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Environmental Implications of the Commodification of Carbon

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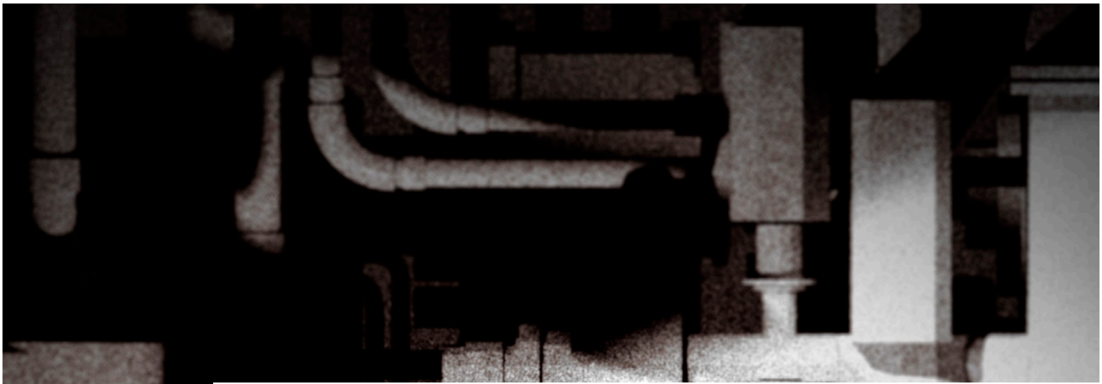

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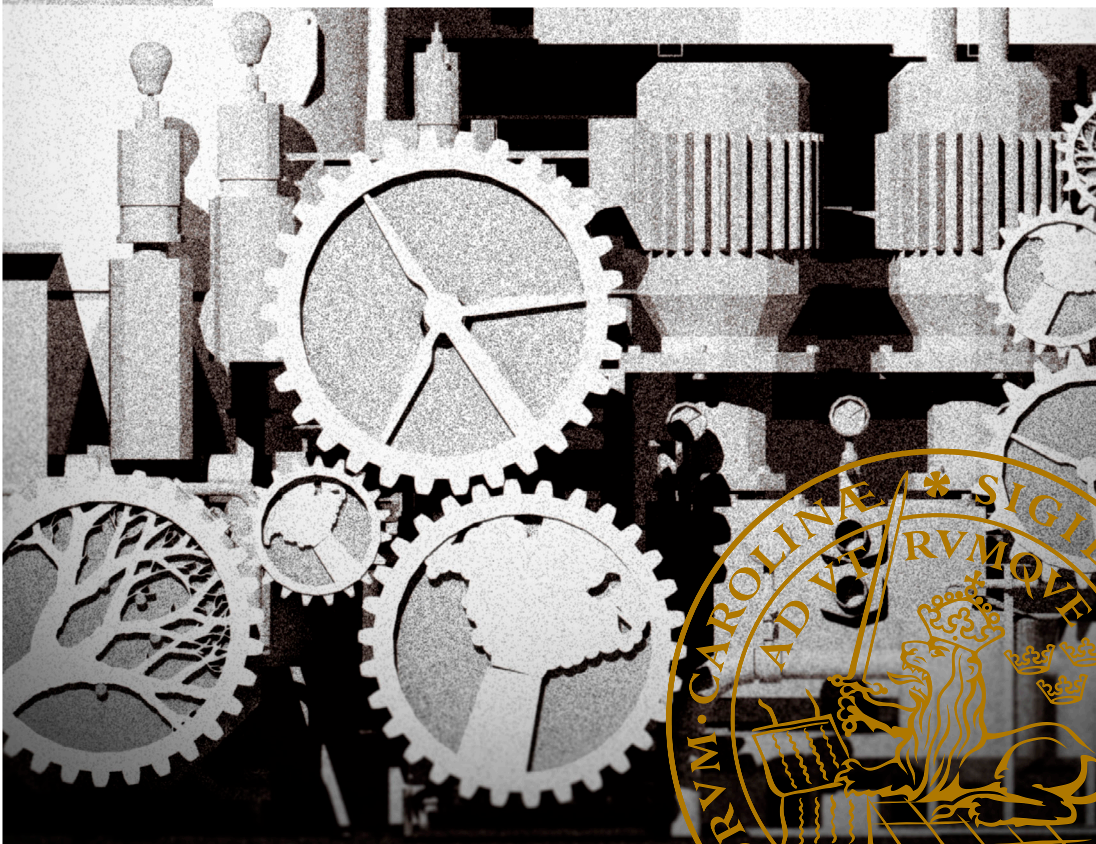
WIM CARTON | FACULTY OF SOCIAL SCIENCES | LUND UNIVERSITY



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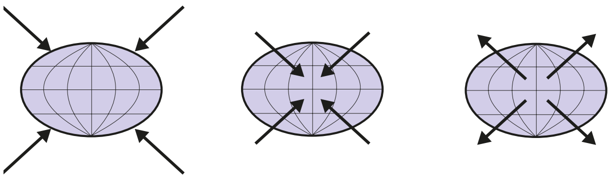

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Fictitious Carbon, Fictitious Change?

Environmental Implications of the Commodification of Carbon

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LUND UNIVERSITY

Faculty of Social Sciences | Department of Human Geography

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Let us not, however, flatter ourselves overmuch on account of our human conquest over nature. For each such conquest takes its revenge on us. Each of them, it is true, has in the first place the consequences on which we counted, but in the second and third places it has quite different, unforeseen effects which only too often cancel out the first. […] Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature – but that we, with flesh, blood, and brain, belong to nature, and exist in its midst, and that all our mastery of it consists in the fact that we have the advantage over all other beings of being able to know and correctly apply its laws.

(Friedrich Engels, 1941 [1883], p. 292)

Content

Abstract

Governments increasingly rely on the use of market instruments to tackle climate change and help decarbonize a deeply fossil fuel-dependent economy. This dissertation examines this trend as one instance of the 'commodification of carbon', or the process through which emission reductions are made into commodities and then traded on the market. It engages the commodification framework and related theoretical perspectives to scrutinize the environmental outcomes that market instruments engender, and how these can be theorized. Three cases are examined: the European Union Emissions Trading Scheme, the Flemish tradable green certificate scheme, and Trees for Global Benefits, a community-based offsetting project situated in western Uganda. The environmental outcomes of each of these cases can be summarized by pointing to the specific spatiotemporal dynamics that they (re)produce. On the one hand, this dissertation shows that market instruments are prone to problem displacement because of the broader socioeconomic imperatives within which they operate. On the other hand, it argues for recognition of the specific temporality that is implied when environmental regulation is subsumed to market dynamics. Because of their prioritization of the cheapest and easiest solutions, market instruments bring the pace and form of decarbonization in line with what is deemed economically feasible, rather than with what is scientifically necessary. It is argued that this occurs at least in part because of the way that market instruments interact with the conditioning effects of our wider socioecological surroundings, specifically the way in which social power is materialized in the contemporary fossil fuel landscape. Due recognition of these dynamics offers insights on the political role that market instruments fulfill, why such instruments prove to be so popular, and what the conditions are for developing feasible alternatives.

Acknowledgements

This work would not have been possible without the selfless support of a number of friends and colleagues. First and foremost among these is Eric Clark, who as my main supervisor has offered me his generous support and guidance over these years. Apart from pouring over endless article drafts, inspiring me with readings and waging a tireless war against the perpetual wordiness of my texts, I'm glad that Eric also found time to discuss some of the more tangible pleasures in life, say, growing winter squash. Guy Baeten has been my second supervisor and gave me the opportunity to develop intellectually in ways that probably would not have been possible with many other supervisors.

