Common Approach to Carbon Assessments in the Public Sector

Purpose

1. This paper describes the uses of carbon assessments, offers suggestions on how consistency could be improved, proposes some common principles which public bodies could consider, and seeks views on next steps.

Background

2. With the introduction of the Climate Change (Scotland) Act, the Public Bodies Climate Change Duties and the CRC Energy Efficiency Scheme, there is an increased focus on the emissions consequences of public bodies' operational, policy and service delivery decisions. In order to gauge the emissions impacts of these decisions, organisations need to undertake carbon[1] assessments. As this is a new area for many bodies there are considerable uncertainties around the 'best' approach to carbon assessments.

3. This paper builds on guidance to public bodies on complying with Climate Change Duties[2] which asks public bodies, particularly 'major players' to "Consider using carbon assessments to ensure that carbon is factored into all decision making. Internal procedures and processes should be put in place using qualitative or quantitative assessments."

Uses of Carbon Assessments

4. Carbon assessments are required to understand the impact of decisions and actions on greenhouse gas emissions. It is important to be clear as to why monitoring or assessing emissions is believed to be required - often a qualitative assessment is all that is needed, although more involved quantitative assessments may be suitable for significant policies and projects.

5. There are a number of possible assessment approaches, and the suitability of each depends on the purpose of the assessment. There is no single approach, methodology or tool that fits all circumstances.[3]

6. Table 1 summarises the main purposes/types of carbon assessments, splitting between different 'levels' of assessments (from strategic to operational) and whether the assessment is needed to inform a decision (*ex ante*) or to measure and evaluate the impact of previous decisions (*ex post*).

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[1] 'Carbon' is used as a short hand for the basket of 6 greenhouse gases.

[2] Draft guidance was published for consultation on 20 September. Consultation closes on 26 November and final guidance will be available by 1 January 2011 or as soon as practically possible thereafter.

[3] The terminology and methods used can be complex. Terms such as carbon 'accounting', 'assessment' and sometimes 'management' are used interchangeably and 'footprint' is sometimes applied to any type of carbon assessment. This paper uses the term 'assessment' throughout.

Table 1: Main Purposes/ Types of carbon assessments

	Assessment to inform a decision. (*'ex ante' assessment*)	**Measuring and monitoring actual emissions (*'ex post' assessment*)**
Strategic Assessment	e.g. total emissions trajectory based on economic growth, sector developments, policy assumptions and modelling of different scenarios.	e.g. Scotland's Greenhouse Gas (GHG) inventory for statutory reporting. e.g. Scotland's carbon footprint for statutory reporting.
Policy Assessment (incl. spending)	e.g. assessment of a particular energy or transport policy using the Scottish Carbon Impact Assessment Guidance (which is still to be rolled out and builds on available DECC guidance[4]) or Scottish Transport Appraisal Guidance (STAG)[5] as part of policy development. e.g. High-level Assessment of the Scottish Government draft budget.	e.g. evaluation of actual impact of energy efficiency policy.
Service Delivery	e.g. assessment of emissions changes produced by different Scottish Enterprise projects. e.g. options for waste collection services e.g. regulatory decision making under the Controlled Activities Regulations (CAR)	e.g. evaluation of effectiveness of insulation scheme.
Capital & Procurement Assessment	e.g. assessment of the emissions embedded in infrastructure under different construction options. e.g. whole-life carbon impact of different products to be procured.	e.g. energy used in practice by procured products.
Corporate/ Operational Assessment	e.g. assessment of different operational practices (IT use, travel, etc.).	e.g. direct organisational emissions (for CRC Energy Efficiency Scheme reporting or Carbon Trust Carbon Management Plan). e.g. organisational carbon footprint (to gauge wider impact of organisation beyond its functional borders)

[4] See http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/valuation/valuation.aspx

[5] See http://www.transportscotland.gov.uk/stag/home

Setting the Parameters for an Assessment

7. One can choose different approaches and emission scopes for each of the assessments described in the table above.

Approaches

8. There are two basic approaches to choose from:

    - *Production-based* emissions only capture the emissions caused directly by a particular entity – in the case of Scotland this encompasses all domestically produced emissions, and this definition can equally be applied for a local authority area or a public sector organisation.[6]
    - *Consumption-based* emissions are more comprehensive and look at all the emissions that are attributable to the choices/behaviour of a particular entity (including the direct emissions caused by the fuel consumed (i.e. *production-based* emissions) but also, for example, the indirect emissions caused by the production of procured goods).[7]

9. For Scotland, the difference between *production- and consumption-based* emissions is the difference between the emissions 'embedded' in (i.e. caused by the production of) imports and those embedded in exports. Scotland is not consuming its exports, and therefore is not deemed responsible for the emissions caused in their production from the consumption perspective. The term carbon *footprint* is shorthand for the *consumption-based* emissions of a particular entity (be it Scotland, a local authority area, or an organisation).

