

22<sup>nd</sup> Meeting of the London Group on Environmental Accounting

Oslo, 28-30 September

**CARBON ACCOUNTING IN THE UK:  
AN OVERVIEW OF PROGRESS AND ISSUES**

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## Introduction

SEEA Experimental Ecosystem Accounting (EEA) identifies carbon as one of four cross-cutting themes that frame our view of ecosystems. Taking a thematic approach to carbon accounting enables carbon information to be assessed in its own right, and also to be used to support the compilation of ecosystem accounts, especially for the estimation of ecosystem extent and condition (stocks) and the measurement of ecosystem services (flows). ‘Such an account would provide partial indicators of ecosystem condition such as net carbon balance... Carbon accounts can also provide information to support measures of the ecosystem services of carbon sequestration and storage of carbon’ (para 4.4.1).

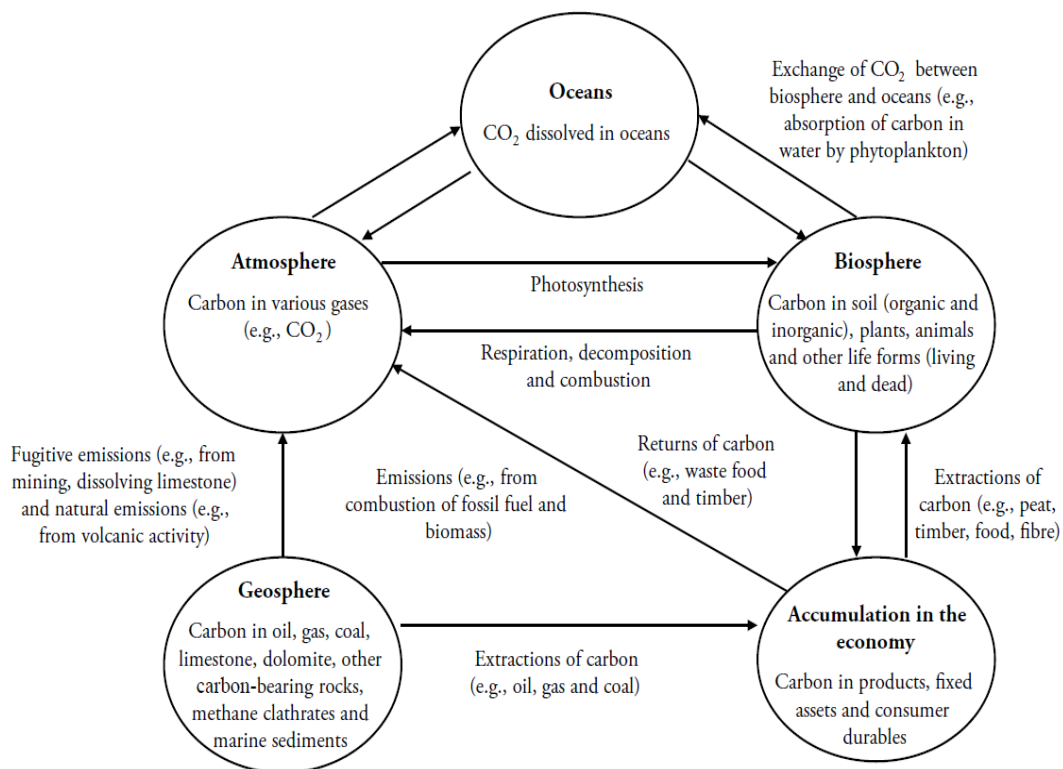
Drawing on guidance from SEEA EEA, and previous work by Ajani and Comisari (2014), ONS undertook work to populate a set of SEEA style carbon stock and flow accounts, and in so doing identify research and information priorities. A link to the accounts can be found [here](#).

The project was part of the ONS’s broader programme of work that aims to incorporate natural capital in UK Environmental Accounts by 2020. This work is being completed in partnership with the Department for Environment, Food and Rural Affairs (Defra).

## Scope of the accounts

The stocks and flows of the carbon cycle give the underlying context for carbon accounting in the carbon accounts.

**Figure 1. The carbon cycle**



Source: Vardon, 2014

The global carbon cycle refers to the biogeochemical cycle by which carbon flows are exchanged between and inside the Earth's various geographic spheres. Broadly, these comprise the: geosphere, the solid part of the earth consisting of the crust and outer mantle; biosphere, the global ecological system integrating all living beings; atmosphere; and oceans.

The main elements of the carbon cycle are presented in Figure 1. In addition to the movement and storage of carbon relating natural processes, Figure 1 builds in carbon accumulated within, and flows to and from, the economy.

Of these five broad stores of carbon, the accounts developed in the UK only cover preliminary stock and flow estimates for selected categories of geocarbon and biocarbon . Appendix 1 profiles our progress in populating the high-level carbon stock account presented in SEEA Experimental Ecosystem Accounts, 2012 (Table 4.6).

