RC UK: Energy and Communities

HEAT AND THE CITY

Response to Scottish Government consultation on draft Heat Generation Policy Statement June 2014

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Draft HGPS Consultation

RESPONDENT INFORMATION FORM

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Summary of Consultation Questions

Heat and the City is a 4-year research project, at the Universities of Edinburgh and Strathclyde, funded by the UK Research Councils' (RC-UK) Energy Programme. The research team work collaboratively with UK District Energy Vanguards Network, as well as community and commercial practitioners and policy makers.

Q1: Do you agree with the heat vision and heat hierarchy?

Yes ☐ No ☐ Don't know ☐

Q1a: And why?

Q2: How can we ensure that Scottish businesses are best placed to take advantage of the new products and services which will be required to deliver low carbon heat?

Q3: Taking account of the cost of implementation, what policies should the Scottish Government pursue that will best ensure the impacts of heat decarbonisation to benefit consumers?

Q3a: What evidence do you have to support this?

Q4: What do you think should be the balance and focus of government intervention, business innovation and individual action and why?
Scenarios and pathways for heat decarbonisation to 2050, developed by Arup, suggest that the most effective action is achieved under high government intervention and high uptake of measures.

We would welcome the inclusion of further detail in the HGPS of the measures which Scottish Government envisages under a high intervention scenario. In the draft statement it is difficult to evaluate the relationship between steps proposed in the draft HGPS and scale of decarbonisation. Assumptions made in modelling and scenario development are unclear. In principle, business innovation and individual choice are unlikely, in the absence of government intervention, to produce significant shift from established high carbon forms of heating; the relatively slow progress with systematic building retrofit for significant energy saving also indicates the need for coordinated, area-based action.

However, taking the scenario modelling results at face value, they indicate that government intervention and uptake are considerably intertwined. Under the scenarios with "low uptake" the difference made by government intervention would be to add over £7bn of cost over 40 years to achieve an additional abatement of

6.6MtCO_2e/year in 2050. Assuming costs are evenly spread through time and that the annual abatement impact builds steadily, this suggests "government intervention" would cost around £60/tCO_2e. This is comparable with the value of £55tCO_2e implied by DECC's GHG valuation toolkit for a steadily increasing abatement profile over 40 years (direct comparison is not possible as the modelling presented in the HGPS does not indicate, among other things, whether costs have been discounted). Parallel calculation for the "high uptake" scenarios puts the abatement cost of moving from low to high government intervention at -£42/tCO_2e (i.e. under these scenarios government intervention creates a net economic *benefit* for every additional tonne of CO_2 it avoids). This suggests two things from the perspective of a government considering whether to be interventionist or not: first, that under the worsts case scenario (low uptake) government intervention would nonetheless reduce (non traded) emissions at an economic cost consistent with the least cost path to meeting the UK emissions targets (which in the near term are less ambitious than Scottish targets); and second, that if uptake of heat decarbonising technologies and practices is high, government intervention produces net economic benefits rather than costs.

Conversely, holding "government intervention" constant at Arup's low level leads to an impact of moving from low to high uptake of -£60/tCO_2e while at Arup's "high government intervention" level the impact of uptake is -£275/tCO_2e (i.e. uptake becomes more economically attractive under high government intervention). While the modelling results are presented as costs and benefits to the economy (not necessarily costs and benefits accruing to individuals according to their level of uptake) this relatively high rate of economic benefit could presumably be harnessed to incentivise and otherwise support higher levels of uptake (which suggests a combined approach of supporting uptake while also intervening). We therefore question the premise of question 4, that heat decarbonisation implies a trade-off between government intervention and the contribution of other sectors. On the contrary, both the modelling presented (to the extent that we can understand it), and experience from other countries' district heating programmes, suggests a joint and coordinated effort has scope for far greater impact and benefit than setting innovation, intervention and users in competition for policy support.