Scope of Emissions

10. There is also a considerable degree of freedom in choosing the emissions that are 'in scope' of the assessment from the perspective of a particular body.

    - *Direct* emissions are those caused by the organisation through industrial process emissions or in the burning of fuels (e.g. for heating or in the use of its own vehicle fleet). These are also called *'Scope 1'* emissions, following a convention by the GHG Protocol[8].
    - *Indirect* emissions are all other emissions. These can be subdivided into *'Scope 2'* (indirect electricity) and *'Scope 3'* (indirect other). The Scope 3 category is very wide and not assessed easily. Emissions *embedded* in - caused by the production of - goods and services procured from others are also indirect emissions.

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[6] Production-based emissions are generally estimated by using information on, for example, fuel use and the application of a 'carbon equivalence factor' to translate the fuel use into carbon emissions.

[7] See Annex 2 for further information on the methods applied to estimate consumption-based emissions.

[8] The GHG Protocol is a partnership between the World Resources Institute and the World Business Council for Sustainable Development and has developed accounting tools that have been transposed into ISO and BSI standards (http://www.ghgprotocol.org/).

11. It is possible to differentiate between emission scopes in another way.

    - *Corporate/Operational* emissions arise from the day-to-day running of the organisation (*Scope 1* emissions and may include Scope 3 emissions – depending on how wide the influence of the organisation is to be drawn. Business travel emissions might be included as the extent of those depends on modal choices that are within the control of an organisation).
    - *Upstream* emissions are caused by the supply chain to an organisation (these include *Scope 2* and *3* emissions).
    - *Downstream* emissions are caused by the use of the outputs of an organisation (all *Scope 3*).

12. For a particular combination of approach and scope, different assessment tools can be developed. For example, when investigating the impact of transport investment options, both *upstream,* '*consumption-based*' emissions caused by infrastructure construction as well as the *downstream*, *'production-based'* changes in traffic patterns and infrastructure use need to be considered. For the *upstream* emissions, the impact of different production methods need to be analysed, using life-cycle analysis[9]. For the *downstream* emissions, a transport model is central to assessing the extent and impact of traffic changes. Translating the changes in behaviour (e.g. the use of public rather than private transport) into 'carbon equivalents' is then relatively simple by applying appropriate emission factors (e.g. carbon emissions per person kilometre in a petrol car).[10]

A Common Approach

13. Due to the complexity of carbon assessments, there is considerable lack of clarity in when and how to use them and what they can be expected to achieve in practice.

14. While a single comprehensive assessment tool may be desirable, this is not achievable given the fundamentally different assessment purposes. Introducing simple and transparent assessments that foster a common understanding of the issues is likely to be more effective in the short term than increasing the sophistication of the tools and the underlying methods. In time it may be possible and appropriate to build up the coverage, deepen the level of analysis and develop common methodologies for specified purposes.

15. An important benefit of following the same, agreed principles is to reduce ambiguity, enable comparability of assessment results and reach a common understanding. To achieve a common approach across the public sector, we need to achieve three objectives:

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[9] See Annex 2 for an explanation.

[10] Such factors and further assessment guidance is presented in the Scottish Carbon Impact Assessment (SCIA), which is based on DECC guidance (http://www.defra.gov.uk/environment/business/reporting/pdf/20090928-guidelines-ghg-conversion-factors.pdf).

- Increase understanding of the role of carbon assessments and agreement on a set of broad principles. Annex 1 provides a draft set of principles which, with wider public sector uptake, could encourage a consistent approach to carbon assessments. Each principle comes with a proposed recommendation.
- Reaching agreement/co-operation on implementation details of particular types of assessments (so that, for example, capital projects are assessed in the same manner).
- Developing on-going exchange of experiences, ideas for improvement and information on new developments.

