 2014, we opened the engagement process to develop a strategy that delivers a network with the capabilities to meet your needs at an acceptable cost. In 6 months’ time (May 2015), this part of the process will conclude and we will present our submission to Ofgem for their consideration. We now have to narrow down the options and make decisions for each of the sites affected by the legislation hence we need your views on what you require from the NTS.

This document has been structured to articulate the full story of why we are undertaking this process and how we got here. It covers the background of the legislation and what it means for us as an organisation and you as our stakeholders; it also discusses other factors such as interactions with planned investment programmes. Finally we present the full range of options available at each site.

What you have told us so far has shaped our approach from our first stakeholder workshop to this consultation. Your feedback will continue to drive our engagement approach right through to our submission. You have been open with us and told us what it is you really value in the decisions we will make. Your feedback has allowed us to develop the scorecard used in this document so that we can demonstrate to you how each option at a site does or doesn’t meet the outputs you have told us you value.

We want your thoughts about all of these options both on a site by site basis and holistically from an overall network perspective. We have assessed, scored and now present the range of options back to you; and we need you to help us make the right decisions for the future development of the NTS.

The consultation opens now and closes on 19<sup>th</sup> December 2014. We will listen to your feedback and ensure we act upon it. This may mean we have to revisit some analysis or explore options we may not have yet considered. Whatever we have to do next, it is important to us that we can demonstrate to you how your feedback has influenced our decision making process.

I'd like to thank you for your commitment to the process to date and we are grateful for your input that has enabled us to consult on this initial range of options. We will continue to work with you as we make these challenging decisions and encourage you to still engage with us either through workshops or bilaterally.

We look forward to continuing our work with you as we start the final leg of this process.

Kind regards,

A handwritten signature in black ink, appearing to read 'Mike Calviou'.

Mike Calviou  
Director, Transmission Network Service  
National Grid

## II. Executive Summary

The EU and GB have agreed targets and directives that determine how we should control emissions from industrial activity. The Industrial Emissions Directive (“IED”) is the biggest change to environmental legislation in over a decade, with implications for everyone who relies on the NTS.

The IED heavily impacts our operations. It principally has two elements that affect our compressor fleet, the Large Combustion Plant Directive (LCPD) and the Integrated Pollution Prevention and Control (IPPC) requirements. On our network, we have 64 gas driven compressor units at 24 sites. In terms of the LCPD, 17 of these units do not comply with the requirements so we have to decide on a unit by unit basis what to do. The main options we are considering are:

- Retain the unit(s) under Limited Life Derogation – which means they will cease operation on 31st December 2023, or after 17,500 hours, whichever is sooner
- Retain the unit(s) under Emergency Use Derogation – which means retain the units beyond 2023 but we cannot run them for more than 500 hours per year
- Replace the unit(s) at a site, either with like for like or with different network capability

Where the chosen option is not to replace units, the associated commercial and operational risks need to be factored into RIIO-T2; for example reductions in obligated capacity (baseline) levels or an increase to the cost target for the constraint management incentive scheme that would apply in RIIO-T2 (this is the incentive scheme to manage situations where we are unable to meet our capacity obligations).

The options discussed within this document have been evaluated in accordance with our duties as a gas transporter and other statutory obligations relating to safety and environmental matters and our obligation to plan and operate the system in an economic and efficient manner.

Against the backdrop of these options, you have helped us build a scorecard to identify the network capability criteria that was most important to you and the reasoning why. We have used this scorecard to evaluate the options at each site and present back the impact of these options for the network as a whole.

With regard to the IPPC requirements, we have an overarching strategy as agreed with the Environment Agency (EA) and the Scottish Environment Protection Agency (SEPA) which allows us to review our compressors as a fleet on an annual basis, targeting sites emitting high levels of NO<sub>x</sub> to maximise the environmental return. This process is managed through

the Network Review which culminates in an annual report. In alignment with this strategy, we are currently undertaking work at five sites and are now proposing three further sites as part of an IPPC Phase 4 programme.

Under RIIO-T1, we received a small up-front allowance from Ofgem to create an integrated and cost efficient plan setting out how we will ensure our units comply with the requirements of the IED. We will submit this final plan to Ofgem in May 2015. The plan must therefore comply with the IED, meet the future requirements of the network and represent best value for our customers.

In terms of costs, the current options represent a wide range. At a site level, low cost options, such as decommissioning may cost less than £10m, whereas a higher cost option, such as replacing units, could be as much as £50m per unit. We have contracted an engineering consultancy to develop an estimated cost for each option. Based on the information available to date, the range of costs for a programme which covers the full spectrum of options is between £300m and £800m. As noted, the £300m cost is purely the upfront capital cost, there would be additional costs or rule changes within RIIO-T2 to manage the risk associated with these lower cost options. £800m represents the cost of replacing all LCPD units and replacing two units at three IPPC Phase 4 sites.

The impact on customer bills of adopting the full replacement programme (LCPD) and multiple unit replacement (IPPC) would peak at approximately 60p (2014/15 prices) in 2022/23, which equates to 0.08% of a typical gas bill.

As can be seen, there is a significant range of options and costs and therefore your input is essential in defining the options that will meet your output requirements at an affordable price.

### **Next Steps**

We welcome your feedback on our initial consultation, particularly with regard to the options you think we should take forward across different sites and how we manage the uncertainty of future legislation. We have set out a number of specific questions that we would like your feedback on and have provided several ways through which you can provide feedback.

The closing date for responses is Friday 19th December. In mid-January we will publish a document summarising your feedback and, subject to responses, we envisage publishing our proposals in mid-February.

### III. The Legislation

European environmental legislation has been developed over recent years introducing new standards which Member States must comply with to ensure their industrial activities have a limited impact on the environment. These pieces of legislation aim to reduce the quantity of air, water and land pollutants which are responsible for damage to the environment (such as acid rain) and to human health (such as respiratory diseases). It is mandatory for all European countries to comply with the new minimum standards.

In the following section we describe the two main pieces of legislation that were previously introduced and then go on to discuss how these were brought together in the IED.

#### **Large Combustion Plant Directive (LCPD)**

One of these pieces of legislation is the Large Combustion Plant Directive (LCPD) which was implemented in 2001 and can be found here;

<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001L0080&qid=1412587742737&from=EN>

The LCPD applies to all combustion plants with a thermal input of 50MW or more. Under the LCPD, combustion plant must meet the Emission Limit Values (ELVs) which are defined in the directive. ELVs are legally enforceable limits of emissions to air, water or land for those installations. An ELV is the maximum permissible rate at which a pollutant is released. The ELVs set out in this directive can be met in one of two ways;

- 1) Choose to opt in – need to comply with the ELV or plan to upgrade and achieve compliance by a pre-determined date
- 2) Choose to opt out and comply with the restrictions defined in the derogations including the Limited Lifetime Derogation or the emergency use provision

#### **Integrated Pollution Prevention and Control (IPPC) Directive**

A further piece of European environmental legislation is the Integrated Pollution Prevention and Control (IPPC) Directive which was implemented in 2008 and can be found here;

<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0001&from=EN>

Under the IPPC any installation with a high pollution potential is required to have a permit. One of the pre-requisites for this permit is that Best Available Techniques (BAT) are used to prevent emitting these pollutants.

BAT assessments are required when developing a solution to avoid or reduce emissions resulting from industrial installations and to reduce the impact on the environment as a whole. They take account of the balance between costs and environmental benefits as the installation is designed, built, maintained, operated and decommissioned.

For National Grid, this means that all of our compressor units are required to have a permit which specifies the maximum ELVs to air for that unit. For new projects, we have developed a BAT evaluation approach which will ensure that the relevant considerations relating to potential environmental impact, whole life costs and operating efficiency are taken into account.

We have an overarching IPPC strategy as agreed with the Environment Agency (EA) and the Scottish Environment Protection Agency (SEPA) which allows us to review our compressors as a fleet on an annual basis, targeting sites emitting high levels of NO<sub>x</sub> to maximise the environmental return. This process is managed through the Network Review, which culminates in an annual report. To date we have undertaken three phases of IPPC works and we are currently in the process of agreeing Phase 4, which is covered within this consultation.

### **The Industrial Emissions Directive**

Subsequently, the Industrial Emissions Directive (IED) brought together a number of existing pieces of European legislation which included the IPPC Directive and the LCP Directive. IED came into force on 6<sup>th</sup> January 2013 and can be found here;

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:EN:PDF>

The major provisions of the IED which impact on National Grid and our compressor units are;

- 1) The use of permits for installations
- 2) Establishment of BAT Reference documents
- 3) The updating of ELV's for installations above 50MW
- 4) Limited Lifetime Derogation
- 5) Emergency use provision

### ***Permits***

The IED<sup>1</sup> specifies that all installations must be operated with a permit. These permits will specify the ELVs for polluting substances which are likely to be emitted from the installation concerned. The permit conditions will also determine the environmental risk of that installation and shall ensure that the principles of BAT have been applied. Therefore, this mirrors the specifications set out in the IPPC whereby installations have to comply with the ELV's set out in that permit, which are based on BAT. We have agreed to continue the Network Review Process to comply with these requirements.

### ***BAT Reference (BREF) Documents***

The IED also introduces an increased emphasis on the status of the BAT Reference (BREF) documents. These BREF documents draw conclusions on what the BAT is for each sector to

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<sup>1</sup> Article 4



comply with the requirements of IED. The BAT conclusions drawn as a result of the BREF documents will then form the reference for setting the permit conditions mentioned above. The BREF document for combustion plants is in draft form and it is anticipated that this will be finalised in 2016. From the date of finalisation there will then be a 4 year period for member states to implement. At this stage it is still uncertain how the BREF documents will be applied and what impact it will have on our compressor units.

### ***Update of ELVs for installations above 50MW***

IED states<sup>2</sup> that for installations with a thermal input over 50MW it is mandatory for the following ELV's to be complied with<sup>3</sup>;

- Carbon Monoxide (CO) – 100mg/Nm<sup>3</sup>
- Nitrogen Oxide (NO<sub>x</sub>) – 75mg/Nm<sup>3</sup> for existing installations and 50mg/Nm<sup>3</sup> for new installations<sup>4</sup>.

In this respect the IED mirrors the requirements set out in the LCPD. These new limits introduced through IED affect 17 of our 64 units. Our compressors that cannot meet the new ELVs for CO and NO<sub>x</sub> must stop operating on 31<sup>st</sup> December 2015, unless the unit receives a derogation.

### ***Limited Lifetime Derogation***

In the IED<sup>5</sup> the requirements to be met to receive a Limited Lifetime Derogation are specified. It states that from January 2016 to 31 December 2023 combustion plant may be exempted from compliance with the ELVs for installations above 50MW provided that certain conditions are fulfilled:

- The operator makes a declaration before 1 January 2014 not to operate the plant for more than 17,500 operating hours starting from 1 January 2016 and ending no later than 31 December 2023;
- The operator submits each year a record of the number of operating hours since 1 January 2016
- The ELV's set out in the permits as per the requirements of the IPPC Directive are complied with

We have already made the declaration referred to above and have been allowed to utilise this derogation for our current stations. However, there is still the option to opt out of using this derogation prior to it coming into force on 1<sup>st</sup> January 2016.

### ***Emergency Use Provision***

The IED also makes a provision for using installations for emergency use;

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<sup>2</sup> Article 30

<sup>3</sup> Annex V, Part 1, para 6

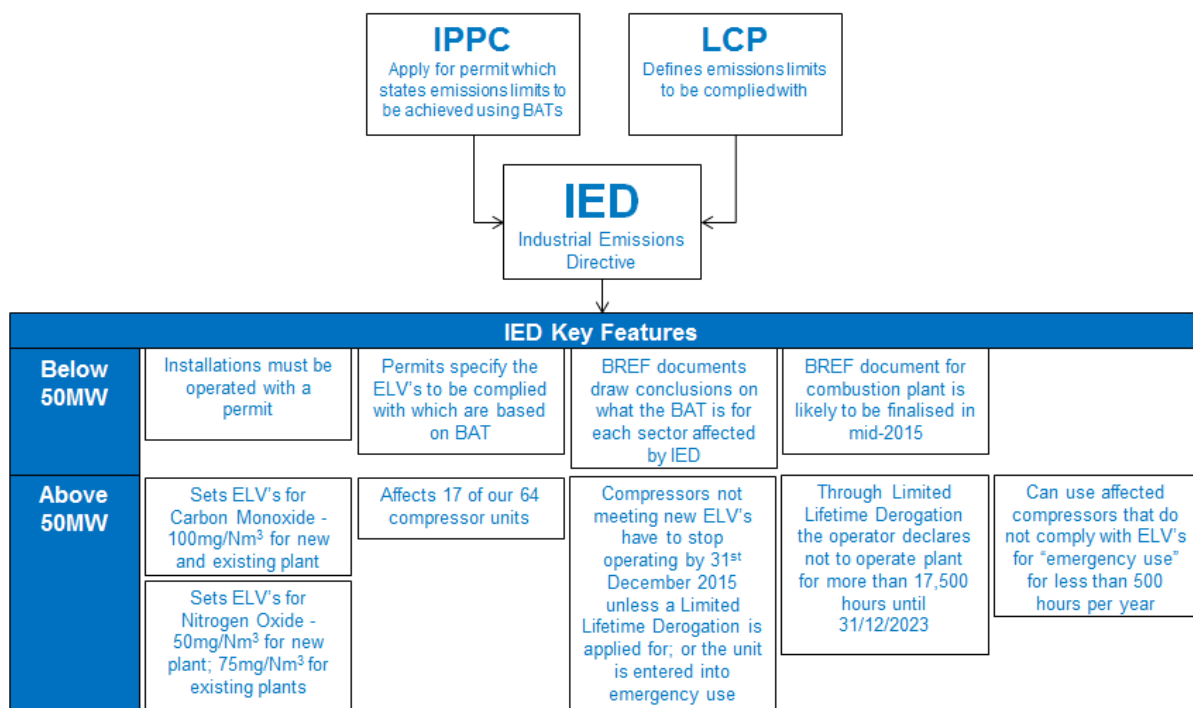
<sup>4</sup> An existing installation is one that was granted a permit before 7<sup>th</sup> January 2013.

<sup>5</sup> Article 33

“Gas turbines and gas engines for emergency use that operate less than 500 operating hours per year are not covered by the emission limit values set out in this point. The operator of such plant shall record the used operating hours.”<sup>6</sup>

This means that we may be able to still use our affected compressor units that do not comply with the above ELV’s if we use them for 500 hours or less. Therefore, as we discuss in the section on our options for compliance with the provisions of IED, this may be one of the solutions that is available at some of our sites. As with the Limited Lifetime derogation, this would also be applicable from 2016.