As a LUCID PhD candidate, I have been a child of two families. I would like to extend my gratitude to everyone at the Human Geography department – my home institution – for their encouragements, support and inspiration over the years. I particularly want to thank Henrik Gutzon Larsen, Erik Jönsson, Ståle Holgersen, Chia-Sui Hsu, Noura Alkhalili, Srilata Sircar, Andreas Malm, Salvatore Paolo De Rosa, Hjalti Nielsen and Rikard Warlenius for providing valuable input on my work at various formal and less formal occasions, and for co-organizing seminars, guest lectures and conference sessions. Erik Jönsson, Ståle Holgersen, Giovanni Bettini, Aron Sandell and the late Alicia Bauzá van Slingerlandt were part of a reading group at the start of my PhD studies, which provided a forum for discussing early ideas and proved influential in shaping my thoughts and the course of my work. Katherine Burlingame has been very helpful in keeping crows and evil clowns away in the final months of writing this thesis.

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Various people have sacrificed their time to plow through the entirety of my project at different stages of writing. Michele Betsill was discussant at my midterm seminar and gave constructive critique and valuable tips on how to proceed. Johannes Stripple scrutinised my work during my final seminar and made me think about the broader picture and how to frame my work in relation to a slightly different set of debates. Stefan Anderberg and Henrik Gutzon Larsen submitted my manuscript to their usual thorough and critical gazes, which has unquestionable benefitted the final form and content of this document. To everyone else who has read, commented, and criticized my work on these and other occasions, your insights have been highly appreciated, even if I wasn't able to take on board all of them.

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Elina Andersson has perhaps shaped this thesis in more ways than anyone else. She helped me come down from my initial theoretical abstractions and warmed me to a deeper engagement with the world of empirics. Even if this isn't entirely reflected in this thesis, my future work will be richer because of her. It's been a pleasure to work on the TFGB case with her and share many moments outside of work as well, in gardens, forests, natural parks and aquariums...

There are many more people who have left an imprint on my PhD process and helped to keep me sane along the way, from my boardgame buddies, to my fellow botany fanatics, to my friends and family back in Belgium and beyond. I will not aspire to mention everyone by name here, but I am deeply grateful of the support, collegiality and friendship that all of you have shown while I got lost in the highs and lows of doctoral research. I also want to express my gratitude towards my brother Bram, who skillfully translated my rambling thoughts into the cover design for this thesis.

Finally, I want to thank my parents, Yves Carton and Linda Sticker. While they have been far removed from the everyday concerns that have marked the writing of this thesis, I would never have been able to pursue this opportunity if it was not for their inspiring generosity and tireless support. I am glad I don’t have to put a monetary value on all that they have done for me, because I could never pay them back. I will stay gratefully, and forever indebted.

List of articles

Article I

Carton, W. (2014). Environmental protection as market pathology?: carbon trading and the dialectics of the "double movement." *Environment and Planning D: Society and Space*, *32*(6), 1002–1018.

Article II

Carton, W. (2016). Money for nothin' and coal for free: "Technology neutrality" and biomass development under the Flemish tradable green certificate scheme. *Geoforum*, 70, 69–78.

Article III

Carton, W. (2016). Dancing to the rhythms of the fossil fuel landscape: Landscape inertia and the temporal limits to market-based climate policy. *Antipode,* in press.

Article IV

Carton, W. and Andersson, E. (under review). Where forest carbon meets its maker… Forestry-based offsetting as the subsumption of nature. *Resubmitted to a peer-reviewed journal.*

Wim Carton wrote the text in close dialogue with Elina Andersson. Fieldwork for this article was shared equally between both authors.

List of abbreviations

A/R	Afforestation and reforestation
AAG	Association of American Geographers
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
DFID	United Kingdom Department for International Development
EC	European Commission
EPA	United States Environmental Protection Agency
EU	European Union
EU ETS	European Union Emissions Trading Scheme
EUA	European Union Allowances
FIT	Feed-in Tariff
GHG	Greenhouse gases
HFC-23	Hydrofluorocarbon-23, or trifluoromethane
ICAP	International Carbon Action Partnership
ICRAF	The World Agroforestry Centre
IEA	International Energy Agency
IETA	International Emissions Trading Association
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
kWh	kilowatt/hour
MBM	Market-based mechanism/instrument
N_2O	Nitrous oxide
NGO	Non-governmental Organization
NO_x	Nitrogen oxides
NREAP	National Renewable Energy Action Plan

OECD	Organization for Economic Co-operation and Development
PFC	Perfluorocarbon
REDD	Reducing Emissions from Deforestation and Forest Degradation
SO_2	Sulphur dioxide
TFGB	Trees for Global Benefits
TGC	Tradable Green Certificate
UNCTAD	United Nations Conference on Trade and Development
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USAID	United States Agency for International Development
VCM	Voluntary Carbon Market

1. Introduction

> *The commodity description of labor, land, and money is entirely fictitious. […] [T]he alleged commodity "labor power" cannot be shoved about, used indiscriminately, or even left unused, without affecting also the human individual who happens to be the bearer of this peculiar commodity. In disposing of a man's* [sic] *labor power the system would, incidentally, dispose of the physical, psychological, and moral entity "man" attached to that tag. […] Nature would be reduced to its elements, neighborhoods and landscapes defiled, rivers polluted, military safety jeopardized, the power to produce food and raw materials destroyed."*
>
> *(Karl Polanyi, 2001 [1944], p. 76)*

Beginnings

This dissertation examines the increasingly popular use of market-based mechanisms for climate change mitigation, a trend that I here choose to call the 'commodification of carbon'. Originally, this research focus emerged out of an interest in the work of the Hungarian economic historian Karl Polanyi. My initial idea, as outlined in my PhD proposal, was to explore the commodification of carbon as the creation of a 'fictitious commodity', one of the main concepts developed in Polanyi's (2001) *The Great Transformation*, and to do so by making an analytical comparison with the fictitious commodities that Polanyi talks about in the book, namely land, labour and money. As it turns out, my PhD studies took me in a slightly more convoluted direction. For the last three years in fact, Polanyi has only been a sporadic presence in my reading and writing, his perspectives submerged by a disharmony of other theoretical voices. Yet as I finally started to think about the introductory accompaniment (or *kappa*) to the four articles comprising this thesis, I came to realize that many of my arguments could in fact be summed up in the Polanyian terms that I had started with. Somewhat unwittingly, the thesis that you are reading here does explore a parallel between contemporary processes and the developments that Polanyi described for the 19th and early 20th centuries in Western Europe: the imposition of a predominantly market-based logic on the social organization of land, labour and money. Indeed, Polanyi was tragically mistaken in believing that he was analyzing a purely historical set of developments; that what he called the “stark utopia” of market society had been too obviously flawed, too devastating, to ever be repeated. “Undoubtedly,” he wrote in 1944, “our age will be credited with having seen the end of the self-regulating market” (2001, p. 149). Much to the contrary, of course, the last decades have seen a remarkable extension of market logics into spheres where this was previously unthinkable. While one can argue about the exact meaning of terms like ‘self-regulating market’, it is clear that we are living in an age where faith in the market as the be-all and end-all of social and economic organization is as strong as ever.

