Programme Area: Smart Systems and Heat

Project: EnergyPath

Title: Peer Review of Proposed Approach for Socio-Economic Assessment of EnergyPath Networks

Abstract:

This Deliverable comprises a report from Arup which was commissioned by the ESC to provide advice on the approach for Assessing Socio-Economic Benefits of the EnergyPath Networks Outputs.

Context:

Energy consultancy Baringa Partners were appointed to design and develop a software modelling tool to be used in the planning of cost-effective local energy systems. This software is called EnergyPath and will evolve to include a number of additional packages to inform planning, consumer insights and business metrics. Element Energy, Hitachi and University College London have worked with Baringa to develop the software with input from a range of local authorities, Western Power Distribution and Ramboll. EnergyPath will complement ETI's national strategic energy system tool ESME which links heat, power, transport and the infrastructure that connects them. EnergyPath is a registered trade mark of the Energy Technologies Institute LLP.

Energy Systems Catapult

EnergyPath Networks Technical Support

Peer Review of Proposed Approach for Socio-Economic Assessment of EPN

Task 008

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Ove Arup & Partners Ltd
13 Fitzroy Street
London
W1T 4BQ
United Kingdom
www.arup.com

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Contents

1 Introduction

Arup was commissioned to undertake a peer review of the Energy Systems Catapult's (ESC's) "Proposed Approach for Assessing Socio-Economic Benefits of the EnergyPath Networks Outputs." This review forms Task 008 under Arup's framework agreement with ESC.

This report presents Arup's findings and recommendations following that review.

1.1 Scope of review

In undertaking this peer review exercise, Arup reviewed the following documents and data which were provided by ESC:

1. Energy Systems Catapult 2016. "Proposed Approach for Assessing Socio-Economic Benefits of the EnergyPath Networks Output" (V2 dated 25 May 2016) (hereafter "the Proposed Approach document");
2. Europe Economics 2014. *Development of a Modelling Framework for Assessing Economic Benefit*;
3. Spreadsheet containing input assumptions and raw output data from SQL used to create the outputs; and
4. Supplementary Health Benefits calculation spreadsheet.

The review also drew upon the following references:

1. HM Treasury, 2011. *The Green Book: Appraisal and Evaluation in Central Government.* London.[1]
2. DECC 2015a. *Valuation of energy use and greenhouse gas (GHG) emissions: Supplementary guidance to the HM Treasury Green Book on Appraisal and Evaluation in Central Government*. London[2]
3. DECC 2015b. *Valuation of energy use and greenhouse gas (GHG) emissions: Background documentation*. London[3]
4. DECC 2016. *Sub-regional Fuel Poverty, England, 2014 data*.[4]
5. Newcastle City Council 2015. *Home Energy Conservation Act Progress Report*.[5]
6. Sandia National Laboratories 2010. *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide*. Albequerque.[6]

[1] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483278/Valuation_of_energy_use_and_greenhouse_gas_emissions_for_appraisal.pdf

[3] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483279/Background_documentation_for_guidance_on_valuation_of_energy_use_and_greenhouse_gas_emissions.pdf

[4] https://www.gov.uk/government/statistics/2014-sub-regional-fuel-poverty-data-low-income-high-costs-indicator

[5] https://www.newcastle.gov.uk/sites/default/files/wwwfileroot/environment-and-waste/heca_progress_report_-_march_2015_0.pdf

[6] http://www.sandia.gov/ess/publications/SAND2010-0815.pdf

7. Neuhoff et al. 2014. Staying with the leaders: Europe's path to a successful low-carbon economy. Berlin: Climate Strategies.[7]

8. Meijjer et al. 2012. "Job Creation through Energy Renovation of the Housing Stock," NEUJOBS Working Paper D14.2.[8]

9. Association for the Conservation of Energy 2000. *Energy Efficiency and Jobs: UK Issues and Case Studies.*.[9]

1.2 Limitations

The following review limitations are noted:

- The review was limited to commentary on the proposed approach and the particular indicators and metrics used in the approach. The scope does not extend to working up alternative methods or formulae where a need for an alternative approach was identified.
- The scope did not include a review of the EnergyPath Economics (EPE) model itself, apart from the specific outputs indicators and formulae provided by ESC. The review did include a review of the EPE method as set out in the Europe Economics report.
- The scope excluded any review of the EnergyPath Networks (EPN) model, method or outputs. These were assumed for the purpose of the review to be reliable.

1.3 Context

The ESC's EnergyPath Economics (EPE) modelling tool was developed in 2014 to enable the production of socio-economic indicators associated with the energy transition pathways developed by EnergyPath Networks (EPN). The EPE was peer-reviewed and comprises a detailed spreadsheet with extensive calculation fields. The subsequent development of EPN has meant that EPE is no longer compatible with EPN outputs. In consequence, ESC faced a dilemma in relation to EPE:

- Modifying EPE to bring it in line with the form and nature of EPN's outputs would involve modifications to EPE which would invalidate the peer review and would be at a high risk of coding errors;
- Abandoning EPE would mean the loss of the value of the previous investment in that tool, and the need for partial duplication of effort to develop its replacement.

