

Cornwall Objective One Partnership FEASIBILITY OF CARBON EMISSIONS AS A MEASURE OF ENVIRONMENTAL SUSTAINABILITY IN ECONOMIC REGENERATION PROJECTS



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1 INTRODUCTION

The Brief

1.1 The Objective One Programme for Cornwall and the Isles of Scilly Partnership Office has commissioned Atlantic / Roger Tym and Partners to consider the feasibility of using carbon emissions as a measure of the environmental sustainability of economic regeneration project funded through EU Structural Funds. The brief specifically asked that we:

- § Collate and review the current state of knowledge with respect to carbon emission based indicators and measurement tools.
- § Make recommendations about the further development of a set carbon emission measurement tools tailored to the needs of the different categories of activity that have attracted investment by a regional economic regeneration and development programme.

Background

1.2 Environmental sustainability is being mainstreamed in the current round of European Union Structural Funds programme by means of a cross-cutting theme. The main aim of the Structural Funds programme is to restructure and strengthen the economies of individual regions. Integrating environmental sustainability into Structural Funds programmes enables them to contribute to sustainable, rather than solely economic, regional development. Although regions have used cross-cutting themes to build environmental sustainability into their Structural Funds programmes, there are currently no widely accepted measures of *environmental performance* equivalent to those used to measure the impact of programmes on regional economies (e.g. GDP / GVA) or results (job creation, additional sales, etc.).

1.3 In the context of a regional economic regeneration or development programme it can be argued that carbon emissions offer a particularly appropriate way of measuring environmental performance. All economic activities require the input of energy, and it should therefore be (theoretically) possible to develop a basket of methods of measuring (approximately) the carbon intensity of different types of economic regeneration activity.

1.4 Climate Change is increasingly being recognised as one of the key global environmental issues. Measurement of environmental impact through carbon emissions has the added benefit of enabling a direct review of environmental impact in relation to issues of climate change and greenhouse gas emissions.

Method

1.5 In responding to this Brief, we have used a two-fold approach, focusing first on what measures, calculators and frameworks presently exist for monitoring carbon emissions and carbon savings, and then considering the principles and potential problems of applying those measures/calculators and frameworks to the types of projects that are funded through Objective One. In order to ensure that our findings are based in practice rather than solely on theory, this has included a detailed consideration of the application of carbon accounting to example projects in relation to each of the generic project types we have identified.

1.6 The study has entailed a combination of desk research and consultations with key organisations, and example projects to canvass their views and experience in a) measuring carbon emissions and carbon savings, b) applying carbon accounting as an assessment/monitoring tool in projects c) to see if there are lessons which can be applied to carbon accounting from within the general principles that existing organisations and projects apply and d) to identify problems they have experienced in

monitoring the environmental sustainability of project activities. (See Appendix Two for a full list of consultees. In some instances we were referred to additional contacts. It has not been possible to pursue all additional contacts within the scope of this study. However recommended contacts have been listed for future reference).

Measuring Carbon Emissions

- 1.7 The following paragraphs give a brief introduction to some of the key terms used. This study focuses on carbon accounting and carbon savings. Others are included for the sake of clarification.

Carbon Accounting

- 1.8 Carbon accounting is essentially measuring the carbon emissions from an organisation's activities. An organisation can produce measured outputs for the energy and other resources they use in building, running and production from their premises/ or in relation to the services they deliver, and by the people involved in these processes/services. The measured outputs can be converted into tonnes of CO₂, which can then be converted into tonnes of carbon. This information contributes to carbon accounting. Different forms of energy use can be accounted for, and DEFRA and the National Energy Foundation have some conversion tables for electricity, gas, petrol, diesel, coal and other chemicals used in manufacturing and running of premises.
- 1.9 Activities such as waste disposal/ sewage etc all use energy, should be taken into account. As for raw materials used in the construction of premises or production of a product, their carbon emissions can be calculated in terms of their transport costs, and their embodied CO₂.

Carbon Savings

- 1.10 Certain practices can reduce the amount of carbon that might otherwise have been emitted into the environment when compared to other alternatives. There will therefore be a carbon saving if such practices are favoured. The level of carbon saving is measured through comparison of the carbon accounting of the different practices. Comparison figures or benchmarks are therefore necessary in order to work out carbon savings.
- 1.11 We look in more detail at the issue of carbon savings and benchmarking in the remainder of this report.

Carbon Offsetting

- 1.12 Carbon offsetting works out the amount of carbon a process/ company/ project has produced and then offsets this by for example, planting trees, or investing in technology for carbon sequestration, which will absorb that amount of carbon released into the atmosphere. This process again depends on the measurability of carbon emissions of projects. However carbon offsetting may well not be considered an eligible cost in the Objective 1 programme. Discussion with Government Office would be needed to check its eligibility.

Ecological Footprint

- 1.13 This is another way of measuring environmental impact. Instead of counting the carbon produced from activities, the area of land that would be needed (i.e. to produce the resources required) to sustain certain activities is calculated. As a result of this, the calculations estimate how many planet Earths would be needed to sustain everybody if they used the same amount of resources. Similar types of activities are measured in estimating an ecological footprint, (such as travel, food, heating etc). The ecological footprint method shares similarities with carbon accounting, but is not being investigated in this instance.

Use of Terms

1.14 The following provides a basic glossary of terms

Activities

1.15 We have used the term activities to describe the range of different things which projects might engage in that have a carbon impact.

Practices

1.16 Where we have used the term practices it should be taken to mean the methods by which an organisation's activities are delivered.

Measures

1.17 The term measures should be taken to mean a method by which a carbon impact can be quantified.

Conversion Factors

1.18 This term refers to the agreed or adopted ratio between a quantified unit of activity to a quantified carbon emissions impact e.g. x Kwh of electricity = y tonnes of CO₂ .

Format of Report

1.19 The remainder of this report comprises:

- § Section 2; Background Research - a summary of information obtained.
- § Section 3; Potential for Carbon Accounting
- § Section 4; Issues and Conclusions

2 BACKGROUND RESEARCH

Introduction

- 2.1 This section presents in summary the various technical data and information sources we have obtained through web based research and consultations, which are most relevant to the measurement of carbon emissions at project level.

Building Research Establishment (BRE)

- 2.2 Sustainable Construction - The Data (2000) contains data on the embodied CO₂ in construction materials. U-values are also potentially useful in the context of this study. They are measured using specialist equipment, and represent the capacity of the building material to reduce heat loss/ hold in heat. The lower the U-value, the better the insulation properties of the material. Lower U-values mean lower carbon emissions.
- 2.3 The BRE U-value calculator covers most types of building element, except those that need to be assessed by detailed numerical analysis (generally those in which insulation is penetrated by metal, although the programme does cover small discrete fixings like wall ties).
- 2.4 Guidance on the use of the calculation methods is contained in BR 443 Conventions for U-value calculations, available from BREbookshop.com. The programme selects the correct method and the appropriate inputs according to the type of element being assessed. Changes to the data are immediately reflected in the calculated U-value, so that the effect of different options is readily assessed.
- 2.5 We have not been able to ascertain the compatibility of U Values measures with other carbon emissions calculations, as the calculator is only available to purchase.