For those concerned with questions of sustainability, this trend has been most conspicuous in the rise to prominence of market environmentalism, that is, the development of new markets for ostensibly environmental purposes. From emissions trading and carbon offsetting to the implementation of tradeable fishing quota, biodiversity offsets or wetland banking, it almost seems there isn’t an environmental crisis out there that markets can’t solve (Bailey, 2010; Heynen et al., 2007; Igoe et al., 2010; Lohmann, 2006a; Lucchetti et al., 2014; Mansfield, 2004; Robertson, 2006, 2012). Yet the diffusion of the market as an organizational instrument is seldom an uncontested or unproblematic process. When Polanyi proposed the concept of the fictitious commodity, he did so exactly in an attempt to capture the inherent problems involved in reducing socially, economically and ecologically complex phenomena to the universalizing act of market valuation. The subsumption of land, labour and money to the imperatives of the market, he argued, wrought havoc on the nature, the people, and the socioeconomic relations that underpin these economisms. In much the same way, scholars have in recent years argued that the articulation of various ‘natures’, including carbon, as an economic category has given rise to a long list of ecological problems and socioeconomic injustices (Bailey et al., 2011; Böhm & Dabhi, 2009; Bond, 2011; Bumpus, 2011; Castree, 2003, 2010a, 2010b; Cavanagh & Benjaminsen, 2014; Fairhead et al., 2012; Goodman & Boyd, 2011; Heynen et al., 2007; Leach & Scoones, 2015a; Lohmann, 2011a; Prudham, 2007; N. Smith, 2006).

In contributing to these debates, this dissertation can be read as a contemporary elaboration of a quintessentially Polanyian argument. The research presented here speaks to the fictions involved in making a commodity – a highly instrumental economic category – out of something ('carbon') that is clearly much more than that. Despite the many other theoretical perspectives that have shaped this work, I therefore deemed it appropriate to acknowledge Polanyi as a key inspiration in the title. *Fictitious Carbon, Fictitious Change?* captures quite well the main arguments put forward in this thesis. It highlights one of the main concerns with the recent proliferation of market-based environmental instruments (whether it contributes to the kind of change that is needed) while simultaneously hinting at the historical precedents that Polanyi wrote about. As such, the nod to Polanyi invokes the construction of carbon – or more correctly: the emission of greenhouse gases – as an economic category subject to inherent limitations (or 'fictions'), and the potential implications this has for the mitigation of climate change. Importantly, it does this by putting a firm analytical focus on socioeconomic *processes* rather than *things*, highlighting the complex social, economic and ecological functions that market-based instruments perform rather than studying those instruments as discrete analytical objects. In other words, framing the perceived shortcomings of market-based climate policy as the outcome of a historical and dialectical process (as the fictitious commodity idea implies) raises the question of how the problematic nature of carbon's 'fictitiousness' manifests itself, and how these linkages can be theorized. That, in a nutshell, is what this dissertation is about.

Just as the work of Polanyi served as a fruitful entry point when I started my PhD, I think it is a good starting point for introducing and synthesizing the arguments laid out in this thesis. One thing that distinguishes my approach here from that put forward in my original PhD proposal, however, is that I now see more clearly that Polanyi's framework is really just that: a starting point. The fictitious commodity metaphor functions as the bare bones of a broader and in many ways much messier narrative on the relationship between capitalist society and nature. To analyze the implications of market-based climate policy in more detail calls for a broader focus and a variety of theoretical perspectives, most of which indeed are more contemporary, more relevant or simply more developed than what Polanyi has to offer. In the articles I have done this by engaging with various traditions in environmental and critical geography, traditions that go under different names but that can somewhat reductively be grouped together by pointing to their common concern with commodification processes. In much of what follows, Polanyi will thereby disappear from the picture, as indeed he has for much of my time as a PhD candidate. In fact, the questions that I am here concerned with could easily be framed without any reference to Polanyi at all. Nevertheless, I believe the analogy with Polanyi's historical argument remains a relevant one. It reminds us of the broader significance of the processes that we are witnessing, and of the consequences that ensue when we start losing ourselves in economic abstractions; when our alienation from nature, from society, and from ourselves as social, ecological, political beings, is taken to new extremes. I won't pretend that this thesis offers conclusive answers to these concerns. Yet by focusing on one particular way in which market instruments are being extended into new areas – climate and energy policy – I believe we can at least help formulate a partial answer to a question that is both timely and highly reminiscent of the one Polanyi was already concerned with over 70 years ago: what are the implications of our increasing reliance on market logics for managing our relationship to the non-human environment?

Research focus and rationale

This thesis, then, examines the roll-out of market-based climate policy as one instance of the commodification of nature. In pursuing this task a number of choices and assumptions had to be made, which helped delineate the research and determined the overall approach. Most fundamentally, the concrete focus of this thesis is shaped by the specificities of my theoretical entry point, which generally implies a critical position towards its subject matter (Bakker, 2005; Castree, 2008). Framing the development of market-based climate policies as a form of commodification means that I am not starting from a 'neutral' or blank vantage point (as no one ever does), but that my approach is inscribed in a long-standing critical tradition that is both normative and associated with a certain political outlook (Bishop, 2007). While I see this as an unproblematic and even desirable entry point for research, it does underline the researcher's responsibility to be as transparent as possible, by explicating what exactly her/his critique exists of, and wherein it is based. In writing this thesis I have attempted to be fully aware of this, as I hope is reflected in the subsequent chapters and in the articles.

For the sake of this introduction, it is therefore worth clarifying that my research starts from the assumption that at some level the commodification of carbon can be seen as a problematic process. To be clear, this is not to suggest that it can simply be dismissed *a priori*, without engaging with the many nuances of its different manifestations in specific contexts. Indeed, previous research on the commodification and neoliberalization of nature shows that the concrete outcomes of such processes are often ambiguous and ultimately context-specific (Bakker, 2005; Fairhead et al., 2012; Mansfield, 2007). What it does mean is that my starting point is an understanding of a general tendency, demonstrated in the literature and supported by different theorizations (including that of Polanyi), which says that the commodification of nature commonly (though not always) disadvantages the poor and often results in new environmental problems, even if or when it (also) produces environmental benefits (Castree, 2010b). As opposed to most mainstream assessments, which generally see market-based mechanisms (MBMs) as "innovative instrument[s] with some teething troubles that can be overcome relatively easily" (Michaelowa, 2011, p. 839), this dissertation starts from the assumption that dilemmas, conflicts and contradictions are (to varying degrees) inherent to ongoing commodification processes. While I have consciously tried to remain open to the potential disproval of this idea, in a way its (in)validity is beside the point that I want to make here. My direct concern in this thesis is not with proving or disproving the problematic nature of commodification, but with understanding the internal dynamics of this process insofar as it predisposes commodification to certain outcomes. In other words, this thesis assumes that existing accounts are correct in pinpointing the commodification of carbon as a contentious and in many ways problematic process, and tries to contribute to a deeper understanding of why exactly this is the case and how its problematic character becomes expressed. One could say that my approach is driven by an attempt to ground the critique of MBMs more firmly in (commodification) theory and empirical analysis.

On a more practical level, three choices have been particularly important in delimiting my research. Firstly, while the ambition with this thesis is to scrutinize the implications of market-based climate policy in general terms, the analysis has mainly been focused on *three concrete cases*. These are (1) the European Union Emissions Trading Scheme (EU ETS), still the world's largest operational emission trading scheme and one of the pillars of European climate policy; (2) the Flemish Tradeable Green

Certificate (TGC) Scheme, a regional market-based incentive scheme for renewable energy production; and (3) Trees for Global Benefits (TFGB), a forestry-based carbon offsetting project in western Uganda that produces offset credits for the Voluntary Carbon Market (VCM). Each of these cases are characterized by their own particularities that set them apart from each other and from other related schemes out there. By examining them together, however, my intention has been to bring out some of their commonalities and thereby shed light on the implications of market-based climate policy beyond the individual contexts that each case represents. Apart from contributing to a fuller understanding of three concrete examples of market-based policy, the aim of this thesis has therefore been to further a more theoretical argument on the outcomes of market-based policies more generally.