ESC's solution has been a hybrid approach which relies upon EPE to provide a selected number of critical multipliers, or coefficients, of socio-economic value.

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[7] http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/Staying-with-the-leaders.pdf
[8] http://www.iza.org/conference_files/neujobs_2014/4.pdf
[9] http://www.ukace.org/wp-content/uploads/2012/11/ACE-Research-2000-09-Energy-Efficiency-and-Jobs-UK-Issues-and-Case-Studies-Case-Studies.pdf

The new approach also reuses a number of specific modelling assumptions from EPE.

1.4 Structure of review document

This document essentially follows the structure of the proposed approach document, and is organised into the following sections:

Table 1 Sections of this report

Report section	Section name	Page number in Proposed Approach document
Section 2	Overall findings	n/a
Section 3	General comments	n/a
Section 4	Proposed approach	5
Section 5	Change in Energy Usage	6
Section 6	Fuel Prices	8
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2 Overall findings

On balance, we find the method to be sound. There are questions which arise on some selected items but these do not undermine the whole. Our recommendations are as follows:

- Consider editing the proposed approach document to be made more clear for the reader.
- Consider extended the time horizon of the EPN and the socio-economic evaluation.
- Review the relevant Five Cases Model guidance and consider engaging with HNDU on this point.
- Investigate energy security and resilience benefits as part of the assessment
- Consider a number of points on future proofing the method
- Report results in multi-criteria analysis form alongside the unified monetary outputs.

- Undertake Monte Carlo type modelling on key sensitivities, and present socio-economic valuation in terms of confidence intervals.
- Use the term “reference case” instead of “counterfactual)
- Consider how the results could be used to support a local authority-specific business case
- Consider using “levelised unit costs” instead of “prices”
- Consider sensitivity testing on carbon prices
- Consider a lower discount rate for carbon savings
- Investigate embodied carbon accounting
- Confirm (or consider) which air quality area type was assumed for the air quality benefit values
- Investigate the employment impact value further.
- Consider inclusion of a supply chain impact multiplier
- Revisit the health benefit method
- Check how PV is treated
- Ensure that increases in fuel bills are reported, and consider how to estimate additional people going into fuel poverty.
- Consider carefully how heat networks are treated.

3 General comments

3.1 Documentation

We found the Proposed Approach document generally clear but somewhat challenging in its current form to review, in particular because:

- The document is very focused on the issues with the EPE methodology and the differences between EPE and the new socio-economic assessment approach. From our external reviewer perspective, this backstory is of little interest and tends to confuse the reader.
- The document lacks a clear summary graphic illustration of the approach which shows how the different elements link together.
- Formulae are presented in prose form. Use of a standard equation notation would allow a reader to see the operations within each formula more clearly.[10]

[10] For example, $A = \pi r^2$ is much easier to read than Area = (circumference / diameter) x (0.5 x diameter) x (0.5 x diameter)

3.2 Appraisal period and discount rates

The appraisal period is over 35 years (2015-2050) and the discount rate is 3.5% in line with Green Book guidance over a 30 year time horizon.

Given that the infrastructure assets being models will have technical lifespans potentially much longer than 30 years, the question arises whether to consider longer timescales of analysis. Indeed, the assets which form part of the second phases of transition are being installed 20 years or more from now, so these assets will conceivably live through to the next century.

It is acknowledged that EPN is currently pegged to a 2050 end date (matching the 2050 carbon target), but a longer modelling timescale would be more in line with the full lifecycle of the assets concerned.

A longer time horizon would also imply a different discount rate. Green Book supplementary guidance on longer time horizon analysis[11] provides a declining discount factor for longer term modelling. For simplicity these are summarised as:

- 0-30 years: 3.5%
- 31-75 years: 3.0%
- 76-125 years: 2.5%
- etc.

ESC may therefore wish to consider extending the time horizon of EPN and/or its socio-economic evaluation to account for the longer term nature of the infrastructure investments being modelled.

3.3 Five cases business case model

The Government recommends, and in some cases requires, that public sector business cases are developed in accordance with the Five Cases model.[12] The five cases in question are briefly described below:

- Strategic case: "a compelling case for change that provides holistic fit with other parts of the organisation and public sector"
- Economic case: "represents best public value"
- Commercial case: "attractive to the market place, can be procured and is commercially viable"
- Financial case: "proposed spend is affordable"
- Management case: "what is required from all parties is achievable"

[11] Lowe 2008. *Intergenerational wealth transfers and social discounting: Supplementary Green Book guidance.* HM Treasury.
[12] HMT 2013. Public sector business cases using the five case model: Green Book supplementary guidance on delivering public value from spending proposals.