The diagram below illustrates how the IPPC and the LCPD directives have fed into the IED and what has resulted in the key features of the IED split by installations below 50MW and above 50MW;

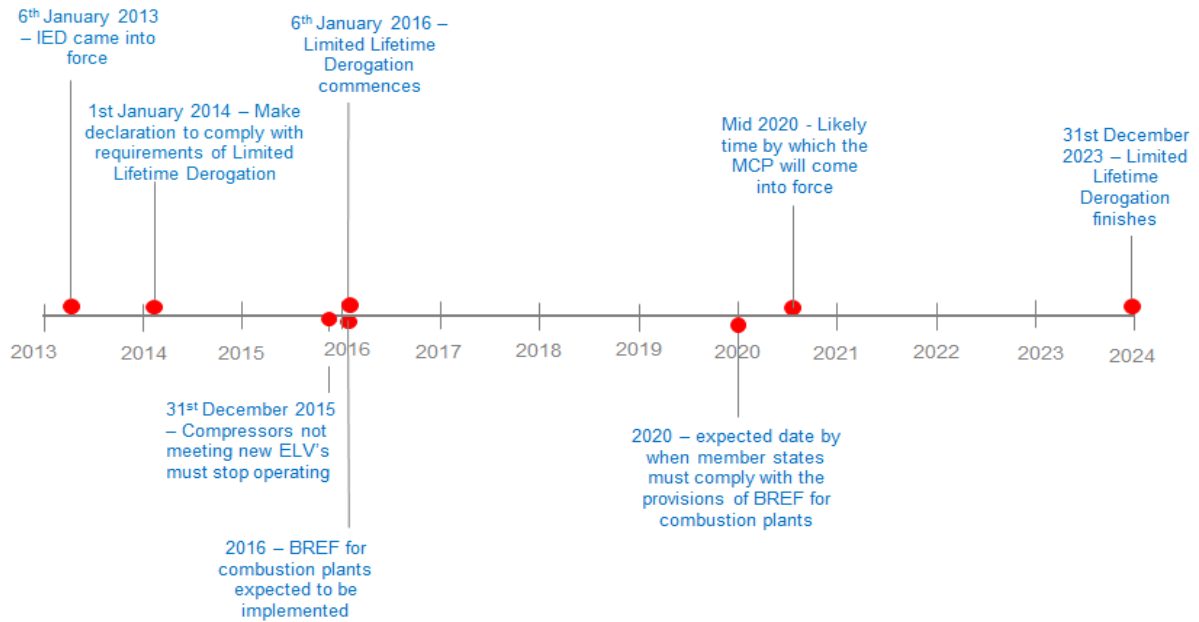


### Upcoming Legislation: *Medium Combustion Plant directive*

The Medium Combustion Plant (MCP) directive will apply limits on emissions to air from sites below 50MW thermal input. It is expected that this legislation will introduce ELVs that are differentiated according to the plant’s age, capacity and type of installation. It is thought that existing installations would be given a long transition period, up to 2025 for the larger (5-50MW) plants and up to 2030 for the smaller ones. It is expected that the MCP is likely to come into force by 2020. At this stage the impact of the MCP on our compressor units is unclear; however, it could impact 26 of our compressor units. Please note, this document is only focussed on the implications of current legislation.

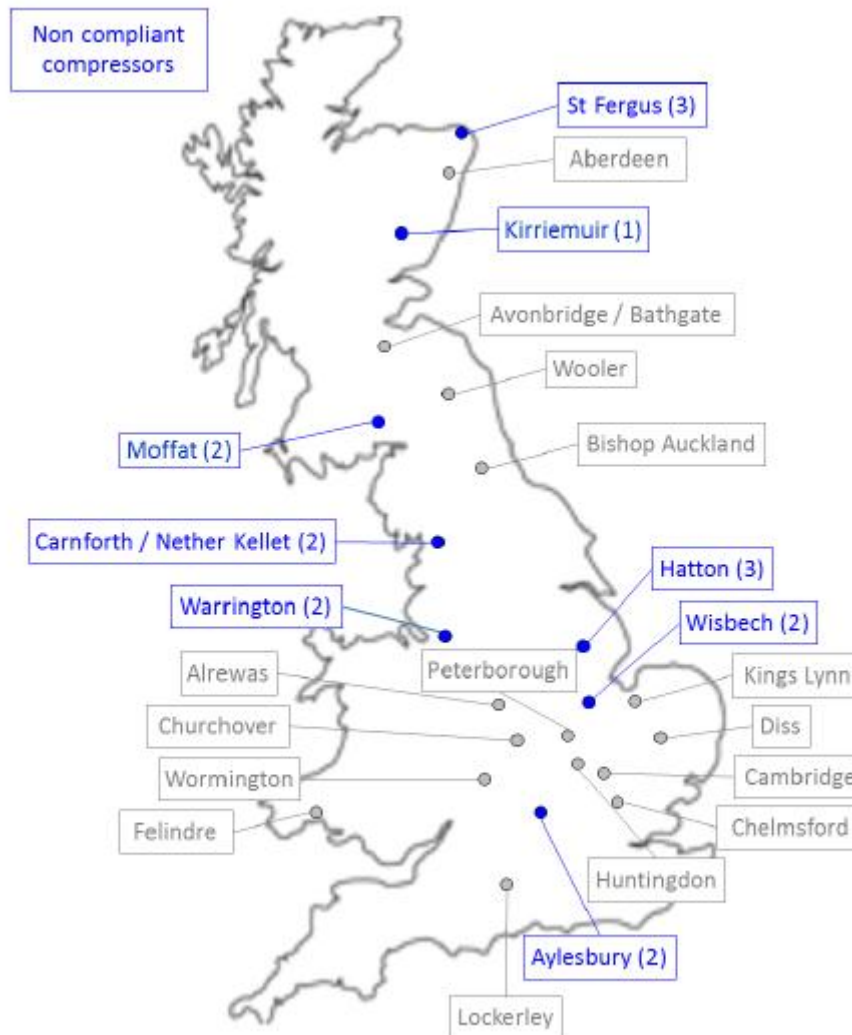
<sup>6</sup> Annex V, Part 1, para 6

Below is a timeline of key dates and milestones related to the new emission abatement legislation.



## IV. How the legislation affects us

As mentioned in the Legislation section the IED heavily impacts our compressor fleet. We have 24 compressor sites and 64 gas driven compressor units on the system. Out of these compressor units, 17 are above 50MW thermal input and do not comply with the ELV's specified in the IED, these can be seen on the map below. We will not be able to operate these compressor units as we currently do by 31<sup>st</sup> December 2023, which will impact network capability.



Aylesbury has already been funded and work is underway to achieve IED compliance at those units affected. More information on how our works are progressing at Aylesbury, along with Peterborough and Huntingdon is discussed later in this document.

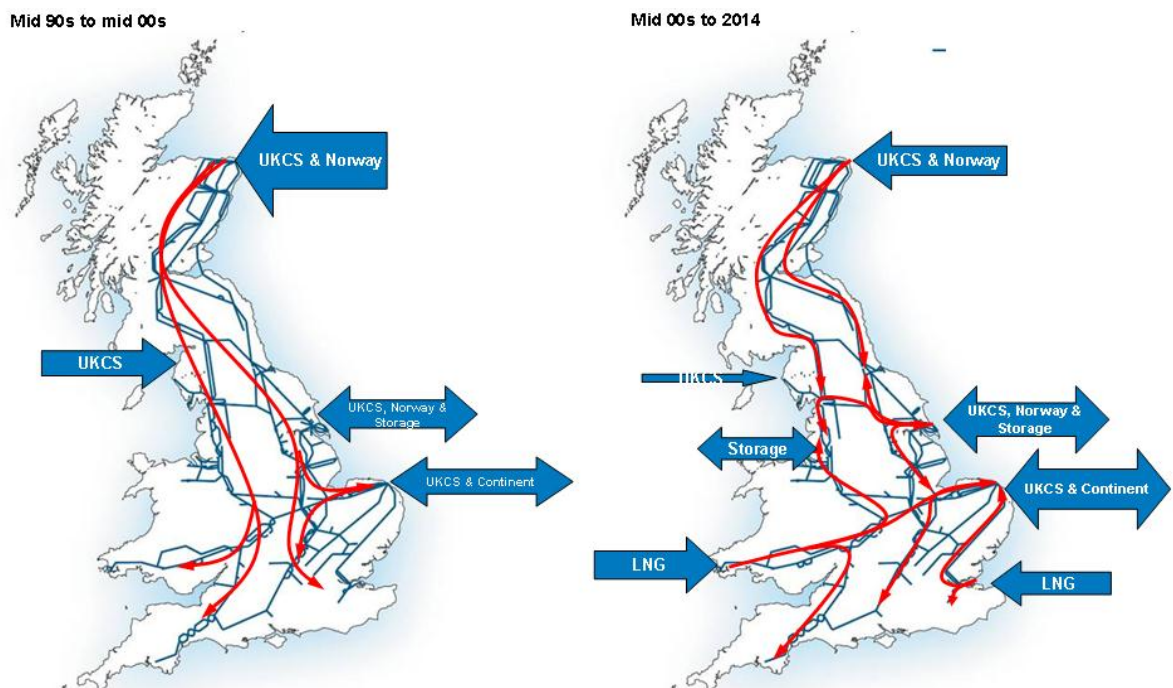
We are also still required to reduce our overall emissions from our units with a thermal input of less than 50MW for the IPPC element of the IED. We expect to do work at three sites which we will detail in the "IPPC Phase 4" section.

**Q1: Would you like to know more about how the IED legislation affects our compressor feet? If so, what further information would you like?**

## V. History and use of the NTS and compressors

### History and use of the NTS

There has been a significant shift in the way the gas transmission network is utilised. Historically the NTS has operated on a north to south flow pattern with compression used to pull and push the gas from the main entry point at St Fergus to the high demand areas in England. However, as shown below, over the last 20 years this has changed significantly. There are now more entry points onto the system which are distributed around the country. The UK continental shelf supplies have declined and in 2004 the UK became a net importer of gas on an annual basis.



Note: Numerous proposed storage projects are not shown

### History and use of compressors

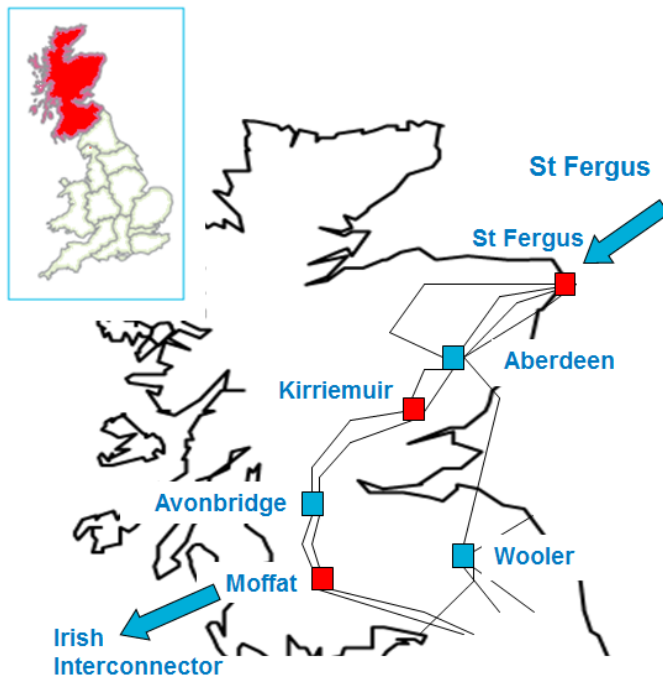
The main reasons we use compressors are;

- To transport gas
- Provide system flexibility to meet rapidly changing use and conditions
- To meet exit pressures
- Occasional use to facilitate maintenance

In light of the changes on the network, use of our compressor units has also changed. Some of the compressors are now required to support network flows in a reversed direction from their original design; some compressors have become increasingly important across a large demand range; and some only at peak demand conditions or certain supply patterns in order to avoid significant constraints. Below, on an area basis, the compressor sites are

shown on the maps with the ones affected by the LCP element of the IED highlighted in red. For each of these sites a brief description is provided about the compressor site's historic and current usage.

**Scotland:**



Site (avg annual usage per site)	Use
St Fergus (11,500 hrs)	Pressurise gas from Total sub-terminal
Aberdeen (2,100 hrs)	Required under medium to high St Fergus flow scenarios and to maintain Scotland LDZ pressures
Avonbridge (2,000 hrs)	Maintain Scotland LDZ pressures
Kirriemuir (1,500 hrs)	Required under high St. Fergus flow scenario; to maintain Scotland LDZ pressures and back-up Aberdeen and Avonbridge
Wooler (1,400 hrs)	Required under high St. Fergus flow scenario and to manage linepack in Scotland
Moffat (700 hrs)	Required under high St Fergus flow scenario

The sites in Scotland that are affected by the requirements of the IED are St Fergus, Kirriemuir and Moffat. The hierarchy of compression usage in Scotland operationally is as follows:

1. Avonbridge
2. Aberdeen
3. Kirriemuir
4. Wooler
5. Moffat

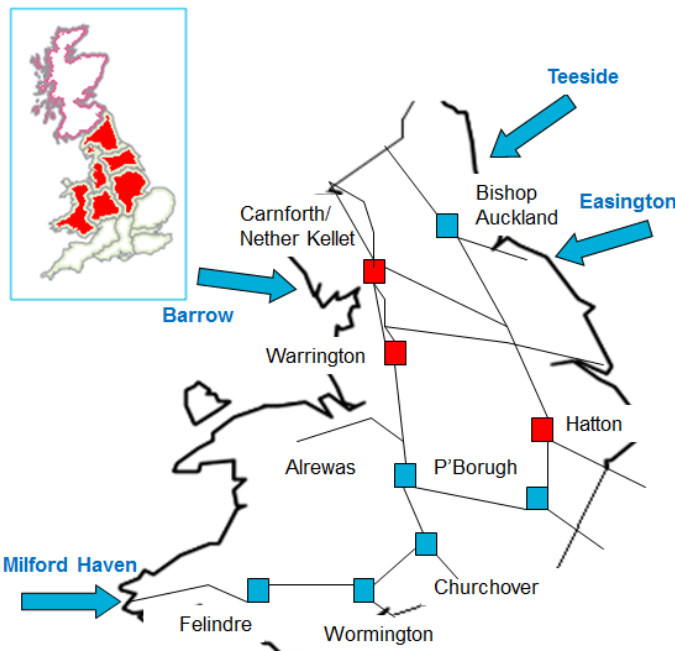
On a typical winter day, with high flows from St Fergus we would expect to have Avonbridge and Aberdeen running. For increased flows and resilience we currently have Kirriemuir, Wooler and Moffat at our disposal.

The compressors at St Fergus are at the Total sub-terminal and have a high usage rate as they are used to pressurise the gas brought in through this sub-terminal to the pressures required on the NTS. Therefore this means that the St Fergus compressors run when the Total sub-terminal is flowing, irrespective of the network conditions. Due to the particular operating requirements, the St Fergus compressor units require a high standard of reliability and availability.

Use of Kirriemuir to transport high flows from the St. Fergus entry terminal has decreased due to the decline in St. Fergus flows however, Kirriemuir is still required to support Scottish LDZ pressures and offer resilience as back up to both Aberdeen and Avonbridge compressor stations.