At this point it is worth clarifying my definition of market-based mechanisms, which I use interchangeably with 'market-based instrument' and the more case-specific 'market-based climate policy'. The term is commonly used to describe policy instruments that in one way or another use financial incentives to influence market dynamics. MBMs in this broad meaning of the term are seen as simply the opposite of command-and-control regulation, and include such policy instruments as environmental taxes, subsidies, procurements, etc. (C2ES, 2015). Others however refer to MBMs in a more narrow sense, to specifically describe those instruments that involve the *creation* of new markets in environmental services, a definition that I find altogether more useful and that I will follow here. With respect to climate and energy policy, this restricts usage of the term 'market-based mechanism' to those instruments that involve the trading of environmental credits in what Lövbrand and Stripple (2012) identify as either baseline-and-credit (i.e. offset) schemes, or cap-and-trade (i.e. quota-based) mechanisms. The term 'market-based instruments' in this dissertation therefore exclusively refers to such trading schemes, and not, for example, to other financial instruments such as carbon taxes or feed-in-tariffs (FITs).

A second major delimitation of this thesis is that it is primarily concerned with the *environmental outcomes* of market-based climate policy. In my reading of the literature, this is the aspect of the critique of MBMs, and indeed of the commodification of nature more widely (Castree, 2008, 2010b), that is least developed. Critical engagements with the implementation of market instruments more often focus on the economic, political or social justice implications of market instruments (Böhm &

Dabhi, 2009; Boyd, 2009; Coelho, 2012; Leach & Scoones, 2015a; Lovell et al., 2009; Osborne, 2011, 2015; Schmidt et al., 2012; Wittman & Caron, 2009). Borrowing from David Harvey, Bumpus and Liverman (2008) for example describe carbon offsetting as a case of 'accumulation by decarbonization', denoting the devolution of climate governance to non-state actors and the opportunities this has created for entirely new forms of capital accumulation to arise. Lohmann (2010) explores the analogy between carbon markets and what he calls 'uncertainty markets', arguing that much the same processes can be discerned in both, namely an increasing focus on economically complex and highly abstract commodities that seem inherently susceptible to speculation and profiteering. Bond (2012) makes a related argument when he frames carbon trading as the privatization or "enclosure (in 19th-century terms) of non-polluted air, oceanic carbon-absorption capacity, land, forests, social commons and indigenous knowledge" (p. 689) that in the eyes of its proponents has become a convenient 'fix' for a capitalist system weighed down by financial crisis. A similar focus can be discerned in common descriptions of market environmentalism as 'carbon colonialism' (Bachram, 2004; Bumpus & Liverman, 2011; Hazlewood, 2012; Lyons & Westoby, 2014a) or 'green grabbing' (Fairhead et al., 2012; Leach & Scoones, 2015b; Tienhaara, 2012).

These accounts have produced rich and extensive analyses of the negative socioeconomic impacts of various market mechanisms, but indirectly they have also left the environmental implications of MBMs somewhat in the shadow. While more environmentally concerned analyses of market instruments certainly exist (see for example Grandia, 2007; Lohmann, 2009a, 2011b; Robertson, 2004, 2006), they tend to be a minority, perhaps a consequence of the explicitly emancipatory political agenda of many critics. Some critical studies in fact seemingly conflate arguments about the environmental outcomes of MBMs with concerns over the unequal distribution of responsibility, unequal access to natural resources, and examples of profiteering and fraud by multinational players, so that a critique of the latter becomes a stand-in for a critique of MBMs over the whole line. While the social, economic, and environmental dimensions of MBMs are necessarily co-constituted,[1] and some of the

[1] Profiteering under the EU ETS for example has led to a significant over-allocation of carbon credits (European Union Allowances or EUAs) and therewith to a drop in EUA prices

articles in this thesis explicitly refer to the interlinkages of environmental and non-environmental outcomes, a distinction between the two is analytically useful if we want to clarify what, exactly, a critique of commodification is aimed at. Recognizing the profound and intricate ways in which social and environmental sustainability are interlinked should not blind us to the possibility that an equitable and democratic solution to climate change could very well entail increased environmental degradation, or that market-based climate policy might bring some sort of environmental gains while remaining socially unjust and morally reprehensible.

What do I mean with environmental outcomes? Most directly my concern is with the environmental effectiveness of the policies here scrutinized, meaning a focus on the impact that market-based policies have in terms of greenhouse gas emission reduction. At one level therefore, my research invokes a form of immanent critique, aspiring to evaluate MBMs against the promises that they make, as effective policy instruments for mitigating climate change. At the same time I believe a focus on environmental outcomes should be more than that. I have chosen to use the term 'environmental outcomes' rather than the more narrow 'environmental effectiveness' to acknowledge the many ways in which the outcomes of our interactions with non-human nature often escape our intentions. The commodification of nature, as Polanyi (2001) already argued, is a necessarily incomplete and incompleteable process. It comes with caveats and unintended consequences that derive both from the abstractive dynamics of the commodification process and the uncooperativeness of nature and labour as agents in that process (Bakker & Bridge, 2006; Bakker, 2004, 2010; Braun, 2008; Castree, 2003; Leach & Scoones, 2015a; Prudham, 2003, 2004). This means that the application of a market-based approach can be expected to have environmental implications beyond the immediate reduction of greenhouse gases, implications that might lead to new forms of resource extraction, pollution, environmental degradation, etc. While my primary concern in this dissertation is with MBM outcomes in terms of their effectiveness, the analysis at times therefore also considers related environmental aspects.

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and a failure of the market to achieve its mitigation objectives (Pearson & Worthington, 2009). More generally, we could of course note that the concern for, and implications of, environmental outcomes are themselves socially constituted.

A third delineation of this thesis is its focus on *structural rather than proximate explanations* of environmental outcomes. In the literature, much attention has been given to questions of governance or the erroneous design of schemes such as the EU ETS or the Clean Development Mechanism (CDM) (Bailey, 2007a; Ellerman et al., 2010; Gilbertson & Reyes, 2009; Helm, 2008, 2010; Hepburn, 2007; Morris & Worthington, 2010; Morris, 2013; Skjærseth & Wettestad, 2009; Stephan & Paterson, 2012). This approach has been instrumental in clarifying the concrete legacy of these schemes and has exposed a long list of problems, all of which are relevant to a full assessment of how market-based mechanisms function and perform. I however want to argue that in order to fully understand the environmental implications of MBMs, we need to be able to look beyond controversies over policy implementation or design and also scrutinize the foundational logics upon which MBMs operate. Policies change over time, as do the priorities of governments and businesses. It is not inconceivable that a market scheme that is malfunctioning today could be improved upon or radically reformed tomorrow, as indeed has been happening with the EU ETS in more recent years (EC, 2012a, 2013). A critique that focuses primarily on the proximate causes of policy failure is vulnerable to these fluctuations and has relatively little to say about the logic of market-based policy or the structural reasons behind some of its outcomes. Insofar as ideology and political economy are less amenable to sudden change, an examination of market instruments at a more structural level can yield an insightful and perhaps more stable and useful critique. To the extent that it accords analytical priority to wider political economic dynamics rather than the behavior of individual market actors, I believe this focus is also more suitable for deciphering trends and tendencies and formulating theories. In abstracting from debates on the implementation, design, governance, etc., of market environmentalism, this dissertation thus focuses a wider 'level of generality' (cf. Ollman, 2003), which I hope usefully complements previous work formulated at different analytical levels. I am not the first to suggest this approach, of course, and a number of relevant precedents of a more structural critique will be expounded in subsequent chapters. The objective of this dissertation has been to expand on these earlier contributions for the particular case of market-based climate and energy policy.