These cases are to be developed in increasing detail over three distinct stages, being the Strategic Outline Case (SOC), the Outline Business Case (OBC) and Final Business Case (FBC).

The ESC's local authority partners are likely to be familiar with the Five Cases model, particularly if they have been involved in major public investments or procurements of public services (e.g. highways schemes or waste contracts). However, we have found practice to be variable across local government, with councils taking different levels of cognisance of the guidance.

In relation to heat networks in particular, DBEIS's (formerly DECC's) Heat Networks Delivery Unit has put considerable effort into more universal adoption of the Five Cases model. To this end, HNDU has produced a template business case document for heat networks, and has commissioned a series of guidance documents (one of which was led by Arup) on developing the Strategic, Economic, Commercial and Financial cases. These were released by DBEIS to local authorities in August 2016.[13]

The relevance for this review is that ESC may wish to ensure its outputs are presented in terms which align with the Five Case Model, and the three key stages of the business case development process. The socio-economic assessment approach reviewed here would fall naturally into the economic case. Overall we consider that the proposed approach would generate outputs which meet the information requirements of the Economic Case, but it is recommended that ESC review the relevant guidance and consider engaging with HNDU on this point.

3.4 Energy security and resilience benefits

DECC's Green Book supplementary guidance on the valuation of energy use and GHG emissions recommends that evidence should be provided "to assess the security and resilience impact of a proposal" (paragraph 4.22). The guidance suggests quantitative and qualitative approaches to carry out this type of assessment.

Given the very substantial investment in the energy system, along with significant renewable energy, the impact on security and resilience of the energy system could be significant. Whether positive or negative, we consider that this is an important omission from the method. It is recommended that ESC investigate this matter further and consider including it as part of the assessment.

3.5 Future proofing

Given the ESC's longer term ambitions for the application of EPN to many other cities around the UK (and potentially internationally), it is prudent to consider

[13] Arup, Lux Nova Partners, Mazars and Willis Towers Watson 2016. Heat Network Detailed Project Development Resource: Guidance on Strategic and Commercial Case. Department for Business, Energy and Industrial Strategy; and Grant Thornton and AECOM 2016. Heat Network Detailed Project Development Resource: Guidance on Economic and Financial Case. Department for Business, Energy and Industrial Strategy.

how to build in future capability to update the economic model as time passes and as different localities are modelled. In particular:

- Data is perishable, and batch data inputs can become out of date relatively quickly. This includes the key assumptions and coefficients used in EPE and in the proposed approach. In addition, data entry can introduce errors which lead to erroneous results.

  ESC should therefore consider (if it has not already done so) protocols for input data updates and checking, as well as options for data updates or checking routines which could be automated.

- The reliability of data depends on the validity and robustness of sample sizes. As such Office for National Statistics (ONS) data sets tends to be much more reliable than local evidence which may be collated, even when following standard statistical approaches. This is because the means by which many surveys access the sample frame introduce an inherent research bias and skew the responses towards one group or the other within evaluation findings. Therefore it is recommended that nationally collected data is used where practical.[14]

  The method applied by the EnergyPath Networks Economics tool is broadly robust in respect of spatial coverage, although this is restricted to the obvious limitations of treating cities as 'islands' within a national grid.

3.6 Changes in legislation

Energy and carbon policy and legislation have been subject to frequent rounds of reform and retreat. Given the recent EU referendum vote, the risk of future changes affecting the assumptions in the EPN and in the socio-economic assessment methodology would appear high. Economic valuation rates – carbon prices, energy prices, for example – may well move significantly in the next few years from current projections.

As with the other future proofing recommendations in the preceding section, ESC should ensure that its socio-economic modelling approach and the modelling files themselves are resilient enough to accommodate an uncertain future.

3.7 Monetisation versus multi-criteria analysis

We note that all of the socio-economic benefit elements are proposed to be converted to money terms and summed to produce single value results for comparison between different EPN scenarios and with the Reference Case. This is consistent with Green Book guidance.

Nevertheless there are very large uncertainties over all of the monetisation formulae, especially energy and carbon prices, which makes the confidence level in the relative results – i.e. which scenario is better than another – necessarily low.

[14] Although this many not always be true, if census data is out of data or a local authority has commissioned specific data which is more suitable for the ESC's purposes.

There is of course no perfect solution to this issue and we recognise that a socio-economic assessment of this nature is necessarily indicative. However we recommend that ESC considers presenting its results in terms of the natural units of measure where possible, alongside the summed monetary units. For example:

- Carbon emissions savings in tonnes CO_2e
- Energy savings in GWh per annum and GWh over the analysis period, or kWh per capita per annum
- Air quality damage in terms of change in total emissions of NO_x, SO_x and PM_x, in µg/m^3 or ppm.

