

# **A small step for emissions accounting, a giant leap for sustainability?**

Unpacking the debate around the consumption-based emissions accounting method.

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Lund University Centre for  
Sustainability Studies



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## **Abstract**

This thesis deals with the problem of outsourced emissions, the situation when the consumption of (predominantly Global North) countries with high carbon efficiency drives emissions in (predominantly Global South) countries with low carbon efficiency. The EU as a climate leader and an economic superpower subsumes a large share of outsourced emissions. Outsourcing can be measured by the consumption-based account as opposed to the current production-based account. Although the indicator to measure outsourcing is at our disposal, climate policies such as the EU's do not address it.

I aim to show that the consumption-based account can benefit climate governance. I seek the answer to the question of what the comparative advantages and implementation barriers of the consumption-based account are, according to the scholarly debate. I contribute to sustainability science with a systematic literature review to synthesize the arguments from the interdisciplinary debate, from an effectiveness, fairness and political feasibility aspect.

The consumption-based account has many advantages from an effectiveness perspective as well as certain limitations. The literature highlights that its implementation could create a fairer distribution of burdens and that it is feasible to implement it as a target base, although related research is limited. Apart from applying it as a target base, it could be used as a monitoring or instrument base, which determines which advantages and implementation barriers apply, and how those potential barriers might be overcome. However, using it as a monitoring base is already unproblematic according to the scholarly debate. The literature predominantly advocates for the complementary use of the method in climate policies, as multiple accounts can ensure better coverage of issues concerning emissions abatement. Research also establishes that the decoupling of economic growth from emissions should be judged from a consumption-based perspective and that growing consumption needs to be addressed to mitigate climate change effectively.

**Keywords:** emissions embodied in trade, outsourced emissions, consumption-based accounting, emissions accounting, climate governance, sustainability science

**Word count:** 14000

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## List of Abbreviations

<b>CBDR</b>	common but shared responsibilities
<b>C40 cities</b>	C40 cities climate leadership group
<b>EE-IOA</b>	environmentally extended input-output analysis
<b>EKC</b>	Environmental Kuznets Curve
<b>EU</b>	European Union
<b>G20</b>	Group of Twenty
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>LSA</b>	life-cycle analysis
<b>MRIO</b>	multi-regional-input-output-model
<b>MRV</b>	monitoring, reporting and verification
<b>UN</b>	United Nations
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>SRIO</b>	single-regional-input-output-model



***“what you measure is what you work on”***

Bill McKibben – 6 March 2019, Lund

‘Fighting Climate Change – with social movements’ panel discussion

# 1 Introduction

Climate change is a complex phenomenon of global scale (IPCC, 2013). Its effects are disproportionate, and contributions to its causes are varied. The contribution ratios and the level of affectedness demonstrate a mismatch between countries (Althor, Watson, & Fuller, 2016; Füssel, 2010; IPCC, 2013, 2014b). As climate change is a global problem, it requires to be looked at through a global lens. The UNFCCC and other climate treaties at the core of global climate governance are not sufficient to tackle climate change alone (Hoffman, 2011; Ostrom, 2010b, 2012; Rogelj et al., 2016; Schleussner et al., 2016). Global climate governance translates to a polycentric system of actors, initiatives and mechanisms of different international, transnational and national domains, such as the European Union (EU), the G20, the C40 cities or bilateral agreements (Betsill, Dubash, Paterson, & van Asselt, 2015; Biermann, Pattberg, van Asselt, & Zelli, 2009; Cole, 2011; Dorsch & Flachsland, 2017; Ostrom, 2010a; Widerberg & Pattberg, 2015). Efforts aimed at addressing climate change span across all scales, though they have not proven sufficient.

Research has highlighted the outsourcing of emissions (a trend in emissions embodied in trade) as an important side-effect of global trade. It is problematic from a climate perspective as countries might produce the same goods with different levels of carbon efficiency, and therefore, it might result in higher emissions (Jiborn, Kander, Kulionis, Nielsen, & Moran, 2018). Its dynamics can be measured by the consumption-based accounting method as opposed to the currently used production-based method (Peters, 2008a). Global South countries tend to be the net exporters of emissions, while countries of the Global North tend to be net importers, the latter benefitting from the displacement of emissions and therefore evading corresponding responsibility (Peters, Minx, Weber, & Edenhofer, 2011). Outsourced emissions are a blind spot of most current climate policies, in particular on the international, regional and national levels.

The entry point of this thesis is the EU as a block of its member states, the second largest economic power and a climate leader, which is responsible for a large proportion of globally traded emissions (Fezzigna, Borghesi, & Caro, 2019). However, its climate policy focusses on reducing territorial emissions, calculated by the production-based account. The decreasing trend in its production-based emissions is considered to indicate that the block's climate policies are successful and that economic growth is decoupled from environmental consequences (in this case from the pressure of emissions), which ignores consumption-based emissions (Delbeke & Vis, 2016).

However, the question remains: if there is an accounting method capable of measuring outsourcing, which can thus serve as a first step to deal with outsourcing, why do climate policies seem to gloss over it? This raises a further question, whether the method's inherent characteristics and current circumstances allow for its implementation at all. In lack of a comprehensive analysis of all discussed arguments, I carried out a systematic literature review to unpack the debate around the potential application of the consumption-based account to find out what its advantages and barriers to implementation are.

This thesis deals with the presumably most complex sustainability challenge of current times. It focusses on climate governance, and on how the potential adoption of the consumption-based account could benefit climate policies to become more effective in addressing climate change. Further, it provides an insight into how the consumption-based account can challenge the idea of decoupling economic growth from environmental harms, and how it might work towards changing the status quo of how we think about the relation between the economy and sustainability.

In the following sections (see *Figure 1*), I delve into the problem of outsourcing that the consumption-based account can measure (*Chapter 2*). Then I explain the aim and research question, along with a detailed description of the process of the systematic literature review that I carried out (*Chapter 3*). Next, I present my findings organized in four subchapters: Effectiveness, Fairness, and Political feasibility, and I close with findings on the implications of the consumption-based account on decoupling economic growth from emissions (*Chapter 4*). Later on, I discuss the findings of this research by highlighting some of the relevant points; and I make conclusions and judgements based on the findings on the consumption-based account (*Chapter 5*). In the last chapter, I provide a summary (*Chapter 6*).

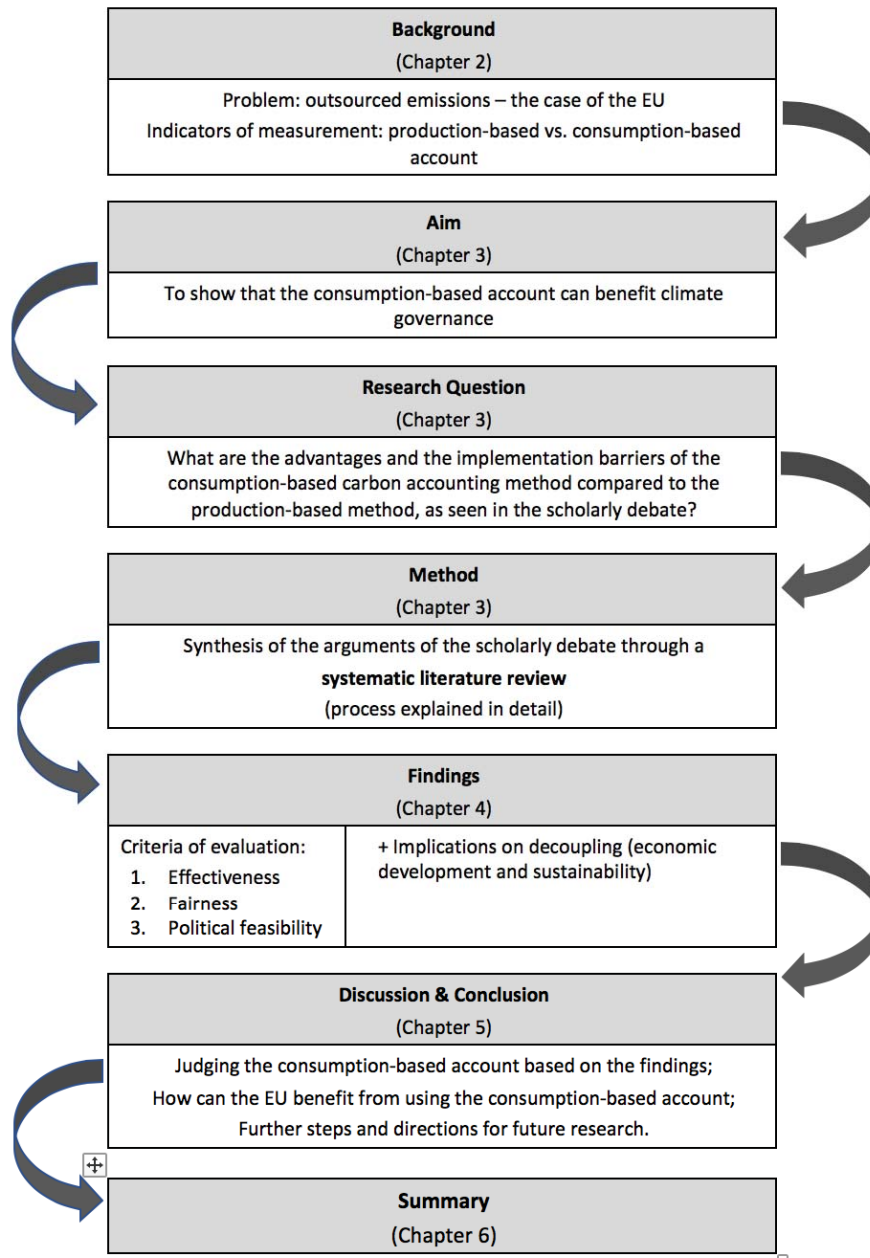


Figure 1. Thesis and argumentation outline

## 2 Background

### 2.1 Emissions embodied in trade and outsourced emissions

Generally, 20-25% of global emissions stem from the production of internationally traded goods (Barrett et al., 2013; Davis & Caldeira, 2010; Peters & Hertwich, 2008a; Peters et al., 2011). Net *emissions embodied in trade* (see Table 1) have in general been increasing by 17% at an average yearly rate, outpacing the rate of reductions in production-based emissions (Peters et al., 2011; Rothman, 1998).

Research has consistently upheld that trends in emissions embodied in trade reveal the significant *outsourcing of emissions* (see *Table 1*) when the production processes in countries of lower carbon efficiency partly satisfy the demands of other countries with higher carbon efficiency (Jiborn et al., 2018; Skelton, 2013). Outsourced emissions are partly due to simple trade mechanisms: the global division of labor, where goods are produced where it is cheapest and eventually transported to the final consumer (see *Table 1*) (Afionis, Sakai, Scott, Barrett, & Gouldson, 2017; Franzen & Mader, 2018; Jiborn et al., 2018).

