Why and how Carbon Flows occur and the implications these have on the global economy

The report has been commissioned under the UNDP/GEF project 'Greening 2014 Sochi Olympics: A Strategy and Action Plan for the Greening Legacy' and co-sponsored by the British Embassy Prosperity Fund through the project 'Russian export carbon intensity and risks associated with lack of reporting capacity'.

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Completed: August 2013

1 Contents

2 Introduction

This report is provided to the United Nations Development Programme with the aim of providing Russian companies on the impact of carbon flows associated with the Russian Federations International Trade.

The content of the report uses information delivered to Russian Stakeholders at a roundtable event in Moscow in July 2013. The report has been commissioned under the UNDP/GEF project 'Greening 2014 Sochi Olympics: A Strategy and Action Plan for the Greening Legacy' and co-sponsored by the British Embassy Prosperity Fund through the project 'Russian export carbon intensity and risks associated with lack of reporting capacity'.

2.1 The Carbon Trust

The Carbon Trust is an independent not-for-profit company with offices in the UK and China working towards its mission of helping business to transition to a sustainable, low-carbon economy.

2.2 Report objectives

The purpose of the report is to demonstrate the importance of quantifying embodied carbon flows for the Russian economy.

The main objectives of the report are to:

1. Explain the concept of embodied greenhouse emissions in products and services;
2. Present a summary of the carbon flows analysis and present the main conclusions;
3. Present carbon flows analysis for the specific examples of the Aluminium and Steel sectors in Russia;
4. Describe the methodology used to calculate the carbon flows;
5. Provide a list of potential implications these flows have on the global economy;
6. Provide an overview of the recent Mandatory Carbon Reporting regulations proposed by the UK Government;
7. Provide a summary of conclusions and recommendations for Russian business

3 Embodied Greenhouse Gas Emissions in Products

Greenhouse gases (GHG) are released across the lifecycle of any product. For example, fuel is needed to produce materials, and this fuel will release a given amount of greenhouse gas.

3.1 The product lifecycle

An assessment is undertaken to measure the GHG emissions that arise across each phase of a product's life. The production, use and disposal of every type of product will include many different phases, with each phase requiring the use of energy and release of GHG's.

An illustration of a product lifecycle is shown below using the example of a can of drink as the product. This product will include phases in its lifecycle such as the mining or reprocessing of raw materials (aluminium) or growing the raw materials in agriculture (sugars). The manufacturing phase will require the processing of the raw materials into the aluminium can and drink, before the finished product is distributed and sold before being used by the consumer and finally disposed of.

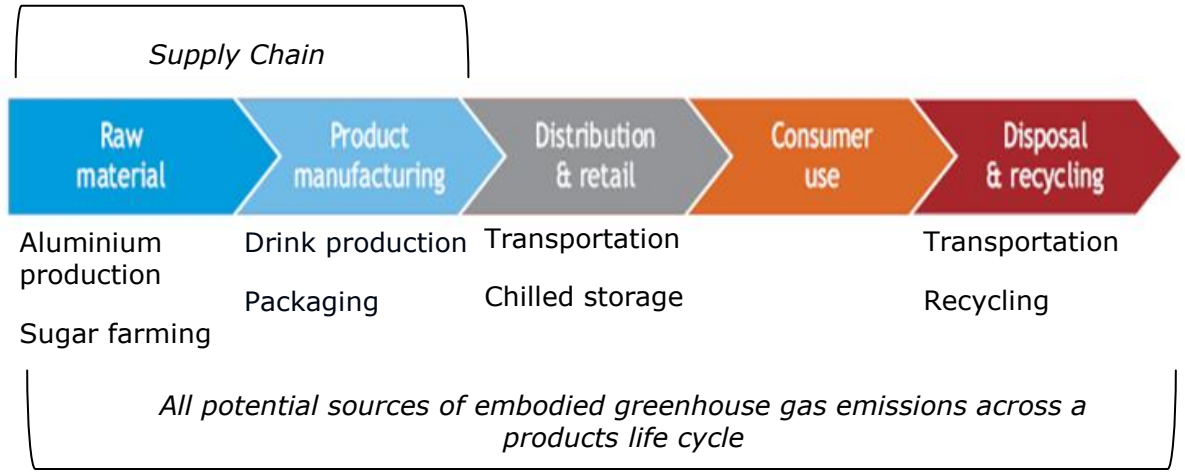

Figure 1. Illustration of the different lifecycle phases of an individual prouct.

The production of raw materials and manufacturing into the final product, prior to sale and consumer use, will usually comprise of many different individual companies, each providing a different process or material.

The final GHG footprint for the product lifecycle is the sum of all GHG emissions associated with every phase of the lifecycle.

3.2 Embodied GHG emissions

The term 'embodied emissions' refers to the sum of GHG emissions for a given material, such as a finished product or a commodity. The embodied emissions are usually reported using the metric CO2equivalent or CO2e for short. This means that all forms of greenhouse gases, such as methane, nitrous oxides and perfluorocarbons, can be reported as a single, functionally equivalent value.

Using the example of a can of drink, as shown above, the measurement of embodied carbon can therefore be applied to the different materials that are used to make the final product. For example, there will be a CO2e value for a given amount of aluminium or the sugar used to make the final product. Generic values for these two materials, known as emission factors are 12.5 Kg CO2e per Kg of aluminium in the EU and 0.3 Kg CO2e per Kg of sugar in the EU.

3.3 Product design and use of lower-carbon materials

Different materials have different amounts of embodied GHG emissions because of the energy required to make them. The table below shows the calculated embodied GHG emissions of Coco-Cola drinks. The GHG emissions of Coca-Cola in a 330ml glass bottle are over twice of those for the same amount of drink in an aluminium can (170g CO2e and 360g CO2e per product). The difference is largely because of the embodied GHG emissions associated with producing aluminium and glass, and because of the GHG emissions of transporting glass, which is much heavier.

	Carbon footprint of different products		
Product	Coca-Cola	Diet Coke	Coke Zero
330ml aluminium can	170g	150g	150g
330ml glass bottle	360g	340g	340g
2 litre plastic bottle	500g	400g	400g

Table 1. Calculated carbon footprints of Coca-Cola products, showing the embodied GHG emissions of each type.

The calculation of this footprint is likely to have required data for each phase of the product lifecycle, which might have included hundreds of different supplier companies around the world.

Companies like Coca-Cola i.e. brand owners and major retailers, are using the information provided by calculating the GHG emissions of their products to make decisions on how to reduce the embodied emissions. Coca Cola are now

introducing different types of materials in their product packaging, such as 22 per cent plant materials and 25 per cent recycled content in their plastic bottles.

Selecting materials and suppliers that have lower GHG emissions is seen by increasing numbers of companies as an effective approach to reducing the embodied GHG emissions of their products. This will therefore have consequences for companies that sell products to businesses i.e. providers of materials with lower embodied emissions will be selected over those companies with higher emission products.

3.4 Supply chains

Supply chains are international, with many separate companies providing intermediate materials and components that are used to make the final finished product.