This approach would effectively represent an alternative, multi-criteria analysis (MCA) approach to the assessment, which could provide audiences with a more balanced, nuanced understanding of the impacts of the alternative scenarios.

An MCA approach would also allow the assessment to include non-quantifiable benefits and benefits that are not easily monetised. This could be particularly relevant for health benefits (see further comments on health, below). This would be in line with the Green Book, which notes in Annex 2 that "there may always remain significant impacts that cannot sensibly be monetised. Sometimes, they can nonetheless by quantified in non-monetary units. Otherwise, they can be described in qualitative terms."

3.8 Probabilistic expression of results

Given the uncertainties, the scale of change contemplated by EPN and the long timespans involved, we recommend that the socio-economic assessments are subject to a Monte Carlo type sensitivity test analysis on a selection of critical uncertainties. The resulting socio-economic impact valuation can then be expressed in terms of confidence intervals. This would communicate a level of caution to be applied to the results which is commensurate with their uncertainty.

4 Proposed approach

4.1 Introduction

This section relates to the proposed approach to deal with the challenges of matching the EPE method to the new EPN outputs (as summarised in Section 1.3 above). The proposed approach is set out at pages 5-6 of the Proposed Approach document.

4.2 Summary of proposed approach

We understand that the central element of the "proposed approach" is to apply a stock model concept to the outputs of the EPN. EPN's outputs are at the granularity of individual addresses plus individual energy networks and distributed generation installations. For the socio-economic assessment these elements are aggregated back up to a defined geographic area.

Although not fully detailed in the proposed approach, we understand from discussions with ESC that the aggregation would occur at a granularity of say LSOA or sub-station cluster. In any case we understand that EPN's outputs from each transition pathway scenario run will be:

- Fuel, electricity and heat consumption
- Electricity and heat generation
- Itemisation of network capital works, generation asset installation and building retrofit measures
- Cost of measures

The proposed approach also involves a comparison of each transition pathway scenario run against a "business as usual" counterfactual scenario run. The result of the comparisons results in a series of net change of each of the outputs noted above.

4.3 Arup comments

4.3.1 Case comparison as the basis of the assessment

We consider the proposed method to be sound. The stock model approach appears to be a practical solution to the situation, and in any case the aggregated data will be sufficiently detailed for the purpose of the analysis. The use of a counterfactual scenario is appropriate given the concern is with the impact of one policy pathway versus another. Put another way, there is no "do nothing" scenario for the city.

We also note that the Five Cases Model suggests a shortlist of at least four options, e.g.

- do nothing / minimum
- reference case
- a more ambitious option
- a less ambitious option

On a minor point of terminology, we would recommend the use of the term "Reference Case" instead of counterfactual, given that this is an *ex ante* scenario modelling comparison between two future scenarios with a particular policy objective (e.g. 90% carbon reduction) and another future scenario without that objective.

4.3.2 Reflecting the Council's specific business case

On the other hand, we note that a future business case for the council would need to relate to that portion of the transition plan which would fall to the council to fund and/or deliver. There is no way of knowing at this stage which part of the plan will fall within the council's business case, and yet it would be advantageous to be able to attribute the correct value of socio-economic impact to the given level of investment. Options for the ESC to consider to address this issue include:

- Apportioning the impact value proportionately to the share of investment provided by the council;
- Generate an EPN scenario run which reflects the particular investments by the council (if this is possible); and
- Assume that the council's investment is an essential catalyst for the full transition, and therefore the full socio-economic impact value can be attributed to the council's share of the total investment.

The appropriate option will depend on the particular circumstances; the point here is for ESC to consider whether an allowance in the method can be made for such partial attributions of socio-economic impact value.

5 Change in Energy Use

5.1 Introduction

This section relates to the proposed approach to change in energy use, as set out at pages 6-7 of the Proposed Approach document.

5.2 Arup comments

The lengthy discussion on how changes in energy use are dealt with appears to us to boil down to a simple matter of comparing the EPN outputs from each scenario run to derive net energy changes for each energy vector. Once in possession of outputs in this form, conversions are made to several impact indicators such as carbon, air quality and health.

We note the commentary around the limitation on the incorporation of asset lifetime where assets last beyond the evaluation window (i.e. beyond 2050). We also note that benefits are limited to the same evaluation widow. In this way the Proposed Approach aims to avoid distortion of the economic impact which would arise if the capital costs were entirely accounted for in the year they were incurred.

We understand that the complexity of dealing with asset lifetimes in a more granular way would necessitate considerable additional processing time for each run. The approach therefore appears reasonable as a way to generate a set of cost and impact results for the defined evaluation window.

6 Fuel prices

6.1 Introduction

This section relates to the proposed approach to fuel use, as set out at pages 8-9 and 11-12 of the Proposed Approach document.