The term of outsourced emissions also entails *carbon leakage* situations, where production processes shift to countries with laxer climate policies due to policy standards (see *Table 1*), which research calls the ‘pollution haven hypothesis’ (López, Arce, & Zafrilla, 2013), although it is contested due to a lack of substantial evidence (Bassi & Duffy, 2016; Marques, Rodrigues, Lenzen, & Domingos, 2012; Pedersen & de Haan, 2006; Peters & Hertwich, 2008a; Peters et al., 2011; Reinaud, 2008; Sartor, 2012). The IPCC also refers to carbon leakage distinctively as policy-induced outsourcing (IPCC, 2014a; Peters, 2008b).

Term	Connotation
<b>‘Emissions embodied in trade’</b>	The emissions attached to the production of goods and services, which are transported across borders, not necessarily between countries with different carbon efficiencies. (An umbrella term denoting the movement of emissions.)
<b>‘Outsourced emissions’</b>	The emissions attached to production processes in countries with lower carbon efficiency, which satisfy the demand of other countries with higher carbon efficiency. Outsourcing is an observed trend in emissions embodied in trade, therefore, data depicting emissions embodied in trade is used to provide evidence for outsourcing. (An umbrella term denoting both weak carbon leakage and strong carbon leakage.)
<b>‘Weak carbon leakage’</b> <b>‘Market-induced outsourcing’</b>	Outsourcing due to the global division of labor, where goods are produced where it is cheapest and eventually transported to the final consumer, as a result of either foreign companies relocating activities to other countries to reduce regulatory or employment compliance or by local companies delivering to meet foreign needs.
<b>‘Strong carbon leakage’</b> <b>‘Carbon leakage’</b> <b>‘Policy-induced outsourcing’</b>	Outsourcing due to production processes shifting to countries with laxer climate policies. As ‘carbon leakage’ usually refers to policy-induced outsourcing, this thesis uses it accordingly.

*Table 1. Terms and their connotations describing the problem, as used in this thesis (own illustration).*

A general trend can be observed where countries of the Global South are net exporters, and countries of the Global North are net importers. The trend dates back to colonial times, where countries of the Global North turned to more service- and knowledge-based activities from agricultural or industrial ones, which are generally pursued in countries of the Global South (Baker, 2018; Jiborn et al., 2018; Peters et al., 2011). However, some argue that this divide is not that clear, as there are some outliers (Baumert, Kander, Jiborn, Kulionis, & Nielsen, 2019; Yoon, Yang, & Kim, 2018). Whether a country becomes a net exporter or a net importer depends on numerous factors such as GDP, population, reliance on resources, economic specialization, etc., which are naturally changing over time (Davis & Caldeira, 2010; Kanemoto, Moran, Lenzen, & Geschke, 2014). The current carbon accounting method is based on territorial emissions. It conceals that the decarbonization of countries of the Global North is to a great extent the result of the offshoring of their emissions to countries of the Global South, whose emissions have skyrocketed in the recent decades (Hertwich & Peters, 2009; Peters et al., 2011). The main reason why they could consume so much energy and materials, was that their imports largely came from developed economies (Clapp & Helleiner, 2012).

Outsourced emissions have become a significant side-effect of global trade, a vast literature studies the emissions transported across borders from countries with high carbon efficiency to those with low carbon efficiency. Research suggests that there are no grounds to suppose that outsourcing trends will become trivial in the foreseeable future (Duus-Otterström & Hjorthen, 2018). Despite the robust scientific evidence on outsourced emissions, it has not received particular attention in most climate policies.

## **2.2 The entry point: the EU, as a climate pioneer and an economic superpower**

The EU as an essential nodal point of the polycentric climate governance system (Rayner & Jordan, 2013), represents its member states in global climate negotiations, nests them in the global regime (Skjærseth & Wetttestad, 2002). It is considered to be a pioneer in climate policy-making and a leading actor in climate negotiations (Afionis, 2017; Bäckstrand & Elgström, 2013; Groenleer & van Schaik, 2007; Kilian & Elgström, 2010; Rayner & Jordan, 2016). It pioneered to implement novel policies such as the ETS, and its territorial emissions significantly decreased in the last decades (see *Figure 2*), its 20% reduction target for 2020 has already been reached in 2015 (European Environment Agency, 2018b; Rayner & Jordan, 2016). It is also the most significant contributor to climate financing for Global South countries (European Commission, 2017).

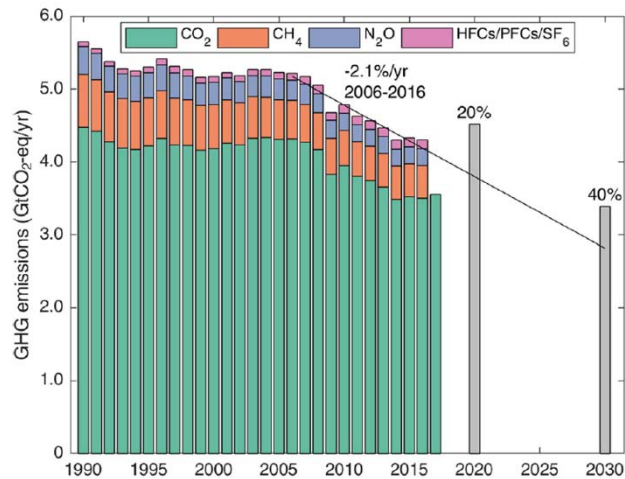


Figure 2. Trends in the territorial emissions of the EU (European Environment Agency, 2018a).

In addition to its great political influencing potential in global climate negotiations, the EU is also an economic superpower. It is responsible for 15% of the world's trade in goods (Eurostat, 2017), and it accounts for the second largest share of trading goods (only surpassed by China). Thanks to its trade, it was the largest net importer of emissions in 2011 (see Figure 3), mainly importing from China (Eurostat, 2017; Zhu, Shi, Wu, Wu, & Xiong, 2018). In 2015, its imported emissions were three times larger than its exported emissions (it imported 1317 Mt CO<sub>2</sub>, while exported only 424 Mt CO<sub>2</sub>) (Fezzigna et al., 2019). Due to the significant role the EU plays in the global flow of transported emissions, its responsibility in driving them upwards ought not to go unacknowledged.

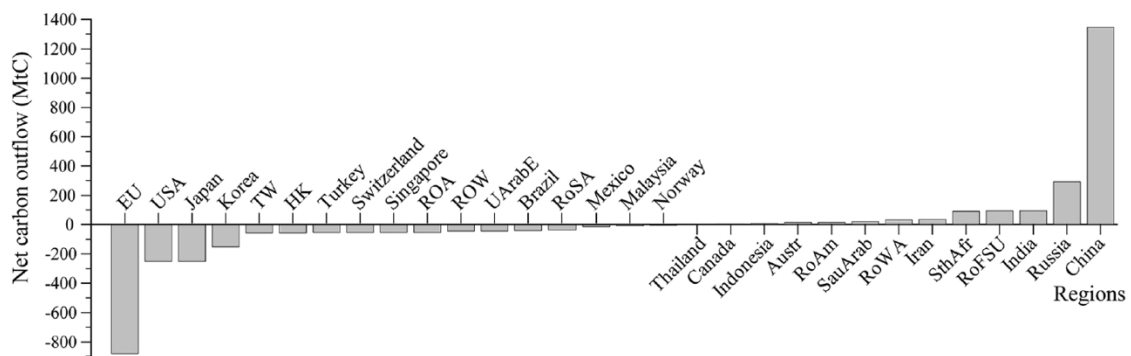


Figure 3. The net carbon outflows of 30 regions in 2011 (Zhu et al., 2018).

Since 1990 until the global economic crisis in 2008, the territorial emissions of the EU had started to decline slowly, which turned into a rapid decline from 2009 on (Karstensen, Peters, & Andrew, 2018). Consumption-based emissions had consistently been higher than territorial emissions (on average approximately 19% above it) until 2014, and they peaked at 27% in 2011 (Karstensen et al., 2018).

However, since the financial crisis' effects unfolded, both the consumption-based emissions and the difference between the two indicators have dropped (Pan et al., 2017). Although some attribute the emission reduction to efficiency improvements (Yoon et al., 2018), according to Karstensen et al. (2018), the immediate driver behind the accelerated decline in emissions since 2008 was the lower economic growth rate augmented by increases in energy efficiency and carbon efficiency. According to recent data, however, EU emissions have picked up again since 2014 due to stronger GDP growth as shown by the Kaya Identity decomposition (International Energy Agency, 2018; Karstensen et al., 2018). If the economic growth rate of the EU remains strong, and as a result, international trade keeps pace, the gap between the territorial and the consumption-based emissions might be expected to widen again (Karstensen et al., 2018).

Though the EU's involvement in outsourcing is significant, the issue seems to be absent from its climate policies (Delbeke & Vis, 2016). The key objectives of the 2030 Climate and Energy Framework of the EU are (a) cutting greenhouse gas emissions by 40% (from 1990 levels), (b) increasing the share of renewables to 32%, and (c) to improve energy efficiency by at least 32.5% (European Commission, 2014). EU climate policy is centered around fostering economic growth and exploiting market mechanisms in policy making (Delbeke & Vis, 2016; European Commission, 2014). It aims to ensure cost-efficiency, the prosperity, and competitiveness of the EU's market, upholding its economic position in the global economy and fostering its technological leadership (Delbeke & Vis, 2016). The EU and its environmental policies in general have been widely associated with the neoliberal discourse, where prosperity is considered to be driven by the market (Apostolopoulou et al., 2014; De Ville & Orbie, 2014; Hudson, 2017; Oulu, 2016; Pepper, 1999; Pollex & Lenschow, 2018; Turnhout, Behagel, Ferranti, & Beunen, 2015; Wigger, 2019), and also the ETS system as a central pillar of EU climate policy (Bailey, 2007; Bailey & Maresh, 2009; Humphreys, 2009). Fused with the neoliberal discourse, it represents an ecological modernization perspective, and it claims that environmental degradation can be decoupled from economic development utilizing technological innovation (Asafu-Adjaye et al., 2015). These objectives highlight the focus of the EU climate policy of reducing emissions with a focus on its territory. It attributes its "considerable success in reducing pollution, decoupling emissions from economic growth and fostering global technological leadership" (Delbeke & Vis, 2016, p. 3) to its climate policies adopted since the '90s (Delbeke & Vis, 2016). Therefore, it measures its success based on territorial accounting (European Parliament, 2013), which ignores the emissions outsourced to other countries.



In summary, the EU is an influential actor of climate governance and an economic superpower, which subsumes a large share of outsourced emissions, yet this seems to be absent from its policy focus. This contradiction constitutes the entry point of this thesis.