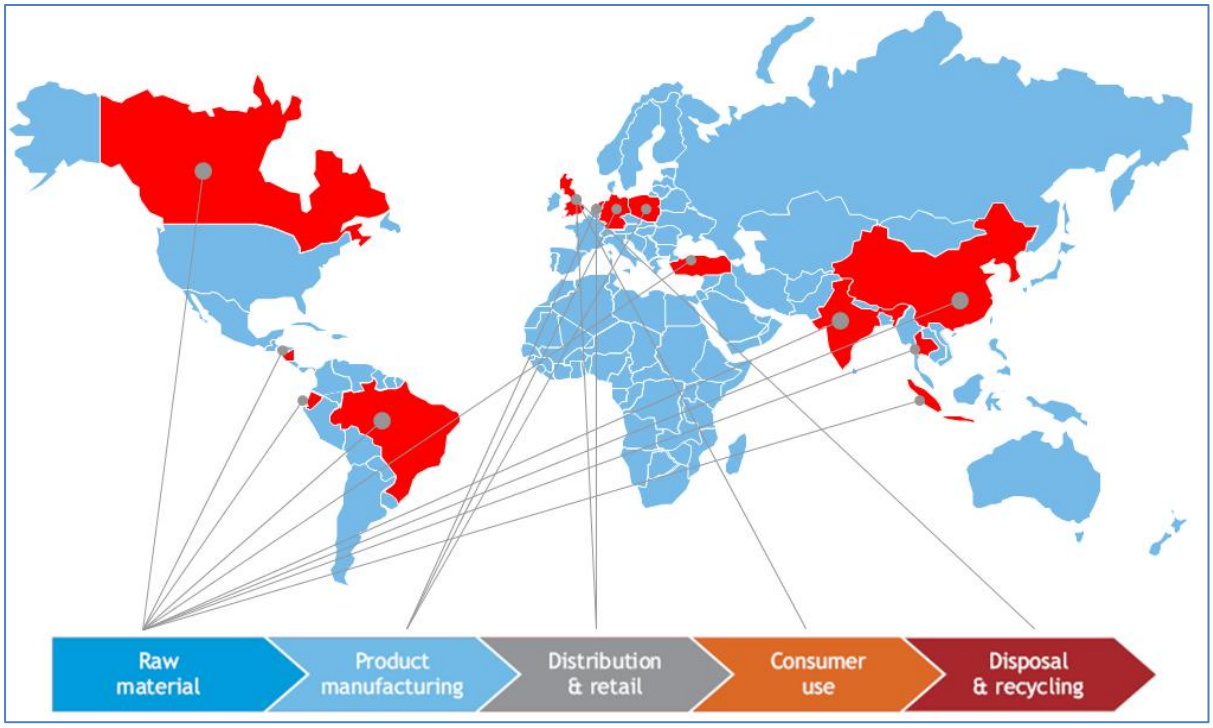

Figure 2. Illustration of the global nature of supply chains that are used across the lifecycle of a product.

Different regions and different factories within those regions will have different emission factors for the embodied GHG emissions in the materials that they produce. For example, one region may use electricity with a lower GHG intensity because more renewables are used in the mix, or 1 particular factory may be more energy efficient because of modern technology that has been installed.

This has consequences for some companies, and some countries, because buyers, such as larger organisations at the final tier of the supply chain i.e. brand owners or major retailers, are increasingly looking for lower-carbon materials.

4 Carbon Flows Analysis

The Carbon Trust published innovative research[1] on international carbon flows in 2011. This research and analysis on carbon flows builds upon the concept that supply chains, across the world, have embodied carbon in the products and services that are sold between companies. The analysis was international and was a proof of concept, which has since been valuable in engaging with policy makers.

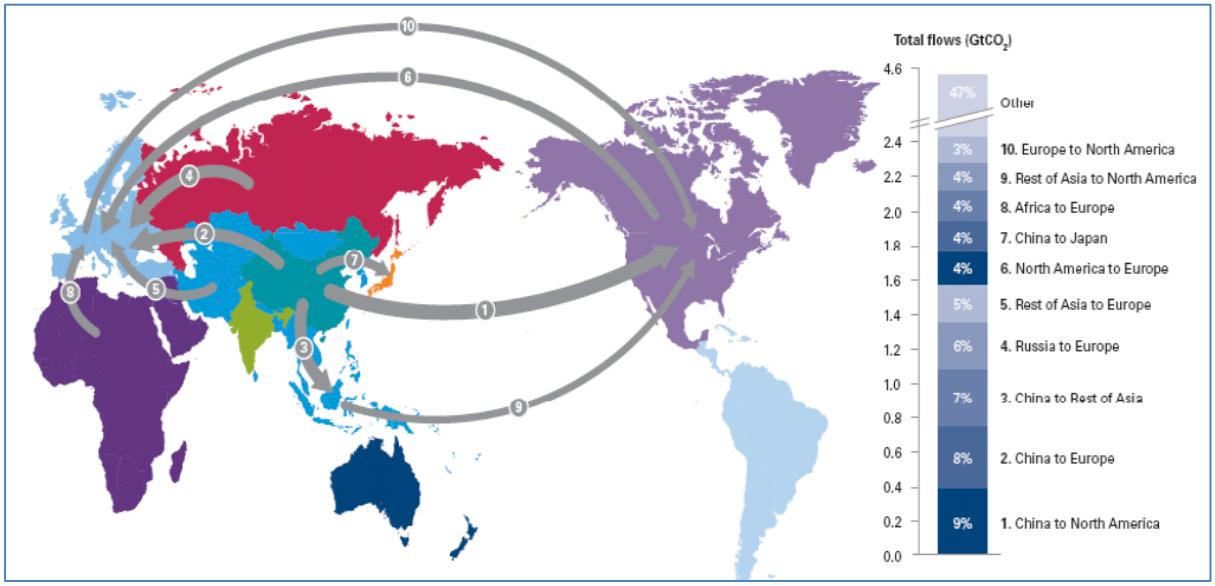

Figure 3. Top 10 largest inter-regional flows of embodied CO2 emissions.

Around one quarter of greenhouse gas emissions are embodied in goods and services which "flow" between the country of production and the country of consumption via international trade. A key focus for business action, and the opportunity to further reduce GHG emissions over the next decade, will be to reduce the carbon intensity of traded goods.

Figure 3 shows that four of the top 10 embodied emissions flow routes originate in China. This is because of China's very large manufacturing base.

[1] http://www.carbontrust.com/media/38075/ctc795-international-carbon-flows-global-flows.pdf