Historically, Moffat has been required to maximise St. Fergus entry capability, maintain assured pressures for Scottish and Northern offtakes and maintain the operating pressure and flows for the Moffat interconnector which feeds the Irish transmission system - this is under high flow scenarios from the St. Fergus supply terminal. Moffat is only required at very high levels of flows from St. Fergus provided other compression capability in Scotland is available.

### North and Midlands:



Site (avg annual usage per site)	Use
Peterborough (4,500 hrs)	Transmission of gas south, east and west and system flexibility
Carnforth / Nether Kellet (4,000 hrs)	High flows north to south. High Easington flows
Hatton (3,600 hrs)	Used for System Flex, high Easington, high IUK export
Alrewas (2,200 hrs)	Facilitates high Milford Haven flows and support North West storage and Welsh pressures
Wormington (2,100 hrs)	Facilitates high or low Milford Haven flows and supports South West and Welsh pressures
Churchover (1,330 hrs)	High MH flows or low MH flows to support Welsh pressures
Bishop Auckland (400 hrs)	Support high Teeside and St Fergus flows
Warrington (17 hrs)	Specific activities e.g. maintenance, resilience

The sites in the North and Midlands which are affected by the requirements of the IED are Carnforth and Nether Kellet, Hatton and Warrington. The order compression is utilised along the west coast of the network operationally is as follows;

- 1) Carnforth
- 2) Carnforth plus Nether Kellet
- 3) Warrington

Carnforth and Nether Kellet have been required to support assured pressures at North West, West Midlands, East Midlands and South Wales offtakes and maximise St. Fergus and Barrow entry capability. Since construction of the trans-pennine pipeline, the stations can also be used to aid Easington entry and therefore help reduce entry constraints on the East Coast. Nether Kellet was constructed to support the large North West offtakes along Feeder 11, but can be configured to also support the main feeders into the North West instead of using Carnforth.

Nether Kellet single configuration will be required to maintain pressures in the area under low flow conditions, then unit C at Carnforth (lead unit) will be switched on if flows are higher (and Nether Kellet switched off) and in very high flow conditions a further unit at Carnforth may be switched on in parallel with unit C. Unit C at Carnforth was constructed to take up bulk duty requirements with units A and B providing back up or additional capability under high flow conditions.

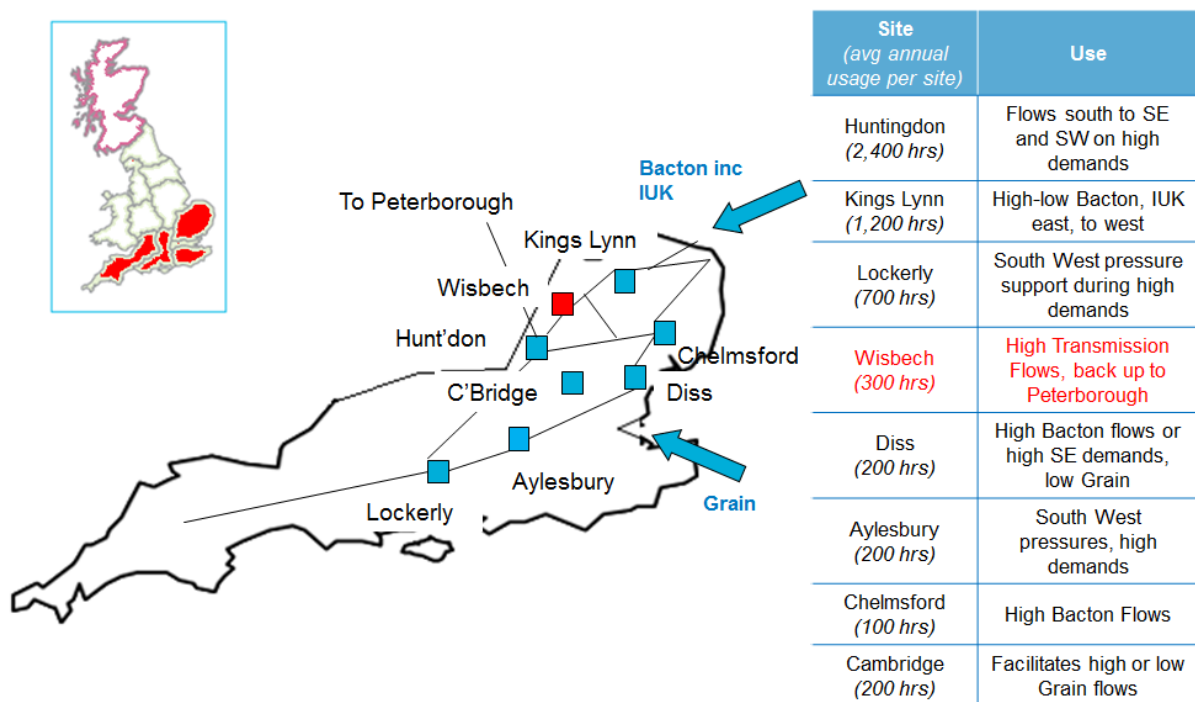
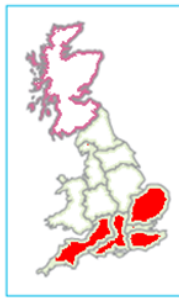
Since the installation of Carnforth flows have decreased from St. Fergus and Barrow therefore significantly reducing the requirement for high flow capability at the site and the requirement to run Carnforth in parallel configuration.

The decreased St. Fergus and Barrow flows along with the Milford Haven terminal being constructed has also occurred since the installation of Warrington in the network in 1983. There have also been a number of storage sites added to the North West of the network, south of Warrington that will provide support for Exit in the area on high demand days. This has considerably reduced the requirement for compression at Warrington compressor which is now mainly used for resilience purposes.

Hatton has historically been used to support north to south flows down the East coast. However, recently it has also been used to support east to west flows, east to south flows and also to support the IUK interconnector which comes onshore at Bacton.



### South West and South East:

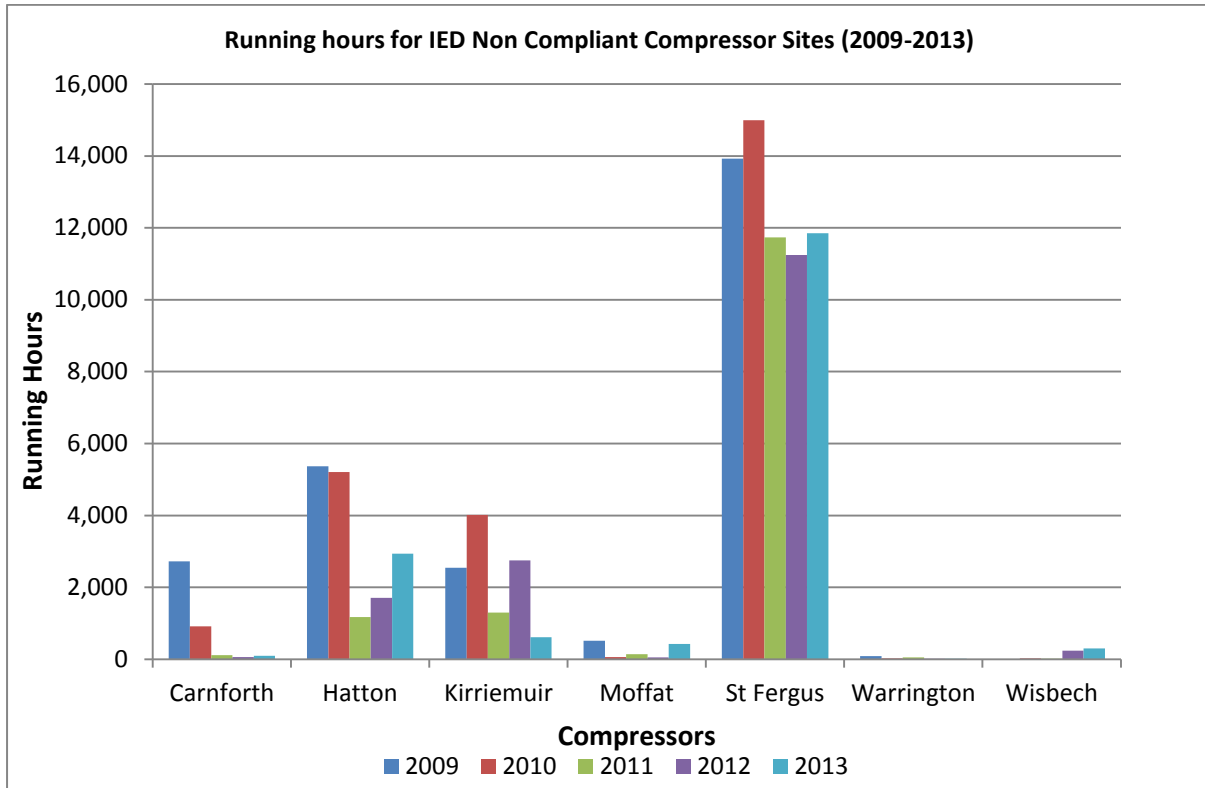


The site in the South West and South East which is affected by the IED is Wisbech. Originally Wisbech was primarily required to support the Southern Feeder (Feeder 7) and ensure extremity pressures in the South West were maintained. This used to be the only compressor on the suction side of Huntingdon. Peterborough was not connected to Huntingdon, but was originally used as the East to West compressor to move Bacton gas and support Wales. As demand increased, the feeders connecting Peterborough to Huntingdon were added to the network therefore reducing the requirement for Wisbech to support Huntingdon.

Another requirement for Wisbech was associated with Theddlethorpe and Easington area Entry requirements. Historically, concurrent high Entry flows at the Easington and Theddlethorpe terminals could be met using both Hatton and Wisbech compressor stations. When the flow through the Hatton station approached the flow limit, high flows from the Theddlethorpe terminal could be directly diverted along Feeder 7 through Wisbech to avoid Entry constraints. The reduction in flows into the Theddlethorpe terminal have reduced the requirement for Wisbech under this scenario. Additionally, since the trans-pennine pipeline has been built there is a further reduction in the requirement for Wisbech due to the introduction of an alternative route for East Coast gas. Finally, a decline in flows from St. Fergus and the introduction of additional LNG supply terminals in the South of the system require some gas from Easington to flow north towards Scotland and therefore reduces the requirement for Wisbech even further.

### Compressor Running Hours

The graph below shows the running hours for the compressor stations that are affected by the IED over a 5 year period. The changes in the running hours each year illustrates the change in use of that compressor station.



## VI. Future use of the gas system

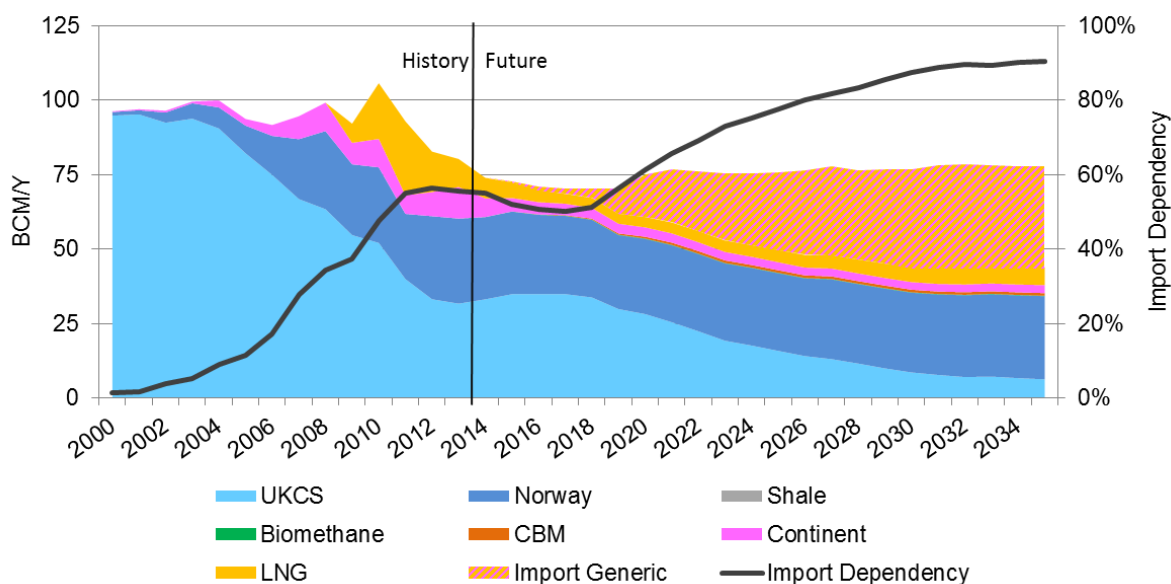
Each year we publish our Future Energy Scenarios (FES) which can be found here:

<http://www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios/>

Our FES provide a detailed analysis of a range of plausible and credible conclusions for the future of energy. Our range of scenarios are based on the tri-lemma of security of supply, affordability and sustainability. Our scenarios flex the two variables of affordability and sustainability, giving the following four scenarios:

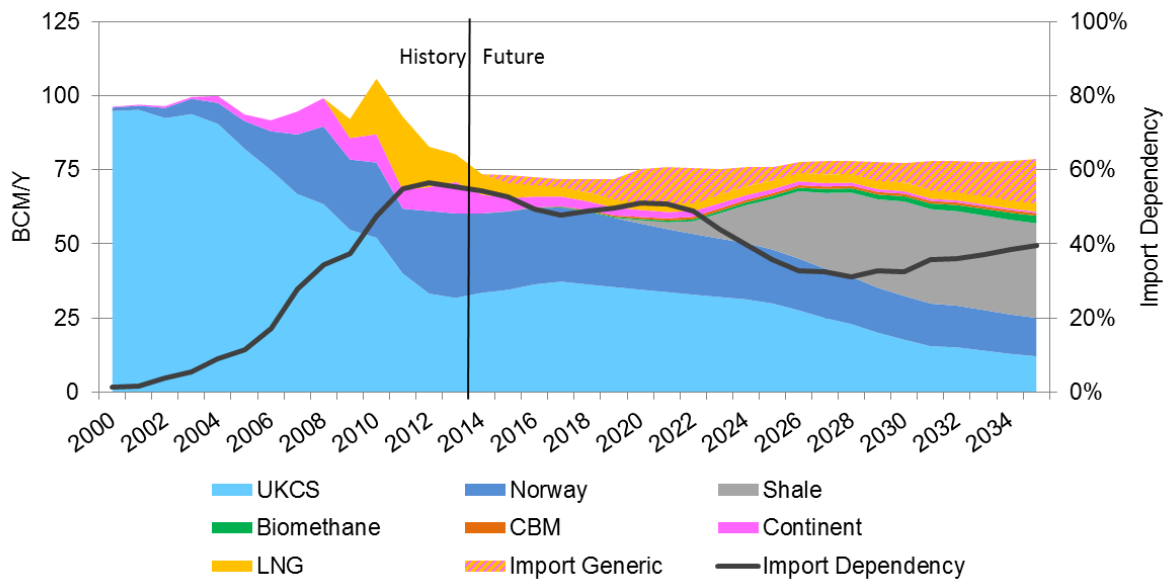
- Gone Green
- Slow Progression
- No Progression
- Low Carbon Life

Our 2014 Future Energy Scenarios outline the level of uncertainty we can expect to see in future gas supplies in particular around shale gas. We have a potential significant new source of gas in shale but the volumes vary from none in our 'No Progression' scenario to 32 bcm/year in the early 2030's in our Low Carbon Life scenario. These 2 scenarios represent our extreme cases with the graph below for No Progression showing a large hatched area for import generic, this area could be filled by any mix of LNG or continental gas, the split of which will be driven by many factors including the price and availability of LNG.