	Low uptake	High uptake	*Impact of uptake (high minus low)*
Low government intervention	2050 emissions: 15.05 MtCO_2e/year 40 year cost £6,303m	2050 emissions: 8.31 Mt$CO2_e$/year 40 year cost -£1,838m	*Abatement impact: 6.74 MtCO_2e/year* *Additional 40 year cost -£8,141* *Abatement cost* *-£60/tCO_2e*
High government	2050 emissions: 8.45 Mt$CO2_e$/year	2050 emissions: 5.05 Mt$CO2_e$/year	*Abatement impact:*

intervention	40 year cost £14,148m	40 year cost -£4,585m	*3.40 $MtCO_2e$/year* *Additional 40 year cost -£18,733* *Abatement cost* *-£275/tCO_2e*
Impact of government intervention (high minus low)	*Abatement impact: 6.60$MtCO2_e$/year* *Additional 40 year cost £7,845m* *Abatement cost £60/tCO_2e*	*Abatement impact: 3.26$MtCO2_e$/year* *Additional 40 year cost -£2,747m* *Abatement cost* *-£42/tCO_2e*	

Systematic and coordinated intervention is therefore needed. Notable actions, given the Heat Hierarchy, are:

1. Comprehensive programmes for reducing need for heat; these measures rely on extensive building insulation, which can be achieved via a mix of mandated requirements on property owners at point of sale or major renovation, and retrofit programmes for social housing and public sector buildings funded from general taxation and revenues. These measures are known to be effective not only in reducing the need for heat, but also in creating long term, skilled, employment in local economies, and improving welfare, which should result in reduced costs to health and social care services.
2. Decisions in relation to the future of the gas grid, and actions to respond to the consequences; this may include increased commitment to creating the framework for affordable long term loans for heat network infrastructure, operated on a non-profit basis, in urban areas.
3. Investment in innovation in heat recovery systems as supply sources for buildings and urban heat networks.

In each of these areas, a spatially-oriented policy approach can be more efficient than a spatially neutral approach. For example, the Scottish Government's approach to ensuring CERT spending in Scotland reached a pro rata share (the Home Insulation Scheme and Universal Home Insulation Scheme) targeted support in specific areas identified by local authorities, enabling local installers to achieve economies of scale and a coordinated approach to solving challenges particular to certain areas (for example mixed social/private ownership common in "four-in-a-block" properties which tend to cluster in particular areas of cities).

Adopting a spatial approach more broadly could similarly achieve economies of scale and focus: domestic heating engineers in the UK are generally organised as small companies working in particular areas, while incentives to install low carbon heat technologies (such as RHI support for heat pumps) is evenly spread across the UK. From the perspective of a small heating engineering firm, uptake of heat pumps in their area under the spatially neutral support mechanism is uncertain but likely to be low, leading to weak incentives to invest in capacity to install heat pumps. Were the government to intervene spatially (e.g. to identify zones where certain technologies may be targeted, or to support local government identify such zones) firms within zones would be incentivised to become more competitive in heat pump installation (improving quality / reducing cost). This is another example where government intervention can go hand-in-hand with supporting higher levels of uptake.

In countries where district heating is well developed this has commonly been achieved with support of spatial zoning of policy as an important means of reducing business risk. The Danish example is at the extreme end, whereby buildings within district heating zones were compelled to connect to a network. A less draconian approach is currently adopted in Norway where district heating operators above 10MW must apply for a licence to operate. Companies applying for licences identify the area in which they propose to operate and, once granted, other companies cannot obtain licences for the same or an overlapping area. This affords the licence holder a degree of security in their business model, the *quid pro quo* being that their proposal has to conform to a range of social and technical standards, prices are capped and the Norwegian government has step-in rights in the event that the company does not comply with the terms of their licence (see also response to Q11).

Scottish Government has a powerful resource to support effective, spatially oriented policies for heat in the form of Scotland's Heat Map. While this tool can support local authorities drawing up policies to include in their local development plans, its use should not be limited to just this activity. Scottish Government should use the heat map to support analysis of different policy options, for example concentrating support for district heating in a few locations to support the rapid creation of systems with greater scale economies, flexibility and potential to exploit low carbon resources than a patchwork of uncoordinated systems.

Overall we recommend the inclusion of statements in the Heat Generation Policy to demonstrate the relationships between intended government actions, and timelines in relation to the targets set in the Climate Change (Scotland Act (2009), RPP2 and heat decarbonisation scenario outcomes.

Q5: Given the existing financial incentives and policies in place, what other mechanisms do you think would result in significant behaviour change in both homes and non-domestic buildings and processes?

Q6: How do you think a national heat map could be used to support the development of a low carbon heat sector for Scotland?