Implementing a Consistent Approach across the Public Sector

16. Possible ways to fostering the common approach mentioned above are set out below.

Carbon Assessment Forum

17. To bring together relevant officials, a carbon assessment forum might help develop knowledge exchange and foster common understanding. This could be organised by the Scottish Government, meeting quarterly for the rest of 2010/11 and half-yearly to yearly thereafter. The idea would be to share experience of assessing carbon in practice, to present new approaches taken in different areas and to discuss ways of improving assessments. The membership should not exceed 15 to 20 members in order to enable more technical discussions and would involve officials undertaking or commissioning assessments.

18. For particular areas (e.g. capital construction assessments), key bodies need to get together and co-ordinate their approaches. Additionally, a mechanism is required to communicate progress to the wider public sector that is not directly involved in the forum.

Bank of expertise

19. Driven by the ambitious greenhouse gas emissions reduction targets and more specifically for the public sector, the Public Bodies Climate Change Duties, carbon assessments are becoming increasingly common. Carbon assessment expertise in pubic bodies is currently sporadic and ranges from no expertise in some organisations to extensive expertise in others. An option would be to pursue the idea of a bank of expertise sitting in one or more public sector organisations to help build capacity across the public sector, offering knowledge transfer from assessment experts. Work on this bank of expertise could be co-ordinated by the carbon assessment forum but the knowledge transfer may require extra resourcing where the assessment experts take on significant additional responsibilities.

Wider/International Forum

20. Scotland is not isolated in its objective to carry out carbon assessments of policies. A wider forum to share experience with other organisations (private businesses or universities) or countries could be established. Otherwise, there is a risk of reinventing the wheel where good practice may already exist elsewhere. This approach need not be limited to Europe.

Network to support local authorities

21. Under the Public Bodies Climate Change Duties, local authorities are required to consider greenhouse gas emissions, adaptation and sustainability when carrying out their functions. As all local authorities discharge similar functions it would be desirable for them to use comparable techniques and co-ordinate their assessment approaches.

22. Consideration could be given to whether the role of local government support organisations, such as the Sustainable Scotland Network (SSN) who provide local authorities with advice on footprint assessments, can be extended to include support on carbon assessments.

23. An event (or possibly a series of events) to bring local authority practitioners together and to present possible approaches in key areas (data recording, procurement assessments, assessment and accounting methodologies) could be a first step towards co-ordinating and supporting carbon assessments in local authorities.

Annex 1 – Draft Key carbon assessment principles

Key principles are set out below which aim to establish a consistent approach to carbon assessments in the Scottish public sector.

1.1 Transparency

To allow for the proper scrutiny and understanding of assessment results, data sources, methodologies, conversion factors and assumptions need to be documented properly and should be made publicly available. The multitude of possible approaches make it impossible to fully understand the results of an assessment without knowing the source data and the assumptions that have been made and thus enable a judgement of their validity and the comparability of the results to other assessments.

The key parts of the calculation should be recorded and be capable of being sourced and followed. The approach (method, emission scopes, GHG gases under consideration, etc.) should be clearly defined and significant assumptions should be stated. All assessments should be publicly available.

1.2 Clear and consistent Setting of Baselines

Baselines need to be set in order to gauge the impact of policy action. For statutory carbon targets[11] the GHG inventory, which is compiled according to internationally agreed accounting principles, provides baseline data (e.g. the 1990 and 1995 baselines for the Scottish emissions targets).

For ex-ante carbon assessments, clear business-as-usual baselines have to be defined in order to gauge the differential impact of a certain course of action over time (its 'additionality'). For example, the impact of improving public transport has to be evaluated in the context of growing affluence and rising travel intensity in order not to overestimate possible reductions in carbon emissions.

For procurement decisions, a 'reference' emission value could be defined for particular goods to be procured to gauge emission savings relative to the reference case.

For measuring and monitoring emissions that are already happening (ex post), the baseline should be based on the most recent available data and thus reflect any baseline revisions.

Public bodies need to use the same key baseline macroeconomic scenarios (economic growth, fuel price trajectories, etc.) in order to allow for consistent and comparable assessments. Baseline assumptions need to be stated, the most recent data should be used and, where possible, taken from publicly available sources.