Annual Gas Supplies for no progression

However, in the graph below showing "low carbon life", we see much higher flows from UKCS and from shale leaving much less room for imports.



Annual Gas Supplies for low carbon life

As a result, our network needs the capability to manage a wide range of potential supply patterns. The uncertainty as to which pattern may occur on a given gas day is increasing and could increase further into the future. The decisions we make on our compressor fleet need to work across the range of scenarios and provide flexibility to meet the changing requirements for the way the network is used. This is discussed further in the System Flexibility section.

## **VII. The RIIO Deal**

Through the RIIO-T1 negotiations we discussed with Ofgem the potential impact the IED legislation could have on our compressor units. As a result of this we received an allowance for this work which can be split into three elements;

- An up-front allowance for three specific sites
- An allowance to undertake the emissions abatement optioneering plan
- A provisional allowance to fund the remainder of our compressors which do not meet the requirements of IED

### **Up-front allowance:**

The up-front allowance that we received is to fund work on three specific units;

- Peterborough – 1 unit under IPPC element of IED
- Huntingdon – 1 unit under IPPC element of IED
- Aylesbury – 2 units under LCP element of IED

This work is to reduce the emissions at these sites and ensure they comply with the specific ELVs specified. The section of this document entitled “Progress on Peterborough, Huntingdon and Aylesbury” will go into further detail and developments at these sites.

### **Emissions abatement optioneering plan:**

We also received funding for “emissions abatement optioneering” to allow for the creation of an “integrated and cost efficient plan” and fund up-front engineering works. This plan, which is being developed with you our stakeholders, partly through this consultation, will set out how we intend to ensure our units comply with the requirements of the IED at the remainder of our sites. This plan will be submitted to Ofgem in the first RIIO-T1 re-opener window in May 2015.

### **Provisional allowance:**

We received a provisional up front allowance to fund the remaining work required to comply with the obligations specified in the IED; this is to cover LCP and the next phase of IPPC, for which we had originally proposed 3 sites. This is subject to an uncertainty mechanism which allows us to make a submission to Ofgem with our emissions abatement optioneering plan, as described above, under the first re-opener window in May 2015. In this plan, of which this consultation forms part of its development, if our expenditure is different from the provisional allowance then an adjustment will be made accordingly.

## **VIII. Progress on Peterborough, Huntingdon and Aylesbury**

As mentioned in the “RIIO Deal” section during the RIIO-T1 negotiations we received an up-front allowance to fund work on specific units at Peterborough, Huntingdon and Aylesbury which are not compliant with the requirements of the IED.

### **Peterborough and Huntingdon**

Peterborough and Huntingdon compressor stations are critical sites on the NTS and are each equipped with three gas compressors driven by Avon gas turbines. Both sites fall under the IPPC element of the IED. As described in the “legislation” section this requires us to comply with the ELV’s for CO and NO<sub>x</sub> specified in the permits for these sites. Due to the high running hours of these sites, we have agreed with the Environment Agency via the annual Network Review process that these sites should be targeted for the next phase of emissions reduction investment.

An early analysis of the costs, risks and timescales associated with provision of a suitable HV electrical supply at Peterborough rapidly eliminated the option of using electrically driven compressors thus any new compressors will be gas turbine driven. At Huntingdon initial indications were that a suitable HV electrical supply was more readily available and as a consequence options for both electric motor and gas turbine driven compressors have been sought with the final decision to be determined via the BAT assessment process.

At both sites, it will be necessary to retain all three existing units until the new units have been successfully commissioned and accepted operationally.

### **Aylesbury**

Aylesbury falls under the LCP element of the IED. This means that it is required that the site complies with the ELVs set out in the directive. Under RIIO-T1 we received an up-front allowance to fund works on two units at this site.

The existing engines at Aylesbury are prototype versions of an upgraded Rolls Royce Avon engine fitted with Dry Low Emissions (DLE) technology to reduce emissions. These are the only engines of this type that we have within our fleet. DLE is today acknowledged as BAT for control of emissions from gas turbines and is supplied as standard on all new gas turbines we are considering.

Analysis of the performance of the Aylesbury engines has shown that whilst they are able to achieve the required NO<sub>x</sub> limits, they are unable to achieve the required ELV for CO. Research has shown that the CO ELV can be achieved by the addition of a CO oxidation catalyst in the exhaust stack and we are working with Rolls Royce to develop this innovative solution.

## **IX. Interaction with other investment programmes**

In order to maximise the value to you, it is essential that we take a holistic view of the development of our network, considering the factors that impact our investments and the portfolio of projects we are progressing. In relation to IED, the two main other investment programmes that interact with the specific sites impacted are:

- Maintain our 1 in 20 obligations in Scotland
- Provide system flexibility to meet rapidly changing conditions

At present we do not have any incremental signals or firm load enquiries that would impact the decisions on IED.

Due to the importance you place on system flexibility, there is a stand-alone section that deals with this topic.

### **Maintain our 1 in 20 obligations in Scotland**

As mentioned in the “History and Use of Compressors” section, overall flows from St Fergus are decreasing and flows are no longer predominantly from north to south. The system has historically been designed around high St. Fergus gas flows and hence significant north to south flows. The network presently has very limited physical capability to actively move gas south to north. Our planning analysis shows that we are approaching a point where, without additional network capability to deliver south to north flows, we will not be able to meet our 1-in-20 demand obligations in Scotland.

We identified a number of modifications to the network, designed to enhance the network capability to maintain Scottish pressures and enhance south to north flows. We requested and were granted funding for these projects within RIIO-T1. However there is a strong interaction between the potential Scottish 1-in-20 projects and the IED solutions at Moffat and Kirriemuir compressor stations. We are therefore progressing both investment programmes in parallel to ensure we develop the optimum solution and minimise any funding request. The output from this and further consultations will provide key inputs into the direction of the Scotland 1-in-20 work.

## **X. System Flexibility**

System flexibility was identified by stakeholders as a key priority with a strong interaction with the solutions for the compressor units affected by IED. This section considers what system flexibility is, the issues we are facing and how this is being addressed both within this consultation and in our wider network development plans. A more comprehensive discussion on this topic, with an associated slide deck, took place at the second stakeholder workshop on 30<sup>th</sup> September. Therefore if you would like to learn more please follow the link below.

<http://talkingnetworkstx.com/IED-Additional-info.aspx>

### **Definition**

System flexibility can be defined as “a requirement for additional operational capability driven by changing user behaviour and explicitly not the provision of incremental entry or exit capacity”.

It is the ability of the gas transmission network to cater for the rate of change in the supply and demand levels which results in changes in the direction and level of gas flow through pipes and compressors and which may require rapid changes in the flow direction in which compressors operate.

### **The issue**

As discussed in the “History and Use of Compressors” section, customer requirements for use of the NTS and the actual way it is used are changing. This has resulted in very different gas flows than those for which the network was originally designed. Currently there is no existing mechanism to trigger enhancement to the capability of the system required specifically in response to changing and/or reducing flows on the network. However, once shippers have procured their entry and exit capacity, they have told us they want to use that capacity with the minimum of restrictions.

### **What we are doing**

We are currently undertaking a project to review the future flexibility requirements for the gas transmission system, considering how different events or factors across gas days and within day might affect the way that the system is managed. This work may lead to changes in the planning processes and may require changes in commercial options (rules), operational arrangements (tools) or physical investments (assets) to be progressed to deliver more capability in this area.

With specific regard to the IED integrated plan, the range of options, as detailed in the “Initial Scoping of Options” section, has been developed with consideration to the impact of network flexibility on a site-by-site basis. Therefore these options take account of flexibility



requirements and you will see that in some cases we have included flexibility enhancements within the range of options in order to ensure that the solutions progressed for IED are fit for purpose into the future.

**Stakeholder engagement**

We plan to commence full stakeholder engagement on System Flexibility with the industry from Q1 2015 and have started this engagement as part of the work we are carrying out with respect to compressors captured by the IED. If material issues are identified in regard to system flexibility then there is an opportunity within the mid-period review to request funding for commercial, operational or physical investments.

## **XI. Best Practice**

The IED is applicable to industries in all European countries. However, its effect will vary from country to country and industry to industry depending on the equipment installed. In order to ensure we are following best practice in how we comply with the IED, we have initiated a programme of works to understand how other European gas transporters are managing the implications. So far this has taken the form of a questionnaire, which we have followed up with a workshop in early November. We are still processing the output from these activities and asking a series of follow up questions. We will present the output from this activity and where appropriate update our options, based on this information, in the proposals we publish in mid-February.

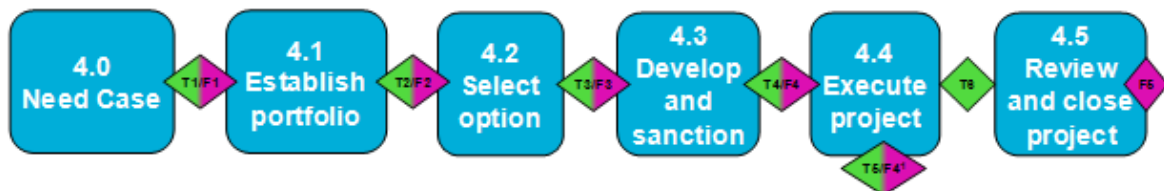
In addition we are seeking to engage with other industries to understand how they are complying with this legislation.

## XII. National Grid’s Network Development Framework

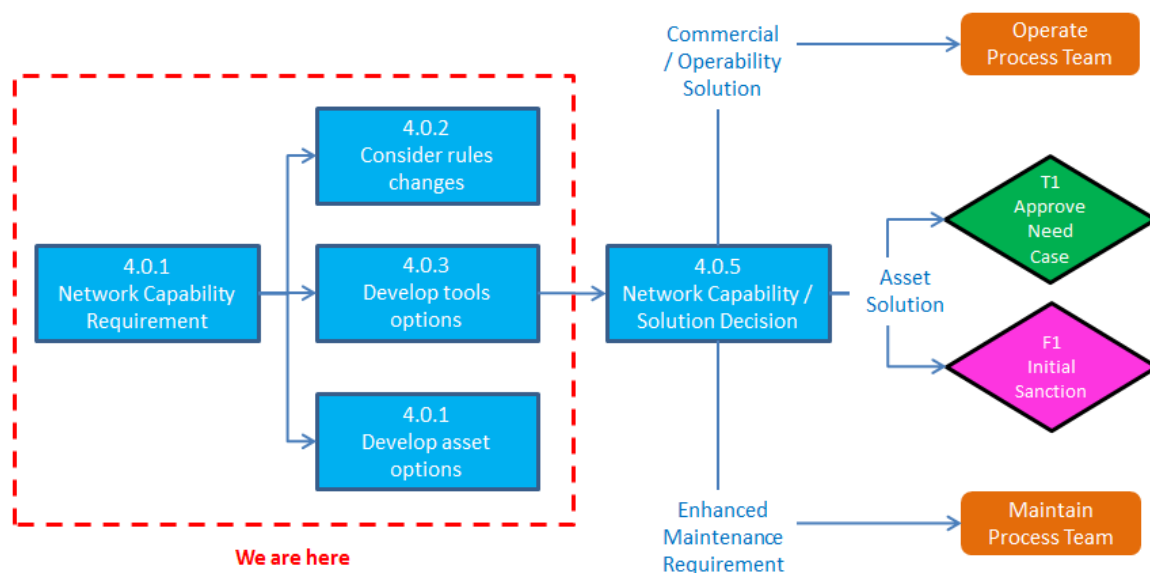
The purpose of our Network Development framework is to define the process for decision making, optioneering, development, sanction, delivery and closure for all projects. The aim of having an end to end process is to deliver the lowest whole-life cost, fit for purpose projects required to meet your needs and our RIIO outputs.

The options for IED compliance for our affected compressor units have been assessed through the 4.0 stage of the Network Development Process (NDP). For each affected site the network capability requirements have been assessed and a range of high level options for each site defined.

The diagram below shows the end to end NDP stages;



The diagram below shows in more detail the 4.0 stage of the NDP. We are currently at the stage of having identified all the possible solutions at each site affected by the IED and are now at the stage of consulting with you to help us arrive at a decision on the most appropriate solution.



### XIII. Stakeholder Process

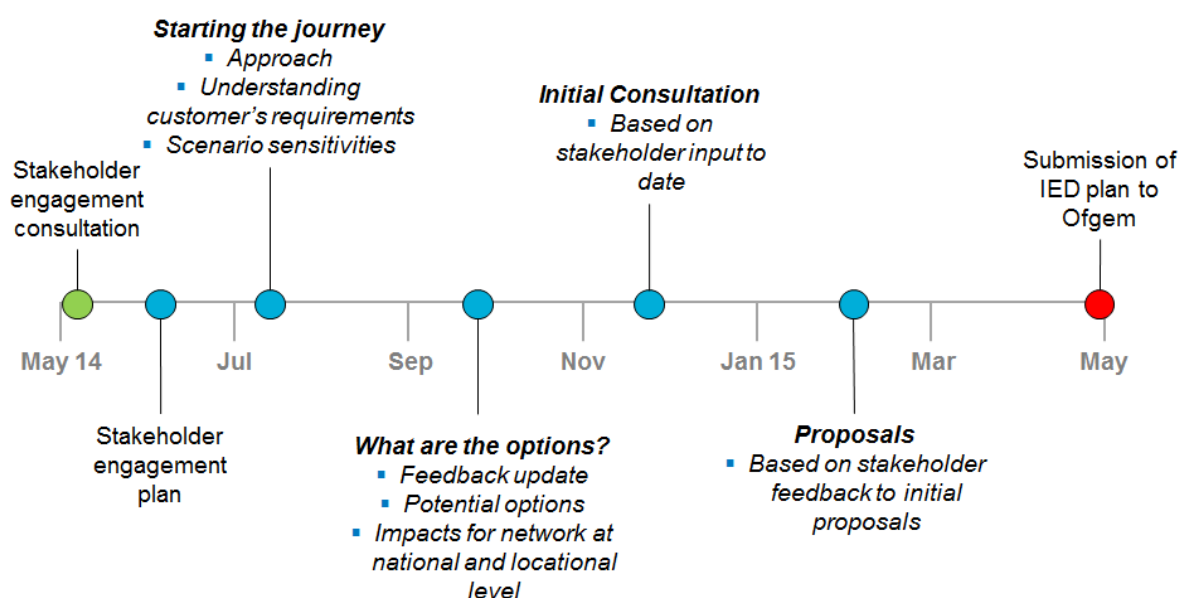
Stakeholder engagement is of fundamental importance to us. We are listening to a large and varied group of stakeholders with diverse views and opinions, and we are acting on what you are telling us. As we work to meet environmental legislation and replace ageing assets it is crucial that we are transparent and clear about the tasks ahead, and that we work with you in producing viable options for our compressor strategy to find the optimal solution. This is how we will continue to play our role of connecting new energy sources, transporting gas and electricity through our transmission networks to consumers, as well as meeting our obligation to comply with IED legislation, to its fullest.