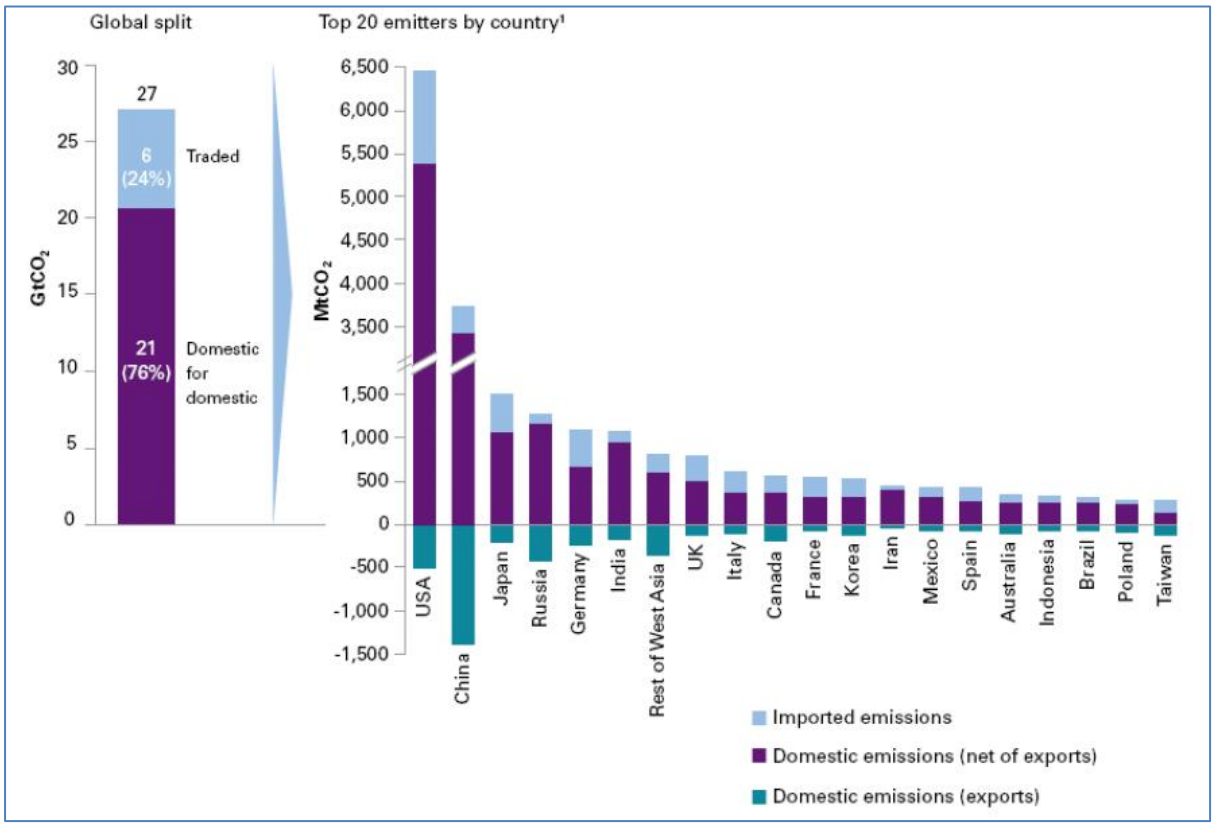

Figure 4. Production of CO2 emissions by country, and the import and export of CO2 emissions embodied in trade.

Figure 4 shows the world's top 20 GHG emitters. The analysis shows each of these countries GHG emissions categorised by imported embodied emissions, domestic emissions and exported emissions.

The analysis shows Russia as the fourth largest emitter of greenhouse gases, with exported carbon accounting for around 25 per cent of Russia's total GHG emissions.

Figure 5 below shows the type of products that carbon is embodied within. For example, 67 per cent of embodied carbon from China is found within finished products. For Russia, this is only around 24%, with the remaining 76% per cent found within commodities. Embodied emissions in exports from the Russian Federation and Africa are overwhelmingly biased towards commodities therefore.

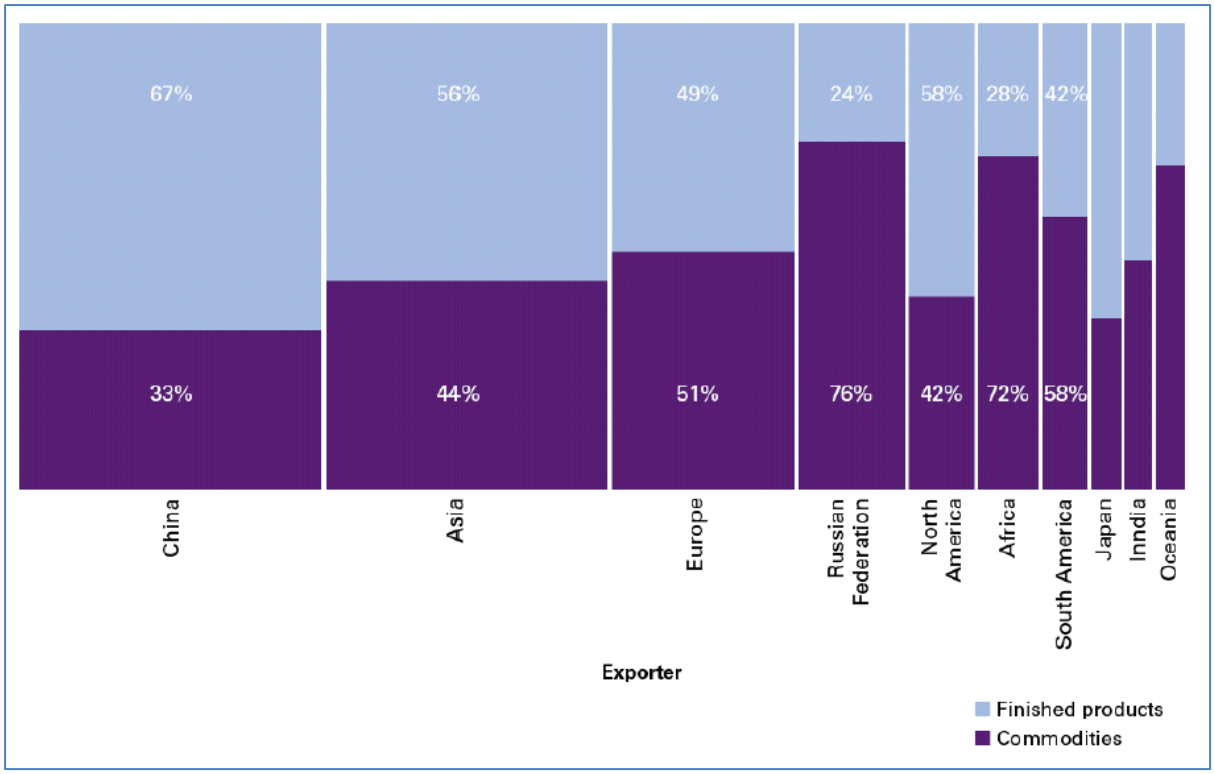

Figure 5. Nature of exported emissions by region showing that the relative importance of commodities or final products in embodied emissions exports varies strongly between regions.

The consequence of the analysis shown in Figure 5 is that the majority of products exported by Russia will be commodities that will be purchased and used by other companies to make the final product. This contrasts to China, where finished products are exported that are ready for sale and purchase by consumers. Therefore, Russian companies that operate in the export markets are more likely to be requested for information on embodied carbon by other companies than from consumers.

4.1 Carbon flows analysis for steel in Russia

Analysis was performed[2] on the international carbon flows of steel, as this is an important widely-used material in many products. The analysis, shown below in Figure 6, shows the 10 largest carbon flows associated with steel. In particular, it shows that Russia (Commonwealth of Independent States (CIS)) is the largest contributor with over 50 mega tonnes of embodied CO2 in steel flowing into the EU.