1.3 Clear and consistent setting of Emission Boundaries (or 'Scopes')

Emission scopes are set in relation to the functional boundaries of the organisation in question, looking at the direct and indirect effects resulting

[11] The greenhouse gas emissions reduction target in Scotland is to reduce annually recurring emissions by 80% in 2050 from the 1990 baseline for carbon dioxide, methane and nitrous oxide and from the 1995 baseline for sulfurhexafluoride, hydrofluorocarbons and perfluorocarbons.

from the actions/policies of an organisation. The 'scope' of an assessment delineates the limits to which *upstream* carbon emissions (caused by the inputs used by the organisation) and *downstream* (caused by the use of the outputs of an organisation) are being included in an assessment.

The Greenhouse Gas Protocol[12] initiative provides guidelines and standards for corporate reporting (ISO 14064 is very similar and is based on the GHG Protocol) and divides emissions into different 'scopes'. *Scope 1* emissions are GHG emissions that occur *directly* from sources that are owned or controlled by an organisation. *Scope 2* emissions are electricity *indirect* emissions and account for the emissions from the generation of purchased electricity. *Scope 3* emissions are all other *indirect* GHG emissions: The extent of reporting on *Scope 3* emissions depends on how far 'upstream' (e.g. emissions caused by building a road) and 'downstream' (e.g. emissions caused by road use) the organisation accounts for the emissions generated by its existence.

The choice of scopes is linked to the decision on the approach taken, i.e. whether to focus on *production-based* or *consumption-based* emissions.

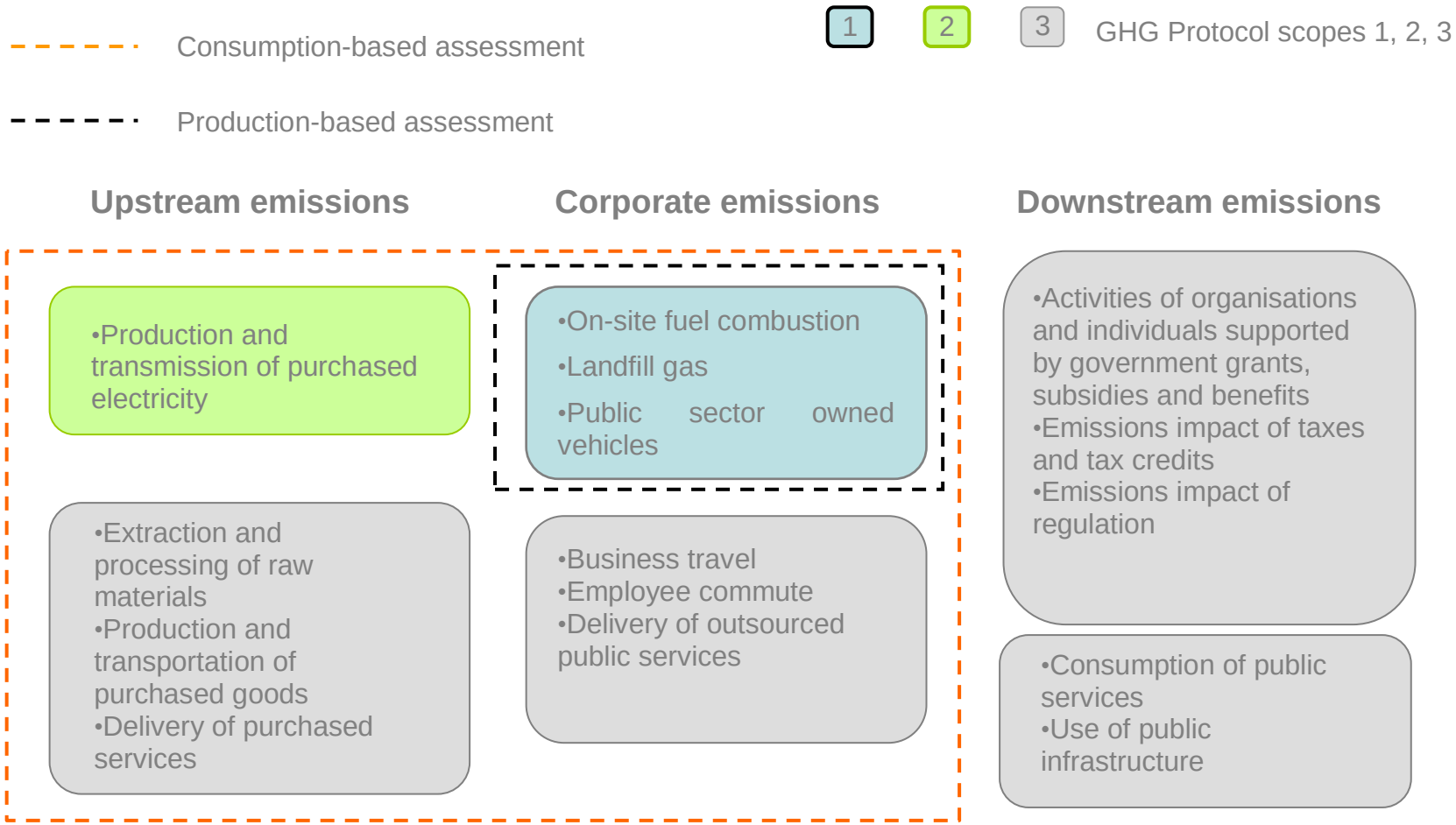
For Scotland as a whole, *consumption-based* emission estimates include emissions embedded in imports and are thus not directly aligned with Scotland's statutory emissions reduction targets, which relate to domestic, production-based emissions only. However, under section 37 of the Climate Change (Scotland) Act, Scottish Ministers must also report consumption-based emissions.