Q7: Do you support the proposed unit of measure for the overall district heating target of 1.5 TWh by 2020?

Yes [x] No [ ] Don't know [ ]

There are many different configurations of district heating which could deliver a given quantity of heat per year. The target could be met with a number of rural heat networks (e.g. supplying heat from local biomass resources), or a smaller number of large city-centre networks, or some combination. High density heat demand in Glasgow (above the commonly used benchmark for district heating of 3MW/km^2)[1] is around 6TWh/year, so it is not inconceivable that the target could be met with a single network in one city, or a patchwork of different networks within one city.

There are advantages to pursuing an open approach to different configurations of heat networks which an energy-based target affords: experiments with different approaches in different locations can be undertaken supporting discovery of effective business models, for example. However, there are also potential costs. Early development of the UK's energy network infrastructure resulted in a series of uncoordinated networks (both gas and electricity) which were difficult to integrate either technically or organisationally.[2] This piecemeal pattern of development was associated with low levels of efficiency. Similarly, a series of small district heating networks may be less efficient than larger systems,[3] and have less scope to support wider decarbonisation ambitions. Larger heat networks in future are likely to afford greater flexibility in future diversification of heat sources. For example, the large amounts of heat estimated to be recoverable from mine water under Glasgow may be more efficiently integrated into a large system than into a series of unconnected networks. The Scottish Government should therefore consider further development of its district heating strategy to include different scales and locations for district heating, and to work to establish (in partnership with local actors and industry) a more nuanced vision of the pattern of district heating development. This could take the form of subsidiary targets (such as *a minimum of x networks each delivering at least y TWh*) or a further layer of detail included in the overarching heat vision.

Setting a detailed vision of the qualities of networks to develop by 2020 and beyond may be difficult at present due to a range of uncertainties across the energy system (such as bioenergy availability, or the scope for heat networks to add value to the electricity system through balancing), and local circumstances (including local capacities for coordination of multiple organisations). However, through the Heat Networks Partnership, and using the Scottish Heat Map, there is considerable scope for Scottish Government to work with local authorities in setting out more detailed spatial visions and strategies than at present. It would be beneficial for these to consider the whole range of heat decarbonisation options (not just district heating) in

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[1] Pöyry Energy (2009) *The potential and costs of district heating networks: A report to the Department of Energy and Climate Change.*

[2] Hughes, T.P. (1983) *Networks of power: Electrification in Western society 1880–1930.* Baltimore, Johns Hopkins University Press.

[3] IEA (2005) *A Comparison of distributed CHP/DH with large-scale CHP/DH.*

order to aid planning and coordination of other actors, particularly operators of incumbent gas and electricity networks. The Heat Map, as is recognised by the government, has far more scope as a planning tool than simply identifying opportunities for district heating in new development: it could form a key tool in supporting a coordinated retrofit programme over the coming decades.

Q8: Do you support the level of ambition for the district heating target?

Yes		No		Don't know	x

Q8a: What evidence do you have to support your views?

The consultation notes that the 1.5TWh ambition would bring deployment of district heating in Scotland up to 2%, a figure commonly quoted as the overall proportion of UK heat supply currently met via district heating. On this comparison, 1.5TWh does not seem ambitious, though the level of ambition is difficult to judge as the consultation does not present a clear rationale for picking this figure. The consultation mentions some modelling indicating 8TWh could be achieved by 2050, though it is unclear what assumptions underpin this figure and how it relates to the Arup work. We note that a straight-line extrapolation from 0.2TWh in 2014 to 8TWh in 2050 implies 1.5TWh in 2020.

Q9: Do you support the level of ambition for the number of homes to be connected to district heating by 2020?

Yes		No		Don't know	x

Q9a: What evidence do you have to support your views?

As with the energy-based target, targeting a number of homes to connect to district heating is helpful in stimulating activity, but given the range of different ways this could be achieved ongoing coordinated planning work will be important to ensure (consistent with the heat hierarchy) that this target is achieved in as efficient a way as possible. Domestic heat demand has a characteristic profile, with peaks in the morning and early evening. Heat networks serving exclusively domestic demand, therefore, have lower utilisation factors (ratio of total demand to capacity) than networks with more mixed user profiles, and hence higher average costs. The Heat Networks Partnership, working with local government, should seek to ensure the number-of-homes target does not translate into a number of networks with exclusively domestic users.