[2] http://www.carbontrust.com/media/38362/ctc791-international-carbon-flows-steel.pdf

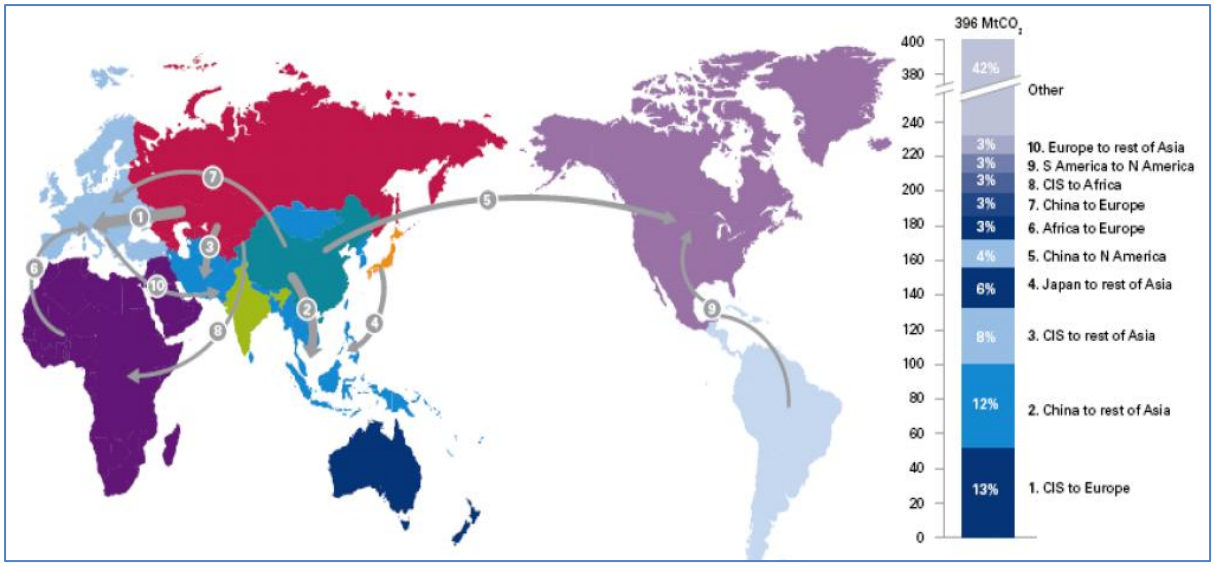

Figure 6. The 10 largest regional flows of CO2 emissions relating to the trade of iron and steel.

The second largest international flow of embodied emissions in steel is from China to the rest of Asia. The third largest flow of emissions is from CIS to the rest of Asia. Therefore, this suggests that Russia exports a significant quantity of steel and that this material has significant quantities of embodied carbon.

The carbon intensity of production of steel varies quite widely according to the technology used and the age of the plant used to produce it. Globally, emissions from blast furnace operations (Figure 7 below) dominate steel production emissions, with Chinese steel production emissions almost exclusively occurring from blast furnaces.

While production volumes from open hearth furnaces are low, emissions from this type of production are significant for CIS states (and, to a lesser extent, Other Asia countries) due to the carbon intensity of the process.

Figure 7. Greenhouse gas emissions from steel production by technology and by region.

It should be noted, as shown in Figure 7, that the emission factor (embodied carbon) for European steel is estimated at 1.3 tonnes CO2 per tonne, whereas Russian steel is estimated at 6.1 tonnes CO2 per tonne. This significant difference in GHG emissions for steel is likely to be a consequence of the technology used therefore, and may have consequences when purchasing companies are looking for lower-carbon steel i.e. will buy from Europe.

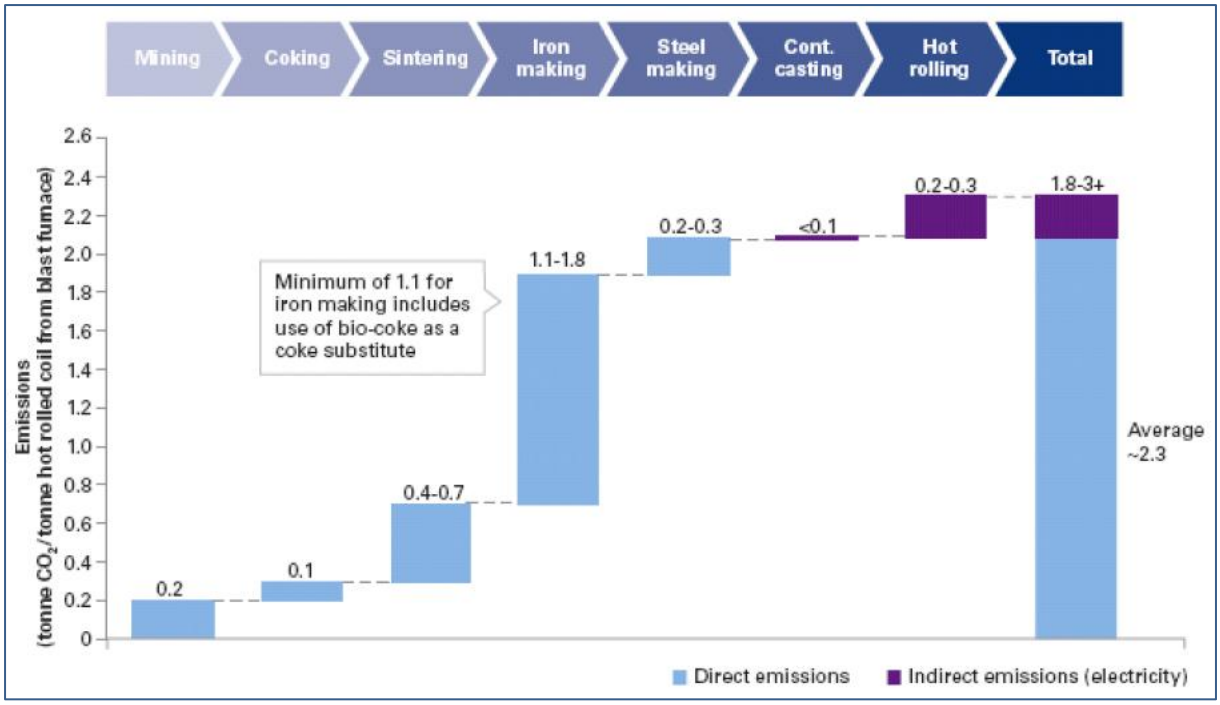

Figure 8. GHG emissions profile across the lifecycle of steel.

The lifecycle of steel requires a series of separate processes, each with corresponding amounts of GHG emissions. Figure 8 shows that the largest contributor to is the process of iron making.

This is important because the largest contributors to the overall footprint are often required to make the largest reductions, which is more pertinent to companies in Russia as they make steel for export.

4.2 Carbon Flows analysis for Aluminium in Russia

Figure 9 shows the 10 highest carbon flows of aluminium (non-ferrous metals) around the world[3]. As with steel, shown in Figure 7, it shows that Russia (CIS) has the largest flow of exported embodied carbon to the EU, at 44 mega tonnes of CO2 per year.

