The Need for Sound Carbon Accounting in Scotland

Key Findings

- **The carbon footprint in Scotland is increasingly driven by emissions from production processes abroad. Between 1995 and 2004, territorial emissions in Scotland reduced by 13%, while consumer emissions grew by 11% over the same time period.**
- **The difference between territorial emissions and consumer emissions grew from 10.6 Mt CO_2e[1] in 1995 to 28 Mt CO_2e over this time period. The satisfaction of growing consumer demand in Scotland between 1995 and 2004 without increasing territorial emissions was only possible through this increased reliance on imported products with the near tripling of imported emissions.**
- **Three key areas of consumption make up household carbon impacts: housing (33%), transport (26%) and food and drink (19%).**
- **60% of the increase in the carbon footprint from 1992 to 2004 comes from transport. Over 45% of this growth relates to the use, purchase and maintenance of cars, 40% is due to aviation, and the remainder relates to other public transport.**
- **The carbon footprint of the highest emitters is over 3 times greater than the lowest. This results in some households having a carbon footprint near 50 tonnes compared to some groups with a footprint of 16 tonnes.**
- **Apart from transport, the growth in consumer emissions is related to other categories such as leisure, clothes and communications equipment. All these categories have nearly doubled between 1992 and 2004.**
- **At present there is no carbon accounting system in Scotland that can ensure that a real reduction in emissions is being achieved and not displaced to other countries, therefore making it very difficult to assess future progress.**

Introduction – the climate change challenge

Climate change is one of the biggest challenges humanity has ever faced. There is overwhelming scientific evidence that human beings are responsible for the rapid planetary warming since the industrial revolution. Because humanity is emitting greenhouse gases much faster than oceans, plants and soils can absorb them, stocks of greenhouse gases are building up in the atmosphere, trapping more and more heat on the planet. As a result, global mean temperatures show an unprecedented rise – at the moment this is 0.76ºC compared to pre-industrial levels.

Since the beginning of the climate change negotiations in 1997, atmospheric concentrations of carbon dioxide have increased by 32ppm[2] and they keep rising every year by 2ppm. This trend needs to be reversed as soon as possible, if we want to stand a good chance in the fight against climate change. Even though we managed to put in place the first international climate change regime with binding emission targets for some countries, this had barely any effect on the global GHG trajectory so far.

With the Climate Change Bill in Scotland, there is a genuine effort to have the most ambitious climate change legislation in the world. This means the legislation will have to achieve a real and deep reduction in emissions. However, understanding whether we are "making a difference" in the global context isn't as easy as it at first might seem. The way we monitor progress is crucial. This policy brief documents the results for Scotland of a large research programme undertaken by the Stockholm Environment Institute, questioning whether progress has been made and outlining the scale of the challenge.

Understanding Scotland's contribution to global emissions

The way we add up our Greenhouse Gas Emissions is extremely important when considering whether we are contributing to positive reduction. Ultimately, what we want to know is whether Scotland's emissions are going up or down. The approach currently used in Scotland to measure its emissions is based on a territorial approach. This assumes that Scotland is responsible for any emissions that occur within the territory of Scotland. This is consistent with reporting requirements as outlined under the Kyoto Protocol.

1 $MtCO_2e$ = Metric tonne (ton) carbon dioxide equivalent

2 ppm = parts per million

This report informs us about the GHG emissions released throughout the world during the production of goods and services consumed in Scotland. This form of consumer based GHG emission accounting has been prominently discussed under the notion of "carbon footprinting". It is vital to consider this approach alongside the territorial emissions when looking at Scotland's GHG emission trajectories.

The carbon footprint includes the GHG emissions released abroad in the production of imports to the UK and excludes GHG emissions from UK exports (see figure 1). Put differently, instead of summing up the GHG emissions of all emis-

Figure 1: Differences between territorial and consumer emissions

sion sources (factory chimneys, car exhausts) on Scottish soil, it traces the GHG emissions throughout the global supply chain of all products consumed in the UK. A good example on the difference between territorial and consumer emissions can be seen when looking at Ravenscraig Steel Mill. Ravenscraig was the largest hot strip steel mill in Western Europe. In some years, steel production was as high as 3 million tonnes a year and was very carbon intensive. After it closed down in 1991, Scotland's emissions reduced substantially. However, Scotland consumption of steel didn't reduce. In fact it increased, although now Scotland is no longer responsible for the carbon emissions from steel as it is not produced on Scottish soil. This would not happen when a consumer approach is adopted. The final consumer is allocated the emissions, not the country of production.