Q10: Do you have evidence of existing communal heating systems installed before 2000?

Yes		No	x	Don't know	

Q10a: If so please provide details.

Q11: Do you believe further regulation of heat supply is required?

Yes [x] No [ ] Don't know [ ]

Q11 a: What level of regulation would be appropriate?

Regulation may be used to achieve a variety of different ends. Consumer protection is an important objective for regulation, but it is not the only objective and can take different forms. The IHCPS is currently under development, but at present its main features are

- Voluntary scheme
- Covering household and SME customers who pay a heat network operator directly for heat
- Mimicking consumer protection in gas and electricity supply (vulnerable customers, contingencies including supplier insolvency, etc.) through heat supply agreements
- Billing transparency including a cost comparison website
- Dispute resolution
- Collection of statistics on consumer complaints, technical failure and customers failing to pay bills

The provisions of the ICHPS (if widely taken up) are likely to be important in building confidence among users that their connection to a monopoly supply will not mean they suffer relative to other energy supplies. However, this does not exhaust the interests of subscribers (or wider society), and international examples where district heating development is further advanced indicate other issues which have been deemed suitable for regulation.

In the Netherlands, district heating regulation (the *Warmtewet*) seeks both to ensure customers are not made worse off by using district heating supply (the *Niet meer dan anders* or "no more than others" principle)[4]. However, concerns about monopoly exploitation are not limited to comparison between district heating and alternative energy supplies, but also consider whether heat network operators make a fair return on the value of their assets. For example, customers taking heat from a network supplied by thermal treatment of waste may consider it unfair if their heat bills rise because of rising gas prices. Regulation of this area has been difficult in the Netherlands, and early proposals to cap returns have been postponed in favour of ongoing monitoring of the rates of return district heating operators achieve in order to identify issues if they emerge. Nevertheless, this highlights an area of regulation currently neglected in Scottish and UK debates. The shift from cost-reflective pricing to competitive pricing in Sweden, for example, has led in some instances to

[4] Maximum tariffs are published here http://www.consuwijzer.nl/energie/warmte/kosten-warmte

concerns that heat network monopolies have been exploited. A comparison of Swedish district heating companies shows that privatisation is associated with higher prices for heating, relative to those companies which have remained in municipal ownership (http://www.nilsholgersson.nu/)[5].

Norway offers another model of district heating regulation, highlighting a different set of issues which regulation may be used to address. The Norwegian Water Resources and Energy (NVE) directorate grants exclusive area-based licences to district heating operators whose proposals satisfy a range of social, economic and environmental criteria, whose purpose is described as "to ensure that district heating plants being built are socially rational and environmentally acceptable."[6] The scheme, therefore, seeks to protect the wider interests of consumers as well as their interaction with a monopoly supplier, and appears to have been effective in supporting connection to heat networks within concession areas. Norwegian district heating customers are further protected by requirements that operators notify NVE of prices and any price changes. The regulations also support coherent network development in several ways. First, NVE is empowered to require different networks to interconnect. Second, the licence granting procedure affords public oversight of proposed schemes, creating scope to challenge possible cherry-picking of limited customers. Third, the exclusivity of the licence mitigates the threat that identified subscribers may instead connect to a competing network. Construction of a large network may take several years, and the exclusivity helps justify early investment in sufficient capacity to ensure subscribers targeted for the latter parts of network development can be served. Without the area-based exclusivity operators would face risks that key subscribers (particularly anchor loads) may be cherry picked by competitors. Further protection is built in through the licencing renewal process: in cases where a licence is not renewed, national or local government are able to take over the heat network free of charge. Contrary to the framing of regulation as a burden stifling development (which is a common framing in UK debates), within this regulatory approach the Norwegian district heating market has been one of the fastest growing in Europe.

Q12: Do proposed consumer protection schemes meet the needs of heat users and supply organisations?

Yes [ ] No [x] Don't know [ ]

Q12a: And if not, what changes are needed or what more is needed?