Given the importance we place on engagement with you, we have tried to ensure we use a thorough range of communication methods to engage with you including:

- An Introductory Letter to Stakeholders
- An Article on our Connecting website
- The Talking Networks Website
- Video
- Stakeholder Workshops
- New innovative techniques e.g. OCC tool

#### Engagement Timeline

At the start of the consultation process, the following timeline was created to enable us to gather your feedback and incorporate it into our analysis. The timeline has encouraged us to engage early and at key milestones; and it is an indicative plan which has been subject to change based on responses to the stakeholder engagement consultation.



## Introductory Letter to Stakeholders

We began our stakeholder engagement by asking you how you wanted to be engaged with on this topic. Our stakeholder engagement has and continues to be driven by the feedback received from you. In order to reach as wide an audience as possible and publicise the project in April we sent an initial introductory letter explaining IED and its implications for the NTS, and asked you to tell us how you would like to be engaged on this topic, including the format and location of engagement events, the frequency of engagement, and particular areas of concern or interest you would like to be addressed in the development of compressor strategy. This letter was sent out via the Joint Office of Gas Transporters to three key groups; the UNC, Transmission, and Distribution workgroup lists in addition to contacting 167 stakeholders individually from our own database. We received 29 responses which influenced the resulting engagement plan.

## Article on our Connecting Website

We also promoted the start of the engagement through an article on our [Connecting website](#)<sup>7</sup> to reach a wider audience and capture further comments, as well as providing background information to the consultation on our gas compressor strategy.

## Talking Networks

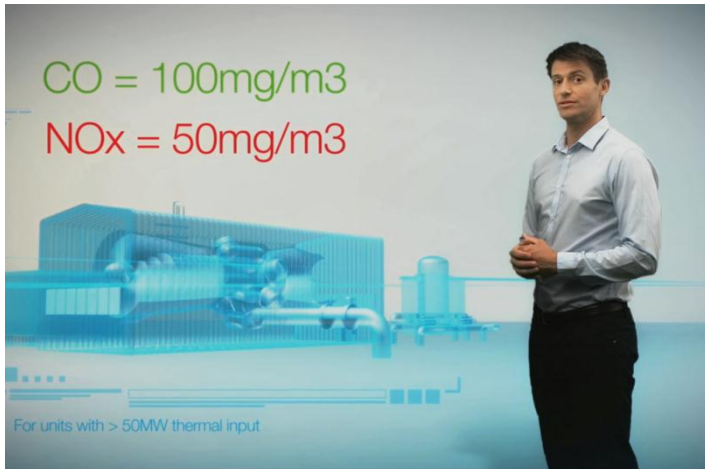
To support our stakeholder engagement we have developed a project specific website under the Talking Networks umbrella which is accessed from different parts of the National Grid website. This provides further background information on the legislation, in addition to originally hosting the initial engagement questionnaire, details of stakeholder workshops and the ability to register for updates on the project.



Stakeholders have regularly been directed to the consultation on our Talking Networks site where there is a short [film](#)<sup>8</sup>, message from the Director of Transmission Network Services, clear articulation of the IED and what it means for the future of the NTS; and a plea for stakeholders to contribute to and work with us to determine the most effective and efficient strategy going forward for our compressor fleet. This site also contains all the presentation material used at the stakeholder workshops.

<sup>7</sup> <http://www.nationalgridconnecting.com/we-want-your-views/>

<sup>8</sup> <http://www.talkingnetworkstx.com/IED-welcome.aspx>



**Video**

We commissioned a video which provides an overview of the IED legislation and its impact on our network and you, our customers and stakeholders.

We showed this video at our first stakeholder workshop discussing this matter and it is also on our website.

**Stakeholder Workshops**

Stakeholder consultation began with an initial workshop in July 2014 and a subsequent workshop in September. Attendance (10 attendees at both workshops), represented a wide range of industry participants including shippers, DNs and trade associations. The following companies participated: Energy UK, National Grid Distribution, Scotia Gas Network, Centrica Storage, Centrica, Oil and Gas UK, Chemical Industries Association, Bord Gais, RWE Supply and Trading, Apache, GE Oil and Gas, E.On, Baringa, Cornwell Energy, Statoil, Ofgem, and IHS.

<b>167</b> Stakeholders contacted by letter	<b>29</b> Stakeholders responded to our letter and survey
<b>10</b> Stakeholders attended each workshop	
<b>All</b> Stakeholder on the Joint Office distribution lists for UNC, Transmission and Distribution invited to workshops	

**“”**

*“Useful to articulate these IED scenarios – well presented, accessible and easy to engage with.”*

As a result of the first workshop in July and responses you, the content of the next workshop was refined to suit their areas of interest and concern, as detailed in the next section of the document. Stakeholders were asked to actively contribute in these discussions and to provide feedback via forms at the end of events, voicing their ideas, interests and concerns. The timeline for engagement (pictured above) was also adjusted consequently.

In the first workshop to get a better understanding of your requirements we asked delegates to complete a Gas Transmission Network Strategy Scorecard, to identify the network capability criteria that were most important to them and the reasoning why. We are using this scorecard in the evaluation of the options available and to present the impact

of the different options back to stakeholders. Use of this scorecard helps us present information to stakeholders in the right context to enable them to digest the impact for them.

### **Further Stakeholder Engagement**

We have and continue to offer specific engagement with you on this topic. We have held a number of bilateral discussions and industry group specific engagement to address particular concerns for these parties; we have outlined the impact of IED and introduced our plan for stakeholder engagement in the development of our compressor fleet strategy. These bilateral meetings with customers are significant especially where customers may be directly affected by our decisions. Of the 4 Distribution Networks (DNs), Scotia Gas Networks (SGN) and National Grid Distribution attended the workshops. In October we held a webinar with the DN's and are following up with bilateral meetings with each one. All these instances have enabled us to listen to these specific stakeholders' areas of interest and concern; and our discussion will continue with future meetings planned. We remain open to further bilateral meetings with you on this topic.



### **New Innovative Techniques – OCC Tool**

We have commissioned Oxford Computing Consultants (OCC) to develop a tool which will help to visualise and articulate the impact that different supply and demand scenarios and different investment options will have on the network. We will soon be releasing videos on our website created using the tool that will summarise the range of scenarios considered at each IED site. We are hoping to upload a fully interactive version of the tool early next year that you can use and play through some of the scenarios we have considered. Our intention is to use this tool to help us and you work through the investment decisions we make on the network, not only for the IED project but also for future projects that will have an impact on the development of the NTS.

### **Going Forward**

We continue to invite our stakeholders to provide their feedback to us through the Talking Networks website or directly to Hannah Kirk-Wilson ([Hannah.Kirk-Wilson@nationalgrid.com](mailto:Hannah.Kirk-Wilson@nationalgrid.com)) or James Whiteford ([James.Whiteford@nationalgrid.com](mailto:James.Whiteford@nationalgrid.com)).

**Q2: What more could we do to improve our stakeholder engagement process?**

**Q3: How would you like us to transition from this process into further discussion areas such as system flexibility or future legislation?**

## XIV. Our response to what stakeholders have told us

We place great value on all comments we receive as we work with you; what you tell us about how we are engaging with you, the topics we are discussing and your identification of what is most important to you is pivotal. We are listening to what you say and acting on what you have told us.

The workshop format was favoured by our stakeholders and from the event on 16<sup>th</sup> July you articulated what specific information you wanted and needed; your comments were used to inform the next workshop on 30<sup>th</sup> September. Our response was therefore to adjust the workshop material so that content was specifically what you told us you wanted to address. Below is a summary of some of the aspects you wanted more information about and how we tailored our engagement to respond to your requests.

### YOU HAVE TOLD US...

*"We need to know more about what compressors do today and how we use them"*



### OUR RESPONSE...

...National Grid presented the Network Evolution Story at the September Stakeholder event

*"More information on different options and impacts"*



...National Grid presented LCP compressor options at the September workshop and covered the options at specific site examples in detail. Full initial proposals will be presented at November Stakeholder event

*"Focus on IED legislation"*



...National Grid did a further deeper dive into the IED legislation and timings at the September Stakeholder event, and put information on Talking Networks

In the first workshop stakeholders were asked to develop Gas Transmission Network Strategy Scorecards to identify the most important criteria in developing the NTS Compressor Strategy. Here is a summary of the scorecard completed by participants at the workshops showing the importance they attached to the various criteria;



Criteria	Importance (from 1 to 10)	Key Question
Sensitivity analysis beyond FES supply and demand scenarios		Does this option allow the network to be operated in sensitivities beyond FES?
Entry Capacity Obligations		Can National Grid meet Entry Capacity obligations considering this option?
Exit Capacity Obligations		Can National Grid meet Exit Capacity obligations considering this option?
Current utilisation		Does this option allow National Grid to retain current capability?
Future Flexibility		Does this option allow National Grid to meet future flexibility requirements?
Resilience		Does this option represent an appropriate level of resilience on the network?
Impact on customer charges		Does this option have a negligible impact on customer charges?
Encouraging new investment		Does this options remove barrier for encouraging new investment?
Future Proofing		Is this option future proof?

Key	= Lowest score	= Average score	= Highest score
-----	----------------	-----------------	-----------------

From this summary it is apparent that stakeholders attach the greatest level of importance to ensuring that the chosen option provides future flexibility for system users and encourages new investment. This priority is then followed with ensuring that the option allows current capability to be maintained, including exit capacity obligations, at a negligible cost to consumers and in a manner which is future proof.

We have listened to what our stakeholders consider to be the most significant outputs of our investment and this information has informed our compressor options which can be found later in this document.

**“**  
*“We need to maintain the levels of flexibility and capability we have today.”*  
**”**

**“**  
*“The cost to customers and the impact on transmission charges are a key concern.”*  
**”**

**Q4: Have we got what is important to you correct?**

**Q5: Do you feel that we are listening and taking account of your views? If not, what more could we do?**

## **XV. Generic Options**

For each site affected by the LCP element of the IED the following potential options in isolation or a combination could be considered:

- 1) Retain under the Limited Life Derogation and subsequently decommission
- 2) Retain under the Emergency Use Derogation
- 3) Retrofit
- 4) Catalytic Converter
- 5) Replace with the same capability
- 6) Replace with different capability

### **Retain under Limited Life Derogation and subsequently decommission**

The Limited Life derogation provides an “opt out” from complying with the specified ELVs. It allows units to continue to operate for a maximum of 17,500 hours from 1<sup>st</sup> January 2016 to the 31<sup>st</sup> December 2023, after which time the unit would need to be decommissioned. A declaration to comply with these requirements must be made by 1<sup>st</sup> January 2014. If no other solutions have been implemented at those units to ensure they are compliant with the ELVs by 31<sup>st</sup> December 2023 then those units must be removed from the network by that date. We have made a declaration to comply with these requirements for all of our affected units. However this option leads to a reduction in capability and therefore a change in risk profile that needs to be considered together with one or more combinations of the following:

- Improve resilience elsewhere on the network;
- Reinforce the network elsewhere;
- Manage commercial risk through long term contracts;
- Manage commercial risk through locational buy and sell actions on the day;
- Manage commercial risk by reducing baselines;
- Change the UNC rules to manage constraints;
- Reflect in constraint management incentive cost target in RIIO-T2.

### **Retain under Emergency Use Provision**

As mentioned in the Legislation section a further “opt out” option is to use the emergency use provision. This means that we will be able to use our affected units that do not comply with the ELV’s if we use them for 500 hours a year or less. This provision will be available to us from 1<sup>st</sup> January 2016. Similar concerns about reduction in capability exist to the above option and therefore a risk management strategy as described above will also need to be considered.

### **Asset Health**

In RIIO-T1 we forecast that the asset health related investment on compressor stations will decline from 2015/16 given the compressor replacement works required to ensure

compliance with the IED. However, for the units retained under either the Limited Life Derogation or the Emergency Use provision the requirement for the asset health related investments on these units will not decline as the units will remain in operation. We are currently assessing the asset health costs associated with each site if either of these two options are followed.

### **Retrofit**

Gas driven compressors are a continuously evolving technology. A retrofit is the exchange or modification of an aspect of the compressor unit with newer elements which offer lower emissions. Under this option only some of the unit will be upgraded, meaning that the unit as a whole will be limited to its original lifespan. Retrofitting of existing gas turbines maybe possible but is limited due to increased space required and matching with existing equipment. The environmental performance and total cost of ownership can be less favourable compared with a new low emission package. Studies have shown that retrofit is not a preferred option for any of our sites.

### **Catalytic Converter**

The use of catalysts to treat stack exhaust gases is well established. Catalytic converters can be used to either oxidise the CO or to reduce the NO<sub>x</sub>.

#### ***Oxidation of CO***

The process to oxidise CO into CO<sub>2</sub> is straightforward. When the CO is passed over a catalyst the CO in the exhaust gases will react with the excess oxygen to produce CO<sub>2</sub>. Technically this solution is relatively simple, requiring sufficient physical space to fit the exhaust gas catalyst unit and possible continuous monitoring of exhaust gas (to ensure a sufficient degree of abatement). Oxidation of CO to CO<sub>2</sub> is considered to be BAT for the post combustion control of CO.

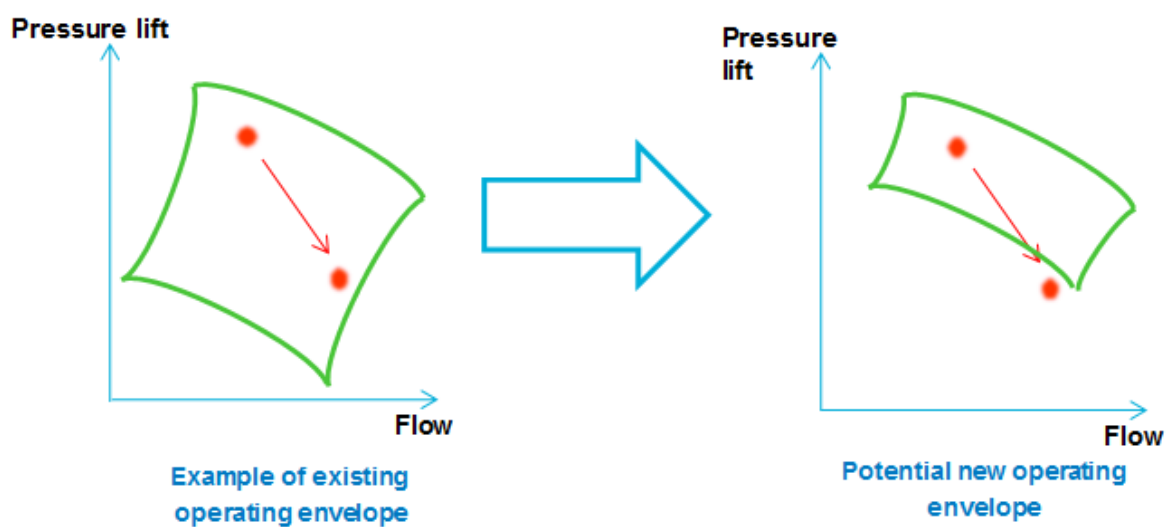
#### ***Reduction of NO<sub>x</sub>***

NO<sub>x</sub> can be reduced to nitrogen and water using a Selective Catalytic Reduction (SCR). This technique requires both a source of hydrogen to be added to the exhaust gases before being passed over the catalyst. SCR is a significantly more complex process to implement than the oxidation of CO. The reducing agents (typically ammonia or urea) are considered hazardous and subject to their own specific control conditions under the Control of Substances Hazardous to Health legislation. To ensure the continuous operation of the plant there would be a requirement to store large quantities of the reducing agent on site, along with the catalyst units themselves and associated process control and monitoring equipment. SCR has been evaluated as a method of secondary abatement through the Network Review process and has not been considered to be BAT.