Other carbon stores proved more challenging to incorporate into the accounts, mainly because the measurement of the amounts of carbon contained in the oceans (marine environment) and the atmosphere are huge and difficult to measure with any precision. Data sources were also a constraint for the measurement of carbon in the economy, although in principle it is likely that these stores will have a stronger policy relevance.

## Geocarbon

Stock and flow estimates for the geocarbon categories of coal, oil and gas were presented in the accounts. Notable omissions included estimates of limestone and other carbonate rocks.

The broadest measure available for the selected geocarbon resources was adopted, while still attempting to align as closely as is possible to SEEA concepts. This is outlined in Table 1 below.

**Table 1. Definitions of geocarbon deposit types**

| Deposit Type                           |          | Definition   |
|--|----------|--|
| SEEA Reserves                          | Proven   | Virtually certain to be technically and commercially producible i.e. have a better than 90% chance of being produced.  |
|  | Probable | Not yet proven, but have a more than 50% chance of being produced  |
| Possible                               |          | Cannot be regarded as probable, but which are estimated to have a significant – but less than 50% – chance of being technically and commercially producible.             |
| Potential additional resources (PAR's) |          | Not currently technically or commercially producible.  |
| Undiscovered                           |          | Provide a broad indication of the level of oil resources which are expected to exist. However, they are subject to higher levels of uncertainty than reserves and PAR's. |

Source: SEEA Central Framework, OGA

**Issue 1. How to define the boundary of geocarbon stores for the purposes of ecosystem accounting**

In cases where stocks are considerable but large quantities are unlikely to be released by anthropogenic or natural activity within a reasonable time frame, it is questionable whether there is any point in recording the relevant amounts in the accounts. This is the case for coal and limestone deposits in the UK: should the carbon content of all known stocks be recorded or only the geocarbon deposits from which flows in the foreseeable future are expected to come?

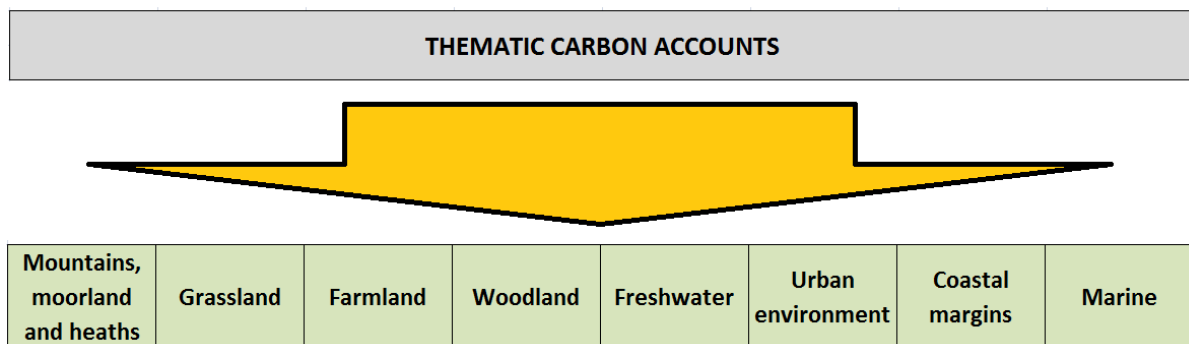
**Biocarbon**

The primary focus of the carbon accounts is on terrestrial habitats/ ecosystems. A lack of data on the carbon stored within, and sequestered by, open water (aquatic) ecosystems meant they were excluded from the analysis.

The carbon estimates for terrestrial and coastal based habitats can be classified into organic soil carbon, vegetation (biomass) carbon, carbon contained in animals living within the ecosystems, and inorganic carbon contained in soils.

Because carbon is one of the condition characteristics included within the physical ecosystem asset accounts, it makes sense to ensure that the biomass carbon accounts adopt the same classification of ecosystem assets as that used in the asset account. This is illustrated in 2 below.

**Figure 2. Thematic carbon accounts’ link to ecosystem accounts**



Indicators relating to carbon can feature in more than one condition characteristic. For example, net carbon balance, which can be derived from the carbon stock, signals the condition of a given habitat through changes in its respective soil carbon stock over an accounting period.

Similarly, the carbon stored in biomass, such as that stored in trees, can be an important indicator of the importance of woodland in supplying other ecosystem services.

**Issue 2. Ensuring no loss of coverage when aligning SEEA habitat classes to IPCC land use classes**

Estimates of carbon flows are generally taken from the Land Use, land use change and forestry (LULUCF) section of the Greenhouse Gas Emissions. This has a classification which accords to the [Intergovernmental Panel on Climate Change \(IPCC\) reporting guidelines](#). Guidance on mapping between IPCC LULUCF Classifications and SEEA-EEA habitat classifications is limited. Guidance

provided by [Weber \(2014\)](#) can be used to concord the two classification systems in the carbon accounts (see Appendix 2).