In sum, then, this dissertation examines the commodification of carbon in *three specific policy instruments* in order to elucidate some of the *structural explanations* behind the specific *environmental outcomes* engendered by market-based climate and energy policy.

Thesis Outline

This dissertation is comprised of four articles and the introductory *kappa* (Swedish for 'jacket' or 'coat') that you are currently reading. The objective of the *kappa* is to contextualize and synthesize the articles and to clarify the thesis' overarching theoretical and methodological approaches. As such, it is meant to be explanatory rather than exhaustive. Inherent to this thesis format is that the argument will at times seem fragmented and that the text will contain repetitions, both between the individual articles, and between the articles and the *kappa*. To the extent possible, I've tried to work my way around this by making the *kappa* into a stand-alone piece that is first and foremost structured around a synthesis of the articles and the overall arguments they make. In doing this, my intention has been to make the *kappa* more accessible than some of the articles perhaps are. While this does increase the extent of repetition in the thesis as a whole, I hope it ultimately contributes to a clearer picture of the overall argument and a contextualization of the findings within their broader empirical and theoretical contexts.

The *kappa* is structured as follows. The next chapter introduces the focus on market-based mechanisms for climate and energy policy. It outlines the general history of market-based environmental regulation and provides a comprehensive literature review for the three market mechanisms that the thesis focuses on. It also establishes some initial linkages between the schemes, hinting at the similarities and differences that underpin the analysis. This second chapter thereby serves as a general background chapter, setting the scene and introducing the concrete focus of the articles. Following this, chapter three elaborates on the commodification idea as the overarching theoretical framework that has guided this research. It discusses the history of the concept, explores diverging definitions and uses of it in the literature, and clarifies the focus adopted in my work. In chapter four I describe the dissertation's methodological framework, whereby I also give attention to the research. Apart from setting out the project's empirical and theoretical methods, I also make a bridge with my conceptual framework by situating the research in a historical materialist philosophy and a methodological commitment to dialectical reasoning. Chapter five then draws the different pieces together. Structured around three main themes, I synthesize the arguments made in the articles and connect them to the methodological and theoretical frameworks discussed earlier. Here, as elsewhere, my intention has not been to be exhaustive. For a full account of the arguments, I refer the reader to the respective articles, which are appended at the back of this book. Rather, section five attempts to build bridges between the articles, highlighting how the different pieces fit together, where commonalities can be discerned, and in which sense the articles complement each other. To the extent that the articles demonstrate an evolution of the research focus, I also briefly elaborate on this. The concluding chapter, finally, briefly summarizes the main findings and reflects on some of the broader lessons that this research holds for market-based environmental regulation and the ambition to decarbonize contemporary capitalist society.

2. Bringing carbon to the market

Economic analysis, which is all but useless in helping us to decide on a policy, is all but indispensable in helping us to decide on the best way of implementing a policy once it has been chosen. The criterion is simply that the best way of implementing a policy is the least costly way, counting all costs.

(John H Dales, 2002 [1968], p. 99)

A brief history of market-based policy

While market-based climate and energy policy in its current form is a fairly recent phenomenon, the idea itself is not a particularly new one. The theory behind the use of market instruments goes back to the work of the English economist Arthur Pigou (1920), widely known as one of the first theorists to put forward the concept of the externality, now commonly used in environmental economics. Pigou famously argued that environmental problems such as air or water pollution can be seen as a form of market failure, reflecting the historical inability of the market to account for the full social and environmental costs of economic activity. In order to solve this problem, Pigou suggested, governments would need to impose these costs through taxation (the so-called 'Pigovian tax'). The resultant adjustment of market prices would then by itself lead to a diminished demand for products or services that have negative social or environmental impacts.

Pigou's reframing of social and environmental problems as market failures proved highly influential, but his suggestion that this could, and should be solved through direct state intervention in market prices was received less enthusiastically. Coase (1960), in particular, disagreed with Pigou's proposed solution and argued that the imposition of environmental taxes would likely lead to further market distortions. Moreover, Coase noted, in many cases it is not at all clear who are the perpetrators, and who the victims of negative externalities, which essentially meant that the whole externality problem should be seen as a reciprocal one. A factory emitting pollutants into the environment has a harmful effect on its surroundings, but efforts to reduce that pollution might in turn impact on that factory's production value. "In devising and choosing between social arrangements [on how to deal with externalities]", Coase therefore argued, "we should have regard for the total effect" (p. 44), which includes taking account of the economic value that harmful activities produce. Coase concluded that potential interventions should be weighed against the objective of economic efficiency, and that from this perspective there was no reason why taxation or other government interventions would be the preferred option.

Coase's insistence on the principle of economic efficiency caught on and in particular inspired the work of Dales (1968, 2002) and Crocker (1966). Dales' 1968 treatise, *Pollution, Property & Prices,* is perhaps the best-known elaboration of this idea, and later became one of the foundational texts on market-based environmental regulation (Shields, 2007). It provides the first full-fledged argument for a market in tradable pollution rights as the best way to deal with environmental externalities. The text's main tenet is summed up well by the quote at the beginning of this chapter: the best way to deal with pollution is the cheapest way, and in that respect the market is clearly superior to different forms of government intervention. Dales' writings thereby contain most of the building blocks for the different market-based instruments discussed in this dissertation. He noted, for example, how the decision on the desired level of pollution should be taken by governments – a principle that is reflected in current climate and energy policy in the form of permit quota or an emissions 'cap' – while the actual distribution of pollution reduction should be left to the market. Following on from Pigou (1920), Dales (1968) argued that problems such as water pollution (the example he uses) are fundamentally to be understood as the "failure to devise property rights to the use of natural water systems" (p. 792), a notion later popularized in more general terms as the 'tragedy of the commons' (Hardin, 1968). Yet whereas Hardin himself still insisted that such tragedies could only be resolved through "coercive laws and taxing devices" (p. 1245), including, most famously, population control, the solution that logically presented itself for Dales (1968) was the creation of an artificial property system:

> The government's decision is, let us say, that for the next five years no more than x equivalent tons of waste per year are to be discharged into the waters of region A. Let it therefore issue x pollution rights and put them up for sale, simultaneously passing a law that everyone who discharges one equivalent ton of waste into the natural water system during a year must hold one pollution right throughout the year. Since x is less than the number of equivalent tons of waste being discharged at present, the rights will command a positive price-a price sufficient to result in a 10 per cent reduction in waste discharge. The market in rights would be continuous. Firms that found that their actual production was likely to be less than their initial estimate of production would have rights to sell, and those in the contrary situation would be in the market as buyers (p. 801).

Since prices for pollution rights will self-adjust based on supply and demand, Dales claimed, the trading of those rights automatically results in the most cost-effective form of pollution control. As a plus, this process was expected to significantly reduce the administrative costs involved with setting standards and calculating taxes or subsidy levels (Koch, 2012).