6.2 Summary of proposed approach

The proposed approach calculates a "price" value of energy for each scenario which is the sum of:

- Commodity prices (based on market prices derived from the ESME model)
- Unit costs of reinforcing and operating local networks (i.e. lifecycle costs divided by total energy flows)
- Unit costs of local generation (same as networks)

The energy price does not include VAT or profit.

The proposed approach is to calculate energy prices at a local authority level, to avoid localised distortions from area to area.

6.3 Arup comments

6.3.1 Long-run variable costs

The proposed approach is similar to the "long-run variable cost" (LRVC) method recommended in the DECC's Green Book supplementary guidance on the valuation of energy use and GHG emissions. The background documentation to the supplementary guidance breaks down the retail price of energy into the following components:

Table 2 Components of energy prices

Grouping	Price component
Non-variable cost components and societal transfers	Government policies with fixed costs
	Taxes (e.g. VAT, CCL)
	Energy supplier profits
	Other fixed energy company costs
	Fixed costs of transmission, distribution and metering
Long-run variable components	Carbon costs (*Measured and valued separately*)
	Variable costs of transmission and distribution
	Primary fuel (including long-run variable capital costs of plant (electricity)) and other variable operating costs
	Government policies to support generation (electricity)

Source: Table 5.1 of DECC background documentation on supplementary Green Book guidance

DECC guidance provides data tables for LRVCs. We consider that these figures should not be used in this case, given that:

- The LRVC excludes fixed costs of transmission, distribution and metering; given the major changes to infrastructure contemplated by EPN, we consider that all costs of infrastructure should be included.
- EPN generates its own cost estimates for energy production and distribution within the city being modelled.

Nevertheless the LRVC could be a useful reference for comparison against the EPN cost outputs.

On a point of terminology, we consider that "price" is a misleading term and should not be used in this instance. Also LRVC should not be used because DECC's LRVC values are not being used. Instead we propose "levelised unit cost" as a more appropriate term.

6.3.2 Local vs. national utility opportunity

We note that many local authorities are attracted to the idea of a municipal energy company which can capture a share of local spending on energy which goes to utility companies which are remote from the local area. ESC may wish to consider this as a variant to the main scenarios, although such financial and commercial aspects are normally beyond the scope of an economic cost-benefit analysis.

The foregoing comment highlights that the destination of energy spend (or avoided energy spend) has a bearing on the local economic impact. However we also recognise that from a national Green Book perspective, this is largely another form of transfer which does not affect the overall socio-economic impact on the UK from the proposed scenario. Consistent application of this principle across all outputs of the EPN would, however, involve significantly more complex economic modelling (e.g. using an input-output modelling approach). On balance, we consider that the current approach is sufficient to provide suitable outputs to inform policy-level decision-making.

6.3.3 Accounting for capex

We note that the "price" appears to incorporate a per unit energy slice of capex for delivering network changes and local generation. We understand from discussion with ESC that capex is spread across the lifetime of the asset, so that the price value is on a levelised basis. As noted previously this appears a reasonable approach.

6.3.4 Wider market price impact

We note that DECC's supplementary Green Book guidance cautions that "this guidance… is applicable when there are no wider impacts on the energy market such as significantly changing energy prices." We consider that the scale of change contemplated for a single city is small enough in the national context for this assumption to hold true.

ESC may wish to consider this point explicitly, if it has not already done so.

7 Energy savings and comfort taking

7.1 Introduction

This section relates to the proposed approach to energy savings and comfort taking calculations, as set out at pages 9-10 of the Proposed Approach document.

7.2 Summary of proposed approach

The proposed approach describes the EPE method in some detail but the actual proposed approach appears to boil down to the formula provided on page 10.

The comfort taking value is assumed to be a constant 15%.

7.3 Arup comments

The energy savings formula on page 10 results in a number with units in GBP, rather than MWh, as would have been expected. We recommend that savings are presented in both energy and money terms, for clarity.

The comfort taking flat value appears an appropriate value, given that it is derived from government guidance. We note that the social adjustments would take account of variations in actual comfort taking in an area that are correlated with socio-economic status.

We note that we have not reviewed the source guidance documentation on comfort taking.

8 Carbon savings

8.1 Introduction

This section relates to the proposed approach to carbon savings calculations, as set out at pages 10-11 of the Proposed Approach document.

8.2 Summary of approach

The Proposed Approach uses EU ETS traded and non-traded carbon prices to convert the carbon savings calculated by EPN to a money value contribution to the overall socio-economic assessment.

8.3 Arup comments

8.3.1 Carbon valuation

The proposed approach is in line with DECC's Green Book supplementary guidance on the valuation of energy use and GHG emissions.

Notwithstanding, we would note that there are tremendous uncertainties around carbon prices. The carbon market itself is still in its infancy and it will always remain an artificial construct which is exposed to volatile price changes in response to policy and legislation changes.