### 2.3 Methods to measure emissions

Account	Calculation basis	Allocation of responsibility
<b>Territorial emissions</b> (widely termed as <b>production-based emissions</b> in the scholarly debate)	Direct emissions (geographic definition): <b>Activity data × Emission Factors</b>	Producer
<b>Production-based emissions</b>	Monetary calculation (economic definition): <b>EE-IOA (SRIO or MRIO)</b>	Producer
<b>Consumption-based emissions</b>	Monetary calculation (economic definition): <b>EE-IOA (SRIO or MRIO)</b>	Consumer

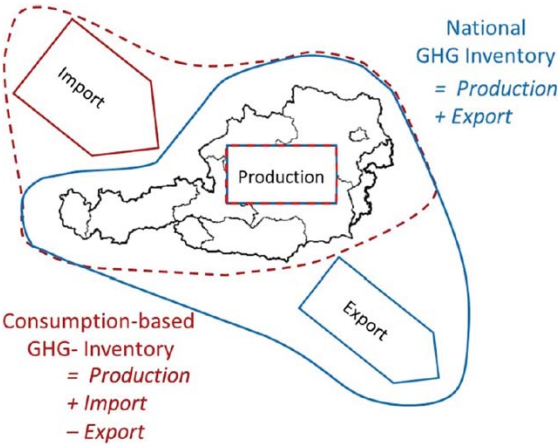
Table 2. The calculation basis of the three main emissions accounting methods (own illustration).

Emissions can be measured using different system boundaries. *Territorial emissions accounting* measures emissions physically released into the atmosphere within the countries’ geographical territories or in offshore areas under the countries’ jurisdiction (Dong, Geng, Fujita, & Jacques, 2014; IPCC, 2006). The territorial account is the basis of reporting to the UNFCCC inventory to monitor compliance with NDCs (European Environment Agency, 2018a; IPCC, 2006; Karstensen et al., 2018). It is divided into five sectors (Energy; Industrial Processes and Product Use; Agriculture, Forestry and Other Land Use; Waste and Other), and it does not include international aviation and shipping (IPCC, 2006). It is calculated by multiplying activity data with emission factors, and it presumes the responsibility of the producer (see Table 2) (Dong et al., 2014).

The *production-based method* allocates emissions to the country where the emitter is resident, irrespective of the place of consumption. It is a set of territorial emissions where the domestic emissions from total consumption are measured, focused on the producing region (see Figure 4) (de Haan & Keuning, 1996; Karstensen et al., 2018; Pedersen & de Haan, 2006; Peters, 2008a). It is usually similar to territorial emissions in magnitude, but they are different due to international transportation, and resident versus non-resident activity, which are considered under the production-based account

(de Haan & Keuning, 1996; Pedersen & de Haan, 2006). It is calculated by the environmentally extended input-output method (EE-IOA) (Dong et al., 2014), and it presumes the responsibility of the producer (see *Table 2*)(Dong et al., 2014).

Its most discussed alternative, the *consumption-based method*, measures global emissions from final consumption (Peters, 2008a). It is calculated by “adding emissions embodied in imports to the production-based emissions and subtracting emissions embodied in exports” (see *Figure 4*) (Karstensen et al., 2018, p. 133). It is also based on the EE-IOA method, and it presumes the responsibility of the consumer (see *Table 2*) (Dong et al., 2014). It allows the embodied emissions to be quantified, while the formers do not.



*Figure 4. System boundaries of the consumption-based and production-based emissions (Windsperger et al., 2019).*

Due to the similarity in their magnitude, their focus on production as a guiding principle and the allocation of responsibility to the producer, the territorial and the production-based accounts are often confused in the literature. Some distinguish between the three types, such as Dong et al. (2014) or Karstensen et al. (2018), who label the current system of national inventories a ‘territorial’ system. Yet others, such as Peters (2008a), Grasso (2016) or Zhu et al. (2018) entitle it ‘production based’, although the IPCC inventories contain data measured by the ‘territorial emissions’ formula. As the scholarly debate, which I am engaging with, consistently uses the ‘production-based’ term to denote the current system, in this thesis, I use the term accordingly.

Two other accounting alternatives have been proposed by the literature, the *extraction-based* (where emissions are attributed to the country which extracts fossil fuels)(Davis & Caldeira, 2010), and the *income-based* (which attributes emissions according to the value they add or income they

earn)(Lenzen & Murray, 2010; Liang, Qu, Zhu, Guan, & Xu, 2017; Marques et al., 2012). However, these do not constitute the main focus of this thesis.

### **3 Aim, research question, method & delineation**

As the consumption-based account allows for the measurement of outsourcing, at first glance, it seems evident to implement it into climate policies. Nonetheless, the questions remain: what the advantages of this approach are, for what purpose might it be used, and what the potential barriers to its implementation are. A response to these questions might shed light on why it has not received much attention in climate policies, like the EU's.

#### **3.1 Aim & research question**

This thesis aims to show that the consumption-based accounting method can benefit climate governance and lead to better climate policies, which are currently informed by the territorial calculations of emissions (by the production-based account, as termed in the scholarly debate). By engaging with the scientific literature, I intend to synthesize the current state of knowledge and categorize arguments for a better understanding of what their implications are for climate policy and governance.

To that end, I seek the answer to the following research question:

**What are the advantages and the implementation barriers of the consumption-based carbon accounting method compared to the production-based method, as seen in the scholarly debate?**

#### **3.2 Method: a systematic literature review**

To answer the research question, I conducted a systematic literature review (Bettencourt & Kaur, 2011; Brandt et al., 2013; Luederitz et al., 2016), which I chose as the appropriate method.

Systematic literature reviews constitute an established method in sustainability science (Luederitz et al., 2016), as they allow to synthesize the arguments from scholars contributing to an interdisciplinary debate. The scholarly debate investigates whether the consumption-based account could bring climate policies closer to solving one of today's most pressing, wicked sustainability problem: climate change. It is an interdisciplinary debate, representing various branches of science. Answering the above research question required the synthesis of the available scientific literature. To provide a coherent analysis of the state of knowledge, it was necessary to gather the available literature in a systematic

way and assess it through a set of criteria (Bettencourt & Kaur, 2011; Brandt et al., 2013; Luederitz et al., 2016). As this thesis is written as a closure of a sustainability science program, using established methods of the field is self-evident. It was obvious that such a synthesis cannot be achieved through fieldwork methods such as surveys and interviews; therefore, turning to the literature was the only possible way.

### ***3.2.1 The necessity of a systematic literature review***

Previous (non-systematic) literature reviews appraised the consumption-based accounting as a method, which allows measuring emissions embodied in trade (Afionis et al., 2017; Steininger et al., 2014; Zhu et al., 2018). They investigated its potential to address outsourcing and to contribute to further emission reductions. Some reviews attempted to give an overview of its pros and cons in contrast to the current accounting method. Though they highlighted many aspects and included certain climate policy implications, these analyses did not include an exhaustive list of all the arguments, how they relate to each other and how they translate into actual barriers when considering different purposes of use. Conducting the literature review yielded articles that brought up new arguments (mainly related to political feasibility) or more in-depth analyses. The previous reviews did not cover the subsequent debate either, and they concluded slightly or profoundly different conclusions for the implementation of the consumption-based approach. These considerations further confirmed the necessity of reviewing the scientific literature. As an up-to-date, systematic stocktaking of these arguments is a necessary step to understand the state-of-knowledge of research, and as only such an analysis could inform further steps, I conducted a systematic literature review to see how a synthesis of those arguments might inform climate policy.

### ***3.2.2 Delineation***

This work is limited to the systematic analysis of the literature on the consumption-based accounting method and the scientific debate around it.

The related literature also discusses measures that do not necessarily require the implementation of a new method but have the potential to imitate its expected environmental outcomes. These measures entail border tax adjustments (Chang, 2013; Ghosh & Agarwal, 2014), the extension of ETS-type schemes, standards, labels, policies to change consumption patterns and carbon footprints, among others (Afionis et al., 2017). These policies might imitate the functions of the consumption-based account (Böhringer, Balistreri, & Rutherford, 2012; Duus-Otterström & Hjorthen, 2018; Lininger,

2015). The inclusion of an extensive argumentation and evaluation of these measures, however, goes beyond the scope of this research.

This thesis is also limited by scale; it focusses on the regional and international level. Therefore, it does not involve the debate on the use of the account on the national level and below (yet it provides insights for nations in relations to their emissions embodied in international trade). Further, it neither includes an extensive evaluation of research on the trends in outsourcing or emissions embodied in trade, nor of the debate on the technicalities of the methods used to calculate accounts and how they can be improved. Lastly, as this thesis focusses on public climate policies and addresses policy-makers, implications on corporate policies adopted by businesses go beyond its scope. Further research could include these measures, scales, and issues for a deeper understanding.

### ***3.2.3 The process of conducting a systematic literature review***

I carried out a systematic literature review according to the methods set out in Luederitz et al. (2016), following the process explained below.

#### ***Definition of selection criteria***

I translated the research question into the following search string applied on Scopus:

**( TITLE-ABS-KEY ( emissions\* ) AND ALL ( consumption-based ) AND TITLE-ABS-KEY ( production-based ) OR TITLE-ABS-KEY ( carbon AND accounting ) )**

I designed the search string based on the experiences from the preliminary literature search. I included 'consumption-based' and 'production-based' criteria, as they are consistently used expressions to capture the difference between the two emissions accounting methods, and as the research question is aimed at exploring their comparative advantages and barriers to implementation. I included 'emissions\*' to exclude any article not strictly related to emissions (e.g., land use), and added 'carbon accounting', as an alternative criterion to expand the search to potential accounting methods other than production-based and consumption-based as they also feed into the same debate. I set the 'all fields' prerequisite for the 'consumption-based' criterion, as this made a great difference in terms of the number of yielded documents (this yielded more hits), and as the core focus of the research was the consumption-based method. To avoid the risk of excluding relevant articles, I decided not to include any specification for outsourced emissions or emissions embodied in trade as the terms used in the literature to describe them are rather varied (see *Appendix 1*). I have not excluded any source based on the year of publication nor for any other criteria. I decided to have a simple search string to

make sure it covers as many of the relevant articles as possible, expecting a potentially high number of false positives or the need to evaluate relevance.

By reflecting on the research string later on, after gaining a more in-depth understanding of different terms involved in the debate, I came to the realization that I could have used 'emissions accounting' as an alternative criterion along with carbon accounting, as (although slightly different connotations can be attached to them) it is used as a synonym in the debate. Similarly, 'carbon footprint' is also seldom used in the context as a synonym, although it is a broader term. Given the time constraint, the available research capacity and the already high number of hits, these terms were not subsequently included in the search string.

The search yielded  $371 + 10 + 2 = 383$  articles (the original search was complemented on the 28<sup>th</sup> of April, 2019 with ten articles, and on the 7<sup>th</sup> of May, 2019 with two articles to cover new publications). I cross-checked the document list by using the documents included in the initial literature search to see whether it covers most of them. I concluded that it does.

#### ***Data gathering, data screening & data cleaning***

I exported the result of the search to an excel sheet (Review Data Table, see *Appendix 3*). I evaluated the relevance of the papers first by reading their titles and abstracts. If that was not enough, I started reading the text of the article to see if it was relevant. I coded the documents with letters A-G indicating the reason for excluding them (see *Appendix 2*). Due to the time limitation and the scope of this thesis, some of the exclusions also serve practical considerations apart from reasonable ones (e.g., code A), acknowledging that their scrutiny might have eventually brought additional valuable insights. These articles could be included at a further stage for a more profound understanding.