Scotland's contribution to greenhouse gas emissions

From a territorial perspective, Scotland's carbon emissions have reduced by 18% since 1990. The carbon footprint tells a very different story to that provided by the territorial emission accounts. The GHG emissions released globally during the production of goods and services consumed in Scotland are higher than Scotland's territorial emissions (see Figure 2).

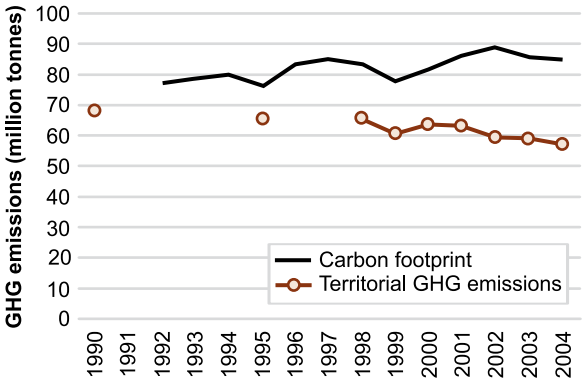

Figure 2: Scotland's territorial and consumer GHG emissions between 1992 and 2004[3].

3 Territorial emissions data for Scotland is not available for 1991 to 1994 and 1996 to 1997. Carbon Footprint data is not available for 1990 and 1991. The isolated data sources for territorial emissions of 1990 and 1995 are shown as two "dots" of the graph.

Scotland's territorial emissions in 2004 were 57 million tonnes while consumer emissions were 85 million tonnes. Accounting practises established under the current climate change regime are therefore favourable for high consuming nations like Scotland. Only 67% of Scotland's consumer emissions are accounted for in the territorial approach. Therefore, consumer based emissions are nearly 50% higher than territorial emissions in Scotland..

The carbon footprint in Scotland is increasingly driven by emissions from production processes abroad. The difference between territorial emissions and carbon footprint grew from 10.6 Mt CO_2e in 1995 to 28 Mt CO_2e over this time period. Our evidence clearly suggests that the satisfaction of growing consumer demands in Scotland between 1995 and 2004 without increasing territorial emissions was only possible through this increased reliance on imported products with the near tripling of imported emissions.

The analysis also highlights that Scotland has not been able to achieve economic growth while reducing its carbon footprint. There has been a 75%[4] increase in "Gross Value Added" in Scotland while emissions have gone up by 11%.

What are the drivers of change in Scotland?

The carbon footprint accounts for all government, household and capital spend. The majority of the impact is caused through households (76%), while government accounts for 11% and the remainder is attributed to capital (infrastructure). All the growth in the carbon footprint has come from household consumption.

Household spending rose by 35% in real terms between 1992 and 2004, while the climate change impacts of spending a pound could be reduced by only 16%. Overall, this resulted in an increase in the carbon footprint of households by 13% from 57 Mt CO_2e to 64 Mt CO_2e or 27.9 to 28.5 tonnes per household[5]. Hence, there is some de-coupling due to greater efficiency in energy use between household spending and its global climate change impacts, but this has not been strong enough to achieve any absolute reduction in the carbon footprint of households overall. Therefore, any improvements in technology have been lost because Scotland is simply consuming more and more.

If the government wants to reduce the carbon footprint of households' activities, priority should be given to food, transport and housing. Together these three consumption areas ac-

4 http://www.statistics.gov.uk/downloads/theme_economy/PROGRESS_NUTS1.xls

5 Estimates of Households and Dwellings in Scotland, 2007, available from: http://www.gro-scotland.gov.uk/files1/stats/gros-estimates-of-households-and-dwellings-in-scotland-2007/j9646a00.htm, last looked at 23/03/09.

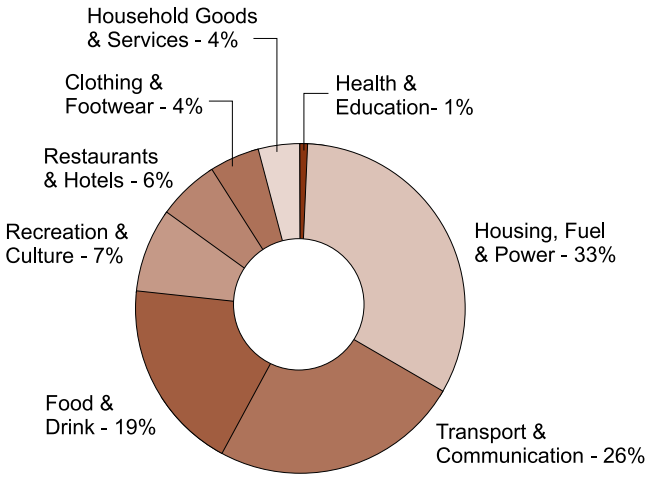

Figure 3: Carbon footprint of Scottish households in 2004

count for about three quarters of households' carbon footprint (see figure 3).