A production-based focus can lead to 'exporting' of emissions – i.e. choosing overseas suppliers over domestic suppliers would mean overseas emissions not being included against emissions targets. This is a particular issue in public procurement and construction projects. The whole-life carbon impact of an investment needs to be considered (taking account of *consumption-based* carbon embedded in products and emitted in construction, as well as the 'in use', operational emissions).

Ultimately, it is global emissions that need to be reduced, whether at home or abroad. Statutory targets are set on domestic emissions as these are under national control and are more clearly delineated. A *consumption-based* approach puts responsibility for emissions on consumers rather than producers and is an equally valid perspective for evaluating policy options – in particular when public expenditure is directed at the consumption of/investment in goods and services.

The diagram below demonstrates the multiple scopes that delineate the emission boundaries of an assessment.

[12] http://www.ghgprotocol.org/


Consumption-based assessment
Production-based assessment
1
2
3
GHG Protocol scopes 1, 2, 3
Upstream emissions
Corporate emissions
Downstream emissions
•Production and transmission of purchased electricity
•On-site fuel combustion
•Landfill gas
•Public sector owned vehicles
•Activities of organisations and individuals supported by government grants, subsidies and benefits
•Emissions impact of taxes and tax credits
•Emissions impact of regulation
•Extraction and processing of raw materials
•Production and transportation of purchased goods
•Delivery of purchased services
•Business travel
•Employee commute
•Delivery of outsourced public services
•Consumption of public services
•Use of public infrastructure

Where possible, public bodies should report on their organisational scope 1 and scope 2 emissions (for the largest organisations this is mandatory under the CRC).

Where Scope 3 emissions are included, bodies assessing similar policies should assess the same Scope 3 emissions.

Where possible, Scope 3-corporate emissions (business travel, etc) should be considered in the optimisation of business processes/location decisions as part of the organisation's carbon management strategy.

Where possible, Scope 3-upstream emissions (e.g. inputs to construction projects) should be considered in procurement/investment decisions. Key public sector organisations are encouraged to agree a common approach (e.g. Transport Scotland, Scottish Water, NHS, LAs)

Where possible, Scope 3-downstream emissions should be considered in the assessment of public sector mitigation policies and, where appropriate, should take account of consumption-based emissions as well as the production-based impact and not stop at arbitrary geographical boundaries.

1.4 Clear and consistent Setting of Geographical Boundaries

Setting consistent geographical boundaries in assessments across the public sector is necessary to make assessments of different bodies comparable. For example, the emission consequences of a large development project can be investigated from a local or a Scotland-wide perspective. For example, while the net emissions impact of a major transport project within a local authority area may be negative, the Scotland-wide impact could be positive if, for example, commuting distances and emissions are reduced as a consequence of the project. If the assessment boundaries are limited to the local authority area, the emission impact cannot be compared to other projects that also have a wider regional impact and affect the emission balance across local authority boundaries

Where there are impacts beyond Scotland – e.g. by supporting the development carbon-saving technology that is used outside of Scotland – the domestic and international impacts should be separated to be able to gauge the effect on target achievement within Scotland (and possible 'leakage' outside of Scotland – i.e. changes in Scotland lead to emissions increase in another country).