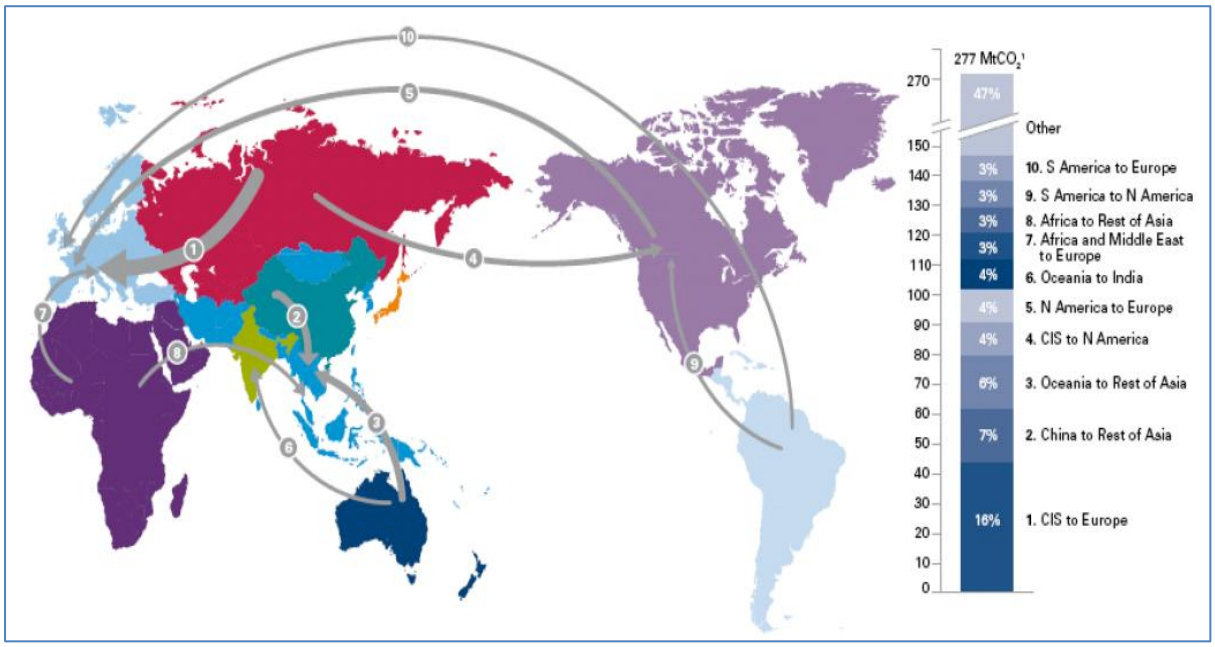

Figure 9. The 10 largest regional flows of CO2 emissions relating to trade of non-ferrous metals.

This flow reflects both the volume of metal shipped and the relative carbon intensity of the country of origin, with both China and Australia being heavy users of coal in their aluminium and other non-ferrous metal production.

About 40 million tonnes of aluminium are consumed each year and this figure is expected to triple or even quadruple by 2050. China has the fastest growing consumption, averaging 10% growth a year between 1980 and 2007.

[3] http://www.carbontrust.com/media/38366/ctc790-international-carbon-flows_-aluminium.pdf

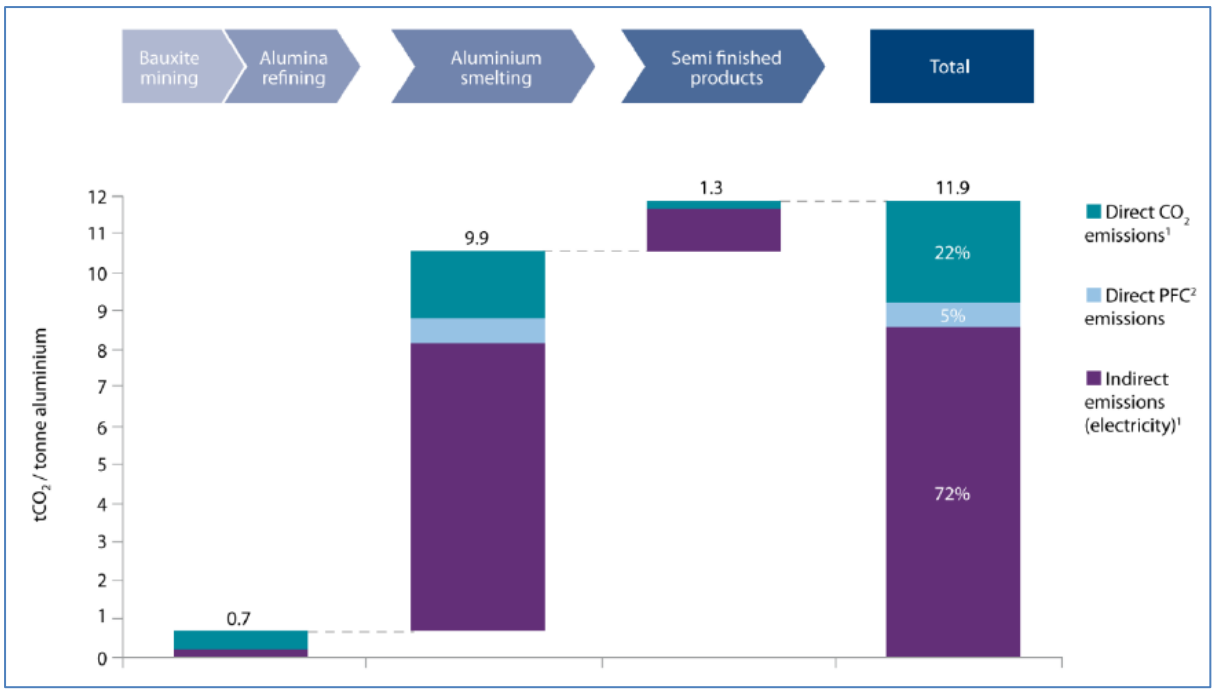

Figure 10. The different phases of the aluminium lifecycle.

Figure 10 shows that the smelting of aluminium is the largest contributor to the overall carbon footprint. This is a similar lifecycle profile for that shown for steel in Figure 8.

Aluminium, however, has a significantly higher embodied carbon footprint than steel with emission factors of 12.5 Kg CO2 Kg for Aluminium and 2.9 Kg CO2 Kg Steel in the EU.

The embodied carbon for steel and aluminium will vary for different countries and regions, depending on the type of technology the factories are using and the source of energy. This could be a potential advantage for producers of steel and aluminium in Russia who have adopted more efficient technology or the use of renewable energy sources, such as hydro-electric. The advantage over its competitors will need to be substantiated by credible measurements of their embodied emissions however.

4.3 Methodology of the Carbon Flows Analysis

The research on international carbon flows was conducted in 2009 and 2010, and published in 2011. It was arguably the first research on this subject using data from around the world. The purpose of the research was to demonstrate that the import and export of GHG emissions embodied in materials and products was a serious concern in the fight against climate change.

The project took 1 year to collect data and make the calculations and used a team of experts from within the Carbon Trust and the project partner

organisations, who included the Stockholm Environmental Institute and various universities.

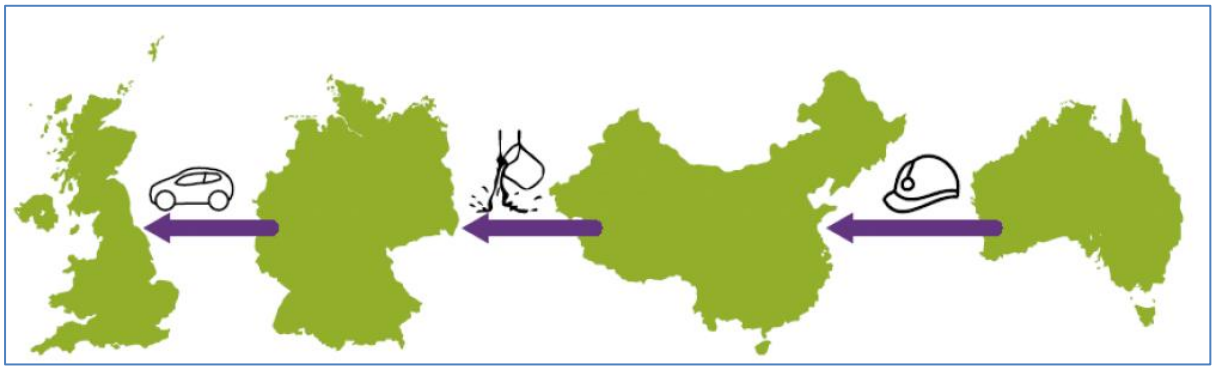

Figure 11. The methodology took a more complicated approach to modelling international carbon flows by applying multi-regional input-output (MRIO) assessment.