We would therefore recommend sensitivity testing around the carbon price which could provide insights to the sensitivity of different scenarios to the share of the socio-economic benefit made up by the attributed value of carbon.

8.3.2 Discount rates

Treasury Green Book supplementary guidance on intergenerational wealth transfers and social discounting recommends the application of reduced discount rates where:

> *The effects under examination are very long term (in excess of 50 years) and which involve very substantial and, for practical purposes, irreversible wealth transfers between generations.* (Paragraph 2.1)

The supplementary guidance was published in response to the Stern Report, in recognition that climate change is of course an intergenerational risk issue where standard discounting practices do not reflect the long term nature of the impacts.

The DECC guidance on valuing GHG emissions does not give explicit advice on rates to be applied, therefore the default position is to apply the now standard cascading discount rates, i.e. 3.5% for years 0-30, 3% for years 31-75 and so on down to 1% for years 301+. The Stern Report, by contrast, used a discount rate of 1.4%. Clearly the discount rate applied can have a dramatic impact on the net present economic benefit valuation of the investments modelled in EPN.

The Treasury supplementary Green Book guidance recommends sensitivity testing of different discount rates. To that end, we propose that ESC test an approach where carbon savings are valued at Stern's flat 1.4% discount rate for the entire assessment period.

8.3.3 Embodied carbon

DECC's supplementary guidance notes that "When analysing projects that result in a large change to the amount of imported goods, commodities or services, it is best practice to consider the emissions associated with these imports" (paragraph 3.27).

We understand that EPN does not provide an embodied carbon estimate for the works to be undertaken. However, this can be estimated by breaking down the total cost estimate into standard industrial classifications (SIC) and applying embodied carbon intensities to each SIC group. Arup has previously employed this method on project and product embodied carbon assessments. We can provide more information on this if requested.

In any case we recommend that this is investigated further, although we note that the policy driver for embodied carbon is limited.

9 Air quality damage

9.1 Introduction

This section relates to the proposed approach to air quality damage reduction calculations, as set out at page 11 of the Proposed Approach document.

9.2 Summary of approach

The proposed approach for air quality benefits is to apply the damage factors which were used in EPE. These derive from the Government's Inter-departmental Analysts Group (IAG) guidance on the appraisal of climate change policy.

9.3 Arup comments

The IAG guidance is now embedded in a toolkit and the data tables provided by DECC to assess energy and GHG-related socio-economic impacts of proposed measures.

The air quality damage values (Table 15 of the DECC data tables) are provided for different types of energy and for different location types. We understand that these have been used by ESC, with the potential to adjust if local data is provided by the local authority. This could be more clearly documented in the method.

10 Incentive payments

10.1 Introduction

This section relates to the proposed approach to incentive payments, as set out at page 11 of the Proposed Approach document.

10.2 Summary of approach

The proposed approach excludes incentive payments as these are a form of transfer.

10.3 Arup comments

We agree with this approach.

11 Employment impacts

11.1 Introduction

This section relates to the proposed approach to employment impacts, as set out at page 15 of the Proposed Approach document.

11.2 Proposed approach

The proposed approach is to apply EPE's job creation coefficient of 18 full-time equivalent (FTE) jobs per £1 million in net costs (comprising both capital and operational costs). We understand that the job creation figures are calculated on a per annum basis.

The job creation figure is reduced by a leakage factor of 17.3%, also from EPE.

Deadweight is not applied, since this is accounted for by the use of a net cost comparison with a Reference Case scenario.

11.3 Arup comments

We recognise that the EPE value of 18 FTE/£m was based on an employment impact meta-evaluation (i.e. study of studies). We also note that the Europe Economics study recommended a ±25% sensitivity to be applied, given the inherent uncertainty around this value.

Looking back into the underlying studies, we have concerns about the age of the underlying data in the studies and the potential for very different employment impacts from different types of spending. For the purposes of this evaluation, we consider the employment coefficient is adequate, but we consider that further investigation of more up to date and detailed studies may be merited.

We note that Europe Economics considered, but did not include, a supply chain impact multiplier of 1:4.5. We consider that supply chain impacts could be significant and inclusion of a factor should be considered. Further study would be needed to confirm the precise formula which should be used.

Additional information on employment generation metrics is provided in Appendix A.

12 Health benefits

12.1 Introduction

This section relates to the proposed approach to health benefit calculations, as set out at page 16 of the Proposed Approach document.

12.2 Summary of approach

The proposed approach follows essentially two main steps:

- Apply a multiplier of 2.4GWh/QALY (or 0.4 QALYs/GWh) for the energy savings for residential properties, which is the calculated average of multipliers for the different energy saving measures.[15]

[15] CWI (HTT), CWI (ETT), SWI, LI, LI top-up, Double-glazing and Boiler replacement

- Apply a second multiplier of £30,000/QALY to monetise the benefits.