As far as practically possible (with respect to the cost of modelling), geographical assessment boundaries should be set to the largest area in which significant impacts are to be expected. Apart from out-of area impacts the assessment should report the Scotland-wide net impact.

1.5 Reporting Persistence of Carbon Impact

The statutory greenhouse gas emissions reduction targets in Scotland are to reduce *annually recurring* emissions. The carbon impact assessments of public sector action need, therefore, to differentiate between one-off savings/increases and permanent savings/increases.

State clearly whether savings/increases are one-off or recurring or what time period they cover. Both recurrent and one-off savings are valuable and need to be considered.

1.6 Target/Non-target treatment

1.6.1 Treatment of traded sector[13]

In the Scottish Net Emissions Account[14], traded-sector emissions follow the trajectory of the emissions cap set by the EU. Thus, the Account does not take account of actual emissions in the traded sector and they are not immediately relevant for target attainment. This does not mean, however, that the reduction of emissions within the traded-sector should be of a lower priority when looking for emissions savings.

Reductions in traded-sector emissions should be part of the assessment but the lack of impact on the Scottish Net Emissions Account should be recognised.

1.6.2 Treatment of consumption-based emissions

While Scotland's statutory emissions reductions targets are set in terms of domestic, production-based emissions, the Climate Change (Scotland) Act also requires consumption-based emissions to be reported. Limiting analysis to domestic emissions could give rise to decisions which 'export', rather than reduce, emissions (e.g. using overseas building materials instead of domestically produced ones).

State clearly whether your assessment is production- or consumption-based. Any production-based assessment should also consider the possible impacts under a consumption-based approach.

1.7 Consistent Emission Conversion Factors

Defra and DECC provide conversion factors for fuels, industrial processes, electricity and transport options, etc.[15]

Assessments should apply conversion factors provided by Defra and DECC. Where Scottish-specific factors are available, their use should be considered.

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[13] The traded sector encompasses all installations that fall under the EU Emission Trading Scheme (EU-ETS). The level of permits traded (emissions permissible) and the reduction of emission levels over time are set by the EU.

[14] The Scottish Net Emissions Account is the basis for measuring achievement of statutory emission targets. It encompasses all non-traded emissions as well as traded-sector emissions attributable to Scotland under EU-ETS. It differs from actual emissions in so far as the traded sector has emitted more or less than its allocation (i.e. bought or sold more permits than are attributed to the traded sector in Scotland). If, for example, actual traded-sector emissions are lower than those attributed to Scotland, there is an upward adjustment in the Net Emissions Account to account for the fact that an installation in another EU country is using permits from Scotland (EU-wide emissions have not been reduced, just shifted away from Scotland but Scotland is still 'responsible' as it sold the permits).

[15] http://www.defra.gov.uk/environment/business/reporting/conversion-factors.htm

1.8 Policy Overlaps

All decisions are made within a given policy context and it is necessary to be clear about the causality of impacts deriving from a particular policy in order to avoid double counting.

For example, the emissions impact of particular policies can be recorded (and double-counted) at different levels: the SG might tighten building standards and assess the impact of this at a Scottish level and a local authority, in applying these building standards to its buildings, could make another assessment of the emissions impact.

In other cases, the system-wide impact is already accounted for in a particular assessment methodology. For example, the declining transport emission factors in the Defra/DECC guidance take into account the electrification of transport over time.

When undertaking assessments possible policy overlaps should be stated so that the relationship between stated emissions impacts is clear.

1.9 Consistent Carbon Price

It can be useful to monetise the carbon costs and benefits of different options to achieve comparability of impacts.

There are several concepts behind carbon values: these include damage cost (cost of an additional tonne of carbon dioxide in the atmosphere), mitigation cost (cost of reducing the amount of carbon dioxide in the atmosphere by a tonne). It is therefore important to be clear and transparent about the type of carbon value used in the assessments.

DECC provide a time series of the 'target-consistent'[16] price of carbon (reflecting the increasing costs of mitigating emissions over time, rather than the damages caused by climate change). DECC carbon values are different for the traded and non-traded sectors, reflecting lower mitigation costs in the traded sector (until the year 2029 – from 2030 onwards carbon values are identical and based on global marginal abatement costs on the assumption that carbon will be traded worldwide and that the globally most cost-effective options at a particular point in time determines the carbon price).