The multi-regional input-output (MRIO) assessment[4] shown in Figure 11 indicates that the GHG emissions are allocated solely to the country of consumption of those goods and services, irrespective of the country of production of the emissions. For example, the emissions from a car produced in Germany and bought in the UK would be tracked, including the GHG emissions embodied in imports into Germany, such as mining and smelting.

Environmental data, in this case, GHG intensity of production, is used to convert monetary data in national input/output models into national CO2 production information. Sectoral CO2 emission data was estimated from the energy data using the IPCC Tier 1 approach (Narayanan and Walmsley 2008). These national tables are then linked via trade data, and matrix mathematics approaches are used to calculate the re-allocation of global emissions on the basis of consumption.

The calculation models were built using the Global Trade Analysis Project (GTAP 7) dataset, using modelling carried out by Dr Glen Peters (CICERO, Norway), Dr Chris Weber (Carnegie Melon University, USA), and Dr Jan Minx (Technische Universität Berlin, Germany).

The calculations used data sets on trade and carbon emissions for countries around the world, not just for Russia. The breadth of the study, and the use of data from various sources meant that there are some limitations to the interpretations that can be drawn from the analysis. For example, the calculations do not include GHG emissions from agriculture and land use change,

[4] http://www.carbontrust.com/media/38350/ctc789-international-carbon-flows-background-theory.pdf

which will be significant for certain countries and sectors. Importantly, the analysis was based on data from 2004 or earlier.

For the data used to calculate the carbon flows associated with Russia, this analysis used data from the Rosstat input-output tables published[5] in "The system of input-output tables for 2003" (Rosstat, 2006). The data were disaggregated, reclassified and balanced to meet the GTAP requirements stated in Huff, McDougall, and Walmsley (2000). A variety of data transformations were required as only 22 sector groups were available, which had to be converted to 59 transition matrix compatible with Russian input-output table before aggregated to 40 GTAP sectors and further transformed to fit the GTAP requirements.

The data and modelling was, however, sufficient to show that embodied carbon is important for global GHG emissions and policy, and that the contribution of certain countries or sectors in particular such as exported commodities from Russia (metals).

5 Implications and Consequences of the Carbon Flows Analysis

The ground-breaking data analysis that was conducted enabled governments and companies to understand how GHG emissions were being imported and exported between countries and throughout supply chains.

The following section provides an overview of the consequences of this research, in terms of how governments and companies are responding.

5.1 Corporate value chain reporting

The international standard[6], 'Corporate Value Chain (Scope 3) Accounting and Reporting Standard' was released in October 2011. This freely available standard

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[5] Rosstat. (2006). System of Input-Output tables of Russia for 2003. Moscow. (in Russian)[Росстат. Система таблиц "Затраты-Выпуск" России за 2003 год. Статистический сборник. Москва 2006 год. (http://www.gks.ru/doc_2006/Zatrat06.zip)]

Rosstat. (2008). National Accounts in Russia, 2000-2007. Moscow. (in Russian) [Росстат. Национальные счета России в 2000 - 2007 годах. Статистический сборник. Москва 2008 год. (http://www.gks.ru/doc_2008/nac_sh.zip)]

[6] Greenhouse Gas Protocol, Corporate Value Chain (Scope 3) Accounting and Reporting Standard http://www.ghgprotocol.org/standards/scope-3-standard

provides the framework for major companies to report the carbon emissions that are outside of their direct corporate boundaries i.e. within their supply chains.

The Scope 3 Standard builds upon the existing and widely used methodology, The Greenhouse Gas Protocol, that most large companies use to measure and report their Scope 1 & 2 emissions i.e. GHG emissions associated with their own facilities.

This means that larger international companies will increasingly be looking to measure and report the GHG emissions within their supply chains, and therefore will require data from suppliers around the world on the embodied emissions within their products and services.

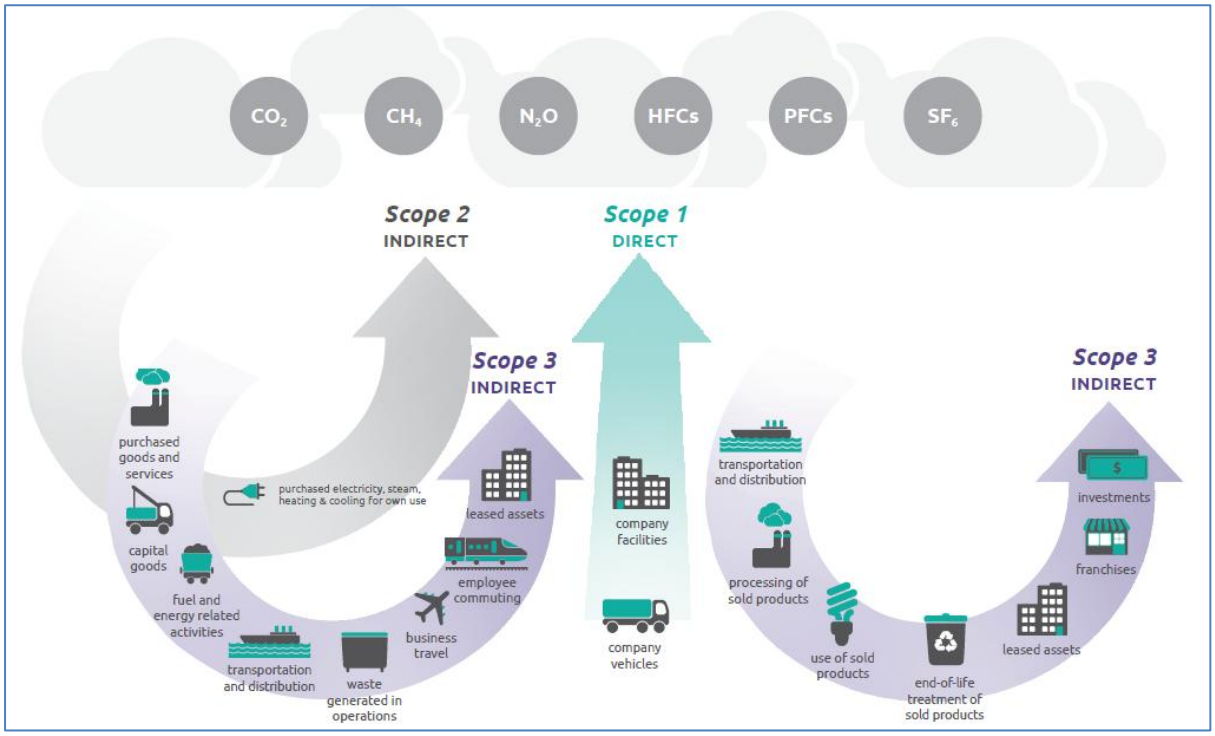

Figure 12. Illustration of the 15 different categories within the Scope 3 Corporate Reporting Standard.

There are 15 separate reporting categories within the Scope 3 methodology (Figure 12), with the most important of these being 'purchased goods and services', because it has a direct link to expenditure and because it usually has the largest proportion of GHG emissions.

At this time, many large companies are looking at the most pragmatic approach to implementing the Scope 3 standard, and how to report this information to the CDP mechanism, which many investors are using to score the sustainability performance of companies. The Scope 3 standard requires a significant amount of data to be collected, and increasingly, this will mean that suppliers will be asked to provide information on their own GHG emissions.