DEFRA

<http://www.defra.gov.uk/environment/envrp/gas/05.htm>

- 2.6 This link contains fuel conversion factors for various fuels used in heating/ maintenance of buildings and structures etc. The output is given in kg of CO₂. This can be converted to kg of C by dividing by 3.66 (the molar weight of CO₂ is 44g, compared to the molar weight of C, which is 12g).
- 2.7 Transport conversion tables are equally as relevant to this study, and they can be found at <http://www.defra.gov.uk/environment/envrp/gas/10.htm>. The output is again given in kg CO₂, which can be converted using the factor of 3.66.
- 2.8 Also potentially relevant is 'Guidelines for Company Reporting on Greenhouse Gas Emissions - How to start reporting on Greenhouse Gases'.

<http://www.defra.gov.uk/environment/envrp/gas/04.htm>

The Edinburgh Centre for Carbon Management (ECCM).

- 2.9 ECCM work in partnership with different projects - mostly in carbon offsetting. They also have links to the Carbon Management Self Assessment Tool (CAMSAT), which is freely downloadable, and works out emissions using a spreadsheet. The tool gives an idea of the things companies/ organisations should be considering, but does not allow the input of raw figures, and would provide guidance on what to do next - not carbon emissions figures.

Good Energy

<http://www.good-energy.co.uk/carboncalculator/quote1.php>

- 2.10 This calculator is quite basic, and does not give conversion factors such as those found on the DEFRA pages.

National Energy Foundation

<http://www.natenergy.org.uk/convert.htm>

- 2.11 This calculator could be used for a building once it is up and running.

UK ACE - The Association for the Conservation of Energy

- 2.12 They carry out a number of research projects on why projects and developments should use reduced energy technologies, and have carried out specific research on the energy usage in offices and different types of buildings.

<http://www.ukace.org/research/respaper.htm>

ODPM

- 2.13 Building Regulations Part L; Document L2 "Conservation of Fuel and Power in Buildings Other than Dwellings".

The Carbon Trust

- 2.14 The Carbon Trust has developed various tools available for download from its website which will calculate carbon dioxide outputs for whole buildings and their external operations. These look as if they could be adapted to fit in with Objective One projects involving builds and transport, and off-site activities - including waste.

- 2.15 These calculators (entitled "baseline tools") are based on DEFRA data and other sources. One is for businesses and focuses on carbon emissions from buildings, transport and commuting, one for Local Authorities includes the same, plus waste, water and street lighting.

- 2.16 They include some elements of benchmarking - showing typical and good practice CO₂ emissions per employee.

- 2.17 Another far more involved "Carbon Management Tool" has been developed and is aimed at larger businesses wishing to enter emissions trading schemes. This includes a range of activities, including emissions from production processes, such as cement manufacture.

- 2.18 The Carbon Trust has a Carbon Management Manual and Carbon Management Pilot Programme. The Carbon Trust presents Carbon Management as the next step on from the more simple measures of energy saving: particularly "selling" energy savings as money savings. The Carbon Trust also specialises in energy savings surveys

- 2.19 The calculators are not difficult to use as such, but are quite involved and rely on appropriate personnel records, and management accounting data being available. They would all be applicable to Objective One projects, but might prove an onerous task for many to complete. In the context in which they have been developed, they are very much aimed at highlighting the business case for organisations to reduce carbon emissions.

- 2.20 .Pay back periods from energy saving survey recommendations are apparently less than 18 months, so this method, if it could be adopted, may also be applicable to some Objective One projects at appraisal stage, to provide an opportunity for considering "carbon-proofing".

Best Foot Forward

- 2.21 Best Foot Forward are an organisation working to promote carbon-saving and accounting in various organisations and businesses - they also design carbon management tools, and help implement these (for a charge) into the everyday running of businesses. They have contributed to public and private sector reports on carbon saving.

The European Union Greenhouse Gas Emission Trading Scheme

- 2.22 In order for this scheme to be implemented, frameworks for carbon accounting and monitoring will be developed by the European Commission. (It is unclear what progress has been made to date)
- 2.23 "The Commission shall adopt guidelines for monitoring and reporting of emissions resulting from the activities listed in Annex I of greenhouse gases specified in relation to those activities, in accordance with the procedure referred to in Article 23(2), by 30 September 2003. The guidelines shall be based on the principles for monitoring and reporting set out in Annex IV."
- 2.24 It may be that if standard measures are developed for monitoring the ETS, these could be applicable in part to some Objective One projects.

GOSW - Regional Spatial Strategy - Renewable Energy Targets

- 2.25 In its work in developing the Regional Spatial Strategy, GOSW has been developing policy regarding the use of renewable energy in new developments. This work has been based on PPS22 and on previous work by London Borough of Merton. Merton have developed a toolkit which developers and Local Authorities can use to assist them in understanding how developments can be designed to comply with targets to obtain 10% of energy use in new developments through renewable sources. GOSW has tested the viability of enforcing such a policy in terms of the financial burden it potentially places on developers and identified what practices produce a good return on investment in terms of carbon savings. Through this work GOSW have confirmed for example that it would be possible to achieve 10% energy from renewables at only 1% additional cost. In complying with this policy, all developers will have to estimate the energy consumption arising from use of their developments and then demonstrate that 10% can be sourced from renewable technologies. It is anticipated that measures available through BREEAM, the Sustainable Action Plan for Energy ratings of dwellings, and Ecohomes standards would be applied. Some of these provide further potential sources for measuring carbon emissions from projects.
- 2.26 From the Merton work the following document has been developed to assist developers in complying with renewable energy requirements - "Integrating renewable energy into new developments: Toolkit for planners, developers and consultants" It can be found at http://www.london.gov.uk/mayor/environment/energy/docs/renewables_toolkit.pdf . It includes guidance on calculating the baseline carbon emissions of a site and calculating the contribution of proposed renewable technologies.

Waste Reduction Model - WARM and Re-con

- 2.27 ReCon and WARM were developed for purchasers and waste managers, respectively. ReCon calculates the benefits of alternative recycled content purchasing decisions. WARM, on the other hand, calculates the benefits of alternative end-of-life waste management decisions. Both tools calculate the benefits of an alternative scenario versus a business-as-usual scenario.

- 2.28 EPA created the Waste Reduction Model (WARM) to help solid waste planners and organizations track and voluntarily report greenhouse gas emissions reductions from several different waste management practices. WARM is available both as a Web-based calculator and as a Microsoft Excel spreadsheet (461 kb WinZip archive). WARM was last updated on 12/15/2004.
- 2.29 WARM calculates and totals greenhouse gas (GHG) emissions of baseline and alternative waste management practices—source reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent (MTCO₂E), and energy units (million BTU) across a wide range of material types commonly found in municipal solid waste (MSW).
- 2.30 The WARM and ReCon tools are based on a life-cycle approach, which reflects emissions and avoided emissions upstream and downstream from the point of use. As such, the emission factors provided in these tools provide an account of the net benefit of these actions to the environment. This life-cycle approach is not appropriate for use in inventories because of the diffuse nature of the emissions and emission reductions contained in a single emission factor.
- 2.31 WARM was recently updated to reflect revised energy and fuel mix inputs associated with boxboard produced from mixed paper, as well as revised average recycled content values for materials available in the marketplace. Five new material types were also added to the model: personal computers, carpets, clay bricks, fly ash, and concrete used as aggregate. WARM now recognizes 30 material types. Their emission factors are available for viewing in units of MTCE or MTCO₂E. Note that the emission factors represent the GHG emissions associated with managing 1 short ton of MSW in the manner indicated. GHG savings are calculated by comparing the emissions associated with the alternative scenario with the emissions associated with the baseline scenario.