### Replace Capability with the same capability

Under this option the capability provided by each unit would be replaced with the same capability which would result in no change in risk profile. However it may not be the optimum solution for the site due to the significant changes in supply and demand patterns over the last 15 years and the way in which shippers use capacity.

However, to ensure the same capability replacement may not be like-for-like (i.e. the same sort of unit) due to technology changes. As shown in the charts below, due to emissions limits for new technology the operating range of a compressor could be significantly reduced. However, this could be addressed by the installation of multiple smaller units to provide the same operating range and capability.



### Replace Capability with different capability

Under this option, we will determine the capability requirement for each site based on forecast flows, operating strategy and legal obligations and replace non-compliant technology with Best Available Technology (BAT). This enables us to take account of the current and future needs of the system and provide a solution that should be a better fit to the outputs that you have said are important to you.

**Q6: Are there other options not described within the “Generic Options” section that you think we should consider? If so, what are they and where can we find information about them?**

## XVI. Initial scoping of options - LCPD

For all the sites affected by the LCPD element of IED we have initially scoped out the range of options available – the generic options that were considered are introduced in section XV. For each site we have assessed the option of entering the affected units into the emergency use derogation which would limit the use of those units to 500 hours; decommissioning the units and a range of other options which are applicable at each site.

The options discussed within this document have been evaluated in accordance with our duties as a gas transporter and other statutory obligations relating to safety and environmental matters and our obligations to plan and operate the system in an economic and efficient manner.

### St Fergus

St Fergus comprises of 3 plants, 4 units at plant 1, 3 units at plant 2 and 2 units at plant 3.

Plant 1 comprises of;

- 4 \* Avon gas generators coupled with GEC EAS1 power turbines

Plant 2 comprises of;

- 2 \* RB211 gas generators coupled with GEC ERB1 power turbine
- 1\* Avon gas generator coupled with GEC EAS1 power turbine

Plant 3 comprises of;

- 2 \* 24 MW Electric Variable Speed Drives (VSD) (currently undergoing gas commissioning and flow trials)

The recent running hours at St. Fergus are as follows;

	2009	2010	2011	2012	2013
<b>Avon 1533</b>	6397	6346	8816	6987	6902
<b>RB211</b>	7527	8645	2916	4255	5893

At St Fergus there are two RB211 units which are affected by the requirements of the IED. Analysis has shown that the remaining units would be able to provide the required flows. Back-up compression requirements at St Fergus are still being investigated but the assumption we have used in the development of the options is that the back-up should cover for a loss of both the electric drives due to the risk of a common electricity supply failure.

The four options, which bound the credible range are as follows:

- 1) *17,500 hours derogation + decommission* - enter both units into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the units once the electric drive units have been operationally proven and accepted.

- 2) *500 hours* - adopt the emergency use derogation and limit both units to 500 hours running from 1 January 2016.
- 3) *Decommission and one new unit* - enter one unit into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission, in addition install one new unit to provide increased resilience and to enable an older Avon unit to be decommissioned.
- 4) *Two new units* - install two new units at the site and decommission the RB211s.

The table below summarises the suitability of each solution, generally the lowest cost options are on the left and the most expensive on the right.



St Fergus	1) 17,500 hours derogation + decommission	2) 500 hours	3) Decommission + 1 New Unit	4) 2 New Units
Does this option allow the network to be operated in sensitivities beyond FES?	Light Green	Yellow	Dark Green	Dark Green
Can National Grid meet Entry Capacity obligations considering this option?	Light Green	Yellow	Dark Green	Dark Green
Can National Grid meet Exit Capacity obligations considering this option?	N/A	N/A	N/A	N/A
Does this option allow National Grid to retain current capability?	Light Green	Yellow	Light Green	Dark Green
Does this option allow National Grid to meet future flexibility requirements?	Light Green	Yellow	Dark Green	Dark Green
Does this option represent an appropriate level of resilience on the network?	Light Green	Yellow	Dark Green	Dark Green
Does this option have a negligible impact on customer charges?	Yellow	Yellow	Yellow	Orange
Does this option remove barrier for encouraging new investment?	Light Green	Light Green	Light Green	Light Green
Is this option future proof?	Light Green	Light Green	Light Green	Dark Green

### Key Considerations

- The 500 hour option would result in insufficient back-up to the electric drives whilst these are being operationally accepted and thus result in increased buy-back risk. The 17,500 derogation will allow enough running hours to ensure the electric units are operationally proven and accepted before decommissioning the RB211s.

- For all of the options remedial work will be needed to be carried out on the Avon machines if the RB211s are not replaced and there is the risk that these will fall under the MCP in the future.
- If the 500 hours option is progressed there will be increased asset health costs associated with the units due to their age - full replacement of the units would by default include a significant quantity of ancillary systems.
- Installing one and/or two new units would provide increased resilience and plant that is better suited to the current operating environment. In addition it may enable us to decommission further Avon units and avoid the necessary asset health spend on these units. However this comes at a significant cost, which for 2 new units would be in the order of £80m.
- There is an interaction with our proposals under IPPC Phase 4, which are discussed in more detail in section XVII.

## Kirriemuir

Kirriemuir consists of 5 compressor units and was constructed in 1977;

- 3 \* Avon 1533 12.34MW machines (installed in 1977; units A, B and C)
- 1 \* RB211 25.3MW machine (installed in 1985; unit D)
- 1 \* VSD 35 MW machine (yet to be fully commissioned; unit E)

Only one unit is affected at Kirriemuir, unit D. All units can be used in single configuration with the exception of unit C which can be used in parallel with any of the other gas driven units for high flow requirements. Parallel configuration is possible with any combination of units A to D apart from A and B in parallel. A and B can be used in series configuration. Operationally, unit D is currently the lead unit due to its reliability and flexibility. The recent running hours at Kirriemuir compared to the running hours in 2003 are as follows;

	2003		2009	2010	2011	2012	2013
<b>Avon 1533</b>	6175		140	891	499	997	457
<b>RB211</b>	6710		2402	3127	795	1756	157

The four options, which bound the credible range are as follows:

- 1) *17,500 hours derogation + decommission* - enter the RB211 into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the unit.
- 2) *Decommission unit D and de-rate/re-wheel unit E* - decommission the RB211 and de-rate and/or re-wheel the new electric drive unit so it can cater for lower flows.
- 3) *Unit D on 500 hours and de-rate/re-wheel unit E* - adopt the emergency use derogation and limit the RB211 to 500 hours running from 1 January 2016 and de-rate and/or re-wheel the new electric drive unit so it can cater for lower flows.
- 4) *One new unit* - install a new unit at the site and decommission the RB211.

The table below summarises the suitability of each solution, generally the lowest cost options are on the left and the most expensive on the right.





Kirriemuir	1)Decommission	2) Decommission unit D + de-rate/re-wheel unit E	3) Unit D on 500 hours + de-rate/re-wheel unit E	4) 1 New Unit
Does this option allow the network to be operated in sensitivities beyond FES?	Light Green	Light Green	Light Green	Dark Green
Can National Grid meet Entry Capacity obligations considering this option?	Light Green	Light Green	Light Green	Dark Green
Can National Grid meet Exit Capacity obligations considering this option?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to retain current capability?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to meet future flexibility requirements?	Light Green	Light Green	Light Green	Dark Green
Does this option represent an appropriate level of resilience on the network?	Yellow	Yellow	Light Green	Dark Green
Does this option have a negligible impact on customer charges?	Dark Green	Light Green	Light Green	Orange
Does this option remove barrier for encouraging new investment?	Light Green	Light Green	Light Green	Light Green
Is this option future proof?	Light Green	Light Green	Light Green	Dark Green

### Key Considerations

- The electric drive will take over lead unit status once it has been fully commissioned and by re-wheeling and re-rating the unit it will enable more frequent use due to the decline in flows from the St. Fergus terminal. We originally anticipated higher flows from the St Fergus terminal when unit E was designed.
- If the 500 hours option was followed for unit D at Kirriemuir this would reduce resilience at the site.
- If the 500 hours option is progressed there will be increased asset health costs associated with the RB211 due to its age.
- The decommission options will require remedial works on the remaining Avon units at the site, in order to provide effective back-up, and there is a risk that these units will be impacted by MCP.
- The 17,500 hour derogation will allow enough running hours to ensure the electric unit is operationally proven and accepted before decommissioning the RB211.
- Installing one new unit would enable us to develop a flexible station, that would be able to meet the output you have requested, but at a significant cost, which would be in the order of £50m.

## Moffat

Moffat consists of 2 compressor units and was constructed in 1980;

- 2 \* RB211 21.2 MW machines

These units are both affected by the LCP element of IED. The units can only be used in single configuration. The recent running hours at Moffat compressor station are as follows;

	2009	2010	2011	2012	2013
RB211	515	56	138	48	427

The four options, which bound the credible range are as follows:

- 1) *17,500 hours derogation + decommission* - enter the RB211s into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the units.
- 2) *500 hours and decommission* - adopt the emergency use derogation and limit one RB211 to 500 hours running from 1 January 2016 and decommission the other RB211.
- 3) *500 hours* - adopt the emergency use derogation and limit the RB211s to 500 hours running from 1 January 2016.
- 4) *Two new units* - install two new units at the site and decommission the RB211s.

The table below summarises the suitability of each solution, generally the lowest cost options are on the left and the most expensive on the right.



Moffat	1)Decommission	2) 500 hours + decommission 1 unit	3) 500 hours	4) 2 New Units
Does this option allow the network to be operated in sensitivities beyond FES?	Light Green	Light Green	Light Green	Dark Green
Can National Grid meet Entry Capacity obligations considering this option?	Yellow	Yellow	Yellow	Dark Green
Can National Grid meet Exit Capacity obligations considering this option?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to retain current capability?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to meet future flexibility requirements?	Light Green	Light Green	Light Green	Dark Green
Does this option represent an appropriate level of resilience on the network?	Light Green	Light Green	Light Green	Dark Green
Does this option have a negligible impact on customer charges?	Dark Green	Light Green	Yellow	Orange
Does this option remove barrier for encouraging new investment?	Light Green	Light Green	Light Green	Light Green
Is this option future proof?	Light Green	Light Green	Light Green	Dark Green

### Key Considerations

- Moffat compressor has not been needed to support the Irish flows at the interconnector for a number of years and our current network analysis has not shown a requirement for Moffat going forwards for this purpose according to our current assumptions regarding future supply and demand scenarios.
- However, all options that reduce the capability at Moffat create a degree of commercial risk for scenarios beyond FES, in particular we would not be able to cover baseline entry obligations at St Fergus. We would therefore need to address this as part of RIIO-T2.
- If the 500 hours option is progressed there will be increased asset health costs associated with the units due to their age.
- From a broader network perspective, resilience may become an issue if a number of units are decommissioned along the West coast of the system and therefore leaving a long stretch of the system with reliance on a small number of units.

- Installing two new units, would allow us to design a station that would better reflect future conditions in terms of flexibility, capability and resilience. However, this comes at a significant cost, which would be in the order of £80m.

### Carnforth (and Nether Kellet)

Carnforth consists of 3 compressor units and was constructed in 1989;

- 2 \* RB211 25.3MW machines (units A and B, installed in 1989)
- 1 \* LM2500 DLE 27.6 MW (unit C, installed in 2000)

At Carnforth there are two units (units A and B) which are not compliant with IED.

Nether Kellet compressor station (adjacent to Carnforth) consists of 2 compressor units and was constructed in 2003;

- 2 \* SGT400 12.9MW

The units at Carnforth compressor station can be used in single configuration and any combination in parallel configuration. The units at Nether Kellet compressor station can be used in single or parallel configuration. The recent running hours at Carnforth and Nether Kellet compressor stations are as follows:

		2009	2010	2011	2012	2013
Carnforth	<b>RB211</b>	1259	480	76	50	68
	<b>LM2500</b>	1464	431	35	14	28
Nether Kellet	<b>SGT400</b>	542	2542	2795	3535	4219

The four options, which bound the credible range are as follows:

- 1) *Decommission units A & B* - enter the RB211s into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the units.
- 2) *Decommission units A & B and flexibility enhancement* - enter the RB211s into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the units. The flexibility enhancements will involve a number of improvements to the site to allow the site to be as configurable as possible e.g. full reversal allowing the site to discharge north towards Scotland.
- 3) *Units A & B at 500 hours* - adopt the emergency use derogation and limit the RB211s to 500 hours running from 1 January 2016.
- 4) *Two new units* - install two new units at the site and decommission the RB211s.

The table below summarises the suitability of each solution, generally the lowest cost options are on the left and the most expensive on the right.



<b>Carnforth</b>	<b>1)Decommission units A &amp; B</b>	<b>2) Decommission units A &amp; B + Flexibility enhancements</b>	<b>3) Units A &amp; B at 500 hours</b>	<b>4) 2 New Units</b>
Does this option allow the network to be operated in sensitivities beyond FES?	Light Green	Light Green	Light Green	Dark Green
Can National Grid meet Entry Capacity obligations considering this option?	Yellow	Yellow	Yellow	Dark Green
Can National Grid meet Exit Capacity obligations considering this option?	Light Green	Dark Green	Dark Green	Dark Green
Does this option allow National Grid to retain current capability?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to meet future flexibility requirements?	Orange	Light Green	Yellow	Dark Green
Does this option represent an appropriate level of resilience on the network?	Light Green	Light Green	Light Green	Dark Green
Does this option have a negligible impact on customer charges?	Dark Green	Yellow	Light Green	Orange
Does this option remove barrier for encouraging new investment?	Light Green	Light Green	Light Green	Light Green
Is this option future proof?	Yellow	Light Green	Light Green	Dark Green

### Key Considerations

- All options that reduce the capability at Carnforth create a degree of commercial risk for scenarios beyond FES, in particular we would not be able to cover baseline entry obligations at St Fergus, which we would need to address as part of RIIO-T2.
- Under the 500 hours option and the pure decommissioning option there will also be an impact on the level of resilience that can be provided by Carnforth.
- Due to the evolution of flows on the network from a predominant north to south flow pattern to a south to north flow pattern, Carnforth will become a key hub on the West of the system and will require a degree of flexibility in terms of configurability and how it can be combined with the operation of Nether Kellet – hence the option that provides enhancement to flexibility at the site.
- If the 500 hours option is progressed there will be increased asset health costs associated with the units due to their age.
- From a broader network perspective, resilience may become an issue if a number of units are decommissioned along the West coast of the system and therefore leaving a long stretch of the system with reliance on a small number of units.