5.2 Supplier data

Historically, companies only used to measure the GHG emissions of their own facilities because it was relatively easy to collect data for, and because any reductions usually had direct financial savings as a consequence of improved efficiencies.

Companies are, however, increasingly aware that the majority of GHG emissions and potential risks are within their supply chains. As a result, larger companies are asking their suppliers to provide data and to show reductions in embodied GHG emissions.

A key commercial mechanism for suppliers to report their GHG emissions data is through the CDP, which is an organisation that collects data in order to evaluate the sustainability of companies. These major companies are increasingly contracting with supplier companies that provide data or report to CDP, and de-selecting those that do not.

Large companies recognise that the embodied carbon within their final products can be reduced if they contract with suppliers that are most efficient and provide materials with lower GHG emissions. Therefore, high carbon materials, and/or supplier companies that do not participate, are likely to be less successful.

For example, in the UK, government departments and large businesses are including environmental sustainability into their procurement tenders. Many supplier companies are therefore being selected on criteria including the GHG emissions of their products. There is evidence that companies with products with lower embodied emissions, that have been measured and certified by a third party, are out-competing their business rivals. One example of this in the UK is a company called Marshalls, who sell building materials, and they have identified an increase in market share since they measured and certified the embodied carbon of their products.

5.2.1 Supporting supplier companies to collect and report data

Often, the first step for suppliers is to collect the correct data, calculate the GHG emissions and present this in the most appropriate form to their business customers. For many smaller supplier companies however, this can be a challenging task without sufficient guidance, information and supporting tools.

The Carbon Trust recently completed a project that was funded by government and delivered in China that worked with supplier companies across a range of different export sectors in order to provide the necessary tools to these companies. The project piloted these bilingual tools with Chinese companies that now enable them to regularly measure and report their carbon emissions, into the CDP framework if necessary.

The project showed that supplier companies require easy to use tools and guidance before they can participate in carbon measurement, reporting and reductions

5.3 Product Design and Materials

As shown previously in Section 3.3, Coca-Cola have recognised that the packaging materials used in their products i.e. plastic, glass or aluminium, has a direct and substantial contribution on the carbon footprint of their products. As a consequence, Coco-Cola have now started to use lower-carbon packaging by using more plastic, and including recycled and plant-based materials within the plastic.

The selection of materials that have lower embodied GHG emissions is likely to increase by all major companies as they look for ways to reduce the embodied emissions of their products.

These companies also believe that buying materials with lower emissions often translates into lower cost too, because they are being made more efficiently. There is increasing anecdotal evidence that suggest supplier companies are not able to pass on costs to their business customers, because of increasing energy costs for example, if the supplier company does not have energy efficiency plans in operation.

5.4 Border Carbon Tax

There has been a recognition by some EU member states that the EU region is at risk of being out-competed by cheaper materials and products sourced from countries that operate their manufacturing using dirtier, cheaper energy. These goods have a corresponding increase in their embodied GHG emissions because of the higher emissions associated with the energy used. The outsourcing of manufacturing in regions with cheaper but dirtier energy is often referred to as carbon leakage.

One approach that has been identified is to introduce a carbon border tax for products that have higher embodied emissions, although it is unlikely that this will be implemented in the near future. It does, however, indicate that senior policy makers recognise the issue of embodied emission within the flow of international trade across borders and supply chains, and their desire to address this issue.

One of the issues associated with implementing a border carbon tax is ensuring that a measurement and verification process is available. The development of Product Environmental Footprinting (PEF) in the EU is discussed below.

5.4.1 Product Environmental Footprinting

The European Commission (EC) has identified the need to improve the environmental performance of products. The proposal[7], 'Communication on Building the Single Market for Green Products and a Recommendation on the use of the methods', aims to bring comparable and reliable environmental information, building confidence for consumers, business partners, investors and other company stakeholders.

The proposal puts forward two methods to measure environmental performance throughout the lifecycle, the Product Environmental Footprint (PEF) and the Organisation Environmental Footprint (OEF). It also recommends the voluntary use of these methods to Member States, companies, private organisations and the financial community.

The EC recognise the problem as:

- Confusion in the market on how to measure, make and understand a claim on the environmental performance of products and companies (leading to misleading claims, unfair commercial practices and greenwashing);

- Lack of a level playing field, fragmentation of the markets on methods for reporting environmental performance of products and companies; and

- Companies would like to invest more in greening their supply chain. The lack of consistent and science-based multi-criteria environmental information covering the entire value chain makes it difficult for companies to address issues like "green sourcing" and investing in tackling the most relevant environmental impacts for their products/sectors.

The underlying purpose is therefore introducing a harmonised approach to life cycle assessment (LCA) across the EU and the provision of information to companies and consumers.

Schedule of development

The proposal announces a three-year testing period from 2013 to 2016 to develop product and sector-specific rules through a multi-stakeholder process. The pilots will include 3 industry sectors in the first year and 3 other sectors in the second year.

[7] http://ec.europa.eu/environment/eussd/smgp/

The harmonised methodology for Product Environmental Footprinting

The 'Product Environmental Footprint (PEF) Guide' is currently in a draft consolidated version and is ready for final approval[8]. The guide, at 154 pages, provides an overview of to the EU's PEF. It is advised that the document is downloaded and read in detail because Report 4 is only intended as a summary. The PEF Guide does not provide any detailed information on how to undertake the multi-criteria measurement, certification or labelling however and it is expected that this will be developed during the 2 pilot phases. It should be noted that a database will not be developed during the pilot.

This PEF Guide document is not intended to directly support comparisons or comparative claims, and this requires the development of additional Product Environmental Footprint Category Rules (PEFCRs) that would complement the more general guidance.

The PEF requires assessment against 15 Environmental Footprint (EF) categories (although users may reduce the scope of Environmental Factors with justification). These categories and the assessment models used are given below.

Climate change	Photochemical ozone formation
Ozone depletion	Acidification
Eco-toxicity for aquatic fresh water	Eutrophication – terrestrial
Human toxicity – cancer effects	Eutrophication – aquatic
Human toxicity – non cancer effects	Resource depletion – water
Particulate matter/respiratory inorganics	Resource depletion – mineral fossil
Ionising radiation – human health effects	Land transformation

Table 2. List of environmental impacts to be considered within the Product Environmental Footprinting scheme currently being developed by the European Commission.

Although all 15 impact categories are to be considered in the initial assessment, it is important to note that only 3 or 4 of these 15 categories will be prioritised, and possibly communicated.

[8] http://ec.europa.eu/environment/eussd/smgp/dev_pef.htm

5.4.2 Response by UK Government to Carbon Border Tax

The UK accounts for 2% of global GHG emissions and has a national reduction target of 80% against a 1990 baseline. The UK has reduced GHG emissions by 20% reduction since 1990 but this is negated by the 20% increase in emissions when consumption is factored i.e. embodied carbon in purchased goods.

A governmental report[9] was published in 2012 by the House of Commons Energy and Climate Change Committee called, 'Consumption-Based Emissions Reporting'. The report stated that the UK government's current position on embodied carbon is:

- When the government refers to the proportion of global emissions that the UK is responsible for, it should always state on what basis that proportion has been determined: territorial or consumption;
- That government departments work together to communicate the full picture of the UK's impact on the global climate by considering both the UK's territorial emissions and consumption emissions;
- Consumption-based emissions reporting does more than inform debate: it is an invaluable tool that should be used alongside data on territorial emissions when making energy and climate change policy.