Environment Agency Nappies Study

- 2.32 A recent study commissioned by the Environment Agency compared using disposable nappies, washing reusables at home and using a laundry service. The Study compiled a detailed life cycle inventory of the environmental burdens associated with the production, use and disposal of reusable and disposable nappies, considering various options for cleaning of reusable nappies, and disposal options for disposable nappies; and used the life cycle inventory data to compare the potential environmental impacts arising from reusable and disposable nappies under the various scenarios considered.
- 2.33 It examined all the impacts while a child was wearing nappies. These included:
- § water use
 - § fossil fuel use
 - § solid waste
 - § various other non-carbon impacts (e.g. phosphates)
- 2.34 The ensuing impact assessment focused on:
- § global warming
 - § ozone depletion
 - § photo-oxidant formation
 - § depletion of abiotic resources
 - § eutrophication
 - § acidification

§ human toxicity

§ aquatic and terrestrial toxicity measures

- 2.35 In terms of measuring carbon emissions it seems that the study focused on energy used (power in production and usage of nappies and fuel for transport in distribution and laundry services) and therefore is unlikely to have developed any new measures, carbon factors or carbon calculators (over and above those we have already outlined) that would be of specific relevance to this study.
- 2.36 However, the study does include two indicators which have been difficult to find from other sources: Based on data published by Water UK (Water UK, 2003), it allocated 0.601 kWh of electricity per m³ of water supplied and 0.598kWh per m³ of sewage treated. Dependent upon reliable data from water bills, these might be applicable to regeneration projects.

3 POTENTIAL FOR CARBON ACCOUNTING

- 3.1 This section reviews the potential for carbon accounting by generic topics that Objective One Programme (ERDF or ESF) could fund:
- § Capital investment in buildings
 - § Revenue investment in business support
 - § Revenue investment in training
 - § Capital investment in public realm type projects
 - § Revenue investment in marketing type projects
- 3.2 For each topic area we:
- § Suggest the key stages of the topic which could be measured for carbon accounting e.g. for buildings this might be construction; operation of the building itself (utilities); type of uses to which the building is put e.g. people travelling to the building to work
 - § Set out, for each stage, where carbon accounting is possible and what calculators can be used
 - § Identify where there are gaps in calculators for use in measurement
 - § Identify what the problems in carbon accounting might be e.g. use of the calculators; areas where measurement is not possible might outweigh those where it is etc
- 3.3 For each topic area: we take example projects already approved by Objective One and test how carbon accounting could have been applied to them, to illustrate/augment the generic discussion points. This utilises project summary information only. It is intended as a guide, not a detailed assessment of each project. We have deliberately selected a range of projects that are particularly complex in nature to ensure a robust consideration of how carbon accounting might be applied. However, an example of a fairly straightforward capital build project is also included.
- 3.4 Example Projects are:
- § Capital investment in buildings - Penryn Townscape Heritage Initiative
 - § Capital investment in buildings - Oakland Mews, development of four office/workshops
 - § Business Support -Developing the Business Support Network (Business Link)
 - § Training - JobCentre Co-financing
 - § Public realm type projects - Kynance Cove Public Product
 - § Marketing type projects - Cornwall Tourism Destination Marketing
- 3.5 In the following table text in normal font is our generic commentary and text in italics is project-specific commentary. Some general issues arising from consideration of the practical application of carbon accounting are summarised in the paragraphs following the table.

	Elements that can be measured for carbon accounting	Potential gaps in carbon accounting	Comments/Issues
<p>Capital Investment - Buildings <i>Project - Penryn Townscape Heritage Initiative</i></p>			
<p>Building construction:</p> <ul style="list-style-type: none"> • Materials - production (energy costs) • Materials - where sourced (transport) • Construction workers - (travel) <p><i>All the above would be relevant - building refurbishment and public realm works</i></p>	<p>Transport can be measured in principle. standard carbon converters are available for travel (by type of vehicle, fuel and distance travelled)</p> <p>Embodied CO₂ in construction materials can be measured</p> <p>U values (capacity to reduce heat loss) can be measured</p> <p>Fuel conversion factors for maintenance of buildings and structures can be measured (from DEFRA)</p> <p><i>A number of different people are carrying out different projects under the umbrella of the THI. Would have to ensure that each separate element provides the appropriate information. This could be complex and would need good systems and guidance notes for participants</i></p>	<p>There is a need for comparisons e.g. to know which are the preferable construction materials from a carbon accounting view point. An advice note on materials for new build and materials for building refurbishment might be helpful.</p> <p>Transport miles saved by use of local materials. However, how would this be benchmarked?</p> <p>Is it possible to benchmark using U values?</p> <p><i>Particular issues of building materials in a historic environment. Would be important to understand what the significance of this is.</i></p>	<p>At application stage, an applicant could not provide information on contractor travel for example and may not have information on materials. They are equally unlikely to be available for appraisal and may only be information collectable at monitoring stage. The applicant could give some indication of potential at application stage e.g., use of local labour, use of local materials (although even at monitoring stage, it may be very onerous to account for all contract workers' movements and fuel consumption etc. accurately).</p> <p>There are potentially some contradictory effects - e.g. local building materials = fewer miles travelled, but may be less efficient in terms of ongoing maintenance/insulation/running costs etc. Materials with low U values, might not necessarily have low carbon embodiment levels. The issue of equal but opposite effects would have to be considered carefully to ensure any such effects are identified in a project.</p> <p>There is an issue of time period over which to measure U values, given that savings made are effectively in perpetuity for the lifetime of the building, but reporting may not continue for that long. Direct use of the building for the purpose funded through Objective One might not continue in the long term.</p>

	Elements that can be measured for carbon accounting	Potential gaps in carbon accounting	Comments/Issues
			<p><i>Obtaining data could be very problematic when there are so many participants rather than one implementing organisation. In theory the process could be applied to all the elements but in practice it would have to be an extremely easy system especially in order to get information from private sector participants.</i></p>
<p>Building Use;</p> <ul style="list-style-type: none"> • Energy use • Waste <p><i>The project does not have any ongoing involvement with building use on a day to day basis.</i></p>	<p>Can be measured for heating and lighting energy sources. Need some comparators. Can be provided for individual buildings. But how would it work for e.g. industrial estate - where it is the occupiers who have this information, which is one step beyond the project.</p> <p>US EPA WARM model measures carbon emissions from a variety of waste sources and compares emissions from different waste management practices.</p>	<p>There do not appear to be established carbon conversion factors for sewage disposal or water disposal. These could potentially be developed, through primary research with various businesses (e.g. SWW) in the industry to ascertain their overall energy costs per unit of production, and thus carbon emissions, IF they are prepared to collaborate.</p> <p>Further contact could be pursued with SWW to ascertain whether they do have any data on carbon emissions per unit of production of water and waste water.</p>	<p>All people's water consumption and sewage disposal must be provided for somewhere. A project might create increased or decreased water consumption or sewage disposal because of what it is doing (e.g. it might be attracting additional users to a new building but at the same time reducing carbon intensity of waste and sewage disposal using certain practices). Should project application/appraisal recognise the potential effects in terms of volumes and resultant carbon emission changes? Should projects which specifically make alternative arrangements that are less carbon intensive be recognised? Is waste disposal taking the process too far?</p> <p>Some industrial estates may have heavy energy users as tenants - how would this be dealt with at application/appraisal? Could it be a means to encourage initial consideration of energy sources during project planning?</p> <p><i>Businesses are reporting on jobs as a result of investment but are not providing details of building use. So this information would not be collected as a matter of course. Could it be collected if there is a specific example of building refurbishment likely to</i></p>