12.3 Arup comments

We make the following notes on the proposed approach and the underlying EPE model which informs it:

- EPE's average impact of measures (i.e. 2.4 GWh/QALY) is unweighted. That is, each of the seven measures and each of the house types and each of the fuel types are weighted equally. This appears fundamentally flawed to us, given that all three of these parameters will occur in very different proportions. This value should not be used. A weighted approach should be applied instead.
- The Europe Economic study noted that a QALY value of £30,000 is used widely as a rule of thumb threshold of cost-effectiveness based on research by the National Institute for Health and Care Excellence. However it also notes that the value should be used with caution, and sensitivity taken for a value of £20,000. We also note that the NICE value is based on drugs and medical treatment research.
- The documents reviewed provide no clarity on the health benefit pathway for energy reduction. We have not undertaken a literature review of the links between health and energy, but we consider that this should be undertaken.

The sample results for health benefit suggest a very modest contribution to the overall, which may reduce the urgency of addressing this issue. Nevertheless we consider that the health benefit estimate should not be used until a further review is undertaken. At the least, ESC should test the impact on the results of a weighted approach to the GWh/QALY calculation.

An alternative approach could consider the following:

- An MCA approach would allow the assessment to look at a range of indicators to consider health and wellbeing more widely. There may be overlaps here with fuel poverty – e.g. if X households are taken out of fuel poverty, those households could experience an increase in their health / wellbeing as a result. It might also be possible to use census / IMD data to build a demographic profile of the study area and look at the potential impact for more vulnerable groups such as older people, children and disabled people.
- The Centre for Sustainable Energy has produced a toolkit to assess health impacts of fuel poverty schemes at the local level, which may be useful as a reference to consider.[16]
- The WHO provides guidance on health impact assessment. Human health is also now included in the EIA Directive, so it would be worth investigating whether there may be other guidance and methodology documents available which could inform the assessment

[16] See https://www.cse.org.uk/news/view/2100

13 Balance of Payments

13.1 Introduction

This section relates to the proposed approach to balance of payments, as set out at page 16 of the Proposed Approach document.

13.2 Summary of approach

The proposed approach excludes balance of payments estimates as these are not relevant to a local authority impact assessment.

13.3 Arup comments

Although not strictly in accordance with the Green Book, we consider this to be a reasonable simplification and reflects our experience of local authority attitudes to economic impact assessments.

Nevertheless it should be noted that the supply chain for the major infrastructure and equipment investments is international in nature, so that a significant share of the capex – especially on original equipment manufacture (OEM) – will be outside the UK.

14 Fuel poverty

14.1 Introduction

This section relates to the proposed approach to fuel poverty calculations, as set out at pages 19 of the Proposed Approach document.

14.2 Summary of approach

The proposed approach, which departs from the EPE method, involves the following steps:

- Derive the energy savings for each residential property (output of EPN)
- Derive the fuel bill savings for each property
- Determine whether the fuel bill savings for that property are greater or less than the average fuel poverty cost gap (FPCG).
- Count the number of properties in each LSOA, which have savings greater than the FPCG and multiply this sum by the ratio of households in fuel poverty for each LSOA.
- Sum the LSOA level results to the full study area for reporting purposes.

The approach is therefore binary, i.e. each property either does or does not save enough to come out of fuel poverty, based on the average FPCG.

The approach does not take account of savings from PV installations.

14.3 Arup comments

14.3.1 Accounting for fuel poverty decreases

Overall, the approach appears reasonable as a compromise in the circumstances and draws directly upon the highly granular information generated by EPN. We would make the following comments on the method:

- Fuel poverty is one area where transfers matter, since the concern is with the impact on a specific subset of the population, rather than on the economy as a whole. Therefore energy prices calculation should ideally be the actual household retail prices for energy in its various forms. This means inclusion of tax, profits and other charges alongside costs, each of which are subject to change and uncertainty over even short timescales. ESC's approach may therefore be the most practicable, but we would recommend a pilot exercise to test whether an alternative price-based method resulted in significantly different fuel poverty reduction estimates.
- Solar PV has the potential to make a significant contribution to bill reductions over time, particularly as PV unit prices continue to fall. The omission of solar PV from the fuel poverty calculations is a significant gap. ESC should consider further whether the method could be amended to include a factor for solar PV. The factor could be included as a variant or sensitivity value, which could in turn provide a prompt for the local authority to consider the potential for solar PV to be used to support their social policy agenda.