Dales' proposal was enthusiastically adopted by his contemporaries and further developed in the following years by economists such as Baumol and Oates (1971), Montgomery (1972) and Tietenberg (1980). At the same time the idea migrated beyond academia and caught the attention of policy makers and environmental interest groups. The 1970s and 1980s thus saw the first careful attempts by the US Environmental Protection Agency (EPA) to apply the economic theory to 'real-world' cases: in 1976 for regions that failed to meet local air pollution standards set by the Clean Air Act, and during the 1980s for the intended phase-out of leaded fuels and the control of ozone-depleting organic compounds. In general, however, policy makers seemed reluctant to abandon their tried-and-tested methods of command and control. It was not until the beginning of the 1990s, building on a more general momentum for neoliberal reform, that the political climate in the US proved ready for the first large-scale experiment with market-based environmental regulation: the implementation of a national SO_2 allowance trading system (Lane, 2012; Stavins, 1998). Also called the Acid Rain Program, this mechanism was adopted in 1990 under the Clean Air Act as part of a broader effort by the EPA to bring down power sector-related emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) by 2010. The system's design was largely reminiscent of Dales' (1968) model property rights market. It instituted a *de facto* limit on the amount of SO_2

and NO_x emissions that could be emitted during each of the program's two phases and then handed out a corresponding amount of tradable allowances to each of the power plants to which the scheme applied. Every year, power plant operators then needed to hand in an amount of allowances corresponding to their emissions for that year or face a penalty (Stavins, 1998). The implementation of the Acid Rain Program is seen by many as a success story and is frequently cited as an example justifying the adoption of market-based mechanisms in related policy areas (Stavins & Whitehead, 1997; Tietenberg, 2010).

This same period, the early 1990s, also marks the moment when concerns over climate change first made it onto the political agenda. Largely inspired by US experiments with SO_2 allowance trading, organizations such as the Organisation for Economic Cooperation and Development (OECD), the United Nations Conference on Trade and Development (UNCTAD) and the International Energy Agency (IEA) began investigating the potential to design a similar system for the reduction of greenhouse gas (GHG) emissions. Emboldened by these studies and by growing concerns over the potential economic impacts of CO_2-reducing measures, US policy makers were quick to adopt the idea. Hence, when the United Nations Framework Convention on Climate Change (UNFCCC) negotiations took place in the run-up to the Kyoto conference, US delegates came to the table with a clear demand that emissions trading be included as part of the CO_2-reduction mechanisms. These demands were met with considerable opposition from European negotiators and developing countries, who were concerned that emissions trading was nothing more than an evasion of serious emission reduction commitments, but ultimately the US managed to push through its proposals (Braun, 2009). The result is well known. The Kyoto Protocol, adopted in 1997 and implemented in 2005, includes three so-called 'flexible mechanisms', all of which are market-based instruments: (1) Emissions trading, a country-level scheme operating in terms similar to the ones discussed above; (2) the Clean Development Mechanism (CDM), a carbon offsetting scheme established to facilitate the exchange of emission rights between Annex I and non-Annex I countries[2], discussed in more detail below; and (3) Joint Implementation (JI), an offsetting scheme for Annex I-

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[2] The Kyoto Protocol (1997) is legally binding only for countries on the so-called 'Annex I'-list, which includes the world's most industrialised countries. Developing countries are included in the protocol but do not have legally binding emission reductions.

countries, mostly to facilitate emission reductions from former Soviet states (Hepburn, 2007; Spash, 2010).

The inclusion of emissions trading and offsetting in the Kyoto Protocol proved crucial for the further trajectory of MBM development at different policy levels. Largely as a result of the Kyoto negotiations, market instruments were put on the agenda of environmental regulators around the world and some of the resistance that had long existed against such approaches was broken (Betsill & Hoffmann, 2011; Voß, 2007). This ultimately paved the way for the development by the EU of its own emissions trading scheme (ETS) and the launch of similar national or regional schemes elsewhere, from the US to Japan, New Zealand, Kazakhstan and China (Paterson et al., 2013). Today, and despite numerous setbacks, resistance and problems, ETSs continue to spread at both national and subnational levels (World Bank, 2015). As of 2015, 17 schemes were in operation across 35 countries, with many more under consideration (ICAP, 2015). In parallel to this, the market-based regulatory approach migrated from emissions trading to other policy areas, including energy policy and biodiversity conservation (Madsen et al., 2011; McAfee, 1999).[3] However, the trend in market environmentalism has certainly not only been upward. With respect to carbon offsetting for example, recent years have seen a leveling off and/or slight decrease in the total amount of credits traded, both in the CDM and on the voluntary market. This is commonly attributed to ongoing uncertainties about the emerging international climate change regime and the role that offsetting will play therein (World Bank, 2015).[4] To the extent that the recent Paris climate agreement (UNFCCC, 2015) provides the institutional framework for a global market scheme that would succeed the Kyoto Protocol's flexible mechanisms, it is not unlikely that the downward trend for offsets will be reversed, and that the proliferation of market-based environmental regulation will continue into the foreseeable future (Szabo, 2015; Widge, 2015).

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[3] That being said, the arrival of biodiversity offsets, for example, also has precedents in US experiences with wetland mitigation banking, which dates back to the 80s and shows a trajectory parallel to, though in tandem with, that of pollution trading (Robertson, 2000, 2004; US Environmental Protection Agency, 2016).

[4] The drop in traded certificates for 2014 and 2015 has been very significant in the CDM, though this is at least partly due to a surge in trading during the years 2011-2013, when European companies rushed to purchase cheap industrial gas-based offsets before these were banned from the EU ETS (Elsworth et al., 2012; World Bank, 2015).

Throughout their history, claims about the superior economic efficiency of market-based instruments were an important reason for why they proliferated as they did. True, proponents put forward a number of other purported benefits as well. With respect to climate change, for example, it has been argued that a global emissions trading system is a much simpler, equitable and politically feasible method of reducing emissions than any of the available alternatives (Grubb, 1990; Stern, 2010). Once it had become firmly established, moreover, the market-based policy regime acquired a dynamic and legitimation all of its own, allowing it to spread to multiple policy domains (Betsill & Hoffmann, 2011). More often than not, however, an enticing economic argument underpins this diffusion. For many if not all of the market-based instruments out there, the claim to economic efficiency figures prominently as part of their self-defined rationale. The EU directive establishing the EU ETS, for example, refers to the need to reduce greenhouse gas emissions "in a cost-effective and economically efficient manner" (EC, 2003) in its very first paragraph. In this way the directive essentially enacts a virtuous marriage between economic and environmental concerns and purports to overcome the kind of economy-environment antagonism that have been put forward by the environmental movement since the 1970s and 1980s (Meadows et al., 2004).

The current widespread acceptance of market environmentalism shows just how successful economists like Coase (1960), Dales (1968, 2002) and their successors have been in garnering support behind their theories. To be sure, this was anything but a spontaneous development. "Laissez-faire was planned," Polanyi (2001, p. 147) famously remarked in response to the common assertion that markets in land, labour or money constitute 'free' or natural markets, and the same can very well be said with respect to the history of environmental markets. The alleged superiority of market instruments, in terms of their economic efficiency, was hardly a self-evident idea for much of the 20th century, nor was it 'natural' to consider economic efficiency a factor at all relevant to environmental regulation (Lane, 2012). The creation of these ideas required consistent efforts by a wide range of actors. From the first property rights model of Dales (1968) to the advocacy work of organizations such as the International Carbon Action Partnership (2014) and the International Emissions Trading Association (IETA, 2015), to the negotiating skills of the US delegation during the Kyoto talks, a lot of work has gone into constructing carbon markets, biodiversity offsetting schemes, tradable certificate systems, etc. Ultimately, these efforts succeeded in building the momentum for MBMs that we witness today. To what extent these claims to economic efficiency are accurate is thereby somewhat beside the point. What matters most in the context of this dissertation is the role that this idea performed, not just in building an environmental alliance between political and economic interests, but also in shaping the kind of environmental outcomes that come out of market-based policies.