	Elements that can be measured for carbon accounting	Potential gaps in carbon accounting	Comments/Issues
			<i>lead to energy savings?</i>
<p>Building Users:</p> <ul style="list-style-type: none"> Where do users come from (travel) <p><i>As above - the project does not get directly involved with this.</i></p>	<p>Transport use can be measured. What would be 'the average' position against which positive results would be achieved?</p>	<p><i>Although transport can be measured in carbon accounting terms, the project would have no information on where town centre uses came from and how they travelled without undertaking primary research (unless available through any town centre health check information). Measuring carbon emissions in relation to town centre users would be very difficult and could be costly if research is required. Baseline information against which to compare change would be necessary.</i></p>	<p>May be a problem at application stage to state what this might be. Could only make estimates. Could be information provided at monitoring stage - although likely to be additional information to be collected.</p> <p><i>Project will not have any control on information about users of the buildings. It might find overall information about increased visitor numbers in general to Penryn but may not have the information about where they are coming from - unless some specific survey work is done.</i></p> <p><i>Project may not have control on the behaviour of building users,</i></p> <p><i>There is also an issue of displacement. For example would travel to the town centre ONLY be counted as an additional carbon emission and therefore a negative in the carbon accounts, or might these journeys replace or reduce other trips? On a wider scale this would depend on the project. For example if it is providing a service in a rural area that was otherwise not available, then carbon accounting could be viewed as either (a) people might not have used that service therefore any travel to this new facility would be additional carbon emissions, OR (b) they might otherwise have travelled much further, therefore the balance is a carbon saving. Gathering activity data to capture such a saving might be onerous.</i></p>

<p>Capital Investment -Buildings <i>Project: Oakland Mews, development of four office/workshops for SMEs</i></p>			
<p>Building Construction:</p> <ul style="list-style-type: none"> • Materials used - production (energy costs) • Materials - transport costs • Construction workers - travel 	<p>The CO₂ effects should all be measurable (see previous example)</p> <p><i>As the project is being implemented by one organisation, it should be possible in principle to identify the CO₂ effects. The construction company will be known and will have information on sources of materials, where workers travel from etc. It will depend on the co-operation of the construction company to provide this information, together with the project applicant</i></p>	<p>There are gaps as noted above, principally in relation to benchmarks and comparator figures.</p>	<p>As indicated above, detailed information would only be available at project monitoring stage, when the contractor is known and information can be assembled. There may be issues about collecting the information e.g. in relation to travel by contractor employees.</p> <p><i>In principle it should be possible to obtain information for this project as it is self contained, a one contract build project, with a single organisation implementing its delivery</i></p>
<p>Building Use:</p> <ul style="list-style-type: none"> • Energy • Waste <p><i>The project applicant manages the workspace and will therefore know the use to which the building is put</i></p>	<p>The CO₂ effects in relation to energy should all be measurable (see previous example). WARM model can provide information on CO₂ in relation to waste</p> <p><i>It will either require the co-operation of the tenants to provide information or otherwise some standard assumptions about usage for the type of users involved</i></p>	<p>Issues around lack of information about sewage/water supply disposal - see previous example</p>	<p>See comments on previous example. Quantified information could be available at project monitoring, once units are occupied. As the type of unit is likely to be known at application stage and if standard information were known for types of workspace e.g. energy use per sq.m. of office space, it could be possible to provide some basic information in the project application.</p> <p><i>Information could be provided. Management arrangements could dictate how easy it is to supply information e.g. if tenants pay an all inclusive rent (space, heat light etc), the project applicant as manager will have energy information. If it is reliant on tenants providing the information this could be more problematic as they are not formally part of the reporting processes. A standard model for office type uses could provide an alternative route to information. However, in all cases, the information would need be assessed against</i></p>

			<i>benchmarks/comparators e.g. if the building included energy saving devices, this would be reflected in energy costs.</i>
<p>Building Users:</p> <ul style="list-style-type: none"> Where do users come from (travel) <p><i>The project applicant manages the workspace and will therefore know the tenants of the workspaces</i></p>	<p>Travel use can be measured. As noted in the previous example, what would be the 'average' position against which this is measured?</p> <p><i>It would require the tenants to provide information on how far their employees travel to answer this question</i></p>	No specific gaps	<p>Information could be provided at project monitoring stage, once it is known who the tenants are (and provided tenants will supply information). Alternatively would it be possible to model alternative scenarios e.g. all employees travel an average of 5, 10 or 20 miles. Selecting the most appropriate scenario and applying the figures would be less onerous.</p> <p>Projects may not have control over the behaviour of building users, and therefore cannot be expected to account for their carbon effects.</p> <p><i>The businesses are small and an average travel distance should be easy to determine for each one. However, as well as travel to work, there are other travel factors relevant to the businesses e.g. if people within the business then travel out in the course of their work and when supplies are brought to the business. Should these factors be built into the data collection/modeling?</i></p>
<p>Revenue Business Support <i>Developing the Business Support Network - Business Link Devon and Cornwall</i></p>			
<p>How the service is provided in relation to travel requirements</p> <ul style="list-style-type: none"> people come to a Centre; Adviser travels to individual business; services provided electronically 	<p>Travel implications should be measurable.</p> <p><i>Electronic services do have a carbon impact due to electricity usage to access them</i></p> <p><i>The project relates to a central information hub - telephone operated? If so, no effects to calculate. Not clear if the 'Enterprise Edge' or Funds elements involves any travel. But travel to work of additional people manning a centralized telephone hub might be a carbon impact. If those staff are funded by the project then carbon</i></p>	No apparent information gaps	<p>May be a problem at application stage to predict some of these. Could be provided as monitoring information.</p> <p>If an organisation already has a policy of encouraging low fuel use e.g. small cars, LPG, how would any carbon savings be calculated and could they be attributable to the project as a direct outcome of the Obj 1 £ invested.</p> <p><i>There is an issue regarding the delegated funds</i></p>