See answer to Q11

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[5] In the Report *Innehållsförteckning – Jubileumsutgåva av Avgiftsrapport Nils Holgersson 1996-2005*, the second point in the box on p.35 states 'There is a clear difference in behaviour in terms of pricing, depending on who is owner [of the DH system] and the directives which the company has to work from'. This is illustrated by the last graph on p.43 where the green line represents the (lower) average price in municipal systems and the red line the (higher) average price in privatised systems over a 5 year period (2001-2005).

[6] "*Formålet med konsesjonsbehandling av fjernvarmeanlegg er å sikre at fjernvarmeanleggene som bygges er samfunnsmessig rasjonelle og at de har miljømessig akseptable løsninger*"
http://www.nve.no/Global/Konsesjoner/Fjernvarme/Fjernvarmeveileder2009.pdf

Q13: Is there sufficient non-financial support for the development of heat networks?

Yes [ ] No [ ] Don't know [ ]

Q13a: If not, please comment on priorities and timescales for support? Please provide evidence, where possible, based on practical examples of district heating development.

Q14: Are the many existing financial support mechanisms sufficient to support delivery of district heating systems?

Yes [ ] No [x] Don't know [ ]

The existing financial support mechanisms have helped to support small scale, and particularly off-gas grid, development of district heating in Scotland, but progress is slow and patchy in urban centres, where the evidence suggests high potential for carbon saving, long term energy security and affordability. Further financial support mechanisms are therefore needed.

Q14a: If no, can you provide information and evidence to demonstrate the need for additional funding or finance mechanisms, indicating the type of funding or finance required, over what timescale and setting out why existing mechanisms do not meet your needs. We would be particularly interested in evidence based on practical experience of development of district heating projects.

New heat network infrastructure development could be accelerated through provision of a loan guarantee fund, or similar risk underwriting mechanism. Loan guarantee mechanisms could be made contingent on requirement of a non-profit business model. In the district heating market in Denmark, 'production and network companies are monopolies and regulated as non-profit undertakings. DERA monitors their prices and delivery terms, and DERA takes regulatory action if the prices and terms of the network companies are not in line with the non-profit regime – or if they are unfair in any other way' (Danish Energy Regulatory Authority http://energitilsynet.dk/tool-menu/english/).

Risk underwriting mechanisms already exist in the UK energy sector. For example, in the wind and nuclear electricity sectors, the UK Government has underwritten development using a Renewables Obligation and Contracts for Difference. This provides investors with certainty over a stable return on investment.

In research carried out as part of the RC UK *Heat and the City* Project and BRE et al, 2013, data from interviews with nine public and private finance sector executives, and from forty-four case studies of UK district heating projects developed in the last ten years, indicated that the government, rather than the business sector, was considered responsible for establishing 'the investment fundamentals' of stable, secure and predictable cash flows for energy infrastructure. District heating was

perceived as lacking the type of government financial sponsorship and covenants which accompanied the Private Finance Initiative and Public Private Partnerships. The main 'risk' in investment in DH stems not so much from its *price* per se, or lack of capital for investment, as from its lack of fit with established centralised markets, and regulation.

District heating projects are typically evaluated as high risk at construction stage. Once costs and revenues are stabilised and scale achieved they become low risk. Consequently low risk investors (such as pension funds which are able to accept the lower returns such a project will deliver) will not invest in the early phase. The purpose of a loan guarantee fund is to bridge this gap. Furthermore, the gap is much smaller than for nuclear - most DH projects begin to payback between 8 - 15 years. At this point the project could be re-financed.

In other European countries with a high proportion of DH, the investment in infrastructure has typically been underwritten by the public sector. In Denmark, for example, loan guarantees were provided by municipalities, which enabled low interest loans to be raised. Given the weaker powers and finances of local authorities in Scotland, Scottish Government could play this role. Developers could then finance construction through low cost loans. In Denmark, loan underwriting was enabled by a Heat Law (1979) which created a stable policy framework and secure demand for heat. The Law required local authorities to use heat mapping to zone areas for DH and to oblige building owners to connect. Customer protection is delivered by a requirement on municipalities to ensure that heat production by utility companies is the least cost option for consumers in the context of government decarbonisation targets. DH utilities are operated as non-profit companies. A recent IEA Report[7] (2014) for example cites the Sunstore 4 project in Marstal, Denmark, which demonstrates DH using 100% renewable energy via heat storage. Total investments were EUR 15.5 million; European Commission support provided EUR 4.1 million; project financing was underwritten by a municipal guarantee for 100% of the investment. The interest rate on a 25-year annuity loan was 3.05%. The expected payback period is less than 10 years (see IEA, 2014, p. 40-44). Marstal DH is a consumer-owned cooperative, and more than 95% of buildings in Marstal are connected.