There are several potential problems when using DECC estimates in Scottish public bodies:

The difference between traded and non-traded carbon values can pose problems where a project in the non-traded sector (e.g. hydro scheme) that, in theory, leads to a substitution in the traded sector (e.g. closing down of conventional power plant). As the DECC carbon price denotes *the opportunity cost of mitigation within a specific sector rather than the damage cost of carbon emissions* the traded-sector price should be applied to non-traded sector measures if they impact on the traded sector (e.g. electricity generation).

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[16] Consistent with UK, rather than the more ambitious Scottish, targets (http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/valuation/valuation.aspx).

The DECC approach uses UK targets and global abatement effort, while Scottish Ministers have set more ambitious targets and expressly demanded that target achievement should be based, as far as possible, on domestic effort, which would lead to higher marginal abatement costs. As there is currently no information on what these costs might be, the DECC price is the next best alternative.

There is also the issue that these estimates focus extensively on mitigation (mitigation costs) whereas adaptation also plays a key role in the Climate Change (Scotland) Act.

If monetisation is deemed useful, DECC carbon prices should be applied when undertaking a cost-benefit assessment but a very clear indication that they have been used and clear presentation of their limitation is required for transparency. Where monetisation is not deemed appropriate, a multi-factor analysis including a carbon weighting is an option.

Annex 2 - Consumption-based emission assessment methodologies and some of the associated applications/tools

Two basic methodologies can be applied in the assessment of *consumption-based* emissions:

- *Environmentally extended input-output analysis (EIO)* uses the production inter-relationships within an economy to calculate the use of intermediate inputs and associated emissions in the production of a particular output.
- *Life-cycle analysis (LCA)* looks in detail at the carbon emitted in the different production processes in the supply chain, use and disposal of a particular product.

Environmentally Extended Input-Output Model

All upstream inputs for a certain amount of economic output/final demand for an industry are recorded through the Input-Output model. Using information on direct GHG intensity of production per industry one can then derive total GHG emissions per unit of final demand.

To fully capture global emission consequences of domestic demand, trade flows and production conditions abroad need to be incorporated using Multi-regional IO models. One source for these IO tables is GTAP (Global Trade Analysis Project), which contains input-output tables and bilateral trade statistics.

This method can be used to calculate national/regional footprints and is also applied to the assessment of the Scottish Draft Budget. It links final demand expenditure to the carbon impacts of the production necessary to satisfy that demand and accounts for all the carbon *embedded* in the goods and services demanded.

As it is based on a whole-economy model it provides a comprehensive and comparable analysis of the carbon consequences of industrial outputs. Its main drawback is the high level of aggregation that limits the analysis to ca.120 domestic sectors (and fewer sectors in the international data tables). The sectoral approach is not well suited to analysing the carbon/environmental consequences of the production of particular goods and services.

Including land-use intensities per industry and converting carbon emissions into land equivalents (i.e. the land required to absorb emissions through vegetation) allows for the calculation of ecological footprints.

Life-Cycle Analysis

LCA looks in detail at the carbon emitted in the different production processes and the use of a particular product ‘from cradle to grave’ (or ‘from cradle to cradle’ if recycling is included).

Attributional LCA shows the emissions associated with the processes directly used in producing a particular good or service through a specific process. It doesn't double-count emissions across different product systems.

Consequential LCA analyses the total GHG consequences of producing and consuming additional units of a product or service. It looks at the marginal global impact of consumption.

For example, the use of sustainable palm oil will have lower carbon consequences in an attributional LCA, where the particular sustainable production process is investigated, than in a consequential LCA, where the substitution of sustainable with unsustainable palm oil by other users is also taken into account.

Attributional LCA is useful for product labelling, and it can help to identify "hot spots" for reducing emissions in the supply chain.

Consequential LCA is useful for understanding the total changes in emissions which result from the decision to consume a product. (e.g. to identify biofuels which create a net reduction in total emissions).

Environmentally Extended Input-Output (EIO) vs. Life-Cycle Analysis (LCA)

EIO is based on industry-average emissions and works at a high level of aggregation and therefore does not allow for the analysis of different production options like LCA.

Conversely, LCAs are produced on very different bases and lack the comparability and coherence of EIO analysis and are often applied to partial, micro-level processes unlike EIO, which is used at a macro level.

EIO generally reports higher emissions consequences than LCA because knock-on effects are traced through the whole economy and not limited to a particular supply chain.