	<i>emissions associated should be counted.</i>		<i>within the project e.g. if BL gives money to another business support provider, it needs to make sure that any requirements to monitor travel etc that it incurs, are passed on. Equally it should be passing on the thought process about considering travel implications of service provision.</i>
<p>How the service is provided in relation to housing staff:</p> <ul style="list-style-type: none"> office requirements and energy implications 		<p>Would need energy consumption per person or per sqm. space figures to make this work. This would be particularly important if any additional staff are housed in an office with others, where it is not possible to attribute all office energy costs to the project.</p>	<p>Could be problematic as information may not be available in an appropriate form? Not all projects will have new staff - may be existing staff providing a new service - in which case there would not be additional building energy costs involved <i>No information given in the project sheet that indicates additional staff and therefore implications in terms of office space etc. This is a similar issue to that of the delegated funds in that any requirements to account for carbon emissions resulting from office use would need to be passed on to other project participants from the lead organisation.</i></p>
<p>Revenue investment in Training <i>Job Centre Plus Co Financing Project</i></p>			
<p>How the service is provided in relation to travel requirements</p> <ul style="list-style-type: none"> people come to a training centre; trainer travels to individual businesses/local venues; training provided on-line 	As for business support	As for business support.	<p>As for business support. Some types of training e.g. mix of training and work experience, would generate a variety of travel patterns e.g. a countywide training programme with work experience could have significant carbon emission implications if people need to travel to training and work experience. If the training programme provided transport, this is a different situation again. <i>The project covers the whole range of training advice, guidance and counselling. As Job Centre Plus will be purchasing this from a number of</i></p>

			<i>training providers, but cannot say, at the time of preparing the application who the providers will be, it would be impossible for any application to scope the potential travel implications. Co-financing works almost as a delegated grant scheme - so it is a case of ensuring that all carbon accounting requirements are passed on to training providers bidding to provide schemes with co-financing financial support.</i>
How the service is provided in relation to housing staff: office requirements and energy implications		As for business support	As for business support <i>Same problems as above</i>
Use of training equipment: <ul style="list-style-type: none"> • specific equipment may have energy use implications • energy implications of use of ICT equipment 		We have not found any calculators which relate specifically to the use of ICT equipment. When it gets to specialist equipment it could be problematic - although some specialist equipment could be quite high energy use.	This might be too complicated. Simple energy use measurements would be easier to capture. <i>Same problems as above</i>
Public Realm Type Projects <i>Kynance Cove - combines building and public realm work</i>			
Construction works <ul style="list-style-type: none"> • Materials - production (energy costs) • Materials - where sourced (transport) • Construction workers - (travel) • Power and fuel used in construction machinery etc 	Same comments as for buildings <i>Should be possible to measure this in terms of travel etc once contractor known.</i>	Same comments as for buildings There is an issue about costs associated with materials production in relation to benchmarks e.g. in relation to power and fuel in construction - are there any standard measures - e.g. a proxy like power/fuel costs per £1,000 capital build investment? A potential source might be Building Cost Information Service. (Specialist information available to RICS	Same comments as for buildings. As this is mostly work likely to be done by public sector organisations, there may be a better knowledge of opportunities for sourcing local material etc. But where organisations have procurement arrangements that require tenders from in and out of County, travel costs etc cannot be stated at application stage

		members). However this has not been specifically investigated. -	
<p>Users:</p> <ul style="list-style-type: none"> Where do users come from (travel) 	<p>Transport can be measured in carbon emission terms</p>		<p>This could be potentially very difficult to measure (a) the scheme may not be proposing additional use - (therefore no effect) (c) if additional use is proposed - how are additional users measured - i.e. how is data on their travel patterns collected? If a town centre improvement scheme is intended to enhance town centre business (as Penryn THI intends to do) it is reasonable to expect more people come to the town as it looks better and is a better experience for shopping. However the effect of this is being measured by businesses in terms of more turnover, more jobs etc. not in terms of user numbers. However if it is the improvements generate more travel it could have a significant and additional carbon emissions effect.</p> <p><i>In this example, people coming to Kynance Cove are most likely to park in the NT car park, so parking numbers are recorded (and at least it would be possible to see any increased numbers, and possibly an average journey distance could be applied) or would be walking to the Cove having parked elsewhere (in which case there is no way of knowing about any increase without primary survey work). In the Penryn example information on growth in parking revenues from a local authority car park</i></p>

			<i>might be a useful measure/basis/proxy for town centre enhancement schemes. It is possible that projects might result in changes to parking arrangements and influence walking/sustainable transport use patterns and levels and this should be captured as a saving but would require primary survey work and a baseline comparator.</i>
Building Use	<i>In this project example there is also an energy use associated with buildings</i>		<i>Energy use of buildings could be measured. Need comparisons The project may not have control on the behaviour of building users.</i>
Marketing Type Projects <i>e.g. Cornwall Tourism Forum and Destination Marketing Campaign</i>			
How marketing material is researched and developed e.g.: <ul style="list-style-type: none"> • Travelling to obtain information • Telephone surveys • Journalist visits 	Should be able calculate transport implications		<i>There could be some significant travelling implications e.g. a programme of journalist visits could entail car, train, plane transport. This project also involves setting up a staff team so all the elements of accounting that relate to office energy costs, staff travel would be relevant. However the staff team is housed in Cornwall Enterprise offices so if they were not there, would someone else occupy the offices and therefore the need to carbon account is irrelevant? Or should an appropriate "share" of office overheads be attributed to the project and costed/carbon accounted accordingly. Activities like journalist visits do raise some interesting carbon accounting questions e.g. flying someone from London - Similarly inward investment marketing campaigns would raise this issue as well. If the project leads to increased visitor numbers or has increased visitor numbers as a target, then how</i>

			<i>could those movements be captured? Again, it depends on evidence collected by the project. which could be quite onerous/costly to collect</i>
Printing and production of marketing and promotional material		It seems there are not necessarily established carbon conversion factors. These could potentially be developed, through primary research with various businesses in the industry to ascertain their overall energy costs per unit of production, and thus carbon emissions, IF they are prepared to collaborate. <i>It is assumed there is an energy cost attached to a printing process</i>	Is this relevant? It is the question of how far down the supply chain carbon emissions are measured. The printing company will continue to operate as a business regardless of whether the project chooses to use its services. It may therefore be inappropriate to extend carbon accounting through the supply chain in the context of measuring the additional activity generated by Objective One funded projects.
Distribution of marketing material: <ul style="list-style-type: none"> • Electronic • Delivery vehicles • Train/car • etc 	Transport costs i.e. making local sourcing a better option		<i>The issue here is likely to be one of comparison - what are the alternatives. The project information available does not give any indication of what might need distribution - but e.g. there are well established distribution systems for tourism guides nationally - generally vehicle based. What about international distribution of marketing material?</i>

- 3.6 There are a number of general issues arising from the above review, which will be relevant to considering the potential for carbon accounting and measuring carbon savings.
- 3.7 There are several areas where the general principle of carbon accounting should be relatively straightforward e.g. transport use. However in practice there could be real problems in applying this:
- § At project application stage as projects will not be able to provide the detailed information needed
 - § Where there is a lack of any baseline data - implying a need to assemble this
 - § In providing benchmarks/comparators
 - § Distinguishing the effects of the project where this might be part of a wider set of carbon emission figures
- 3.8 The situation is likely to be very complex where there are a number of organisations involved and/or delegated funds are used. Systems would need to clearly set out what is required. At present the monitoring requirements passed on to final beneficiaries are unlikely to provide any information relevant to carbon accounting
- 3.9 It is relatively more straightforward to see how carbon accounting could be applied to capital projects rather than revenue projects. If applied to revenue projects, the transport implications may be the most straightforward aspect to account, but will depend on detailed activity data on personnel and users.
- 3.10 There is an issue of the length to which carbon accounting is taken within a project. Ideally it would encompass all project activity including that of suppliers, users etc. Realistically this could be very difficult and onerous for projects to measure. One specific and important consideration is that of contradictory effects (the equal and opposite effect referred to in the table). Any framework for measuring carbon emissions would need to be sufficiently robust to feel confident that such effects are not missed.
- 3.11 Further work would be needed to develop benchmarks and comparators.
- 3.12 It is most likely that projects would be able to provide information relevant to measuring carbon emissions and possibly carbon savings at the monitoring stage. It is unlikely any figures could be provided at project application stage although projects could indicate where they consider there is potential to achieve carbon savings e.g. by using energy saving devices in buildings. Building consideration of carbon emissions/savings into appraisal processes could therefore be difficult, beyond a general overview.