Heating and powering our homes had the greatest impact in 1992 and this is still the case, taking up 33% of Scotland's household carbon footprint. This is followed by transport, accounting for 26% of the footprint and food and drink representing 19%. Figure 4 gives an indication of the changes in different household commodities over time.

Transport is the area of biggest concern. Unless a fundamental shift in the government's transport policies are undertaken that curbs the total distance we travel each year and provides better opportunities for modal shift, a substantial decarbonisation of households' activities appears difficult, if not impossible.

In the current institutional setting, a low carbon lifestyle is simply not sufficiently rewarded. Unless the government is willing to change this, there is very little it could expect households to do – even though opportunities exist. However, there is little doubt that substantial behavioural adjustments of households will be required for Scotland to be successful in the climate change challenge. It must therefore be the government's prime concern to consistently incentivise and enable low carbon living.

However, all these efforts need to reflect the differences in households' contributions to climate change. Fair burden sharing is as important within a country as it is across countries. Our data shows that the climate change impacts of one household group can be as much as 3 times higher than for another household group.

A map of Scotland gives an indication of the variation in the carbon footprint of residents in different locations (see figure 5).

The carbon footprint of the highest emitters is over 3 times greater than the lowest. This results in some households having a carbon footprint near 50 tonnes compared to some groups with a footprint of 16 tonnes.

Across groups there is a linear relationship between household income and carbon footprint: the more we earn, the more we spend, the higher the carbon footprint. It therefore does not help that richer households are more likely to live in better insulated houses, to buy new, fuel efficient cars or to own more energy efficient appliances. Richer households are also likely to own cars with particularly large engine sizes, their houses are usually bigger, they are likely to travel more frequently and further and their fridges, freezers and TVs are usually bigger as well.

Ultimately, the government needs to make sure that the costs for cutting carbon are borne by those who have contributed most to driving GHG emissions and that it supports those households in the climate change challenge, which are most in need. For example, households suffering from fuel poverty often live in the most inefficient houses. Insulating their houses would not only be good for fighting climate change, but would also leave them with important additional funds to live their lives.