Total no. of articles reviewed ('reviewed articles') (see *Appendix 4*): 51

#### ***Data scoping & full-text review***

I downloaded the full text of all 51 reviewed articles and included them in the Final Review Data Table. Next, I conducted a qualitative content analysis, the categories of which I created during the iterative content review. I organized the results of the analysis according to the evaluative framework by Pickering et al. (2012) used in Grasso (2016). While analyzing the relevant papers, I also included some sources that were cited by the reviewed articles.

### **3.3 Structuring findings: the evaluative framework**

To structure the findings of the systematic literature review, I organized the arguments into three categories based on the climate policy evaluative framework recommended by Pickering et al. (2012). The suitability of this framework became apparent during the analysis of the literature. The arguments brought up by the literature to date revolve around the aspects of effectiveness, fairness and feasibility, the categories used in the evaluative framework by Pickering et al. (2012). The framework was used similarly in one of the core articles of the reviewed literature, by Grasso (2016). These criteria can serve as a basis to prospectively evaluate the consumption-based accounting method from a climate policy perspective. Consequently, the findings are organized accordingly (Grasso, 2016; Pickering, Vanderheiden, & Miller, 2012).

## **4 Findings: The advantages and the implementation barriers of the consumption-based account**

The literature unanimously establishes that the consumption-based emissions accounting method could be beneficial to adopt, although certain limitations and implementation barriers have to be considered. In this section, I present those advantages and limitations organized in three (interconnected) categories on the basis of the evaluative framework by Pickering et al. (2012): effectiveness, fairness and political feasibility. Next, I discuss the stand of the scholarly debate on the relation of the consumption-based account, economic growth and sustainability.

### **4.1 Effectiveness, fairness and political feasibility**

#### ***4.1.1 The effectiveness of the consumption-based approach***

Effectiveness in the evaluative framework is understood as environmental effectiveness, more specifically, the comparative potential of the consumption-based account to bring significant results in reducing global greenhouse gas emissions. The findings presented herein entail arguments for as well as against the method (see *Table 3*).

Pros	Cons
(1) Measures emissions embodied in trade and therefore outsourcing  ↓	(1) Potential rebound effects a) Turn to more carbon-intensive domestic production b) Rationalize consumption
(2) New avenues for climate mitigation	(2) Technical issues (complex, many uncertainties, time-consuming) a) Wide system boundaries b) Lack of data c) Methodological issues
(3) Awareness raising	
(4) Combatting climate complacency	
(5) Serve as a knowledge base	
(6) Inform policy	
(7) Other political benefits a) Allow higher ambition of net exporters b) Facilitate climate negotiations and agreements c) Incentivize cooperation d) Support technology transfer e) Increase the competitiveness of exports from developed countries	

Table 3. The pros and cons of the consumption-based account from an effectiveness perspective (own illustration).

## Pros

### Measuring outsourcing & new avenues for climate mitigation

The most prominent argument for the consumption-based accounting system is that as it allows to measure emissions embodied in trade, it can depict outsourcing trends. It can serve as a base to work towards its reduction. It holds the promise of more effective climate mitigation, where outsourcing, which entails a large share of global emissions, might be dealt with (Liu, 2015; Peters & Hertwich, 2008a; Steininger et al., 2014; Vetóné Mózner, 2013).

The literature consistently argues for the necessity of involving consumption and its indirect effects into decision-making, as an effective response to climate change, with the imperative to take all implications into account (the ones unfolding within country borders and those beyond). It opens up new avenues for climate change mitigation (Bows & Barrett, 2010; Duus-Otterström & Jagers, 2012), as it would expand the source of emissions included in the scope of the consumer countries' climate policymaking that already tend to have stricter mitigation measures. Therefore, this could translate to more emission reductions globally (Duus-Otterström & Hjorthen, 2018).

As the consumption-based accounting is the appropriate method to measure outsourcing, it includes carbon leakage, though it is not able to indicate its proportion (Windsperger et al., 2019). In contrast to the production-based accounting method, it does not promote the relocation of the carbon-intensive industries to regions with softer environmental regulations (pollution haven hypothesis)



(López et al., 2013), which enhances carbon leakage (Marques et al., 2012; Pedersen & de Haan, 2006; Peters, 2008a; Peters et al., 2011; Peters & Hertwich, 2008a).

The specialization of countries and the intensification of international trade result in an even higher proportion of emissions embodied in trade, which can further increase outsourcing in the future (Barrett et al., 2013; Davis & Caldeira, 2010; Peters et al., 2011; Peters & Hertwich, 2008a).

### **Awareness raising**

Furthermore, the consumption-based accounting method could also serve as a basis for raising awareness of environmentally harmful consumption patterns. As it connects consumers with the carbon-intensive production processes abroad influenced by their demand, it can inform individuals about the ecological impact of their consumption and serve as a basis for transitioning to more sustainable choices. A consumption-based accounting system would identify the particular segments of consumption where a more environmentally sound approach is necessary (Harris & Symons, 2013; Liu, 2015; Windsperger et al., 2019), though it can mostly provide sector-specific information.

### **Combatting climate complacency**

Proponents also argue that it can combat climate complacency in countries/regions where the production-based emissions have been decreasing, reportedly due to climate policies (e.g., improvements in energy and carbon efficiency). The use of the consumption-based account would provide a more realistic and complete picture of the effectiveness of abatement measures (Barrett et al., 2013; Davis & Caldeira, 2010; Duus-Otterström & Hjorthen, 2018; Gupta, Rashmi, & Bhatt, 2018). As consumption-based emissions are increasing both in Annex I and Non-Annex I countries, they have to be kept track of (Gupta et al., 2018). Some contend, that it is by no means an achievement to reduce emissions by outsourcing them to other countries and that countries should not be allowed to improve their emissions numbers by outsourcing them (Mir & Storm, 2016; Spaiser, Scott, Owen, & Holland, 2018). For this purpose, to use the consumption-based accounting method as a monitoring base would be sufficient and non-contentious.

### **Serve as a knowledge base & to inform policy**

A significant benefit of the consumption-based account is that it allows for a better understanding of the environmental effects of global trade dynamics (Afionis et al., 2017). For this purpose, to use the consumption-based accounting method as a monitoring base would again be sufficient and non-contentious. The literature also brings up the argument of the imperative of exploring causal chains regardless of where emissions take place, to inform policymaking (Caldeira & Davis, 2011). Effects

along supply chains need to be understood before envisaging effective policy measures or strategies to reduce emissions. Therefore, the system boundaries might be expanded beyond national borders to have a full picture of how national consumption effects the state of the global climate. The use of the consumption-based accounting system would then reveal problem areas or areas for improvement, and it could also potentially incentivize industries to rethink their trading activities (Gupta et al., 2018; Windsperger et al., 2019). It is also considered to help prioritize certain mitigation policies, harmonize trade and climate policies as well (Yoon et al., 2018).

### **Political benefits**

The dynamics of outsourcing are also argued to compromise export-intensive countries' ability to fulfill their nationally determined contribution pledges or to have higher ambition levels. Therefore, outsourcing might undermine the effectiveness of climate policies of net exporters (Fezzigna et al., 2019; Gupta et al., 2018). Policies based on a consumption-based account could (a) counter this by potentially reducing outsourcing or mitigate its impacts (Fezzigna et al., 2019). Furthermore, it has also been discussed to (b) facilitate climate negotiations and the implementation of climate-related agreements, (d) to incentivize interregional cooperation, and (e) to support the case of technology transfer between trading partners (Afionis et al., 2017; Grasso & Roberts, 2014; Windsperger et al., 2019). According to Peters & Hertwich (2008b), the adoption of the consumption-based accounting would be (f) beneficial from a competitiveness perspective to Global North countries too, as it would not affect the price of their exports (i.e., a carbon tax), and the production of goods would be subject to the same mitigation requirements (Peters & Hertwich, 2008b).

Based on the above, Steining et al. (2014) argue that the use of the consumption-based account can result in a more cost-effective mitigation, and it could also lead to a sustainable transition of geopolitical processes that would deal with the unequal exchange of ecological harms and benefits (Baker, 2018; Lamb et al., 2014). Karakaya et al. (2019) argue that the implementation of the consumption-based account can ensure a self-enforcing system of coordination, which would improve the effectiveness in emissions abatement (Karakaya, Yılmaz, & Alataş, 2019).

### **Cons**

#### **A hypothetical scenario: a global price on carbon**

Some argue that the consumption-based accounting approach would be the most effective if a global carbon tax were to be introduced, which would require accurate information on the carbon content of products, and the disbursement of those revenues to net exporter countries for the greening of

their industries (Steckel, Kalkuhl, & Marschinski, 2010). However, this is considered impossible in the short to medium term (Lininger, 2015; Steckel et al., 2010). Others argue, that if there was a global price on carbon, and climate policy would cover all global emissions, then the accounting system would not matter (Steininger, Lininger, Meyer, Muñoz, & Schinko, 2016). They establish though, that even if there is no global price on carbon, it would still be unsure whether the consumption-based approach would result in emission reductions as reductions in a country's emissions does not necessarily mean that it would not eventually occur elsewhere (Michael Jakob, Steckel, & Edenhofer, 2014; Lininger, 2015; Steininger et al., 2016). However, if emissions shifted elsewhere due to a specific policy, measuring emissions embodied in trade could identify that. Introducing a global price on carbon is an ideal situation, which is not likely under real-world circumstances, where some of the environmental and cost-effectiveness is necessarily lost (whose extent depends on the accounting system and subsequent policies) (Markusen, 1975; Steininger et al., 2016).

### **Potential rebound effects**

One of the most common arguments against the consumption-based accounting is that due to its focus on the balance of exported and imported emissions, it might be that to avoid emission-intensive imports, countries would turn to possibly more carbon-intensive domestic production to satisfy domestic needs (Afionis et al., 2017; Jakob et al., 2014). However, this effect can be remedied by using the consumption-based account as a complementary method to the production-based one, which can incentivize countries to keep decreasing territorial emissions (Steininger et al., 2016).

Skeptics also argue, that one of the possible outcomes based on the implementation of the consumption-based accounting would be to incentivize energy efficiency improvements in net exporter countries. This, however, would not necessarily decrease emissions, as consumption and therefore energy demand per se would not necessarily decrease (as consumption shows an increasing trend, it might in fact increase)(Afionis et al., 2017; Barrett et al., 2013; Liu, 2015). They contend that promoting the technology transfer to net exporter countries from net importer countries might serve as a rationalization of consumption and even accelerate as a rebound effect. Therefore, the consumption-based accounting would not be suitable to pave the way for decoupling from economic growth, it needs to be complemented with decreasing consumption (Liu, 2015).

### **Technical issues**

The production-based method is supported for its simplicity in calculation, data availability, consistency with GDP accounting and energy statistics methods (Peters, 2008a).

Another question prevalent in the debate is whether the consumption-based accounting would bring along effectiveness sooner than the production-based accounting due to complexities within the method. This relates to the second main argument against the consumption-based accounting system, that as it is more complex, it involves a large number of uncertainties, and therefore, it is more time consuming to work with (Afionis et al., 2017; Windsperger et al., 2019; Yoon et al., 2018).