The UK's Committee on Climate Change also provided a report[10] to the UK Government in April 2013, 'Reducing the UK's Carbon Footprint'. This report provided the following recommendations:

- Border carbon adjustments aim to create a level playing field by adjusting for carbon costs embodied in trade (e.g. through a carbon tax on imports, or the purchase of emission allowances by importers). Border carbon adjustments could be imposed unilaterally by countries, by blocs of countries (e.g. the EU) or by all countries as part of a global deal to carbon costs;
- To identify the obstacles to implementing border carbon adjustments, such as concerns over barriers to trade, accurate measurements of embodied emissions in products and regional coverage;
- Border carbon adjustments are not an alternative to a global deal but should not be ruled out as a possible transitional measure if there were to be slow progress agreeing a global deal.

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[9] http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1646/1646.pdf

[10] http://www.theccc.org.uk/publication/carbon-footprint-and-competitiveness/

6 Mandatory Carbon Reporting

The UK has introduced legislation requiring UK companies reporting to the London Stock Exchange to report their organisational carbon emissions within their annual financial reports.

The legislation applies to UK incorporated, listed either on the London Stock Exchange's Main Market or in a European Economic area and excludes non-UK registered, AIM-listed and privately owned companies. These companies are now legally bound to report their GHG emissions as part of their annual financial report.

The specific requirements are given below.

6.1 Companies Act 2006

This new legislation[11] has been inserted into the 'Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013'.

DISCLOSURES CONCERNING GREENHOUSE GAS EMISSIONS

15.—(1) This Part of this Schedule applies to the directors' report for a financial year if the company is a quoted company.

(2) The report must state the annual quantity of emissions in tonnes of carbon dioxide equivalent from activities for which that company is responsible including—

(a) the combustion of fuel; and

(b) the operation of any facility.

(3) The report must state the annual quantity of emissions in tonnes of carbon dioxide equivalent resulting from the purchase of electricity, heat, steam or cooling by the company for its own use.

(4) Sub-paragraphs (2) and (3) apply only to the extent that it is practical for the company to obtain the information in question; but where it is not practical for the company to obtain some or all of that information, the report must state what information is not included and why.

16. The directors' report must state the methodologies used to calculate the information disclosed under paragraph 15(2) and (3).

[11] http://www.legislation.gov.uk/ukdsi/2013/9780111540169/contents

17. The directors' report must state at least one ratio which expresses the quoted company's annual emissions in relation to a quantifiable factor associated with the company's activities.

18. With the exception of the first year for which the directors' report contains the information required by paragraphs 15(2) and (3) and 17, the report must state not only the information required by paragraphs 15(2) and (3) and 17, but also that information as disclosed in the report for the preceding financial year.

19. The directors' report must state if the period for which it is reporting the information required by paragraph 15(2) and (3) is different to the period in respect of which the directors' report is prepared.

20. The following definitions apply for the purposes of this Part of this Schedule— "emissions" means emissions into the atmosphere of a greenhouse gas as defined in section 92 of the Climate Change Act 2008(a) which are attributable to human activity; "tonne of carbon dioxide equivalent" has the meaning given in section 93(2) of the Climate Change Act 2008.".

6.2 Supporting methodology

A supporting document[12] has been issued by Food and Rural Affairs (Defra) UK Government called 'Environmental Reporting Guidelines: Including mandatory greenhouse gas emissions reporting guidance'. This document provides the methodology on measuring and reporting the GHG emissions.

The document requires 6 GHG's to be included in the assessment:

1. Carbon dioxide (CO2)
2. Methane (CH4)
3. Hydrofluorocarbons (HFCs)
4. Nitrous oxide (N2O)
5. Perfluorocarbons (PFCs)
6. Sulphur hexafluoride (SF6)

The report also states that 'The indirect environmental impact of your supply chain may be greater than your own impact. Engaging with your supply chain can provide you with valuable information to inform a strategic assessment of where, in your supply chain, the most significant environmental impacts are occurring'. The report suggests that companies:

12 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/206392/pb13944-env-reporting-guidance.pdf

- Engage with your suppliers. Encourage your suppliers to report on the key impacts.
- Influence purchasing decisions with the information gathered.
- Consider post-contract supplier development to focus on engaging suppliers in continuous improvement in environmental management.

7 Conclusions

Given the information provided in this report, it can be concluded that:

1. Materials and products have embodied GHG emissions due to the energy and processes required to make them.
    a. Different materials have different amounts of embodied emissions depending on how they are made
    b. Companies are beginning to select materials with lower embodied emissions for their products
    c. Companies are expecting international suppliers to provide information and beginning to select suppliers based upon this

2. The 2011 study into carbon flows has provided evidence of 'embodied carbon' flowing across borders and supply chains as part of international trade.
    a. Embodied emissions in exports from the Russian Federation are overwhelmingly biased towards commodities, such as steel and aluminium into EU
    b. The quality of data used in the carbon flows project contains some uncertainties due to the global scale of the modelling and analysis

3. Internationally, companies and governments are responding to this challenge of reducing the embodied emissions within products.
    a. The Carbon Trust is currently supporting the development of product carbon Footprinting schemes in China, Malaysia, Taiwan, Korea, Hong Kong
    b. Product Environmental Footprinting and labelling is currently being trialled by the European Commission
    c. The UK government recognises that national emission targets and reporting should also include emissions associated with importing goods
    d. Carbon Border Taxes are being identified as 1 potential measure to mitigate against carbon leakage

8 Recommendations

Given these conclusions, it is recommended that:

1. Improve the quality of the data used for Russian carbon flows, using more recent data on trade movements and more regionally accurate emission factors. This will provide greater confidence in which sectors are most at risk
    a. Collect sector-specific data to improve current understanding of GHG landscape in Russia.

    It is recommended that the original university in Russia (Section 4.3) is contacted to determine if this analysis could be updated, using better quality and more recent data. It is also possible that a local consultant could undertake this work.
    Trade organisations in the key sectors, i.e. commodities, could also be involved in provided data for this analysis.

2. Any new policies or schemes, such as Recommendation 2, need to be carefully designed in order to demonstrate clear economic advantages that help Russian companies, with both the domestic and export markets.
    a. The approach needs to be simple, credible and internationally relevant
    b. Determine the most important information currently being requested by international business customers, in terms of information on GHG emissions and wider environmental impacts of supplier companies
    c. Aim to demonstrate the positives of Russian business, such as factories using renewable energy and modern efficient technology

    Key academics and consultants could be used, working with the relevant Russian government departments, to create policy recommendations using a review of existing climate change policy and a review of successful business practice and technology in other countries. Specific attention should be given to the subject of measuring, reducing and reporting GHG emissions associated with embodied carbon.

3. Key Russian companies and sectors to pilot methods to measure the embodied GHG emissions within their products.
    a. This should be conducted using established and internationally recognised standards
    b. Support of government and trade organisations should be encouraged, as this will increase participation and facilitate sharing of knowledge
    c. Key export markets, such as aluminium and steel, should be included in these pilot studies

d. A full scheme for the measurement of embodied emissions should be introduced following the pilot studies

It is recommended that a variety of organisations are involved with the pilot study, led by trade bodies that represent and coordinate the key companies in key sectors.
A methodology and calculation tools should be developed to support the companies to measure and report in an accurate and consistent manner. Consultants in Russia should be able to develop this, with support from consultancy in the EU to ensure that it is meeting the needs of business customers in this region (Section 4.1 & 4.2).