- Installing two new units, would allow us to design a station that would better reflect future conditions in terms of flexibility, capability and resilience. However, this comes at a significant cost, which would be in the order of £80m.

## Hatton

Hatton consists of 4 compressor units and was constructed in 1989;

- 3 \* RB211 25.3 MW machines (installed in 1989, units A, B and C)
- 1 \* VSD 35 MW machine (yet to be fully commissioned, unit D)

Three compressor units (units A, B and C) are affected by the requirements of the LCP element of IED at Hatton. All units can be used in single configuration and any combination of parallel operation is possible including with the new electric drive unit. Unit D has been designed to take up bulk duty requirements and was installed due to IPPC emissions requirements. Once unit D is commissioned and operationally proven, the RB211s will be used as back-up and also to provide additional capability to compress high flows above the capability that unit D currently provides. The recent running hours at Hatton are as follows;

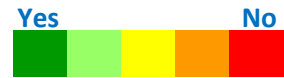
	2009	2010	2011	2012	2013
RB211	5371	5207	1169	1705	2936

The four options, which bound the credible range are as follows:

- 1) *17,500 hours derogation + decommission* - enter the units into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the units.
- 2) *500 hours* - adopt the emergency use derogation and limit the units to 500 hours running from 1 January 2016.
- 3) *Two large new units* - install two large new units similar in size to the current RB211s at the site and decommission the RB211s.
- 4) *Three medium new units* - install three new units at the site to offer a broader operating range and decommission the RB211s.

The table below summarises the suitability of each solution, generally the lowest cost options are on the left and the most expensive on the right.





Hatton	1)Decommission	2) 500 hours	3) 2 Large New Units	4) 3 Medium New Units
Does this option allow the network to be operated in sensitivities beyond FES?	Red	Orange	Light Green	Dark Green
Can National Grid meet Entry Capacity obligations considering this option?	Red	Orange	Light Green	Dark Green
Can National Grid meet Exit Capacity obligations considering this option?	Red	Yellow	Light Green	Dark Green
Does this option allow National Grid to retain current capability?	Red	Orange	Light Green	Dark Green
Does this option allow National Grid to meet future flexibility requirements?	Red	Orange	Yellow	Dark Green
Does this option represent an appropriate level of resilience on the network?	Red	Red	Dark Green	Dark Green
Does this option have a negligible impact on customer charges?	Dark Green	Light Green	Orange	Orange
Does this option remove barrier for encouraging new investment?	Red	Orange	Light Green	Dark Green
Is this option future proof?	Red	Orange	Light Green	Dark Green

**Key Considerations**

- If units A, B and C at Hatton are all decommissioned and no new units are installed or entered into the 500 hour derogation there will be no or reduced back-up to unit D and for Peterborough therefore reducing the resilience provided at this site. In our view, this would not represent an appropriate level of resilience on the network.
- All options that reduce the capability at Hatton create a degree of commercial risk, in particular we would not be able to cover baseline entry obligations at Easington, which we would need to address as part of RIIO-T2.
- If the 500 hours option is progressed there will be increased asset health costs associated with the units due to their age.
- Installing two new large units or 3 medium sized units, would allow us to design a station that would better reflect future conditions in terms of flexibility, capability and resilience. The 3 medium sized units, would offer greater flexibility benefits compared to two large units. Both options come at a significant cost, which would be in the order of £100m for either option.

## Warrington

Warrington consists of 2 compressor units and was constructed in 1983;

- 2 \* RB211 22.3MW machines

The units can only be used in single configuration. The recent running hours at Warrington are as follows;

	2009	2010	2011	2012	2013
RB211	91	25	51	16	13

The four options, which bound the credible range are as follows:

- 1) *17,500 hours derogation + decommission* - enter the RB211s into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the units.
- 2) *500 hours and Decommission* - adopt the emergency use derogation and limit one RB211 to 500 hours running from 1 January 2016 and decommission the other RB211.
- 3) *500 hours* - adopt the emergency use derogation and limit the RB211s to 500 hours running from 1 January 2016.
- 4) *Two new units* - install two new units at the site and decommission the RB211s.

The table below summarises the suitability of each solution, generally the lowest cost options are on the left and the most expensive on the right.



Warrington	1)Decommission	2) 500 hours + Decommission	3) 500 hours	4) 2 New Units
Does this option allow the network to be operated in sensitivities beyond FES?	Light Green	Light Green	Light Green	Dark Green
Can National Grid meet Entry Capacity obligations considering this option?	Yellow	Yellow	Yellow	Dark Green
Can National Grid meet Exit Capacity obligations considering this option?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to retain current capability?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to meet future flexibility requirements?	Light Green	Light Green	Light Green	Dark Green
Does this option represent an appropriate level of resilience on the network?	Light Green	Light Green	Light Green	Dark Green
Does this option have a negligible impact on customer charges?	Dark Green	Light Green	Yellow	Orange
Does this option remove barrier for encouraging new investment?	Light Green	Light Green	Light Green	Light Green
Is this option future proof?	Light Green	Light Green	Light Green	Dark Green

### Key Considerations

- All options that reduce the capability at Warrington create a degree of commercial risk for scenarios beyond FES, in particular we would not be able to cover baseline entry obligations at St Fergus, we would need to address this as part of RIIO-T2.
- From a broader network perspective, resilience may become an issue if a number of units are decommissioned along the West coast of the system and therefore leaving a long stretch of the system with reliance on a small number of units.
- If the 500 hours option is progressed there will be increased asset health costs associated with the units due to their age.
- Installing two new units, would allow us to design a station that would better reflect future conditions in terms of flexibility, capability and resilience. However, this comes at a significant cost, which would be in the order of £80m.

## Wisbech

Wisbech consists of two compressor units and was constructed in 1980;

- 1 \* RB211 21MW machine
- 1 \* Avon 1534 13.97 MW machine

Both machines are affected by the LCP element of IED. The units can only be used in single configuration with the Avon being the lead unit and the RB211 used as back up. The recent running hours at Wisbech are as follows;

	2009	2010	2011	2012	2013
<b>Avon 1534</b>	2	18	10	218	200
<b>RB211</b>	3	6	6	19	104

The four options, which bound the credible range are as follows:

- 1) *17,500 hours + decommission* - enter both units into Limited Life Derogation i.e. 17,500 hours from 1 January 2016 and decommission the units.
- 2) *500 hours* - adopt the emergency use derogation and limit both units to 500 hours running from 1 January 2016.
- 3) *Limited life derogation on RB211 and replace maxi Avon engine for an Avon engine* – this would provide 17,500 running hours on the RB211, which would then need to be decommissioned. For the Avon we would have unlimited running hours, although this would be captured by IPPC and MCP (when introduced).
- 4) *Two new units* - install two new units at the site and decommission the RB211 and maxi Avon.

The table below summarises the suitability of each solution, generally the lowest cost options are on the left and the most expensive on the right.



Wisbech	1)Decommission	2) 500 hours – both units	3) 17,500 hours derogation on RB211 and decommission / replace maxi Avon with Avon	4) 2 New Units
Does this option allow the network to be operated in sensitivities beyond FES?	Yellow	Light Green	Light Green	Dark Green
Can National Grid meet Entry Capacity obligations considering this option?	Orange	Yellow	Yellow	Dark Green
Can National Grid meet Exit Capacity obligations considering this option?	Yellow	Light Green	Light Green	Dark Green
Does this option allow National Grid to retain current capability?	Light Green	Light Green	Light Green	Dark Green
Does this option allow National Grid to meet future flexibility requirements?	Yellow	Yellow	Light Green	Dark Green
Does this option represent an appropriate level of resilience on the network?	Orange	Orange	Light Green	Dark Green
Does this option have a negligible impact on customer charges?	Dark Green	Light Green	Light Green	Orange
Does this option remove barrier for encouraging new investment?	Yellow	Light Green	Light Green	Light Green
Is this option future proof?	Orange	Yellow	Light Green	Dark Green

### Key Considerations

- Due the fact that Wisbech provides back up to Peterborough and we will be undertaking extensive IPPC works at Peterborough, we would be concerned about limiting both Wisbech units to 500 hours. Therefore where we are not replacing units, the Limited Life Time derogation looks more favourable.
- In the case of Wisbech there is a unique option of replacing the maxi Avon engine for an Avon engine, which provides additional advantages in the short to medium term, as there would be no running hour constraints on this unit.
- All options that reduce the capability at Wisbech create a degree of commercial risk for scenarios beyond FES, in particular we would not be able to cover baseline entry obligations at Theddlethorpe or aggregate exit obligations in the South East, we would need to address this as part of RIIO-T2.

- There is a reduction in resilience for the derogation options. However if we undertake the full IPPC Phase IV programme, we are proposing at Peterborough, this risk would be partly mitigated.
- If we do not install new units, there is also likely to be an increase in asset health costs to keep the old units on the system, which is currently not provided for in the RIIO-T1 settlement.
- Installing two new units, would allow us to design a station that would better reflect future conditions in terms of flexibility, capability and resilience. However, this comes at a significant cost, which would be in the order of £80m.

**Q7: For each site, do you think we have articulated the viable range of options? If not, what is missing?**

**Q8: Do you agree with our assessment of the options? If not, which aspect(s) would you change?**

**Q9: What additional information would help you better understand our assessment?**

**Q10: Which options would you propose for each site?**

**Q11: Do you think we have taken account of system flexibility sufficiently? What would you like to see on system flexibility ahead of the mid-period review?**

## XVII. IED - IPPC Phase 4

As discussed within “The RIIO Deal” section, the May 2015 reopener covers both the LCP aspects of IED and the next phase of IPPC, termed IPPC Phase 4. As part of our RIIO submission we proposed undertaking works to reduce emissions at the three most polluting sites. We have therefore undertaken analysis to identify these, taking into account historic running hours, the investments currently in progress and future supply and demand patterns.

### Historic running hours

The table on the next page shows the running hours at each site, with relevant breakdowns by unit. Units highlighted in red are potential candidate units for replacement under IPPC Phase 4, due to their size and emissions performance.

Compressor station	Units	Running Hours					
		2009	2010	2011	2012	2013	5 year average
Alrewas	A and B (Avon 1533s)	221	1061	305	258	146	398
	C (Solar Titan DLE)	222	1091	1209	28	120	534
Cambridge	A and B (Avon 1533s)	41	117	18	40	42	52
	C (Cyclone DLE)	40	4	21	44	26	27
Chelmsford	A and B (Avon 1533s)	14	28	15	27	553	127.4
Diss	A, B and C (Avon 1533s)	108	432	15	19	918	298
Kings Lynn	A and B (Avon 1533s)	10	14	8	21	66	24
	C and D (Siemens SGT400)	1126	1392	505	69	1723	963
Kirriemuir	A, B and C (Avon 1533s)	140	891	499	997	457	597
	D (RB211)	2402	3127	795	1756	157	1647
	E (Electric VSD)	N/A	N/A	N/A	N/A	N/A	N/A
St. Fergus	5 Avon 1533 Units	6397	6346	8816	6987	6902	7090
	2 RB211 Units	7527	8645	2916	4255	5893	5847
	Electric VSD Unit	N/A	N/A	N/A	N/A	N/A	N/A
Wormington	A and B (Avon 1533s)	456	3746	5053	541	81	1975
	C (Electric VSD)	907	1098	2021	961	926	1183
*Peterborough	A, B and C (Avon 1533s)	5559	8268	4958	6621	7448	6571
*Huntingdon	A, B and C (Avon 1533s)	2964	6201	1444	842	4586	3207

\* One new unit to be installed as part of IPPC Phase 3

Based purely on a five year historical average, the most likely candidate sites are:

St Fergus – 7090 hours

Peterborough – 6571 hours

Huntingdon – 3207 hours

Wormington - 1975 hours

### **Adjusting for recent and planned investments**

At all of the above four sites there have been or will be investments that impact these future running hours, a review of these is provided below:

*St Fergus* – two new electric drives are in the process of being commissioned, these will largely take up the bulk duty previously undertaken by the two RB211s. However, we do not anticipate these significantly reducing the usage requirement of the Avons, which are required for single duty operation and start-up.

*Peterborough* – one new unit will be installed to cover bulk duty, however there is still a requirement for a small single unit to cover the lower part of the operating envelope. Based on a historical view of single unit operation this has been estimated at approximately 2000 hours per annum.

*Huntingdon* – one new unit will be installed to cover bulk duty, however there is still a requirement for a small single unit to cover the lower part of the operating envelope. Based on a historical view of single unit operation this has been estimated at approximately 800 hours per annum.

*Wormington* - the commissioning of the Felindre gas compressors and increased confidence in the electric drive unit at Wormington are likely to significantly reduce operating hours of the two Avon units. It can be seen that over the last 5 year there has been growing reliance on the electric drive, with run hours at Wormington A and B reducing to only 81 hours in 2013.

### **Future supply and demand patterns**

We then considered whether changes in supply and demand patterns would have a significant impact on the candidate compressors. The best way to consider this is to consider the driver for the usage of each site:

*St Fergus* – required to support entry flows at St Fergus, although St Fergus flows are forecast to decrease, significant volumes are still anticipated at the Total sub-terminal for the foreseeable future. Therefore a high level of run hours on the Avons is likely into the future.



*Peterborough* – mainly used to support demand, therefore continued regular use anticipated into the future. In addition, Peterborough is used to provide flexibility, therefore if this requirement increases, additional running hours may be experienced.

*Huntingdon* – mainly used to support southerly demand, therefore continued regular use anticipated into the future.

*Wormington* – supply driven site, running hours highly dependent on Milford Haven flows, as can be seen from historic running hours. Therefore running hours are likely to remain variable.

### **Summary**

Based on the analysis described above the three sites at which investment is most likely to provide the greatest emission reduction are St Fergus, Peterborough and Huntingdon.

In discussion with Environmental Regulators and our experiences with the earlier phases of IPPC, the intention is to restrict remaining units at IPPC sites to limited hours running. In order to provide effective back-up to cover any unforeseen outages and also to operate units efficiently, we would propose installing two new units at each of these three sites. In the case of Peterborough and Huntingdon, two of the most critical sites on the network, this would mean that all units would be compliant with IED and therefore we would not need to undertake further works to respond to the requirements of BREF and MCP. In addition constructing two units at the same time, rather than in a piecemeal fashion, provides efficiency savings to benefit all stakeholders.

