Integrating consumption and international trade into energy and climate policy

Glen P. Peters, Robbie M. Andrew, Jonas Karstensen

Center for International Climate and Environmental Research – Oslo (CICERO)

Abstract

Energy and climate policy are historically considered from a national territorial perspective. Yet, for global issues, the interconnections between countries via consumption and international trade blur national boundaries. Around one-third of energy consumption and one-quarter of climate related emissions are from the production of goods and services which are consumed in a different country to where they were produced. Large variations occur at the national level, but it is generally found that rich countries are net importers of energy and emissions, while developing countries are net exporters. For traded goods and services, recent studies have shown that officially reported territorial carbon dioxide emission reductions in rich countries are more than offset by an increase in emissions in other countries due to increased imports. When additionally linking goods and services to international trade in fossil fuels, recent studies show countries are becoming more dependent on both foreign sourced energy and production. For land use change, recent work suggests that around 30% of Brazil's deforestation can ultimately be linked to consumption outside of Brazil. While these results often have high appeal to the social sciences, most studies have been focused on quantifying traded energy and emissions and, as yet, there has been very little research initiated from the social sciences. There is a large scope to develop interdisciplinary research questions to better integrate existing and on-going research on consumption and international trade perspectives into energy and climate policy. This paper gives an overview of potential areas of interdisciplinary collaboration related to international trade and consumption, with a focus on the implications for climate policy.

Introduction

Perhaps by design, global climate policy has always embraced the notion of sovereign control over territorial emissions. The reasons for this are not entirely clear. Neither the UNFCCC, nor its Kyoto Protocol, reference the system boundaries of the "Parties". The UNFCCC is clearly focused on addressing a "global" problem, and the Parties "cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development". Indeed, this is reinforced by stating that "[m]easures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade".

This global focus of the UNFCCC is potentially not reflected in the reporting of emissions. Rules for emission reporting are delegated to the IPCC: "[m]ethodologies for estimating anthropogenic emissions…shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties at its third session". The IPCC states in the 1996 Guidelines, national GHG inventories "include greenhouse gas emissions and removals taking place within national (including administered) territories and offshore areas over which the country has jurisdiction". There is no discussion on the reasons for a territorial focus, but it is perhaps natural to base emission statistics on existing "energy balances" of national territories and it is unlikely that the potential problems with a territorial perspective were realised at the time.

While a territorial focus is important for understanding emissions for which countries have administrative control, a potential problem arises given the guiding principle of the UNFCCC that "the developed country Parties should take the lead in combating climate change and the adverse effects thereof". This has led to the "two-tier" system of climate policy: the mostly developed countries (Annex I) have "quantified emission limitation and reduction commitments", while the remaining countries do not (non-Annex I). Within a global economic system with fragmented implementation of climate policy via the "two-tier" system, emission leakages may arise (Aichele and Felbermayr, 2012; Peters et al., 2011).

Especially given the "two-tier" system of mitigation, for global environmental problems there is a rationale to take consumption as a system boundary; that is, emissions are allocated to the country where goods and services are consumed rather than where they're produced. The argument follows that for a global pollutant, the location of emissions does not matter. Based on economic causality, demand for products (consumption) gives rise to increased production and this production may, perhaps unintentionally, occur in another country. If a territorial (production) system boundary is used, perceived progress at the territorial level may be offset by consumption driven changes at the global level. This issue has already been noted for global environmental change (Hoel, 1996; Markusen, 1975), yet the focus has remained firmly on a territorial system boundary.

This article takes as a starting point that the efficiency with which society mitigates anthropogenic climate change would be enhanced through broad-based and globally harmonised climate policies. The fragmented implementation of existing climate policies creates opportunities for emission leakages between distinct areas of regulation. One way to address this issue is via different methods of accounting (allocating) greenhouse gas emissions. We briefly present an overview of our research in the last five years, and demonstrate the quantitative advantages of different methods of accounting. We (and others) have so far failed to draw strong connections between our research and its policy relevance. More specifically, there is little research on the design and implementation of policies that build on our research. Our motivation in this paper is to draw some connections of our research to policy, and thereby point to potential areas of fruitful interdisciplinary collaboration.