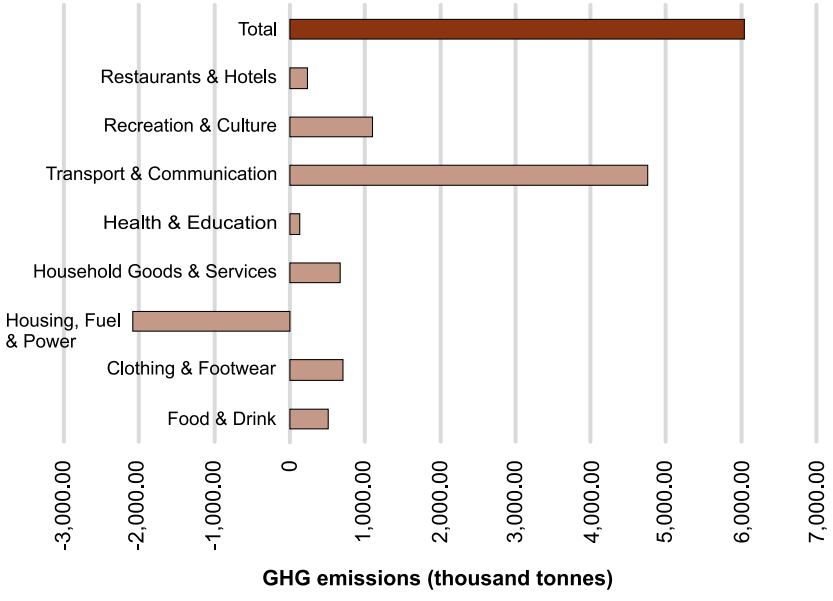

Figure 4: Comparison of carbon emissions between 1992 and 2004

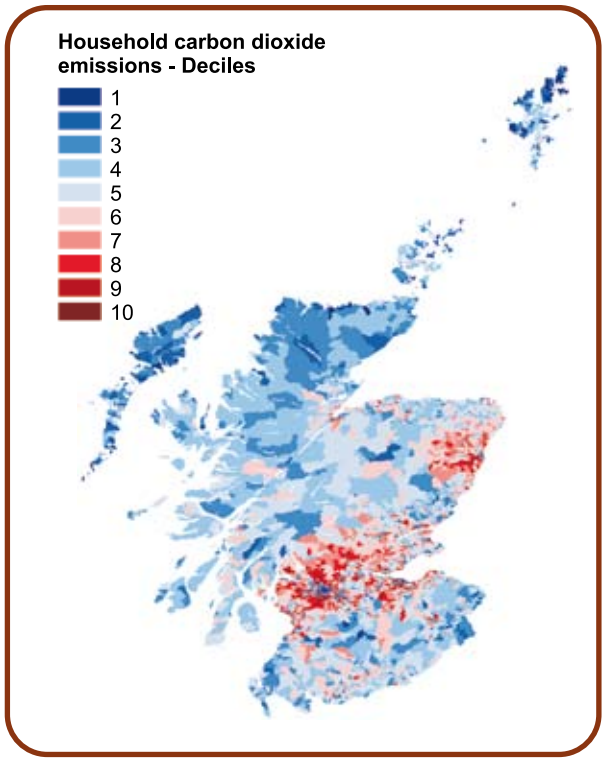

Figure 5: Variation in the carbon footprint of Scotland by output area

Conclusions

Humanity cannot afford a second Kyoto Protocol. Post-Kyoto negotiations will need to lead to a much more ambitious set of targets, which need to bring the radical cuts in GHG emissions required. These changes will affect all aspects of our lives and the way we do business. They will be concerned with international cooperation, human development, the way we produce and price our goods and services as well as the way we consume them.

Scotland is a key part of the global economy and an approach to monitoring emissions that fails to take account of this global context offers an incomplete picture of progress. It has to be the aim of every government across the world to ensure that a "real" reduction in emissions occurs and not merely a shift of responsibility, particularly when responsibility is allocated to a country that has low per capita emissions.

Carbon footprinting is more than just an interesting academic exercise. It has numerous applications that make it important to include such an approach as part of any national accounting framework. It:

- Reveals deficiencies associated with the accounting practises established in the Kyoto Protocol;
- Poses important questions associated with fair burden sharing in an increasingly economically integrated world;
- Answers a completely different set of policy questions associated with the climate change impacts of peoples' consumption and lifestyle choices in the UK.
- Addresses the question "Is Scotland increasingly relying on imports that are produced less efficiently than they were historically produced in Scotland?"

There is a need to consider both our territorial and consumer emissions in Scotland to achieve the scale of the change required. Ignoring our consumer emissions means that we are only addressing part of the problem. By addressing production and consumption, new possibilities open up to achieve emission reductions. It is hoped that this document does not provoke a defensive response, but opens the minds to the challenge ahead of the politicians and civil servants who have the responsibility for climate change.

The content of this publication has been drawn from Wiedmann, T., Wood, R., Lenzen, M., Minx, J., Guan, D. and Barrett, J. (2008). *Development of an Embedded Carbon Emissions Indicator - Producing a Time Series of Input-Output Tables and Embedded Carbon Dioxide Emissions for the UK by Using a MRIO Data Optimisation System*. Final Report to the Department for Environment, Food and Rural Affairs by Stockholm Environment Institute at the University of York and Centre for Integrated Sustainability Analysis at the University of Sydney. Project Ref.: EV02033, July 2008. Defra, London, UK.
Full report:: http://randd.defra.gov.uk/Document.aspx?Document=EV02033_7331_FRP.pdf.

Recommendation

To assess real progress towards a low carbon economy in Scotland, it is essential that the Scottish government measures both its territorial and consumer emissions. Without both, its monitoring of greenhouse gas emissions related to Scotland is incomplete.

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Technical Notes

What is the Stockholm Environment Institute?

The Stockholm Environment Institute York Centre is an independent, international research institute located at the University of York specialising in sustainable development and environment issues. SEI has been engaged in this broad field of research for a quarter of a century. The York Centre shares SEI's mission to support decision-making and induce change towards sustainable development by providing integrative knowledge that bridges science and policy. The Institute currently employs 35 staff in the fields of sustainability, water management, atmospheric science, climate change and future thinking and has a broad staff profile including ecologists, environmental scientists, GIS specialists, policy analysts and social scientists. The annual turnover from externally funded projects is £1.74 million.