Uncertainties of calculating the consumption-based emissions are firstly due to its wide system boundary that it involves calculating emissions embodied in imports and exports too (Peters, 2008a). Supply chains can be long and sometimes complex, which contributes to the nebulosity of traded emissions (Harris & Symons, 2013; Peters & Hertwich, 2008b). As it is severely assumption-prone and data-intensive, some do not consider it feasible to implement it (Liu, 2015).

Secondly, it is problematic to calculate due to poor monitoring, reporting and verification systems and weak statistical infrastructures in Global South countries (Harris & Symons, 2013; Peters & Hertwich, 2008b). This calls for a strategy for the improvement of infrastructures in countries with weak monitoring systems (Grasso & Roberts, 2014).

Thirdly, as regards to the existing methods of the consumption-based accounting, Windsperger et al. (2019) argue that they only display data per different sectors. Therefore, it lacks data at the product level. This would be necessary for effective policies focused on single products to avoid carbon leakage. Also, the different measurement standards or models lead to differing conclusions on the levels of emissions, which is another issue (Kim & Heo, 2016; Yoon et al., 2018).

Another set of difficulties arise from different methods to calculate the consumption-based emissions. The three main methods of accounting consumption-based emissions (among others) are the (a) EE-IOA (environmentally extended input-output analysis) (Lutter, Giljum, & Bruckner, 2016; Wiedmann, 2009), the (b) the life-cycle analysis (LSA) based or coefficient approach (Dittrich, Bringezu, & Schütz, 2012) and the (c) hybrid approach, which combines the former two methods. The limitation of the EE-IO models is the high level of sector aggregation, which on the one hand increases uncertainty due to potential double-counting in data, as it includes the entire life cycle from resources to the product (Windsperger et al., 2019). On the other, it does not provide data on the product level. It also uses monetary structures as a basis for criticism for its unsuitability for calculating emissions (Lutter et al., 2016; Wiedmann, 2009). The limitation of the LCA based approach is that it only takes imports and exports into account, it does not link national consumption to the entire supply chain. It does also not allow depicting carbon leakage effects (Windsperger et al., 2019). However, potential solutions to

these have been brought up by Windsperger et al. (2019) to reduce uncertainties, while it has stressed the need for interdisciplinary research on how to improve current methods.

Some found that the uncertainties involved in calculating the production-based emissions as a base are higher in some cases (Karstensen, Peters, & Andrew, 2015b), such as China's, which affects the accounting of the consumption-based emissions of countries importing from that specific country (Guan, Liu, Geng, Lindner, & Hubacek, 2012; Peters, Davis, & Andrew, 2012). Nonetheless, the uncertainties involved in measuring emissions embodied in trade add to the prevalent uncertainties measuring its calculation basis, the production-based emissions.

There is no scientific consensus whether these technical difficulties constitute actual prohibitive barriers or constraints to implementing a consumption-based approach on the short term (Afionis et al., 2017) or they can be bridged and handled (Grasso & Roberts, 2014; Peters & Hertwich, 2006). As modeling of the outcomes of a potential shift to the consumption-based accounting system would have to rely on models burdened with uncertainties, some suggest handling the question with some level of skepticism (Afionis et al., 2017; Duus-Otterström & Hjorthen, 2018). The assessment of the environmental effects are based on a complex set of parameters including market effects and the climate policy architecture (Lininger, 2015; Steininger et al., 2014). Thus, it can only lead to reductions if certain conditions apply. Although potential positive environmental effects are unclear, there are other benefits to it which might be enough to prefer the consumption-based system (Duus-Otterström & Hjorthen, 2018). Some argue that the capacity of the consumption-based accounting to further international cooperation should outweigh the complexities and skepticism about the method (Grasso & Roberts, 2014).

#### **4.1.2 *The fairness of the consumption-based approach***

Pickering et al. (2012) understand fairness as “a criterion of evenhanded, impartial, or nonarbitrary treatment of persons and groups in the distribution of benefits (or goods) and burdens” (Pickering et al., 2012, p. 426). Fairness is ensured if mitigation responsibilities are allocated according to the responsibility for present and past emissions and the capacity to pay for mitigation (Pickering et al.,

2012)<sup>1</sup>. As Grasso (2016) interprets their definition, the accounting method is justified, “when it attributes the bulk of the onus of emissions to those who bear a lower burden than fairness demands” (Grasso, 2016, p. 405). The arguments brought up in the scholarly debate on justice revolve around the same concern, the fairer allocation of burdens and responsibilities between the consumer and the producer countries.

A core idea of climate policy is that justice plays a fundamental role in emissions abatement (Jamieson, 2013). Grasso (2017) brings up the moral imperative of establishing climate governance systems consistent with justice. In the reviewed scientific debate, many believe that the consumption-based accounting method could create a fairer situation than the production-based account (Pan, Phillips, & Chen, 2008; Peters & Hertwich, 2008a, 2008b; Steininger et al., 2014).

### ***The current system of attributing responsibility: the CBDR***

The production-based accounting system is perpetuated by the common but differentiated responsibility (‘CBDR’) (Gupta et al., 2018) outlined in the UNFCCC (United Nations, 1992). The CBDR is based on production-based emissions and the distinction between Annex I and Non-Annex I countries (industrialized and non-industrialized countries), on different historical emissions and therefore differentiated responsibility for having contributed to climate change. Annex I countries (industrialized countries) are bearing a greater responsibility to mitigate climate change due to their higher historical emissions (United Nations, 1992).

However, since the adoption of the UNFCCC, globalized trade and the outsourcing of emissions have started to take off. Since then, the debate started emerging around the stock (historical emissions) or flow of emissions (production-based emissions) as a base for the differentiation of responsibility. Post-UNFCCC, the Global North countries tried to reframe goals and targets to shift from the historical emissions to the current flow of emissions (production-based) to determine responsibilities. This would have resulted in the easing of their responsibility for climate mitigation while increasing the responsibility of Non-Annex I countries. However, evidence shows that the increase in emissions in Global South countries was benefitting Global North countries as they could displace their energy-

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<sup>1</sup> The question of fairness of justice belongs to the realm of moral philosophy, and there are longstanding competing perspectives on such concepts. As the choice of the word ‘fairness’ might signal, it seems that Pickering is adopting John Rawls’s idea of justice (“Justice as Fairness”)(John Rawls, 1971).

intensive activities (Davis & Caldeira, 2010). It was especially so with China, where approximately a third of the increase in emissions was due to the offshoring of emission-intensive manufacturing units from Annex I countries (Weber, Peters, Guan, & Hubacek, 2008). According to Gupta et al. (2018), the fact that Global North countries have become more energy efficient is mainly due to the shifting of their energy-intensive industries to Global South countries, which has particularly been the case concerning the EU. Due to the economic benefit of reduced production prices enjoyed by Global North countries, they should be held partly responsible for emissions in Global South countries (not just based on historical emissions). Thus, the argument of shifting to the current flow of emissions (production-based) without considering historical emissions should be rejected as it would bring along the reduced responsibility of Annex I countries. In fact, they should subsume a larger share of responsibility due to their high current consumption-based emissions (Gupta et al., 2018).

### ***The responsibility of the consumer?***

The consumption-based account can measure emissions embodied in trade. Therefore, it connects consumers to production processes demanded by them. The implementation of the consumption-based approach (with its formula) would mean that consumers would take full responsibility for emissions embodied in imports. Thus, it would shift responsibility from the producers to the consumers (Afionis et al., 2017).

In this thesis, I am not addressing the question of micro-level and individual responsibility for consumption. As the problem definition above shows, I am concerned with the governance of emissions, and the implication of different indicators of measurement to climate governance and goals countries (such as EU member states) set themselves. Consequently, when I refer to consumers, I mean consumer countries, and when I refer to producers, I mean producer countries.

According to Duus-Otterström & Hjorthen (2018), by identifying the greater responsibility of net importer countries (and thus putting a greater burden on them) would create a more just order where responsibility is distributed more fairly. Therefore, countries with significant imported emissions would no longer be able to evade their responsibility for emissions induced by their consumption. They argue that none of the principles of burden sharing allows assuming that the consumption-based accounting system would be less just than the production-based, in fact, they imply that it might be more just, in a governance system where the contributions to the emissions are relevant in defining responsibility. When resolving over the exclusive responsibility of consumers rather than producers, there are three main principles considered according to Duus-Otterström & Hjorthen (2018).

### **The Polluter Pays Principle**

The '*Polluter Pays Principle*', a principle that is fundamental to environmental policies, which requires the polluter to bear the costs and responsibility, is the most natural argument against the consumption-based approach (Duus-Otterström & Hjorthen, 2018). Its logic would assume that the producer is the direct polluter; therefore, the producer should bear the responsibility for emission. Having a closer look at the principle, however, reveals that the polluter may not only be the direct emitter but whoever is 'responsible' for emissions. In the case of outsourced emissions, both the producer and the consumer are causes for the emissions (they mutually cause the emissions); therefore, they both are jointly and causally responsible.

One way to determine who is more responsible is to identify who has more 'causal power' to change emissions. However, as it depends on many economic, environmental and social factors, it is complex to settle on. Another way is what is called 'agent responsibility' where one party is more in control of its causation than the other. In the case of outsourcing emissions, this would mean that countries have a better position to regulate activities within their country borders. If we adopted this standard, it could be argued that the production-based approach is more appropriate (based on territorial jurisdiction). However, a problem with this approach is (a) to decide whether a country can control its production and consumption. The other is that (b) both the consumer and the producer knowingly and avoidably keep up their practices that eventually lead to higher emissions. Also, (c) when countries real choice to decide about the production of emission-intensive goods is examined, it might be that the country has no choice but to keep producing to provide for its population, then we should conclude that consumers are more responsible (Duus-Otterström & Hjorthen, 2018). On a general level, it is troublesome to decide who is responsible based on these arguments as they require context-specific information. Also, the exploitative character of trade relations is not that obvious, but it could be used in individual cases to advocate for the consumption-based approach (Duus-Otterström & Hjorthen, 2018).

An argument often used to defend the consumption-based approach is that it does not sanction countries that have a more pollution-intensive resource base (Peters & Hertwich, 2006). However, those countries still have a choice to decide what and how they produce to a certain extent. Also, the consumption-based approach might create an incentive for countries not to import from those countries with low carbon-efficiency; therefore, such a system would potentially not result in them being less disadvantaged (Duus-Otterström & Hjorthen, 2018).



The problem with the polluter pays principle is that it is complicated to determine who is causally responsible, to determine the relative causal shares and who will be affected in the future and that its bearers might be ignorant to the harmful impact of their practices, which limit its applicability (Steininger et al., 2016).

### **The Ability to Pay Principle**

The '*Ability to Pay Principle*' means that countries should pay according to their GDP. The consumption-based approach would be able to shift responsibility from poorer to richer countries, but if poorer countries would be net importers than a consumption-based system would burden poorer countries more. As such a world is unlikely to form in the foreseeable future, the consumption-based account would produce a more just outcome according to this principle (Duus-Otterström & Hjorthen, 2018).