Overview of key results

In terms of CO_2 emissions there is a clear asymmetry between exporters and importers. When emissions are allocated to consumption and compared to a territorial allocation, it is clear that developed countries overall are net importers of emissions and developed countries are net exporters (Peters et al., 2012), Figure 1. Consumption-based emissions are conceptually the territorial-based emissions less the emissions embodied in exports plus the emissions embodied in imports (net traded emissions, or emission transfers). The consumption-based emissions in most countries are dominated by the non-exported share of the territorial emissions, Figure 2, but there is a correlation with country size; small countries import a greater share of their territorial emissions probably since they have smaller resource and capital bases (Peters and Hertwich, 2008). After the territorial component, the net emission transfers into most countries are dominated by imports from China, with the main importers being the EU27, USA, and Japan, Figure 3. There are large changes in these flows over time, with developed countries increasing their net import and this more than offsets emission reductions achieved in the Kyoto Protocol (Peters et al., 2011). It is also possible to allocate emissions at the point of extraction of fossil fuels (extraction-based emissions), and thereby

consider the full supply chain from fossil-fuel extraction, fossil-fuel consumption (territorial emissions), and the consumption of goods and services (Davis et al., 2011), Figure 4. The advantage of the latter approach, which suggests supply-side regulation, is that there are fewer actors at the point of regulation, compared to the point of production or consumption.

These figures give an overview of the main findings in our research, and the literature more broadly. We have focussed on CO_2 emissions here, but it is possible to extend this to consider land-use change (Karstensen et al., 2012), carbon in biomass (Peters et al., 2012), human appropriation of net primary productivity (Erb et al., 2009), water (Hoekstra and Mekonnen, 2012), biodiversity (Lenzen et al., 2012), in addition to other air pollutants other than greenhouse gases. There are a growing number of researchers in these fields (Wiedmann, 2009), with results across studies broadly consistent.

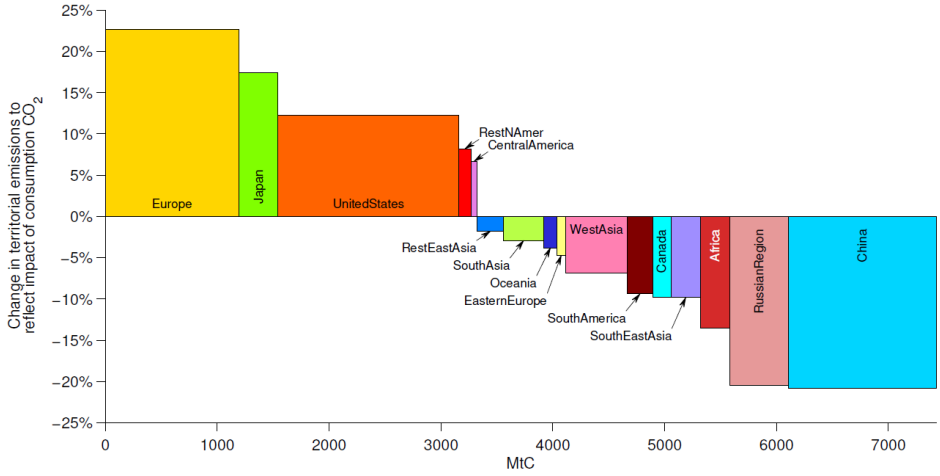

Figure 1: The change in territorial-based CO_2 emissions when adjusted to a consumption basis (2004). The horizontal axis shows the territorial emissions, while the vertical axis shows the relative change.