**Q12: Is there more analysis you would like to see with regard to selecting IPPC Phase 4 sites? If so, what would this be?**

**Q13: Do you agree with our IPPC Phase 4 chosen sites based on the analysis presented?**

## XVIII. Financial Summary

As described within the section on “Initial Scoping of Options” there are a range of options which stakeholders may elect. We are in the process of costing each option, so that this information can be presented to you and Ofgem as part of our RIIO reopener submission. At a site level we anticipate lower cost options, such as decommissioning, may cost less than £10m. Whereas, higher cost options such as replacing units could be up to £50m per unit. We have contracted an engineering consultancy to develop a budget price for both capital and on-going asset health works to inform our submission. These costs should be available by the end of January, ahead of issuing our proposals.

Based on the information available to date the table below provides an indication of the anticipated range upfront capital costs for the following options;

- IED - Lower cost options (where feasible)
  - Replacement units
- IPPC - Single unit at three sites
  - Two units at three sites

The costs are for the full programme, which will extend into RIIO-T2. A detailed breakdown of costs per year will be provided in our re-opener submission.

IED	Lower Cost Options	Replacement
	£165m	£585m
IPPC	Single unit replacement	Two unit replacement
	£135m	£220m
Total	£300m	£805m

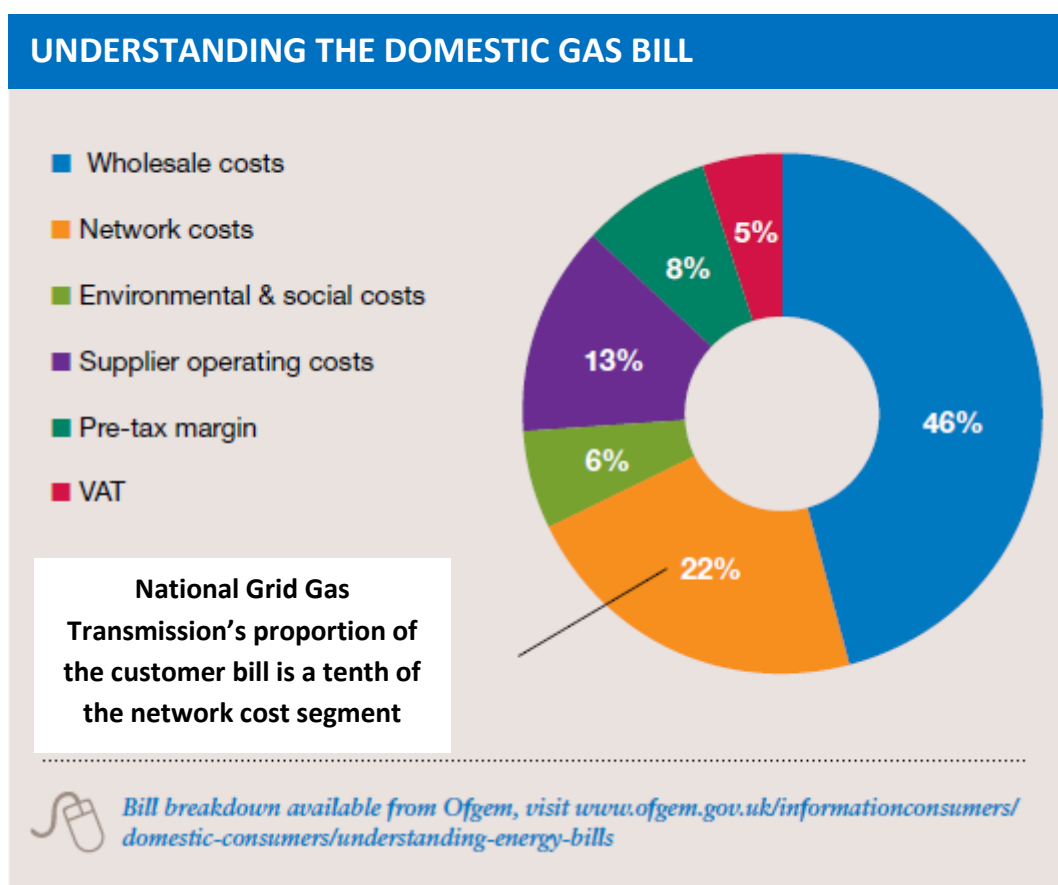
*Outturn Prices*

In terms of upfront capital costs for the full programme, the current options represent a wide range, between £300m-£800m. In the case of following the lower cost options programme, the associated commercial and operational risks would need to be factored into RIIO-T2, for example through baseline reductions or associated increases to the constraint management incentive target (this is the incentive to manage situations where we are unable to meet our capacity obligations).

## XIX. Impact on Customer Bills

Under RIIO our allowances are set by Ofgem through to 2021. In return for these allowances, we have committed to deliver the outputs agreed with you. Our allowances form the basis of what we charge our customers.

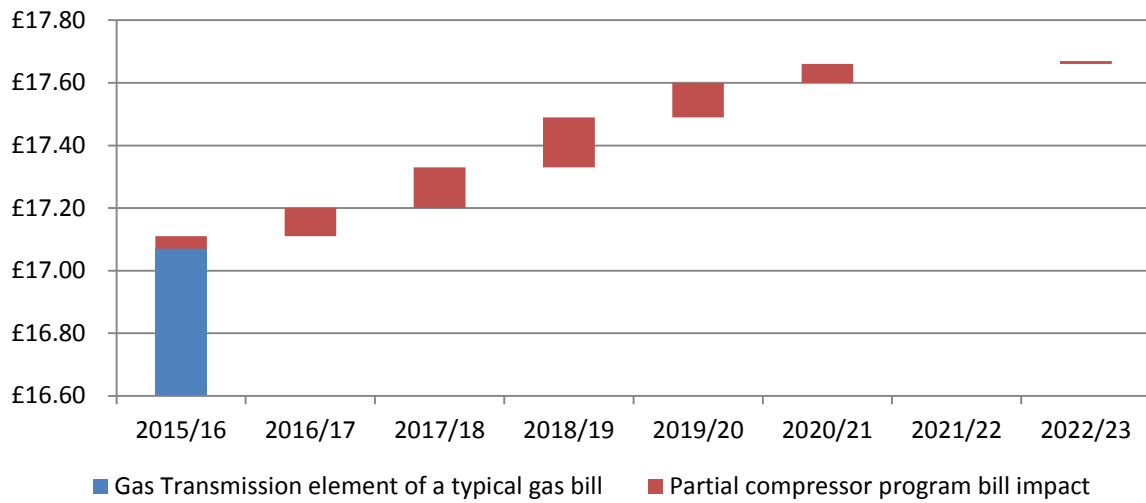
In 2013/14 approximately £17 of an average domestic customer bill related to National Grid Gas Transmissions services. This represents 2.2% of the £755 typical gas bill as can be seen on the chart below.



As mentioned in “The RIIO Deal” section, we have received a provisional allowance up-front to fund the remaining work required to comply with the obligations specified in the IED which we have discussed in this document. This is then subject to an uncertainty mechanism which allows us to make a submission to Ofgem with a plan of how we intend to ensure our units comply with the requirements of the IED, which we are consulting on here.

Specifically, in terms of the remaining work required to comply with the obligations specified in the IED, we anticipate that a full replacement programme for the LCP impacted IED sites and multiple units for IPPC Phase 4, would, at its peak, comprise 60p (2014/15 prices). The graphs below show the impact of the IED work on our proportion of a typical domestic customer bill.

### Cumulative impact on domestic gas bill



The table below show what the impact on the current domestic gas bill (2014/15 prices) on a year by year basis.

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
IED (LCP) Compressor Programme Bill Impact	£0.04	£0.13	£0.26	£0.42	£0.53	£0.59	£0.59	£0.60

**Q14: Is the financial information presented appropriate for the views we are seeking from you? If not, what more would you like to see?**

## **XX. Questions**

Throughout this document we have asked you a series of questions that we would like you to hear your views on, below is a consolidated list of these questions.

**Q1: Would you like to know more about how the IED legislation affects our compressor feet? If so, what further information would you like?**

**Q2: What more could we do to improve our stakeholder engagement process?**

**Q3: How would you like us to transition from this process into further discussion areas such as system flexibility or future legislation?**

**Q4: Have we got what is important to you correct?**

**Q5: Do you feel that we are listening and taking account of your views? If not, what more could we do?**

**Q6: Are there other options not described within the “Generic Options” section that you think we should consider? If so, what are they and where can we find information about them?**

**Q7: For each site, do you think we have articulated the viable range of options? If not, what is missing?**

**Q8: Do you agree with our assessment of the options? If not, which aspect(s) would you change?**

**Q9: What additional information would help you better understand our assessment?**

**Q10: Which options would you propose for each site?**

**Q11: Do you think we have taken account of system flexibility sufficiently? What would you like to see on system flexibility ahead of the mid-period review?**

**Q12: Is there more analysis you would like to see with regard to selecting IPPC Phase 4 sites? If so, what would this be?**

**Q13: Do you agree with our IPPC Phase 4 chosen sites based on the analysis presented?**

**Q14: Is the financial information presented appropriate for the views we are seeking from you? If not, what more would you like to see?**

## **XXI. How to provide feedback**

We welcome your feedback on our initial consultation, particularly with regard to the options you think we should take forward across different sites affected by the LCP element of the IED and how we manage the uncertainty of future legislation. We would also like your feedback on the sites we have identified to form the next phase of IED IPPC Phase 4. In addition we would welcome any observations on the analysis we have presented and the assumptions we have made.

Your feedback is very important to us and we appreciate the time you take to provide it. We will consider all the feedback we receive on this consultation ahead of producing our proposals in the New Year. We welcome feedback via different channels, whether it is a formal written response, by completing the survey or via a bilateral meeting.

Please send written responses to Craig Dyke at [ntsinvestment@nationalgrid.com](mailto:ntsinvestment@nationalgrid.com).

Alternatively, please complete the survey by going to the following link:

[https://www.surveymonkey.com/s/NG\\_IED\\_Investments-Initial\\_Consultation](https://www.surveymonkey.com/s/NG_IED_Investments-Initial_Consultation)

If you would like a bilateral meeting to discuss the initial consultation in more detail please contact either Hannah Kirk-Wilson at [Hannah.kirk-wilson@nationalgrid.com](mailto:Hannah.kirk-wilson@nationalgrid.com) or James Whiteford at [James.Whiteford@nationalgrid.com](mailto:James.Whiteford@nationalgrid.com) and we will arrange a mutually convenient date. Please send us your written feedback by close of business by Friday 19<sup>th</sup> December.

## XXII. Next Steps

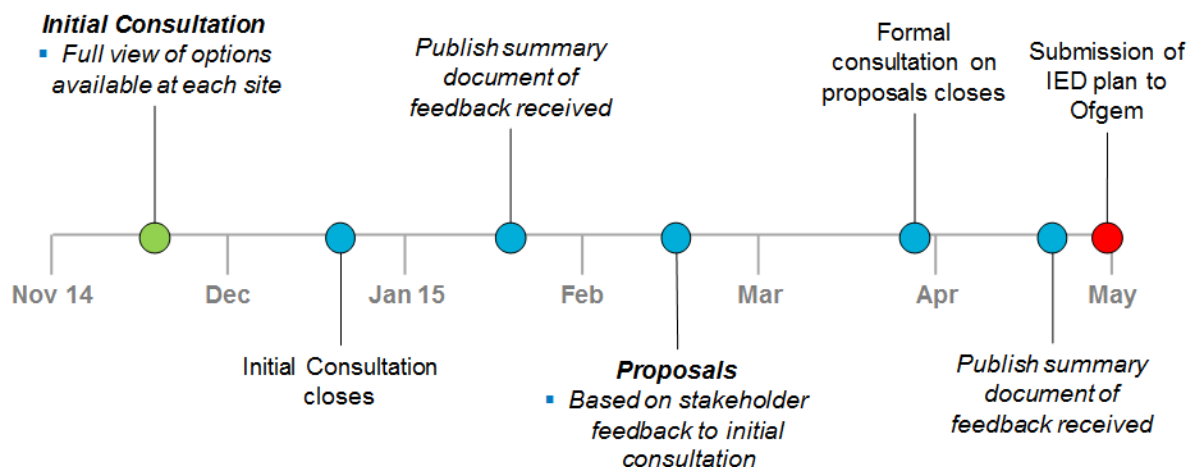
This consultation is open for responses for a month from Monday 17<sup>th</sup> November 2014 until close of business Friday 19<sup>th</sup> December 2014. During this time we are happy to arrange any additional meetings which may be of interest to discuss the consultation in more detail and answer any questions which you may have. In this instance please contact Hannah Kirk-Wilson at [Hannah.kirk-wilson@nationalgrid.com](mailto:Hannah.kirk-wilson@nationalgrid.com) with your requirements.

Following the close of the consultation in December we will review all of the feedback we receive. By mid-January 2015 we will publish a document summarising this feedback ahead of publishing our proposals.

Where possible we will look to produce our proposals in line with this feedback. In our proposals we will clearly articulate the feedback we have received from you and how we have responded to it. We recognise that it is not always possible to meet all your requirements and where this is the case we will provide clear explanation in our proposals of where and why our proposals do not align with some of the feedback we have received.

We plan to publish our proposals in the form of a formal open consultation in February 2015. In this consultation we will present our preferred strategy for compressor replacement as driven by the IED. Following the closure of this consultation we will review any additional feedback from you ahead of our formal submission to Ofgem in May 2015. We would expect a decision from Ofgem on the proposals sometime in the Autumn 2015. The timeline below illustrates the schedule going forward.

### *Timeline of IED project going forward*



In addition to formal submission of our compressor strategy proposals to Ofgem in May 2015, we also plan to continue stakeholder engagement focussing on system flexibility. We

have yet to determine timings for any engagement events as we await the completion of a current ongoing project to deliver a model to generate credible scenarios for analysis. Once this is complete and we begin to have a clearer understanding of the potential network capability issues that may arise in the future we will look to share this with you and open the debate on the potential measures which could be taken to address the arising issues.

We will continue to utilise the area on our talking networks website currently dedicated to the IED project for ongoing stakeholder engagement on our gas network developments. Please register on this site to be kept updated with developments. The website is accessible here: <http://www.talkingnetworkstx.com/IED-welcome.aspx>



## **XXIII. Glossary**

BAT = Best Available Technique

BREF = BAT Reference

CO = Carbon Monoxide

CO<sub>2</sub> = Carbon Monoxide

DLE – Dry Low Emissions

EA = Environment Agency

ELV = Emission Limit Value

EU = European Union

FES = Future Energy Scenarios

GB = Great Britain

IED = Industrial Emissions Directive

IPPC = Integrated Pollutions Prevention and Control

LCPD = Large Combustion Plant Directive

LNG = Liquefied Natural Gas

MCP = Medium Combustion Plant

mg/Nm<sup>3</sup> = milli grams per normal meter cubed

MW = Mega Watt

NO<sub>x</sub> = Nitrogen Oxide

NTS = National Transmission System

OCC = Oxford Computing Consultants

RIIO – T = Revenue = Incentives + Innovation + Outputs – Transmission

SCR = Selective Catalytic Converter

SEPA = Scottish Environment Protection Agency