The LULUCF classification does not include marine ecosystems including those intertidal areas recorded within the Coastal Margins Land Cover category.

***Issue 3. Identifying and isolating carbon flows resulting from natural processes within the LULUCF class of GHG emissions***

The IPCC LULUCF category of GHG emissions reports flows resulting from both anthropogenic and natural processes. Flows to and from the biocarbon stocks relate only to those resulting from natural processes. However, there is considerable difficulty in correctly identifying and isolating flows from natural processes, with the LULUCF source category: Other, harvested wood products being one example.

Furthermore, the LULUCF classification does not distinguish between soil and biomass carbon, so estimates of changes in flows need to be combined together.

Finally, LULUCF flow data are reported on a net (emissions to, less removals from, the atmosphere) basis and are calculated based on estimated annual stock changes. As a result, they do not provide estimates of the gross flows i.e. /physical additions to (i.e. carbon sequestration) and removals from biocarbon stocks using this source.

## Appendix 1. UK Carbon Account

| Mega tonnes of Carbon (MtC)      | Geocarbon (1) |       |     |         |       | Biocarbon                  |                    |                        | Atmosphere | Water in Oceans | Accumulation in the Economy |              |                   |       | Total |
|----------------------------------|---------------|-------|-----|---------|-------|----------------------------|--------------------|------------------------|------------|-----------------|-----------------------------|--------------|-------------------|-------|-------|
|                                  | Limestone     | Oil   | Gas | Coal    | Other | Terrestrial Ecosystems (2) | Aquatic Ecosystems | Coastal Ecosystems (3) |            |                 | Inventories                 | Fixed assets | Consumer durables | Waste |       |
| <b>Opening Stock</b>             |               | 1,799 | 773 | 140,523 |       | 4,286                      |                    |                        |            |                 |                             |              |                   |       |       |
| Additions to Stock               |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Natural Expansion                |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Managed Expansion                |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Discoveries                      |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Upward Reappraisals              |               | 35    | 5   |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Reclassifications                |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| <i>Total Additions to Stock</i>  |               | 35    | 5   |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Reduction in Stock               |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Natural Contraction              |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Managed Contraction              |               | 33    | 19  | 10      |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Downward Reappraisals            |               | 6     | 18  |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Reclassifications                |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| <i>Total Reductions in Stock</i> |               | 39    | 37  | 10      |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Imports & Exports                |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Imports                          |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| Exports                          |               |       |     |         |       |                            |                    |                        |            |                 |                             |              |                   |       |       |
| <b>Closing Stock</b>             |               | 1,796 | 741 | na      |       | 4,266                      |                    | 7                      |            |                 |                             |              |                   |       |       |

\* Excluding inventories included in biocarbon (e.g., plantation forests, orchards, etc.), since they are recorded in terrestrial ecosystems

(1) Geocarbon stocks refer to the 2013 to 2014 reference period

(2) Terrestrial biocarbon stocks refer to 1998 to 2007 reference period

(3) Closing stock balance for 2007

**Appendix 2. Concordance between SEEA-EEA based habitat classes, UK Countryside Survey broad habitats and IPCC Land Use classifications**

| <b>SEEA-EEA-based habitat classes</b>     | <b>UK Countryside Survey broad habitats</b>   | <b>IPCC Land Use Classification</b> |
|---|---|-------------------------------------|
| Rainfed and irrigated herbaceous cropland | Arable and horticulture if herbaceous crops   | CL - Cropland                       |
| Permanent crops, agriculture plantations  | Arable and horticulture if permanent crops    |                                     |
| Pastures/Improved grassland               | Improved grassland                            | GL - Grass Land                     |
| Semi-natural grassland                    | Neutral grassland                             |                                     |
|   | Calcareous grassland                          |                                     |
|   | Acid grassland                                |                                     |
|   | Bracken                                       |                                     |
| Forest tree cover                         | Broadleaved, mixed and yew woodland           | FL - Forest Land                    |
|   | Coniferous Woodland                           |                                     |
| Shrubland, bushland, heathland            | Dwarf shrub heath                             | OL - Other land                     |
| Barren land/Sparsely vegetated areas      | Inland rock                                   |                                     |
|   | Montane if covered by rock by more than 95%   |                                     |
|   | Any land if vegetation cover is less than 10% |                                     |
| Open wetlands                             | Fen, marsh, swamp                             | WL - Wetlands                       |
|   | Bog   |                                     |
| Inland water bodies                       | Standing open waters                          | WBR - Water bodies, rivers          |
|   | Rivers and streams                            |                                     |
| Coastal margins                           | Supra-littoral rock                           |                                     |
|   | Supra-littoral sediment                       |                                     |

Source: SEEA-EEA, IPCC, Weber-2014