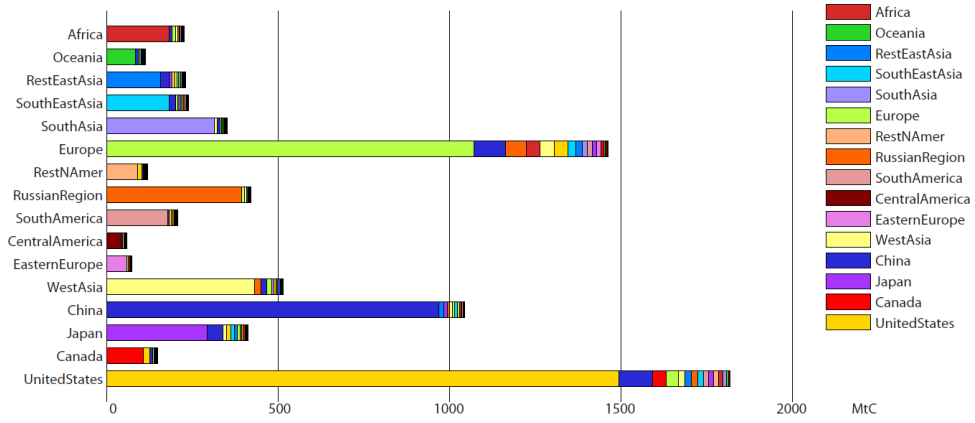

Figure 2: Consumption-based emissions by region, disaggregating the regions where the emissions occur after adjusting for international trade (2004). Developed regions have a higher proportion of consumption emissions from other regions, and the largest single contributor to imported emissions in developed regions is China.

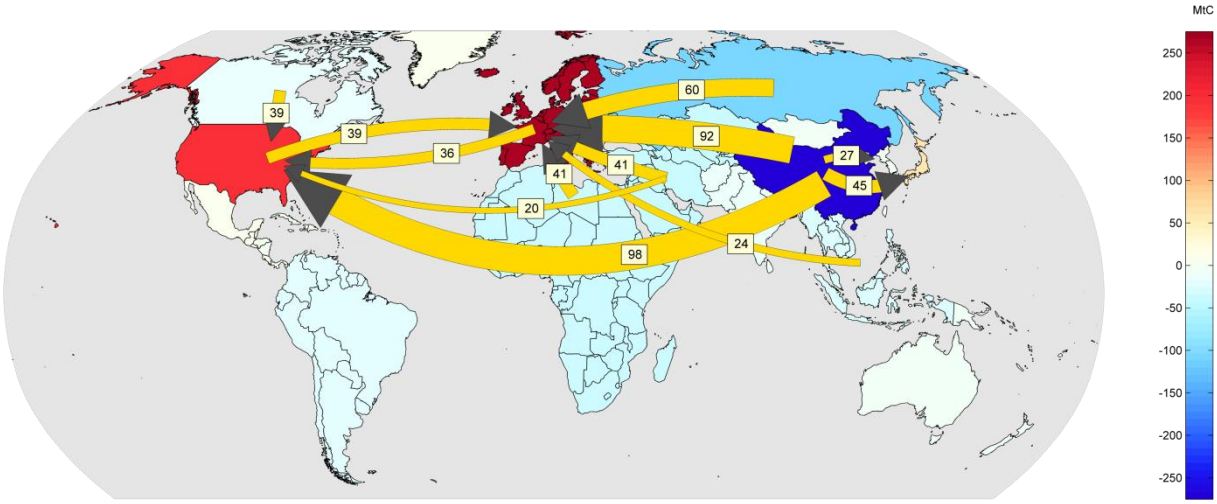

Figure 3: The 12 largest inter-regional flows of carbon embodied in trade, from origin of emissions to the region of final consumption, with key regions disaggregated (2004). The largest single inter-regional flow is from China to USA (98 MtC). These 12 flows account for 40% of all inter-regional flows using this grouping.