4 ISSUES AND CONCLUSIONS

- 4.1 In this section we summarise the findings of this report to set out what the key issues are likely to be, associated with use of carbon accounting.
- 4.2 We look at alternative ways forward in pursuing the concept of using carbon emissions as an indicator of environmental sustainability and consider what future work might be needed to pursue these routes.

Issues

Project Application, Appraisal and Monitoring

- 4.3 At any stage of the project lifecycle, the ability to carbon account depends heavily on activity data being available to which the relevant conversion factors can be applied
- 4.4 For each stage, we have considered what information the project applicant might have to provide/appraiser consider, what information is easy to provide and where the problems in providing information might lie.

Project Application and Appraisal

- 4.5 It seems that at the present time it would be an overly onerous and unrealistic task to expect project applicants to obtain sufficient information/forecasts on their activities to be able to quantify their carbon impacts or carbon savings at the project application stage.
- 4.6 However, steps could be taken to help project applicants develop their knowledge and understanding of carbon emissions and ways to reduce these, which could be incorporated into project development without the need for quantification. In the same way that a project's response to the Environmental Sustainability cross cutting theme is assessed at project application stage, so a more detailed carbon impacts checklist/scoring system could be developed, and prospective project deliverers could be "signed up" to particular practices, incorporating them into their project design - this may even take place during project development phases, prior to application and may be occurring to a greater or lesser degree at present. If specific practices are seen to hold weight within funding decisions, then this approach could constitute an incremental step in deepening and widening the understanding and implementation of the Environmental Sustainability cross cutting theme.
- 4.7 As awareness and buy-in to the theme, particularly in terms of carbon emissions, increases over time, so it may become more realistic to begin to introduce a more robust method which quantifies carbon emissions, at later stages in the project life cycle.
- 4.8 If projects are to be compared to each other at the application stage, and this is to influence funding approval decisions, then clear guidance on what is considered good practice in carbon saving, must be provided early so that it can be incorporated into project design. (See also Performance Assessment - paragraph 4.23.)
- 4.9 What can be done at appraisal stage relies wholly on what information is requested/provided at application stage, therefore we have not distinguished between the two here.

Project Monitoring

- 4.10 Initial discussions with a handful of projects regarding their capacity and inclination to report on carbon emissions has produced some relatively negative responses. Most are very amenable to environmental sustainability as a cross cutting theme and to implementing carbon saving practices, particularly where there are economic benefits and cost savings associated (e.g. solar kilns). However, several are very resistant to any overly onerous monitoring requirements, particularly if they are perceived to

outweigh the benefits of doing so and if they seem not to be commensurate with the size of the project. This is primarily because operational concerns take priority for project officers.

- 4.11 In the instance of projects with a very strong environmental sustainability theme, initial findings are that some of their activities/carbon impacts/carbon savings would be easy to capture. Some activity data is already available, but other aspects might be more difficult to capture. Where project specific improvements have been made (e.g. Kynance public toilets refurbishment) in the absence of data on former carbon impacts, the savings made cannot be easily benchmarked. These comments generally reflect what we have reported in our matrix in Section Two.
- 4.12 In the case of simple capital build projects it seems realistic to expect that carbon accounting could be carried out at project monitoring stage. Activity data would have to be collected and provided by projects, and projects could be encouraged to use one of the carbon calculators and carbon management tools such as those produced by the Carbon Trust. If projects are to be compared with one another then benchmarks will be needed to determine acceptable and good practice levels of carbon impact, both from construction and eventual usage.
- 4.13 The Carbon Trust's Baseline Tools for Local Authorities and for private sector businesses include typical and good practice levels of Electricity and Gas/Oil consumption for different types of buildings (e.g. office, retail, warehousing, housing, public sector buildings, leisure centres etc). These could potentially be used and/or developed further for benchmarking energy use in buildings constructed using Objective 1 funding.
- 4.14 In interpreting PPS22, we understand that GOSW will through regional planning policy require all developments over a certain size to source 10% of the development's energy requirements through renewable energy. In order to substantiate how the development will achieve this, all developers will need to undertake an energy use analysis. Methods being developed to achieve this may be applicable to Objective One projects (see also paragraph 2.25 and 2.26, especially tool kit)

Benchmarking

- 4.15 If carbon savings are to be quantified, then some method of benchmarking (to quantify what emissions would have been created given a different method of delivery of the project) is implicit.
- 4.16 Without a clear benchmark position, in its application, a project could report significant forecast savings in carbon emissions, by putting forward the worst case scenario option for delivery of the project in terms of resultant carbon emissions, thereby suggesting that its chosen method of delivery (the "environmentally sustainable" option) makes carbon "savings" that in reality are only theoretical.
- 4.17 In addition, over time as new technology, policy and legislation advances, practices which were originally considered to make "savings" become established as the standard good practice, so it may be difficult to determine what has been "saved" by a project. For benchmarking to take place a robust "baseline" position (in terms of what practices "save carbon" and what the alternative, less carbon efficient methods are) would have to be set.

Capturing Activity

- 4.18 Accurate carbon accounting would rely not only on a project to fully record its activities, but also on it being able to capture and only record the "additional" activity resultant from the Objective One Investment. It could be difficult to apportion carbon emissions to some additional activity. Data capture systems would need to be set up from the outset of the project (i.e. in advance of monitoring requirements) to ensure that all data required is gathered and does not have to be assembled in retrospect.

Resource Implications

- 4.19 In fulfilling monitoring requirements for capturing and reporting carbon emissions there are clearly resource implications for applicants/project deliverers, and for the Objective One office - e.g. support to projects in completing their carbon monitoring information, aggregation of data at programme level.
- 4.20 We would suggest that at the project monitoring stage, it might be that to begin with activity data would be provided by projects and then carbon emissions calculations applied by the Objective One Office

Extent of Monitoring

- 4.21 Using the example of Capital Build projects - there are some simple measures which might be fairly easily captured, but there is a broad spectrum in terms of the effort to which one *could* go to capture a whole variety of different carbon emissions/savings associated with the building. Clear and standardised guidelines about what does and does not have to be captured and what does and does not "count" in the carbon accounting for all projects would have to be set out, especially if projects are to be compared with one another by their carbon emissions at application or evaluation stage.
- 4.22 Although a purist method would undoubtedly seek to capture all emissions associated with projects, applying some sensible limits on what is and is not accounted for could make the difference between a monitoring system that is unwieldy and therefore unsuccessful and one which provides an admittedly partial picture, but which is manageable and can be used to make comparisons between projects and over time. Focusing on the carbon emissions resultant from the direct outputs of projects would seem to make sense.