### **Beneficiary Pays Principle**

The '*Beneficiary Pays Principle*' would require the country who benefits, to pay, according to the proportion of benefitting. Whether the principle supports the consumption-based approach is dependent on how we weigh present and historical benefits. It might be argued, that countries of the Global South draw the largest benefits by the production of energy-intensive goods, or that countries of the Global North derive the largest benefits by importing inexpensive goods. Hence, it is not clear if the principle supports the consumption-based account (Duus-Otterström & Hjorthen, 2018).

Duus-Otterström & Hjorthen (2018) argue that as the question of burden-sharing justice is not clear, the question whether to shift to a consumption-based system will be decided based on weighing the normative question of justice and mitigation benefits against each other. Hence, the choice of the accounting method needs to be made amidst a pluralism of value. As there are no strong arguments contending that the consumption-based system would be more unjust, they argue, that we can circumvent the question of justice as an obstacle and focus on climate effectiveness. Despite all uncertainty, they state that there is little reason to think that the consumption-based system would yield less mitigation; therefore, it is "worth trying" (Duus-Otterström & Hjorthen, 2018, p. 14).

However, Liu (2015) argues, that if the consumption-based accounting were to be implemented as a means to pass on the responsibility to the consumers from the producers is not practical, it would be more beneficial to incentivize the exporter to invest in cleaner production and transfer extra costs onto the consumers.

### ***The responsibility of the consumer and the producer?***

By measuring the emissions embodied in trade, the consumption-based account links the consumer to the emissions originating from production. Another branch of scholars argue that the question of attributing responsibility should not be focused on deciding whether the consumer or the producer should be held responsible for their emissions, but it should acknowledge that both are causally responsible, and therefore the responsibility should be divided between them. This branch of literature argues for a compromise solution: the 'shared responsibility approach', where the responsibility for transported emissions is shared between the consumer and the producer.

The shared responsibility for the costs and efforts of climate change mitigation is based on the logic that both parties benefit from international trade. The exporter enjoys the economic benefits from the production and sale of goods and employment opportunities, while the importer gains benefits from price-difference and avoiding local emissions that would be released if the same unit of goods were produced domestically (Andrew & Forgie, 2008; Zhu et al., 2018). Consequently, the use of a solely production-based emissions accounting system (especially in the specific case of the EU) has the potential to mask shared responsibility for outsourced emissions, it allows to disregard outsourcing, and it is deemed to allow countries to reduce their emissions by outsourcing them. The production-based system benefits net importers by alleviating responsibility for driving emissions elsewhere, and hinders net exporters by putting an unshared burden on them (Fezzigna et al., 2019; Gupta et al., 2018; Liddle, 2018b, 2018a; Long, Yoshida, Zhang, Sun, & Dou, 2018; Yoon et al., 2018).

Supporters of the shared responsibility approach argue, that the redistribution of responsibility would create positive outcomes for mitigation in both the exporter and importer countries, as it would incentivize the adoption of more energy and carbon efficient technologies in the producer country (Caro, Bastianoni, Borghesi, & Pulselli, 2014; Peters & Hertwich, 2008b). Also, it would make the consumer countries aware of their unsustainable consumption patterns and by facilitating enhanced technology transfer (Afionis et al., 2017).

Therefore, to determine shared responsibility, the consumption-based account would only be a method to show trends in emissions embodied in trade, not the actual calculation base for attributing emissions. The actual emissions to be attributed to countries would be decided based on the agreed principle of sharing burden (what formula would be used). Proponents of the shared responsibility approach have come up with different bases for quantifying the extent of responsibility, and therefore how to allocate emissions. The most prominent ones are the following.

Some have advocated sharing responsibility based on (a) a simple 50-50 principle, acknowledging that both exporter and importers benefit from the environmentally harmful activity (Gallego & Lenzen, 2005). Others would share responsibility based on (b) the value added (Andrew & Forgie, 2008; Lenzen, Murray, Sack, & Wiedmann, 2007; Liu & Fan, 2017; Meng, Peters, Wang, & Li, 2018), or (c) the carbon emissions added at each phase of production carried out within countries' territories (Bastianoni, Pulselli, & Tiezzi, 2004; Simone Bastianoni, Caro, Borghesi, & Pulselli, 2014). Marques et al. (2012) would determine shared responsibility based on (d) income, where responsibility is allocated to the suppliers who gain the revenue from the product (Marques et al., 2012). According to some, (e) the beneficiary-based emissions sharing would be the most appropriate, where responsibility should be allocated to the country where economic benefits accrue in terms of profit, government income and employment (Csutora & Vetóné Mózner, 2014). The (f) CBDR approach, as an equity-based approach, would consider levels of development, emissions per capita, historical emissions and gains from trade (Liu, Wu, & Huang, 2017). They suggest the application of "horizontal allocation rules" (respective levels of development, which is measured by the combination of the Human Development Index, gains from trade and emissions per capita) and "vertical extending rules" to determine national responsibilities. The vertical extending rules are according to which historical emissions are accounted for related to the horizontal allocation rules, which is then added to the present level of responsibilities (Liu et al., 2017). Others argue for sharing responsibility based on (g) carbon intensity (Zhu et al., 2018). According to this approach, if the imported goods are produced with higher carbon intensity in the producing country than the domestically produced goods (as in the relation of the EU and China), the importing country should be responsible for the amount of emissions it avoided by outsourcing. The extra emissions caused by more carbon intensive production should be attributed to the exporting country. This means that countries producing with high carbon intensity should take responsibility for all the imported emissions and a large share of carbon outflows. Otherwise, countries take a shared responsibility of carbon inflows and no responsibility at all for outflows. Some others established other alternatives, such as the (h) the inter-country input-output table based method (Jiang, Chen, & Yang, 2018).

Some approaches have attempted to implement modifications to the formula of consumption-based account to produce fairer outcomes, such as the (j) technology-adjusted perspective, whereby consumption accounts are discounted by having greener exports than the world average, which would encourage cleaner trade practices (Kander, Jiborn, Moran, & Wiedmann, 2015; Zhang, 2018), and the inequality-adjusted approach, which focusses on differences in economic and social status (Moghaddam, Moghaddam, & Cheriet, 2014).

The promise of the shared responsibility approach is that it represents a compromise between those countries in favor of the consumption-based approach, whose economies strongly rely on exports (such as China or India) and those against, who greatly rely on imports (like the EU and the USA). Some of the studies focused on the allocation of responsibility within countries, however, failed to solve issues in transnational trade (Zhu et al., 2018).

#### **4.1.3 The political feasibility of the consumption-based approach**

From a feasibility perspective, the current accounting system is the most feasible, as it is accommodated in existing institutions and accepted by the international community. The literature on political feasibility and the political dimension of the consumption-based approach is limited. It mostly investigates whether a shift to a new target base is politically feasible. Evaluating feasibility is crucial to the acceptability (whether there is a practical route to the new state of affairs) and stability (whether the new state of affairs can be maintained once it is put in place) of a new regime such as the implementation of the consumption-based account (Gilabert & Lawford-Smith, 2012; Pickering et al., 2012). The aspect of political feasibility ties the perspectives of effectiveness and fairness (justice) together; it incorporates them into the question of the feasibility of the consumption-based approach.

#### ***The consumption-based accounting as a target base***

Shifting to the consumption-based method would alter the stringency and baseline for national commitments (Duus-Otterström & Hjorthen, 2018). It would mean that countries would have an obligation to focus reduction efforts on emissions not only within their borders but also emissions imported from beyond in order to achieve their targets (Aichele & Felbermayr, 2012; Simone Bastianoni et al., 2014).

It is argued by Grasso (2016, 2017), that it is highly politically feasible, though some criteria are context-specific. The two intertwined perspectives of political feasibility are the normative and the positive (Grasso, 2016).

From a *normative perspective* (the perspective of political theory), Grasso (2016) applies the three-stage approach by Gilabert & Lawford-Smith (2012). The first stage or criterion is (a) morality and justice, which he considers satisfied as the consumption-based accounting allocates the burden of emissions to those who bear less than the principle of fairness would require (as discussed above) (Pan et al., 2017; Peters & Hertwich, 2008b; Steininger et al., 2014). The second stage is (b) stability (i.e., its maintainability after its implementation), which is also justified, as the individual application of the

system already has shown consistent results (Peters et al., 2012). The third stage is (c) accessibility (i.e., that it is possible to implement it), which is also considered to be justified, as there are well-established methodologies in place for the inventories (Peters et al., 2011), and as issues of monitoring, reporting and verification (MRVs) in Global South countries can be overcome by the support of richer countries through technology and financial transfers (Grasso & Roberts, 2014). Therefore, the implementation of the consumption-based account is highly politically feasible (Grasso, 2016, 2017). As it favors net exporters (usually countries from the Global South), the political feasibility is distinctively high in those areas, but it also depends on countries' institutional capacities (Grasso, 2017).

The second aspect is the *positive perspective*. When it comes to the domestic adoption of the consumption-based accounting, drawing on the literature about the political economy of climate change, Grasso (2016) looks at burdens, institutional capacity and democracy, and interest groups (Grasso, 2015). From the perspective of burden, the consumption-based accounting is justified in net exporters, as it would account for emissions embodied in trade. He argues that from a democracy and institutional capacity perspective, the shift to consumption-based accounting is more feasible in democratic countries where institutional capacity is high. From the perspective of interest groups, the role of lobbies is not clear.

From the perspective of the *international adoption* of the consumption-based accounting, Grasso (2016) looks at the international dynamics that might favor the adoption of the approach. He argues, that the potential adoption of the consumption-based accounting brings up concerns of countries as for dominant powers in global trade relations and that some will achieve greater economic gains. However, he argues that it would not disproportionately penalize anyone and that net importers (such as the EU) might be even more willing to undertake higher reductions to maintain their economic position (Grasso & Roberts, 2014). In the case of the EU, it is already visible in its EU 2030 Framework, as it already contains bold and unparalleled production-based emission reduction goals (reduction of domestic emissions by at least 40%; increase renewable energy use by at least 27%). Therefore, he argues, that net emitters would have to pioneer to adopt the consumption-based account and by exerting their structural power, inducing other countries to join the collective action towards the further reduction of emissions and the eventual global adoption of the approach. This should be accompanied by technological, financial and institutional support of countries from the Global North to the countries of the Global South (similarly to the example of the REDD+)(Grasso, 2017).

According to Grasso (2017), there is a political momentum at the moment for implementing the consumption-based approach. This is due to (a) the scientific consensus on the imperative to reduce

the impacts of climate change through effective and coordinated international effort, which meets (b) a generalized, and increased political will to act, (c) the attention to the cost of handling climate change, (d) high sensitivity for ethical considerations, (e) widespread agreement of the negative environmental implications of consumerism, (f) and that emerging economies also obtained awareness of the climate threat and more important role in international climate negotiations.

