Piloting the Global Protocol for Community Scale Greenhouse Gas Emissions in Lochaber

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The UK has adopted ambitious targets for significant changes in the way we use fossil fuels and significant changes are needed in the way we live to achieve a more sustainable use of natural resources. A key issue in planning for change is to construct a clear inventory of current resource use. A key issue in bringing about change is to make this clear at a local level. A trial was carried out in summer of 2012 of a new standard published by the Greenhouse Gas Protocol project in May 2012, the *Global Protocol for Community Scale Greenhouse Gas Emissions*, focussing on Lochaber, in the west Highlands. This offers the possibility of moving from national inventories and individual company accounts, to giving a comprehensive and comprehensible account at the level of a local community. A carbon inventory has been undertaken based on guidance from the protocol. National statistics, research findings and interviews with local people have all been used to derive the best data available. The protocol provides a clear framework for the construction of a simple account. There are significant gaps in the data and suggestions are made about some areas where this could be resolved and others where it could prove more difficult. A considerable wealth of detail is available publically that can be used to build up a picture locally. This offers the opportunity to examine the role of carbon at a local level in a way that could prove more accessible to people than national or international data. This production based account could be enhanced by extension to consideration of the embedded emissions in our consumption of goods and services.

Carbon footprint of the Danish electricity transmission and distribution systems

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The electricity sector is among the main sources of greenhouse gas (GHG) emissions; today, those are mainly due to combustion of fossil fuels, but with increasing renewable sources the importance of infrastructures both in electricity generation and in transmission and distribution (T&D) will likely grow. Several studies are available on renewable energy technologies, but only a few on transmission of electricity, and none on its distribution. This study provides life cycle inventory data for electricity distribution networks, and a life cycle GHG accounting of the Danish T&D networks.

The purpose was to evaluate the potential importance of environmental impacts associated with T&D in current and future electricity systems. Including the emissions from electricity T&D is needed to provide a full carbon footprint of electricity systems, and is essential to properly assess the environmental consequences of potential changes in an electricity system. So far, the basis for such assessments has not been available.
The functional unit of this study was the delivery of one kWh of electricity in Denmark. The 2010 Danish electricity T&D networks were modelled, including power lines, transformers, and relevant auxiliary infrastructures.

Electricity T&D provided respectively 29 and 17 gCO2e/kWh, mainly related to power losses. Emissions from distribution were larger than those from transmission, because of higher losses and higher complexity and material consumption. Large differences were found between overhead and underground lines (i.e. for 50 kV lines, 3.2 and 17 kgCO2e/km respectively)

A new specific dataset for infrastructures in the distribution network was provided and used to evaluate the role of electricity distribution in Denmark. Both T&D provided non-negligible emissions. In the future, due to more renewables and decentralized electricity generation, emissions from T&D may become significant compared to electricity generation itself. Consequently, it is recommended that emission from electricity T&D are included in relevant GHG studies.

Understanding the demand for low carbon food products

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In 2010, the agricultural sector was found to be the fourth largest contributor of greenhouse gases (GHG) in Scotland (AEA 2012) and therefore is a key sector to consider for Scottish parliament GHG emission targets. However agricultural products react to demand, hence the purpose of this PhD is to study the demand for food products, particularly low carbon food products and to understand what factors affect their purchases. Through understanding these variables the following questions can be answered: (1) Are Scottish households interested in consuming low carbon food products? (2) How are these products affected by price and income? (3) What is the possible nutritional effect of switching to more low carbon food consumption? (4) What is the impact of a low carbon diet upon agricultural production?

An Almost Ideal Demand System (AIDS) is used in the paper because of its extended use in economics and also because it meets demand theory conditions (Deaton & Muellbauer 1980). The model is expanded using dummy variables to study the evolution of elasticities over time. Questions one to three should be answered with the assistance of an AIDS model. While question four will require use of a Land Use Allocation Model (LUAM) (Arnoult et al. 2010) in order to understand the impact of a low carbon diet upon Scottish agricultural production.

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Mitigating emissions from livestock: Assessing the effectiveness of the Farming for a Better Climate Initiative

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It is estimated that agriculture and related land use is responsible for around 20% of Scotland's greenhouse gas emissions. To help farmers identify what they can do to contribute towards Scotland's interim target of a 42% reduction in emissions by 2020, based on 1990 levels, Scottish Government have funded the Farming for a Better Climate initiative. Three focus farms that are broadly representative of the main farming types in Scotland, beef and sheep, dairy and arable were selected to participate. A fourth farm was selected to communicate measures to the general public via its farm shop and café. Relevant baseline data was collected from the beef and sheep, dairy and arable focus farms at the start of the initiative.

Using Agri-CARB, SRUC's carbon calculator, emissions were estimated, highlighting areas where reduction could be made. Meetings focused around five key action areas were held on the beef and sheep, dairy and arable focus farms to discuss relevant and practical mitigation actions. Emissions were re-calculated yearly to quantify the impact of adopted actions. Due to a replacement arable farm being was sought during year two of the initiative, limited results are available and have therefore been excluded. The beef and sheep and dairy focus farms implemented actions aimed at improving nutrient use, reducing energy and fuel use, locking in carbon and improving livestock management.

It is probable that actions implemented by the beef and sheep focus farm reduced emissions from 31.39kg to 27.76kg CO_2e/kg output between 2010 and 2012 and actions implemented by the dairy focus farm reduced emissions from 13.01kg to 12.73kg CO_2e/kg output; further investigation is require before this can be concluded. The wet weather resulted in increased grain drying, longer livestock housing periods and lower grass and crop yields, reducing the expected drop in emissions.