Performance Assessment

- 4.23 Promoting activities which reduce carbon emissions would not necessarily require the same level of detail as monitoring the carbon effects of projects. A simpler approach may be possible, which weights different carbon saving activities according to the scale of their impact (analysis would be required to do this weighting process) and "scores" projects according to whether and at what level they apply those carbon saving activities. Clearly, such an approach is not quantitative and does not generate a measure of "environmental outcome" (i.e. tonnes of CO₂). However, in the short term it could provide a stepping stone towards more robust carbon accounting.
- 4.24 Current work for DEFRA by the Centre for Sustainable Energy has begun to draw some conclusions on measuring the environmental impact and environmental sustainability of local authorities and regional bodies (which could for example, include the Objective One Partnership).
- 4.25 The research (not yet finalised) explores the potential for setting carbon targets (based on carbon emissions) for such organisations, focusing on four areas of their activities:
- § Renewable Energy
 - § Transport
 - § Building Energy Performance
 - § Equipment Energy Performance
- 4.26 Discussion has suggested that some activities may be relatively easy to capture in terms of their carbon emissions. However, the monitoring required to capture other effects would be unduly onerous (for example, in relation to tourism, and allocating the carbon emissions of tourists travelling to say Cornwall in relation to the other counties through which they pass). In addition, organisations (like projects) might not be in control of all the factors influencing their carbon emissions.

- 4.27 The study identified in its early phases that setting single targets for such organisation would not be feasible and therefore began to explore different ways of measuring and reducing carbon impact.
- 4.28 Discussion identified that the importance of carbon emissions in terms of environmental impact is such, that the idea of capturing it should not be abandoned because it is difficult. Instead, an approach is being investigated by CSE based on performance assessment - setting a framework around the various practices that can be employed to achieve the aims of these organisations, and assessing their performance depending upon the extent to which carbon saving practices are being implemented.

Further Work Required

- 4.29 Depending on whether the overall aim is to reduce carbon emissions from Objective One funded activities, or account for carbon emissions OR account for carbon savings and compare projects on the basis of their carbon savings, carbon accounting or performance assessment may be suitable to a greater or lesser extent.
- 4.30 Depending on the route chosen, a variety of further work by the Objective One Partnership will be required before measurement of carbon emissions, or performance assessment can be put in place.

If carbon accounting at the project level is to be pursued at the project monitoring stage:

- § User friendly calculators need to be developed, probably one for each project type, although some may be transferable.
- § Use of EU monitoring frameworks for the ETS may become applicable. Guidelines and calculators from this source may prove very useful and progress in their development and application should be followed as the method for using carbon emissions as an indicator in economic regeneration projects is developed. However, we note that this scheme and its monitoring framework will be based on "installations" - i.e. single sites or sets of sites and their activities - and Objective One projects may not manifest themselves as a single site-based set of activities.
- § There will be a need to keep updated records of any other carbon emissions calculators and tools being developed and apply them to Objective One as appropriate.
- § Primary research may be needed - for example to set measures and calculators and conversion factors for sewage waste and printed materials. We have made some initial enquiries regarding the water industry, and it would seem that at a local level carbon emissions may be complicated to measure. Resultant carbon emissions from water supply and waste vary from place to place, dependent upon the predominance of use of gravity pressure, or pumping for the transfer of water and waste (depending on local topography). It may be more feasible to apply a blanket measure calculated from South West Water's region-wide water supply, waste handling and energy consumption figures.
- § There may be a need for individually tailored monitoring tool/reporting requirements for each project/type of project.
- § Baselines for benchmarking savings will need to be set. These will need to gather together indicators and quantify what savings are expected from one practice compared to another (this may be easier across some activities than others - e.g. for construction projects, the number of different materials being used and how their carbon efficiency is determined, could be very complicated).
- § For project application and appraisal in particular, and for accounting for carbon savings (if this is to be done) at the monitoring stage, benchmarking needs to be

included - setting standards as to the expected/good practice levels of carbon emissions that should be expected. A database of benchmarks could be built up over time, from project specific data gathered and averages applied, or for some activities, standard good practice emissions levels may be applicable as a benchmark. Benchmarking could be approached in a different way - e.g. by calculating the ratio of carbon savings:carbon emissions that are made by a project.

- § There is a need to determine whether monitoring includes simply stating what (net or gross) carbon emissions the project is responsible for, and in doing so to separate what is additional (i.e. would not have taken place without the project - see paragraph 4.18) or to measure what carbon savings have been made through particular practices or approaches - the latter could prove more difficult (see benchmarking).
- § Clear guidance will be needed to accompany frameworks/calculators - particularly to ensure that only carbon emissions/savings that are attributable to the investment by Objective One and its match funder are counted. This is also required to ensure that if projects are to be compared using carbon emissions, that a fair comparison can be drawn. Comparisons might only be possible across projects of a similar nature.
- § A pilot programme will be needed to test feasibility further, and refine methodologies.
- § Standardised reporting formats for activities will need to be developed, through piloting with a number of projects, and before rolling out introduction of carbon emissions monitoring. There may be a number of adjustments to be made to how activities are recorded.
- § The Partnership may need to consider carbon emissions against other outputs from projects, i.e. what "value for money" do the project's other outputs represent in terms of their carbon "cost".

Carbon Accounting - Summary

- § Overall, even if projects are expected only to provide activity data (and not translate this themselves into carbon accounting) it remains the case that for most project types, in order to capture activity data, some considerable effort will be required.
- § Education programmes will be needed to achieve this level of detailed monitoring. There will need to be clear guidance notes on what to be included, the level of detail required and at what stage in the project cycle, information is required.

If a Performance Assessment approach is to be taken:

- § Frameworks would need to be developed. It might be appropriate to link with the work being undertaken by CSE for DEFRA
- § Projects would need to be prepared, guided appropriately from the application stage onwards.
- § As is the case with any project monitoring, projects would have to gather evidence to substantiate the practices against which they are being assessed - again clear guidance on what records to keep and how to prepare information for performance monitoring would be needed.

Performance Assessment - Summary

- § This represents a way forward which could potentially be progressed relatively easily from now (in partnership with DEFRA), which may be less onerous on projects than carbon accounting, but still allows the Partnership to pay attention to carbon emissions as an important factor in climate change

- § It represents a phased approach, raising consciousness and awareness at the project application stage potentially through a system which scores its proposed practices, and then prepares projects for performance monitoring against that appraisal.