Underwriting finance for district energy reduces the risk to developers (including public sector developers) at the expense of financial risk incurred by Scottish Government. If done well, this could represent an example where "government intervention" and "uptake" (to use the terms of Arup's modeling) can be made to work together (see response to Q4). By shouldering some of the risk of heat network development, Scottish Government would support the development and interlinking

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[7] IEA 2014 *Linking Heat and Electricity Systems: Co-generation and District Heating and Cooling Solutions for a Clean Energy Future*
http://www.iea.org/publications/freepublications/publication/LinkingHeatandElectricitySystems.pdf

of larger heat networks than would otherwise be possible (as reduced financial risk within each project would increase the range situations in which a heat network is financially viable). Infrastructure networks (particularly energy networks) display increasing returns to scale, so the additional cost borne by Scottish Government through underwriting may be offset by the improved performance of the networks it supports. Concretely, larger heat networks can operate more efficiently than smaller ones by being able to balance the profiles of a range of different users, and have more flexibility to absorb heat from a wider range of sources, including residual industrial heat, excess electricity (when the wind blows too hard), heat from thermal treatment of waste, geothermal heat, and inter-seasonally stored heat.

Q15: If the mechanism that you propose was in place, what additional specific outputs and outcomes for district heating would result from your own work and on what timescale?

The loan underwriting mechanism, allied with user protection measures similar to those introduced in Denmark under 1979 Heat Law provisions, would ensure accelerated development of heat networks in urban areas, where carbon savings, costs reductions and energy security improvements are expected to be highest (see Heat Roadmap Europe, 2050 - http://www.euroheat.org/Heat-Roadmap-Europe-165.aspx). In Denmark, 63% of households now use district heating (98% in Copenhagen), and there are 450 DH networks.

Q16: Do you have any further evidence on thermal storage and consideration of how it might interact with other technologies and policy priorities?

Q17: Do you see heat recovery and information about excess heat available as a useful tool for industry to maximise the benefits of the heat it consumes?

Yes ☐ **No** ☐ **Don't know** ☐

Q17a: Do you have any comments?

Q18: Are there any Scottish specific issues that should be dealt with in the review of the non-domestic RHI?

Yes ☐ No ☐ Don't know ☐

What are they, and what evidence do you have to support your views?

Q19: Without interim milestones and taking into account the existing mechanisms to support uptake of renewable heat technologies, what non-financial mechanisms do you think are most effective in driving this uptake?

We do not have information on what mechanisms drive uptake of RHPP-supported technologies, but note that there are different ways of appraising the extent to which

Scotland has achieved higher uptake than elsewhere. The consultation notes that Scottish take-up of RHPP vouchers is 12.5% of GB total this year. This is higher than the proportion of GB population living in Scotland. However, the RHPP (and domestic RHI) are most attractive to households without access to the gas grid as savings are higher, and usually such homes are in relatively low density and/or rural areas where certain single-building renewable heat technologies are more suitable (e.g. biomass, ground source heat pumps). According to Consumer Focus's report on off-gas communities[8], Scotland has 541,000 of GB's 3,929,000 households which do not use gas for heating (i.e. 13.8%), and 317,000 of GB's 2,041,000 households outside gas grid postcode areas (i.e. 15.5%). Against these measures Scottish take-up is below pro-rata.

Q20: Do you support the approach to focus on three areas to support geothermal: demonstration projects; ownership issues; and development of our geothermal vision and a routemap?

Yes ☐ No ☐ Don't know ☐

Q20a: If not, which recommendations should be prioritised and deprioritised?

Q21: How can the anaerobic digestion industry be best encouraged to avoid useful heat being wasted? We are interested in any evidence or practical experience to support your views.

Questions in the Strategic Environmental Assessment (SEA)

Details of the questions included in the SEA and how to respond are set out at page vi of the SEA document which can be found on the Scottish Government website at: http://www.scotland.gov.uk/Consultations/Current

[8] http://www.consumerfocus.org.uk/files/2011/10/Off-gas-consumers.pdf