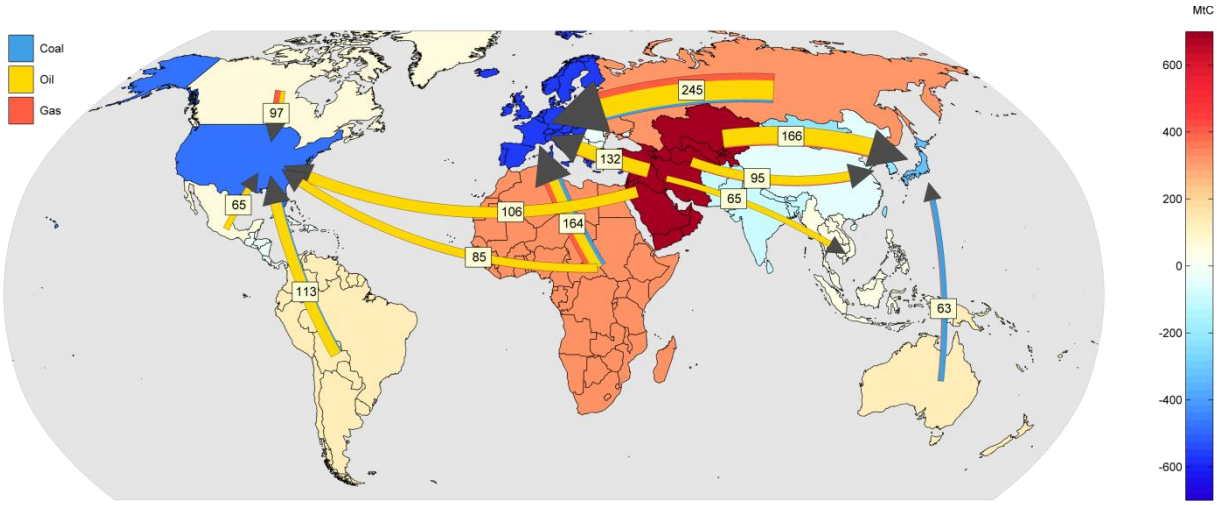

Figure 4: The top 12 inter-regional flows of fossil fuel carbon embodied in trade from extracting region to producing region, broken down by primary fuel type, and disaggregated further to highlight key countries (2004). With Japan and China separated, the largest single interregional flow is from Russia to Europe (245 MtC), primarily oil and gas. This grouping also highlights that most of the emissions imports to North America are in fact to USA.

Potential research with other disciplines

Most of the research outlined above has served the immediate research community, with a slower penetration into other fields. Most studies are quantitative, with only limited qualitative discussions of the policy implications. It has recently been argued that the current slow progress in climate negotiations, and recent moves away from the UNFCCC "two-tier" structure, gives opportunities for new research into alternative policy design (Aldy and Stavins, 2012). There is a clear lack of literature on using extraction-based or consumption-based emission accounting as a complementary policy instrument in climate policy. In the following, we give an outline of some potential areas where collaboration could be fruitful, primarily with the economic and political sciences.

<u>Understanding and regulating consumption</u>

Current knowledge: One key advantage of global supply-chain models is that they can study the supply chain from the point of consumption back to the point of production or even extraction (Davis et al., 2011). From the point of consumption it is possible to clearly identify which sectors are important, and how this varies across countries (Hertwich and Peters, 2009). By following the supply chain, "hot spots" linking production and consumption can be identified as these may be optimal point for policy intervention (Lenzen, 2003).

Extensions: While there are now many studies which list important sectors and "hot spots", the next step is to understand how this information can be utilised for regulation. Intervention points could be located at the point of consumption (e.g. carbon labelling), distribution (to be neutral towards wholesale and retail margins), processing (increased processing could be used to avoid regulation imposed on less processed commodities), border adjustments (equal treatment of local and imported goods), or production (e.g., a tax). There are opportunities to integrate our analysis with experts on policy instruments, particularly including countries with different governance structures and types of "hot spots".

Responsibility for greenhouse gases

Current knowledge: Arguments of equity (Caney, 2009), distribution of greenhouse gases (Chakravarty et al., 2009), and questions of responsibility (Munksgaard and Pedersen, 2001) are often-mentioned applications of alternative accounting systems, though operationalizing these allocations has received less research.

Extensions: While it is relatively easy to rank countries according to different equity criteria, it is more difficult to understand the implications of different allocations. It may also be that some "equitable" distributions of emission rights might not be equitable or feasible for some countries. There are options here to explore what may be politically feasible forms of allocation rules or protocols, considering their practical feasibility (e.g., feasible mitigation rates) and the economic feasibility at the national and global level.

Carbon leakage and consumption-based emission reductions

Current knowledge: There has been a longer discussion on using consumption-based emission inventories as a complementary measure in climate policy (Peters et al., 2011), and there are many links to existing policies on subsidising exports and introducing Border Tax Adjustments (BTAs) (Peters, 2010). With fragmented climate policy, BTAs in combination with export subsidies, can reduce carbon leakage and reduce competitiveness concerns, but at the expense of distributional impacts (Böhringer et al., 2012c).

Extensions: While there is a rich literature in this field, there are also several important gaps. A large part of the growth in international trade is in the highly mobile, non-energy-intensive sectors, while most studies focus on the less mobile, energy-intensive sectors. Exploring alternative designs of BTAs may help understand underlying dynamics and more optimal designs (e.g., Böhringer et al., 2012a). BTAs also lead to distributional issues (Böhringer et al., 2012b), but this may encourage broader participation (Helm et al., 2012). The direct use of consumption-based emission inventories in policy has received little empirical attention (Access Economics, 2009), but may provide interesting insights. Exploring the implications of have a "carbon added tax" with similar design principles to a "value

added tax" is a relatively unexplored area (Lockwood and Whalley, 2010). Carbon leakage is intimately related to competitiveness concerns, and considering these two issues together is another important area of research.