The Future Sustainability Group is one the biggest and fastest growing research groups at SEI York currently comprising 8 staff members. The works takes places in the broad area of Ecological Economics and focuses on the development of information tools for policy makers in the UK and other European countries (Sweden, Germany etc.). The group has established a UK-wide reputation for developing consumer emission accounts from national to very small spatial levels. The most prominent development of the group has been the REAP software tool, which is used by policy makers at national, regional and local level for strategic planning and sustainability appraisals. Through its consumption perspective the tool has made an important contribution to bringing complete supply chain impacts into sustainable development discussions in the UK and closed an important evidence gap on the sub-national level. The stakeholder based approach followed in REAP applications ensures a wide outreach of the group and a close relationship with private and public institutions. A 7^th framework EU proposal – currently in the negotiation phase – is aimed at continuing REAP's success story on the European level (see below). Currently REAP versions for Germany and Sweden are in the planning phase.

The work of the group has been published in academic articles, policy reports and is frequently picked up by the media. The group has received funding from a variety of sources including the Department for Environment, Food and Rural Affairs, the European Environment Agency, The UK's Environment Agency, the Biffaward scheme, the Natural Environment Research Council and regional and local governments. The group is part of the UK energy research centre currently and contributes to efforts initiated by the World Resource Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) to develop GHG accounting standards at the product and supply chain levels.What model was used to produce the results?

The results from this report were generated by the Resources and Energy Analysis Programme, produced by SEI. This report also builds on previous work undertaken by the Stockholm Environment Institute (SEI) for the Department of Environment, Food and Rural Affairs (DEFRA) (Wiedmann et al., 2008). All methodological details associated with our calculations are described in detail there (http://randd.defra.gov.uk/Document.aspx?Document=EV02033_7331_FRP.pdf). In addition to this, a detailed sensitivity analysis has been undertaken and is available from http://randd.defra.gov.uk/Document.aspx?Document=EV02033_7332_FRP.pdf. The most important methodological issue to understand is that our calculations fully take into account the differences in carbon intensity of economic production processes in different parts of the world. For example, one tonne of steel produced in China is associated with a much larger amount of GHG emissions than one tonne of steel produced in Sweden due to considerable differences in the available technology and energy infrastructure. Apart from the UK our model distinguishes differences in production technology and carbon intensity in three foreign regions:

- EU OECD
- Non-EU OECD
- Non-OECD

We extend the study for DEFRA here in various respects. First, this report not only covers CO_2 emissions, but all six major GHG emissions covered under the Kyoto Protocol. This does not mean that our calculations represent "complete" climate change impacts. A lot of effort was put into the integration of data sources, which allow the estimation of carbon footprints for specific consumption categories (e.g. food, drink, clothing, travel, housing etc.), distinct government activities (health, education etc.), regions, local authorities, product groups, industries etc.. This allows a much more comprehensive assessment of 'how Scotland is doing', where the most important GHG emission hotspots are and what drives them.

How has electricity been dealt with?

This study assumes that Scotland is part of the national grid, which is clearly the case. However, there is an argument that Scotland's electricity consumption should be calculated based on the production mix of Scotland and not the UK mix. Scotland has a far higher percentage of renewables for electricity generation than the UK average. As a rough guide, our initial estimate is that this would reduce the carbon footprint of Scotland by 3% in 2004, meaning that there would still be an increase in consumer emissions of 8% taking this into account.

How "Scottish specific" are the calculations?

The methodology employed considers the methods of production and multiplies this coefficient by the level of consumption. In our analysis the economy (production) is broken down into 123 sectors and the efficiency of where the products that were produced are taken into account. Therefore, the UK's trade relation with the rest is reflected in the efficiency of technology. When a product is produced and consumed in Scotland, the co-efficient is UK specific. It is assumed that this created a small deviation from a Scottish specific figure, as there is not a significant difference in production technologies and Scotland is part of the national grid for the distribution of electricity. Finally, there is a high of levels of imports into Scotland for consumption in Scotland and these co-efficients reflect the production technology and are therefore appropriate for us in a consumer based modelling approach.

When and how will the analysis be updated?

No funding has been secured to update these figures apart from a release in June, 2009 of 2006 data.