Overview of the three cases

This dissertation concretely focuses on three quite different examples of market-based climate and energy policy: the EU ETS, the Flemish tradable green certificate (TGC) scheme, and Trees for Global Benefits (TFGB), a Ugandan-based carbon offsetting project. Each of these is introduced below, whereby I try to highlight both the specificities of each scheme and the commonalities with other MBMs. Connecting these three instruments are various manifestations of the commitment to economic efficiency described above. Given that my focus is on structural explanations, it is at this level that the schemes have been analyzed and at this level that the overall conclusions can be formulated. To contextualize the experiences with these instruments, however, their history as well as common concerns over market design and governance will be briefly elaborated on.

The EU Emissions Trading Scheme

In the negotiations leading up to the Kyoto Protocol, the EU was one of the most vehement opponents of US proposals for emissions trading. At that time, European legislators were committed to more direct forms of emission control and feared that an international emission trading system would weaken legally binding commitments. As mentioned above, the EU ultimately had to back down and accept the flexible mechanisms in exchange for legally binding targets (Braun, 2009). The consequences of this development were not restricted to the outcome of the UNFCCC negotiations but also set in motion a volte-face for the European Commission's own climate policies. For much of the 1990s namely, the EU had been engulfed in its own battles to implement a European-wide carbon tax, an effort that was met with considerable opposition from both member states and industries. The idea proved unpalatable and the Commission ultimately had to abandon it. Against the background of this failure, the Kyoto Protocol concessions, together with the budding belief that emissions trading would inevitably come to play some role in climate policies, convinced the EU to completely change tactics. It commissioned feasibility studies on an EU-wide emission market and presented a first Green Paper on the idea in 2000 (EC, 2000). The Commission then set about garnering broad support for emissions trading and by 2001 managed to convince member states and industries that a European ETS would be more amenable to their interests than the failed carbon tax proposal (Bailey et al., 2011; Christiansen & Wettestad, 2003).

Following this, the EU moved uncharacteristically fast. The directive establishing the EU ETS was adopted in 2003 and the trading scheme itself came into force in 2005 (Convery, 2009; EC, 2003). When it did, it quickly became the flagship instrument in the EU's climate change policy as well as the main reason for the Union's self-perceived role as a frontrunner in international mitigation efforts (Hedegaard, 2011; Pearson & Worthington, 2009). Moreover, the EU began actively promoting the ETS as a pilot for a future global trading scheme and an example for other countries to learn from. In a complete departure from its position during the 1990s, the European Commission's current aspiration with the EU ETS is that it will serve as "an important building block for developing an […] international carbon market […] through the bottom-up linking of compatible domestic cap-and-trade systems" (EC, 2012b, p. 5). Ongoing negotiations to link the European scheme to a number of other trading systems, most prominently the Swiss one, can be seen as decisive steps in this direction.

As of 2016, the EU ETS is still the largest emissions trading scheme operational anywhere, covering over 11,000 installations in key industrial sectors or about half of the EU's total CO_2, N_2O (nitrous oxide) and PFC (perfluorocarbon) emissions (EC, 2013b). The scheme sets an annually-declining cap on these emissions and then allocates a corresponding amount of emission rights (European Union Allowances (EUAs), each of which represents 1 tonne of CO_2-equivalent emissions) to affected companies. Every year, these companies then need to hand in a sufficient amount of EUAs to cover their emissions for that year or pay a fine of €100 per tonne. Companies can save (or 'bank') unused credits for future years or buy and sell extra credits on the market. Following the so-called 'linking directive' (EC, 2004), they are also allowed to use a limited amount of emission rights from the Kyoto Protocol's offsetting mechanisms within the EU ETS. In parallel with the US SO_2 trading scheme, the implementation of the EU ETS was divided into three phases: a first pilot phase (2005-2007), a second phase corresponding to the Kyoto commitment period (2008-2012), and the current third phase (2013-2020) (Bailey, 2010; EC, 2003). This allowed a gradual yet swift roll-out of the scheme while enabling the Commission to adjust the design and targets as needed, reinforcing the idea that the EU ETS can be seen as some kind of real-life experiment (Callon, 2009).

To say that the implementation of the EU ETS has not gone smoothly would be an understatement. Major difficulties and controversies have transpired over the years, the nature of which is hotly contested by critics and market proponents. It is generally agreed, though, that the scheme is facing a number of challenges that if unresolved threaten to undermine its key claim to environmental effectiveness, a situation that even the European Commission acknowledges (EC, 2012c). This problem is most apparent in the estimated market surplus of some 2 billion allowances, which essentially means that there is currently no incentive for most companies under the scheme to make any emission reductions at all. This situation is the legacy of a significant over-allocation of EUAs during Phase I, and of countries' overly optimistic estimations of business-as-usual emissions prior to the 2008 financial crisis, which all but rendered estimated growth trends and future emission projections meaningless (Morris, 2012). Contributing to this is the disproportional use of the Kyoto Protocol's offsetting mechanisms in recent years, which has limited the need for domestic action and effectively aided companies in circumventing the EU-level emissions cap (Elsworth et al., 2012). Aside from this, the EU ETS has in the past been criticized for prioritizing industrial interests, exemplified by the practice of 'grandfathering' – a distributional principle favoring key industrial actors – and for a failure to implement EUA auctioning as the standard form of allocation (Lohmann, 2006a). Governments' extensive use of free credit allocation in the first two phases meant that several companies were able to reap windfall profits simply by selling their surpluses on the market or passing on non-existent costs to consumers (Gilbertson & Reyes, 2009; Koch, 2012; Morris, 2012, 2013; Pearson & Worthington, 2009; Reyes, 2011; Sandbag, 2012). These different problems are reflected in the history of the EUA market price, which has oscillated between almost zero in 2007 and close to €30 in 2008 and has in more recent times been stuck around the €5 mark, far below the level that analysts say is needed to provide an unambiguous ‘price signal’ to renewable energy investors (Boasson & Wettestad, 2013; Bond, 2011; Ellerman & Joskow, 2008).

Many of these shortcomings persist despite continuous reconfiguration attempts by the Commission. At the start of the current Phase III, a number of revisions were introduced to improve EU ETS governance and create a greater sense of predictability about the future direction of the scheme. Volatility and regulatory uncertainty had been a constant source of frustration for many companies, who argued they could not make sound investment decisions when policy makers kept changing the conditions of the carbon market. In the process, the EU ETS has shifted from being a fairly decentralized system that left substantial leverage to member states, to one in which decision making power is centralized at the level of the European Commission (Ellerman et al., 2010; Skjærseth & Wettestad, 2009). Concretely, these changes included the creation of a common EUA registry (instead of separate national registries), stricter rules on the use of Kyoto offsetting credits within the EU ETS, a gradual move towards auctioning as the default form of allocation, and the implementation of the annually-declining emissions cap (EC, 2009). In an attempt to deal with persistently low EUA prices, the Commission also decided to temporarily withhold some 900 million credits from the market – so-called ‘backloading’, a measure that is expected to strengthen the market in the short term (EC, 2013c; Out-Law.com, 2013a). As a (supposedly) long-term solution, meanwhile, the EU ETS will see the establishment of a ‘market stability reserve’ as of 2018, a mechanisms that will automatically adjust the amount of EUAs that enter the market depending on the existing level of surplus (EC, 2014). To reflect the EU’s recent commitment to reduce emissions by 40% by 2030, further changes to the pace of emission cuts and the method of allocation are expected for the proposed Phase IV (2021-2030) of the ETS (European Council, 2014).