APPENDIX 1

Activities that can be Measured for Carbon Emissions

Activities that can be Measured for Carbon Emissions			
General Activity Category	Energy Consumption/Material used/Activity	Data required Measure	Source of Calculator/Conversion Factor
Energy use - Heat light etc	Electricity	KWh	National Energy Foundation Energy to Carbon Dioxide Converter
	Gas	Kwh	"
	Gas	therms	"
	Gasoil or diesel	Litres	"
	Electricity	kWh	DEFRA Fuel Conversion Factors
	Natural Gas	kWh/ therms/ tonnes	"
	Gas/ diesel oil	kWh/ litres	"
	Heavy fuel oil	Tonnes/ kWh	"
	Coal	Tonnes/ kWh	"
	LPG	kWh/ therms/ litres	"
	Coking coal	Tonnes/ kWh	"
	Jet kerosene	Tonnes/ kWh/ litres	"
	Coal	tonnes/ kWh	Carbon Trust Baseline Tool
	Electricity	£/ kWh	"
	gas	M ² / kWh	"
	LPG	Kg/ kWh	"
	Oil	Litres/ kWh	"
	Area	M ²	"
Transport			
	Diesel	Litres	National Energy Foundation Energy to Carbon Dioxide Converter
	Petrol	Litres	"
	LPG	Litres	"
	Coal	Tonnes	"
	petrol car	miles	"
	Train or bus	Miles	"
	Aeroplane	miles	"
	Fuel used- petrol	Litres	DEFRA Transport Conversion tables
	Fuel used- diesel (inc. low sulphur)	litres	"
	Fuel used- compressed natural gas	Kg	"
	Fuel used- liquid petroleum gas	litres	"
	Size of car and distance- small petrol car Max 1.4 litre engine	Miles/km	"
	Size of car and distance- medium petrol car from 1.4 to 2.1 litres	Miles/km	"
	Size of car and distance- large petrol car above 2.1 litres	Miles/km	"
	Size of car and distance-	Miles/km	"

Activities that can be Measured for Carbon Emissions			
General Activity Category	Energy Consumption/Material used/Activity	Data required Measure	Source of Calculator/Conversion Factor
	average petrol car		
	Size of car and distance- small diesel car 2.0 litre or under	Miles/km	""
	Size of car and distance- large diesel car over 2.0 litres	Miles/km	"
	Size of car and distance average diesel car	Miles/km	"
	Rail	person/kms traveled (pkm)	"
	Air- long haul	person/kms traveled (pkm)	"
	Air- short haul	person/kms traveled (pkm)	"
	Freight road mileage- articulated lorry	Tonne/km*litres fuel per km	"
	Freight road mileage- rigid lorry	Tonne/km*litres fuel per km	"
	Freight- rail	Tonne/km	"
	Freight- air- long haul	"	"
	Freight- air- short haul	"	"
	Shipping- small ro-ro (1,268 deadweight tonnes)	"	"
	Shipping- large ro-ro (4,478 deadweight tonnes)	"	"
	Shipping- small tanker (844 deadweight tonnes)	"	"
	Shipping- large tanker (18,371 deadweight tonnes)	"	"
	Shipping- small bulk carrier (1,720 deadweight tonnes)	"	"
	Shipping- large bulk carrier (14,201 deadweight tonnes)	"	"
	Air - Long Flight	Miles/ km/ litres of fuel	Carbon Trust Baseline Tool
	Air - Short Flight	"	"
	Car - Diesel Lrg	"	"
	Car - Diesel Sml	"	"
	Car - LPG	"	"
	Car - Petrol Lrg	"	"
	Car - Petrol Med	"	"
	Car - Petrol Sml	"	"
	FUEL - Diesel-Litres	"	"
	FUEL - LPG-Litres	"	"
	FUEL - Petrol-Litres	"	"
	Lorry - Diesel Articulated	"	"
	Lorry - Diesel Rigid	"	"

Activities that can be Measured for Carbon Emissions			
General Activity Category	Energy Consumption/Material used/Activity	Data required Measure	Source of Calculator/Conversion Factor
	Lorry - LPG Articulated	"	"
	Lorry - LPG Rigid	"	"
	Lorry - Petrol Articulated	"	"
	Lorry - Petrol Rigid	"	"
	Rail (or Diesel Coach)	"	"
Water Supply	0.601 kWh of electricity per m3 of water supplied.	kWh of electricity	Environment Agency Nappies Study
Waste Water/Sewage	0.598 kWh per m3 of sewage treated.	"	"
Construction			
	Roadstone	Tonnes embodied CO ₂	BRE Sustainable Construction Data
	Cement	"	"
	Concentrated aggregate	"	"
	Other aggregate	"	"
	masonry	"	"
	Iron and steel	"	"
	Wood	"	"
	Plaster and board	"	"
	other	"	"
Waste	Metal wastes, e.g. aluminium cans & steel cans	Tonnes- (results are given in metric tonnes of carbon equivalent- MTCE)	US EPA WARM Model- Conversions are provided depending on the waste option used, e.g. landfill, combustion, composting, recycling & reduction
	Glass	Tonnes	"
	Cardboard & paper e.g. boxes, office paper, newspaper, phone books etc	Tonnes	"
	Organic waste, e.g. leaves, branches, food waste	Tonnes	"
	Wood products, e.g. fibreboard, lumber etc	Tonnes	"
	plastics	Tonnes	"
	Computer equipment, e.g. printers, computers	Tonnes	"
	Building waste, e.g. bricks, aggregate	Tonnes	"
Buildings and Structures	Insulation properties	U Values	BRE U Values Calculator/Conventions for U Value Calculations

APPENDIX 2

Consultees

The Table below shows organisations and individuals consulted and our progress towards completing these consultations. It also notes additional contacts to which we have been referred but where it has not been possible to make contact within the scope of this study.

	Organisation	Contact Name	Referrer	Attempted	Completed	Additional Contact (A)
1	Centre for Sustainable Energy	Simon Roberts	Mike Twomey	Y	Y	
2	Community Energy Plus	Ian Smith	Mark Yeoman	Y	Y	
3	Community Energy Plus	John Edwards	Ian Smith	Y	Y	A
4	Environment Agency	Donna Sibly	Mark Yeoman	Y	Y	
5	Environment Agency	Tim De Winton		Y	Y	
6	Environment Agency	Martin Fodor	Tim De Winton	Y	Y	A
7	Environment Agency	Simon Bingham	Martin Fodor	Y	Y	A
8	FWAG (Farm Environment Link)	Paula Hitchens	Mark Yeoman	Y	Y	
9	FWAG	Rosalee Goldsworthy	Paula Hitchens			A
10	FWAG	Edward Strawbridge	Paula Hitchens			A
11	National Trust (Kynance)	Kevin Marsh	Mark Yeoman	Y	Y	
12	GOSW	Mike Twomey	Mark Yeoman	Y	Y	
13	National Trust	Mike Hardy	Kevin Marsh			A
14	National Trust	David Griffiths	Kevin Marsh			A
15	NETCEN	www.netcen.co.uk	Simon Bingham			A
16	South West Energy and Environment Group	John Crabb	Mark Yeoman	Y	Referred to alternative contact	
17	South West Energy and Environment Group	Tony Norton	John Crabb	Y	Y	
18	SWRDA (Tolvaddon)	Miles Cardin	Mark Yeoman	Y		
19	Working Woodlands	Caroline Harrison	Mark Yeoman	Y	Y	
20	Working Woodlands	Chris Bow	Caroline Harrison			A
21	Forum for the Future	Vanessa Mamo-Mason	Donna Sibley	Y		A

Continued overleaf...

	Organisation	Contact Name	Referrer	Attempted	Completed	Additional Contact (A)
22	Carbon Sense	Antony Turner	Donna Sibley	Y	Y	A