From a political point of view, the largest challenge is that Global North countries would likely not be willing to accept liability for emissions they exert no control over, while Global South countries would not be willing to allow Global North countries to influence production processes within their territorial jurisdiction. Shifting to the consumption-based account as target base would also mean that countries would be responsible for emissions released not only within their borders but also emissions imported from beyond (Aichele & Felbermayr, 2012; Simone Bastianoni et al., 2014). This would likely involve issues around the monitoring, reporting, and verification of exports, as a potential source of infringement of sovereignty (Dimitrov, 2010). Thus, it can be argued, that it would be difficult to reach an agreement on the extents of respective responsibilities, and an allocation that would satisfy all parties (Zhu et al., 2018), as this would require an unprecedented level of international collaboration which is questionable to realize (Steininger et al., 2014). Lininger (2015) argues that a shift to the consumption-based approach is politically infeasible. Therefore, any inquiry to it is pointless, as it would please neither the countries of the Global North (as their responsibilities would increase), nor the countries of the Global South (as their export sectors would be affected). According to Duus-Otterström & Hjorthen (2018), however, political infeasibility does not mean that it is impossible or unthinkable and that circumstances cannot be changed. Some argue that it translates to a feasible compromise between Global North and Global South countries (Davis & Caldeira, 2010; Fezzigna et al., 2019; Grasso, 2016; Grasso & Roberts, 2014).

### ***Different uses, multiple accounts***

As it is burdened with tensions, opting for the use of the consumption-based account is a matter of weighing its pros and cons against each other and determining how to make potential tradeoffs. However, the pros and cons are unequally problematic depending on for what purpose it would be used and whether it would be used as an exclusive account or complementing another.

### **The different uses**

The different accounts including the consumption-based and the production-based can be used for different functions or purposes. Firstly, they can be used as a (a) *target base*, as a reference scale for

reduction targets, such as the current accounting method. Secondly, they can be used as a *(b) monitoring base*, to evaluate how policies influence global emissions and to broaden the understanding about how trade relations affect the global climate. Using the consumption-based account for a monitoring base is unproblematic, its technical limitations are not prohibitive (Duus-Otterström & Hjorthen, 2018) Lastly, they can serve as *(c) an instrument base* to inform policy measures (Lininger, 2015; Steininger et al., 2014, 2016). An accounting method can inform all three bases at the same time, for instance, the production-based system is currently a target base, which makes it natural to use it both as monitoring and an instrument base to inform policies. The account chosen as a target base implies that it is also a monitoring and instrument base, but it can be complemented with other accounts, to broaden the horizon for and fill in gaps in climate policy.

### **The complementary use of multiple accounts**

Some argue that none of the accounts is the best under real-world circumstances; therefore, it might be beneficial to consider the use of multiple accounts and to collect reliable data essential for their calculation (Steininger et al., 2016; Yoon et al., 2018). Others contend that the accounting system would have to be a global unified system to cover all emissions to exploit all emissions potential, a system which ideally makes use of more accounting methods (Salk, Jonas, & Marland, 2013).

Climate policy can influence different areas: consumption, production and the extraction of fossil fuels. Each of these can be best covered and informed by different accounting methods. Income-based accounts are debated to be appropriate to address policy, but production-based, consumption-based and extraction-based are ideal for informing those policy measures, despite that all have blind spots. Given the fact that all have blind spots, it is likely that some abatement potential goes unexploited and leakage can occur. However, different accounts have comparative advantages. As for the scope of emissions, extraction-based does not cover all emissions. To achieve a higher environmental stringency, however, the consumption-based or the income-based accounting would be more beneficial. The implementation costs are higher for the consumption-based accounting, and so is the data uncertainty (Steininger et al., 2016).

The complementary use of the income-based, consumption-based and the extraction-based system as an additional monitoring basis could open up new avenues for a more effective climate regime. It could depict a more realistic image of how policies affect the global climate, it could improve knowledge, the identification of potential abatement pathways, and it could facilitate the conclusion of parallel agreements (Steininger et al., 2016). In the international regime, they could be used as complementary satellite accounts, as better monitoring can inform better policies. Countries ambitious to reduce their

impact on the global climate could consider the idea of using multiple accounts for different policy purposes. However, eventually, only an analysis of the situation using models can inform the use of accounting system (Isenhour, 2012; Karstensen, Peters, & Andrew, 2015a; Steininger et al., 2016). The interest in the complementary use of the consumption-based account is not unprecedented among actors, the OECD has already expressed interest in doing so (OECD, n.d.), as well as the UK, which aimed to understand the impact of its trade activities on the global climate and to encourage new policy options (ECCC, 2012).

It is argued that it is not the accounting system that is more just or more effective than another, but the policies implemented based on the different accounts (Steininger et al., 2014). Skeptics argue, that depending on the policy measure the consumption-based accounting would inform, it would not address the issue of carbon leakage, for instance, in the case of border tax adjustments (Jakob, Marschinski, & Hübler, 2013). A quick response to the outsourcing of emissions would be to encourage countries of the Global North to increase their investments in renewable energy development in countries of the Global South and further technology transfer. Some argue that would only lead to the offsetting of consumption-related emissions, and it might involve controversies witnessed before under the Clean Development Mechanism (uneven allocation of projects, benefits to the host country overstated, etc.) (Scott & Barrett, 2015). Consequently, when deciding about the question of the accounting method, the policy measures it would inform also have to be evaluated.

#### **4.2 The consumption-based account and economic growth in the debate**

The literature on the debate about the consumption-based account has briefly touched upon the issue of the fundamental tension between economic growth and ecological sustainability, whether economic growth can be decoupled from environmental harms in the current practice of the reduction focused on territorial emissions. They argue, that the idea of decoupling economic growth from emissions should be reconsidered and approached carefully based on consumption-based measurements, to guarantee the overall reduction of global emissions and thus not overshoot the critical threshold (Davis & Caldeira, 2010; Jiborn et al., 2018; Karakaya et al., 2019; Spaiser, Ranganathan, Swain, & Sumpter, 2017; Steinberger, Krausmann, Getzner, Schandl, & West, 2013).

This branch of the literature represents an additional critique point in the debate around the Environmental Kuznets Curve (EKC) (see *Figure 5*). The EKC depicts the hypothesized relationship between environmental quality and economic growth. It is considered the environmental degradation is expected to increase with economic growth, until a turning point where a certain level of average



income is reached. From then on, with further economic growth, the pressure arising from environmental harm starts to decline. Therefore, it visualizes the hypothesis that the solution to environmental degradation is economic growth (Shafik, 1994).

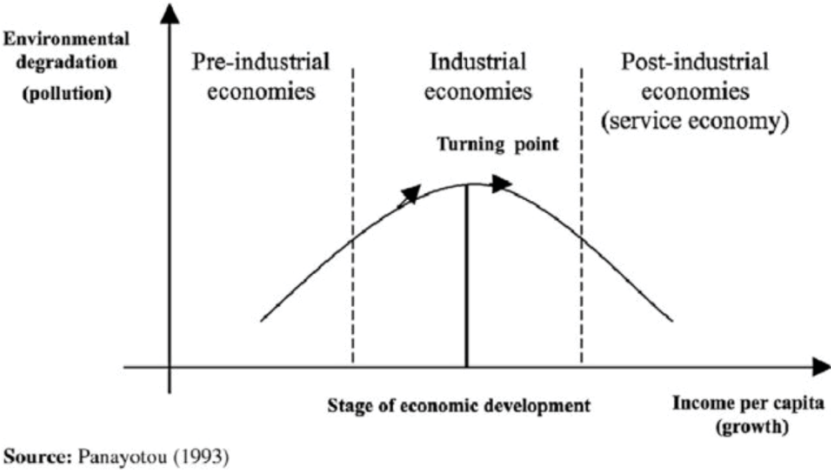


Figure 5. The Environmental Kuznets Curve (Tanger, Zeng, Morse, & Laband, 2011) adapted from Panayotou (Panayotou, 1993).

Ensuring economic growth is the cornerstone of current policies, as reflected in the SDGs (SDG 8)(United Nations, 2015). Exploring SDG 13 about addressing climate change, the tension between economic development and ecological sustainability becomes more tangible (Spaiser et al., 2018). While under the production-based accounting it seems that the wealthier countries are reducing their CO<sub>2</sub> emissions (as assumed by the EKC), under the consumption-based accounting it becomes clear that they satisfy their increased consumption demands from foreign production (Davis & Caldeira, 2010; Jiborn et al., 2018; Karakaya et al., 2019; Spaiser et al., 2017, 2018; Steinberger et al., 2013) Spaiser et al. (2018) argue, that when emissions are calculated based on the consumption-based account, the trends in wealthier countries' emissions do not stall or decrease as opposed to when it is calculated based on production-based measures.

Therefore, they argue, that the consumption-based account challenges the EKC: economic development might not bring along the reduction of emissions in absolute terms, it might lead to partial displacement. Karakaya et al. (2019) contend, that interpreting the production-based emissions as a proof of decoupling creates a “false sense of achievement and misinformation for the public and policymakers” (Karakaya et al., 2019, p. 4), as it masks weak carbon leakage.

Liu (2015) and Afionis et al. (2017) also pointed out that to effectively reduce emissions, the consumption-based accounting would not be suitable to pave the way for decoupling from economic

growth alone, it needs to be complemented with decreasing consumption. They argue that potential policy responses such as technology transfers would only rationalize consumption, which would keep increasing and pushing up energy demand.

Further, Spaiser et al. (2017) argue that to ensure development, the development goals should rather use indicators of human well-being, such as health and education or sustainable technologies, instead of focusing on economic indicators.

## **5 Discussion & conclusion**

In this chapter, I evaluate and judge the consumption-based account based on the findings of the systematic literature review, relate them to the EU as an entry point, and I discuss questions to consider in further research.

### **5.1 Judgement of the consumption-based account based on the findings**

#### ***5.1.1 Effectiveness, fairness, political feasibility***

##### ***Effectiveness***

The largest benefit of the consumption-based account as opposed to other accounting methods is that it allows measuring outsourced emissions and its dynamics, a side-effect of global trade. Doing so, it might bring further benefits, such as raising awareness, combatting climate complacency and increasing interregional cooperation. Despite its many benefits, the method is not flawless. The fact that it can have rebound effects and that it involves a higher level of uncertainty might cast a shadow on its implementation. As for the issue of countries potentially turning to highly carbon-intensive domestic production to avoid emission-intensive imports, this is a concern only if the consumption-based account is used as a single method. If it is complementary to the production-based, this no longer seems to be a concern, as the incentives to clear domestic production would still apply. The argument of the potential rationalization of consumption as a rebound effect of technology transfer applied based on the consumption-based account should be considered when choosing the appropriate policy measures. Nevertheless, this concern also applies to current technology transfer projects as outlined in the Kyoto Protocol and the Paris Agreement. The latter concern also highlights the issue, that the extent of consumption, which comes along with economic growth, need to be in the focus of attention. Technical issues around complexity and uncertainty can be partially improved, for instance, by developing monitoring infrastructures. The extent to which these technical issues are

prohibitive, also depends on the purpose of using the consumption-based account, whether as a target, instrument or monitoring base. Using it as a monitoring base might not require it to be as accurate as if it was used as an instrument base, for example.