Growth in consumption-based emissions

Current knowledge: The drivers of increased consumption-based emissions in developed countries are currently poorly understood (Peters et al., 2011). Since carbon leakage is rather small (Böhringer et al., 2012c), it is most likely that changing division of labour is the cause behind most of the growth.

Extensions: Reconciling the different definitions of carbon leakage (Peters, 2010), and putting them on a comparable scale is important. There is a need to understand the growth of consumption-based emissions in dynamic economic models and using decomposition methods, to determine the key drivers of upwards trends. This requires improvements in existing economic models, such as the realistic representation of bilateral international trade differentiating intermediate and final products (e.g., Koopman et al., 2010), and a realistic representation of differential growth rates between countries.

Extraction-based (supply-side) policies

Current knowledge: There has also been a variety of studies on supply side policies. Taxing fossil-fuel resources at the point of extraction reduces the number of actors (Davis et al., 2011), and the tax income may more than compensate for a drop in income (Whalley and Wigle, 1991). It is also possible to purchase rights to fossil-fuel resources, and thereby compensate for otherwise inefficient policies (Asheim, 2012; Harstad, 2012).

Extensions: Most economic analysis in this area has been theoretical, but there is potential to incorporate these concepts into empirical economic models. More detailed information on the potential costs, and identifying the winners and losers, may identify advantages in supply-side policies for fossil-fuel extractors. This can then be combined with analysis of negotiating strategies around supply-side policies, which may have many similarities to the dynamics of negotiations associated with consumption-based policies, and BTAs in particular.

Global agreements

Current knowledge: It may be necessary for a global agreement to include international trade (Barrett, 2011) and the unilateral incorporation of trade measures in domestic policies may lead to a global agreement (Helm et al., 2012).

Extension: There is a growing literature which looks at the role of international trade as an enforcement measure in climate policy. However, there has not been a more systematic analysis of how extraction-, consumption-, or more broadly, trade-based approaches may affect negotiations. There is scope for the application of different quantitative and qualitative approaches from the political sciences to determine how different climate regimes may operate.

Effectiveness of global agreements

Current knowledge: Several authors have looked at measuring effectiveness of global agreements. This originated with qualitative approaches, but recent work has applied quantitative approaches in a variety of applications (Hovi et al., 2003).

Extension: The analysis of effectiveness requires investigation of counterfactual, actual, and optimal emission pathways. It is not obvious how to derive these pathways (Hovi et al., 2003). Several lines of research could be followed. It may be possible to define "effectiveness" of the accounting system used in a climate regime and this would draw on work comparing consumption and production emissions (Peters et al., 2011). Alternatively, various methods of estimating emissions in the short to medium term can be investigated, such as based on historic pathways, considering inertia in the system (Davis et al., 2010), or the use of economic modelling. Using these types of approaches to explore effectiveness may help in the formulation of alternative climate agreements.

Power

Current knowledge: Power is a key concept in political science. Power can be directed bilaterally, or can be aggregated through a third country (Hovi et al., 2011).

Extension: Power can be transferred between various actors, such that two disconnected actors have power relationships transmitted through a third actor. Methods of modelling this are similar to methods of modelling the global trading system. Bringing these two fields together may allow combination of quite different concepts under the same methodological framework. By combining different methods of transferring power using the same class of models, it may be possible to identify currently unknown factors affecting negotiations. For instance, transmission of power through global financial systems may have an important consequence compared to the power transmitted through existing political forums which may encompass different actors.

Conclusions

In this paper we have presented the main research findings associated with climate policy in a two-tier mitigation regime. We have argued the importance of including extraction or consumption into climate policy, perhaps indirectly via international trade. While there is a large body of quantitative research, we have argued that the literature is quite small in the economic and political sciences. Given the recent political interest in these issues, and openings in terms of climate policy (Aldy and Stavins, 2012), we feel time is opportune to develop interdisciplinary research in these areas.

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