14.3.2 Heat networks

The assumption around the heat price for customers on heat networks should be considered carefully. In our work on new heat networks, we recommend applying a market comparator approach with a built in discount (typically 10%) on the market basket. A market comparator basis considers what a typical householder or business is paying to get an equivalent service to that of the heat network supply. Because heat networks comprise a very small share of the heat market (around 2%), the relevant comparator would be in-unit gas boilers. However, the "equivalent service" comparison means that the price comparison needs to take account of:

- Cost of gas (standing charge and variable charge)
- Levelised cost of boiler purchase / replacement
- Annual maintenance and servicing

Taken together appropriate heat tariffs have been calculated to be in the range of 10-12p/kWh.[17]

[17] For further information see the presentation by Thomas Briault for the CIBSE Symposium. http://www.cibse.org/getmedia/e59fa045-9e59-4c18-8629-c4cbb58850ac/040-Briault-Slides.pdf.aspx

Arup's market comparator approach is now embedded into new guidance which has just been released by DBEIS.[18]

If in the future there is a significant transition from gas boilers to heat pumps, it would make sense for the market comparator calculation to make a similar adjustment. .

As implied in the market comparator approach, the switch from gas to heat networks for home heating needs means a change to a different type of service. This change may be incompatible with the standard methodology for calculating fuel poverty. This issue should be investigated further.

14.3.3 Accounting for fuel poverty increases

The results provided in the sample outputs spreadsheet indicate that average bill reductions are very modest in the early years and reverse over time to result in average bill increases of between £50 and £150.

The number of homes taken out of fuel poverty is calculated to be around 1300 in 2020 down to 500 in 2050. This compares with a 2014 estimate of around 16,000 homes in Newcastle Upon Tyne which are in fuel poverty[19], implying a reduction of around 8% in 2020 and falling to around 3% by 2050 (making the crude assumption that the total in fuel poverty remains unchanged).

This histograms provided by ESC show the numbers of households which experience increases and decreases in fuel bills. This is summarised below.

Table 3 Summary of fuel bill direction

Fuel bill direction	2020	2030	2040	2050
Increase (no. of households)	133,000	121,000	124,000	125,000
Decrease (no. of households)	5,000	18,000	15,000	14,000
Ratio of increases to decreases	27:1	7:1	8:1	9:1

In view of the much greater proportion of increases to decreases, we consider that it is very important that the method attempts to quantify the number of households which enter fuel poverty. Otherwise the results will be biased towards the benefits. This issue should therefore be investigated further.

[18] Grant Thornton and AECOM 2016. Heat Network Detailed Project Development Resource: Guidance on Economic and Financial Case. Department for Business, Energy and Industrial Strategy.
[19] DECC 2016. Sub-regional Fuel Poverty, England, 2014 data. https://www.gov.uk/government/statistics/2014-sub-regional-fuel-poverty-data-low-income-high-costs-indicator

Appendix A

Employment calculations - additional information

The following notes provide additional detail on employment metrics. The information is drawn from some of the published studies where were referenced in the Europe Economics report on EPE.

There are a range of studies quoted that inform the employment benchmark which is a key input and driver of the EPN Economics model outputs. Thus:

- It appears that a figure of 18 jobs created per £1 million of investment is partly based on French research that for every €1 million spent by energy-efficiency programmes in the residential sector 11.3 – 13.5 FTEs were created[20];
- There is also reference to French research[21] that for every €1 million invested in property related thermal renovation work that 14.2 jobs were created (or safeguarded) in the fields of energy performance energy related occupations;
- The International Institute for Labour Studies reported in 2012 on the 'Green Jobs' initiatives[22] that a prudent figure of 12 direct and indirect jobs can be created for every $1 million expenditure. Based on the exchange rate at the time translated this into 15.7 jobs.
- The research also cites the variability across countries and uncertainties and focused on a figure of up to 19 new local and non-transferable jobs in the construction sector.

According to the Neujobs research into energy and green jobs it is clear that some other cases in other countries are presented but it is unclear what assumptions lie behind the calculations.

What is clear, however, is that the job effects (resulting from an investment of €1 million) can vary greatly between countries. In certain countries in Eastern Europe, far more jobs can be created with €1 million than in the west of Europe. This demonstrates the important (and uncertain or difficult to measure) effect of factors such as the average cost of labour and labour productivity.

The Energy Efficiency Industrial Forum (2012) presents the most promising picture. This research states that on average, investing €1 million energy efficiency for buildings would create 19 new local and non-transferable jobs in the construction sector."[23] Therefore, according to this source, EU policy makers can rely on this 1 to 19 calculation factor when formulating new policies[24].

Based on an average exchange rate in 2012 of 1.23 €/£, this equates to 23.4 jobs per £1 million.

[20] Installation, supply chain, management and some R&D jobs.
[21] L'Union Social pour l'Habitat (2011).
[22] http://www.ilo.org/global/topics/green-jobs/lang--en/index.htm
[23] (Cited in Job Creation through Energy Renovation of the Housing Stock, December 2012)
[24] Frits Meijer, Henk Visscher, Nico Nieboer, Robert Kroese et al, (p.22)