### ***Fairness***

The literature about the fairness of the consumption-based account provides insight into the question of whether it would bring about a fairer distribution of responsibility. It is based on the premise that the consumption-based account allows for the measurement of outsourcing, so it links the consumer to production they demand. One branch of scholars aims to determine if the consumer or the producer should bear the mitigation burden. They consider the use of the consumption-based approach as a calculation formula, which attributes the burden to the consumer. Findings are not definitive; only the Ability to Pay Principle might indicate that the former would produce a fairer outcome. It is also argued that the decision whether the consumer or the producer should bear responsibility and thus which of the two accounts should be chosen has to be made amidst a pluralism of values and contexts. Another (seemingly more mainstream) branch of the literature also appraises the consumption-based account for its capacity to measure outsourcing, but it advocates for the shared responsibility for outsourced emissions of the consumer and the producer (the 'shared approach'). The shared approach is considered to be a compromise solution between the production-based and consumption-based accounts. The shared approach would use an alternative formula for allocating responsibility between the consumer and the producer; variations of this are discussed in the scholarly debate. Although a trend can be observed in outsourcing, that countries of the Global South tend to be net exporters and the countries of the Global North tend to be net importers, there are outliers. This might hinder the decision over fairness; for instance, when Global South countries are net importers, consequences can further their disadvantaged position. The literature on fairness seems to indicate that emphasizing the shared responsibility of the consumer and the producer is beneficial from a fairness perspective, which constitutes a fundamental criterion of climate policy.

### ***Political feasibility***

From a feasibility perspective, the best option would be the current accounting method, which is supported by existing institutions. However, as it might bring higher effectiveness and it might create a fairer allocation of burdens, the question of feasibility needs to be addressed. The literature on the aspect of political feasibility seems to be limited. The attention is mainly directed to the feasibility of using it as a target base. Using it as a target base is considered to be feasible, which is enhanced by a

political momentum to such a transition. Although it seems to be feasible, it is also tension-ridden. The major challenge concerning feasibility is the governing principle of territoriality. Some argue that it is a prohibitive barrier as adopting the consumption-based account would require unprecedented and seemingly unlikely cooperation of countries. Although, others contend that it could facilitate cooperation. Other aspects relevant from a feasibility perspective (such as institutional capacity) constituting a potential barrier might also be seen as room for further improvement to enhance feasibility. Some of these necessary changes might go against the political status quo, which might be complicated, yet possible to change.

Research on the political feasibility of the consumption-based account could be expanded by bringing in more aspects and examining more cases through the lens of political feasibility.

### **Different uses, multiple accounts**

The literature also discusses that the consumption-based account can be used for different purposes (as monitoring, instrument or target base). The different uses translate to different issues around political feasibility. It is also discussed by some, that the different methods can be used at the same time, which might make implementation barriers related to effectiveness less problematic and also enhance feasibility.

### ***5.1.2 Decoupling under the production-based approach***

The scholarly debate highlighted that the idea of decoupling economic growth from emissions should be reconsidered and approached carefully, through the lens of the consumption-based approach. This would better guarantee the reduction of global emissions, which is necessary not to overshoot the critical threshold.

Article 10 of the Paris Agreement promotes economic growth (UNFCCC, 2015), as well as SDG 8, which endorses the “sustained, inclusive and sustainable economic growth”(United Nations, 2015). The literature on the debate revealed a critical aspect of how the global goal of sustained economic growth can be proven to be in conflict with the goal to address climate change under current real-world circumstances. They argue that although production-based emissions indicate that wealthier countries have managed to keep their economies growing while substantially decreasing their emissions, measurements by the consumption-based account reveal that part of the emissions reported to have decreased is due to the outsourcing to other countries with lower carbon efficiency. Therefore, the consumption-based account shows that a large part of those emissions has not decreased in reality,

they have only been displaced (Jiborn et al., 2018; Karakaya et al., 2019; Spaiser et al., 2017; Steinberger et al., 2013).

Decoupling can be understood as either 'relative decoupling' or 'absolute decoupling'. Relative decoupling describes the situation when environmental impacts rise at a slower rate than the economic growth, while absolute decoupling denotes when environmental impacts peak and start to decline (Asafu-Adjaye et al., 2015). The decoupling of economic growth from environmental degradation in the case of climate change can be understood as ensuring economic growth while emissions either grow at a slower rate (relative decoupling) or they stall or decrease (absolute decoupling). As the current climate change mitigation targets require the reduction of emissions (UNFCCC, 2015; United Nations, 1992), in climate change debates, only absolute decoupling can be an indication of success in meeting the required abatement; therefore, emissions need to decrease regardless of economic growth.

Further, as climate change is a global problem, a country's success in decoupling economic growth from emissions should be dependent on whether their share of emission reductions contributed to the global emission reductions, and whether it was partly displaced. The scholarly debate entitles this 'real decoupling', when emission reductions contribute to the reduction of global emissions (though it might not result in decreasing global emissions due to potential increases elsewhere). To reveal real decoupling and real emission reductions and their real extent, and so that countries are not lured into complacency, consumption-based accounts should be considered.

The debate also highlighted that to reduce emissions on time, the increased consumption and therefore energy demand also needs to be addressed.

## **5.2 Implications to the EU**

In the case of the EU, its role in outsourcing emissions shown by the consumption-based account is not taken into consideration by its climate policies. Measuring outsourced emissions through the consumption-based account could contribute to fighting climate complacency of the EU, and to revise the picture of the decoupling of its economic development from emissions. The EU is not only an influential actor of global climate governance but also an economic superpower subsuming a large share of emissions embodied in trade. By implementing the consumption-based accounting method at least as a monitoring base, the EU could lead by example, potentially inducing changes in the international arena as well. Utilizing the consumption-based account in this way could be the first step towards a more effective and fairer climate change mitigation.

Given the potential political barriers of the EU as a supranational political entity, and the dominance and institutional embeddedness of the production-based approach, implementing the consumption-based method from within its decision-making bodies might be ambitious. However, with a bottom-up effort, through social movements or lobbying by civil society actors, it might be possible to challenge the status quo.

This research might provide encouragement for actors to consider the effects of consumption and trade on the global climate and push for the complementary use of the consumption-based account, which might unlock potential to deal with climate change effectively.

### **5.3 Directions for further research**

This thesis provides a stocktaking of the advantages as well as the potential barriers to implementation of the consumption-based approach based on the scholarly debate. To investigate which of the advantages and barriers would apply in a specific context, and how the potential barriers can be overcome, *(a)* the scale and context of implementation; *(b)* the purpose of using the consumption-based account and the policy measures it would inform; and *(c)* a decision on the exclusive or complementary use would have to be considered. Literature not reviewed as part of this thesis might deliver a context-specific evaluation of these questions, these considerations could be in the focus of further research.

Further research could also explore how a transition to the use of the consumption-based method could be facilitated in the case of the EU and other countries, and who would be the actors of change.

## **6 Summary**

To sum up, outsourced emissions have been proven to be a significant side-effect of global trade, as shown by the consumption-based accounts. A pattern can be observed, as Global South countries tend to be net exporters while the Global North tends to comprise net importers (such as the EU as a block of countries). Due to differences in carbon efficiency, emissions embodied in trade allows net importers to benefit from the displacement of emissions by avoiding domestic discharges and therefore the corresponding responsibility. Though the nationally decided contributions cover the entire carbon budget, the production-based accounting of emissions does not count with the movement of emissions along supply chains. As emissions abatement can be incentivized by supply-side and demand-side strategies, involving consumption-related effects into decision-making can unlock potential in addressing climate change.

Based on a systematic literature review, this thesis provides a stocktaking of the advantages and implementation barriers of the consumption-based account, along the three criteria of the policy evaluative framework by Pickering et al. (2012). The criterion of effectiveness shows the many advantages of the approach, such as combatting climate complacency or increasing international cooperation. It also highlights implementation barriers need to be considered by policy-makers, such as uncertainties within the method. From a fairness perspective, the findings indicate that it might create a more just allocation of burdens, especially when the responsibility is shared. As for political feasibility, though research is limited (mainly to a change of the target base) and impediments persist, it seems feasible to implement the consumption-based method. The discussion on feasibility also provides the aspects to consider when evaluating its potential use. Nevertheless, the approach can be used for different purposes (as monitoring, instrument and target base); therefore, corresponding issues and benefits are different. Research also widely suggests the complementary use of different approaches for better coverage of issues influencing emission rates.

The research also highlighted that the consumption-based account challenges the idea of decoupling economic growth from environmental degradation under the current production-based method, and that growing consumption, which can also undermine policies informed by consumption-based accounts, needs to be countered to reduce emissions effectively. As the choice of accounting method influences the way success in reducing emissions is seen in climate governance, the complementary use of the consumption-based account might allow for better mitigation of climate change, and it might even challenge the status quo of how we think about economic development and sustainability.

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## 8 Appendices

### Appendix 1. Different terms used in the literature

Term	Connotation
'emissions embodied in trade' 'traded emissions' 'embodied emissions' 'emission transfers' 'imported and exported emissions'	The emissions attached to the production of traded goods and services, which are transported across borders, not necessarily between the countries with different carbon efficiencies (umbrella term denoting the movement of emissions).
'outsourced emissions' 'displaced emissions' 'carbon displacement' 'carbon leakage' (sometimes a synonym)	The emissions attached to production processes in countries with lower carbon efficiency, which satisfy the demand of other countries with higher carbon efficiency (umbrella term denoting both weak carbon leakage and strong carbon leakage).
'weak carbon leakage' 'carbon leakage' (sometimes a synonym)	Outsourcing due to the global division of labor, where goods are produced where it is cheapest and eventually transported to the final consumer, as a result of either foreign companies relocating activities to other countries to reduce regulatory or employment compliance or by local companies delivering to meet foreign needs.
'strong carbon leakage' 'carbon leakage' (usually a synonym) (related to this: 'pollution haven hypothesis')	Outsourcing due to the production processes shifting to countries with laxer climate policies. As 'carbon leakage' usually refers to policy-induced outsourcing, this thesis uses it accordingly.

### Appendix 2. Coding of articles

Coding	Status	No. of articles
<b>Green</b>	Articles found to strictly fall within the scope of this research	51
<b>Grey</b>	Articles found to not strictly fall within the scope of this research, because:	
A	<b>Geographical focus too narrow</b> (they don't capture the debate around core transnational nature of outsourced emissions and	197

	how that relates to accounting methods, or they serve as a case study for emissions embodied in trade);	
B	<b>Focus on specific sector</b> (the arguments are expected to largely be sector-specific, while this work focusses on the general trends and considerations);	42
C	<b>Focus on the drivers of emissions and emission trends</b> (and thus pointing out the necessity of CBA, not how to weigh accounts against each other);	25
D	<b>Focus on a different or narrower issue/topic</b> (such as climate coalition, taxes, carbon networks, convergence, carbon footprint, benefits from trade, etc., the scope is too broad or not strictly related to the debate);	32
E	<b>Focus on other actors</b> (businesses, etc.);	8
F	<b>Could not get free access to the document;</b>	7
G	Focus on <b>technicalities</b> of modelling/accounting methods (suggestions for other methods, and methods to share responsibility, comparative advantages of methods).	21
<b>Total</b>		<b>383</b>

### **Appendix 3. Review Data Table and Final Review Data Table**

(included in the ZIP file)

### **Appendix 4. Reviewed Articles**

(included in the ZIP file)