The Flemish TGC scheme

The second case analyzed in this dissertation is the Flemish tradable green certificate scheme, a regional example of a commonly used incentive system for renewable energy production. TGC schemes are fairly common both in Europe and the United States, where they are better known as ‘renewable energy certificate’ markets. They are meant to increase the share of renewable energy-sourced electricity in the overall energy supply by treating the benefits of renewable energy production as a positive externality. In a sense the mechanism at work here is the mirror opposite of that of an ETS. Whereas carbon pricing instruments increase the costs associated with fossil fuel combustion, a TGC system attaches a financial reward to the social and environmental benefits of low-carbon technologies. Generally speaking, this means that a regulatory body decides on an annual renewable energy quota that *electricity distributors* must meet – say 20% of total electricity production by 2020 – and then hands out tradable green certificates to all *producers* of electricity from eligible renewable energy sources.[5] Governments in this way actively construct a market by creating the demand for renewable energy (by setting a yearly renewable energy quota on electricity distribution) and inventing the commodity (TGC credits) that is able to fill that demand. Electricity distributers are then supposed to meet their yearly quota by purchasing certificates from producers (Nielsen & Jeppesen, 2003; Verhaegen et al., 2009). Raising the total quota every year, meanwhile, guarantees that the demand for renewable energy gradually increases. A TGC system is thereby similar to an ETS in that both are quota-based systems in which the initial demand (for renewable energy/emission rights) is created by a public institution but pricing is left to the market and affected companies are largely at liberty to decide themselves how their quota will be filled. This is at the same time also the main difference between a TGC system and the main alternative support system for renewable energy, a feed-in tariff (FIT), which operates with fixed subsidy prices but leaves governments with little leverage over the amount of renewable energy that will be produced (Jaraitė & Kažukauskas, 2013).

The Flemish government decided to introduce a TGC system in 2002 as a way to dramatically increase the share of renewable energy in its power sector. At that time, Flanders, and Belgium as a whole, were significantly lagging behind the rest of Europe with respect to renewable energy production. As late as 2001, a mere 0.7% of the country's electricity came from renewable energy, the rest being provided by nearly equal shares of nuclear power and fossil fuel-fired (primarily natural gas) installations. EU regulation in 2001 required the Belgian government to step up its efforts and increase this share to 6% by 2010 and, later, as part of its commitments

[5] In practice, this picture is complicated by the fact that in some instances, the electricity distributor and the electricity producer are one and the same company.

under the Belgian Renewable Energy Action Plan (NREAP), to 20.9% by 2020 (Belgian Government, 2009; EC, 2001). For Flanders, the implementation of a TGC mechanism became the main instrument through which these objectives would be achieved.

Initially, the Flemish government awarded 1 TGC for every 1000 kWh of electricity produced through any of the eligible technologies, which included on-shore wind energy; water, wave, and tidal power; biogas and biomass combustion; and solar energy installations. This meant that all technologies received the same amount of support, irrespective of differences in actual construction or operation costs. The resulting commensurability of different technological alternatives under a single support system is seen as one of the main benefits of a TGC system and was heralded by the Flemish government as a convenient way to steer the market towards the most cost-effective choices (VREG, 2011). A non-compliance penalty was established (which sets a de facto maximum TGC price) but other than that certificate pricing was left entirely to the market. Fairly quickly though, the government realized that some kind of price guarantee would be necessary in order to create a secure investment climate for potential energy producers. In 2004 it therefore decided to introduce minimum prices for different technology groups. These minimum prices differed only slightly between technologies, except for solar power, for which the minimum price was set at €450, far above the then-market price of €100 - €110 (Vlaams Parlement, 2009; VREG, 2014). This *de facto* decoupled the support for solar power from the rest of the TGC market and instituted a guaranteed subsidy for this technology. Over the years, as technology costs for photovoltaic panels fell, support levels proved out of proportion with actual construction costs and as of 2009 minimum prices for solar power were rapidly brought down (Vlaams Parlement, 2009; VREG, 2016).

Much like the EU ETS, the Flemish TGC system has faced a number of difficulties and controversies. In parallel with the European scheme, it has generated windfall profits for incumbent electricity producers, thereby negating the polluter-pays principle and resulting in a regressive distribution of policy benefits. The TGC scheme's environmental effectiveness is believed to have suffered from the lack of a long-term political vision and the disproportionate use of waste-processing for the generation of bio-energy, at the cost of investments in more sustainable technologies (Verbruggen & Lauber, 2012; Verbruggen, 2009). As explored in detail in Article II, these concerns can be extended to the use of biomass in old coal power plants, which for some time constituted the majority of awarded TGCs. The use of this technology provided a way for incumbent electricity producers such as Electrabel to valorize existing infrastructure, yet brought on the ire of environmental organizations, who were outraged by the idea that renewable energy policies were benefiting coal power operators.

Just as with the EU ETS, also, the continuous problems and challenges faced by the Flemish TGC system have over the years forced significant changes to the TGC's policy framework. The scheme has evolved from being a 'pure' TGC system in which all technologies were treated equally and pricing was left entirely to the market, to what the Flemish energy regulator (VREG) calls a 'hybrid' support system mixing elements of a TGC market with that of a FIT system (2011). After introducing minimum prices in 2004, the Flemish government changed them again in 2009 and at the same time also halved the amount of certificates awarded for the co-firing of biomass in coal power plants. The amount of certificates awarded to fully-converted plants was reduced to 70%, though an exception was granted for Max Green, the region's largest biomass plant (Greenpeace Belgium, 2012). In 2013, the government introduced technology banding, implying that the amount of certificates that producers receive per 1000 kWh now depends on the kind of technology that is being used. This marks an attempt to hold on to a uniform TGC market while still taking account of the widely differing costs that renewable energy technologies incur.

Trees for Global Benefits

Whereas both the Flemish TGC and the EU ETS are quota-based market mechanisms, the third case – Trees for Global Benefits (TFGB) – is rather different. TFGB is an example of a forestry-based carbon offsetting scheme, an increasingly popular method by which countries, companies and individuals compensate for (or 'offset') their own GHG emissions by investing in purportedly carbon-saving activities – mostly, though not exclusively, in the developing world. The main idea behind offsetting is fairly straightforward and in fact goes back to the first experiments with emissions trading in the US in the late 1970s (Lane, 2012; Lohmann, 2006a). To mitigate climate change, the argument goes, it does not really matter where carbon-saving actions occur or what form they take, as long as the result is an overall, global reduction in GHG concentrations. Since mitigation tends to be more expensive and more difficult to achieve in industrialized countries, it makes economic sense to 'outsource' mitigation obligations to developing countries, where emission reductions can be achieved more cheaply and have the added benefit of contributing to broader sustainable development goals (Leach & Scoones, 2015a). This, indeed, is the logic of globalization applied to climate change policy: reduce the costs of emission reduction by taking advantage of differences in income levels between industrialized and developing countries. The alleged result is a win-win situation for everyone. Global emission increases are prevented, while developing countries receive the fringe benefits associated with investments in renewable energy projects or reforestation (Nel & Hill, 2014; Pattanayak et al., 2010).

There are a number of different offsetting schemes operational today, working at different levels and with slightly different objectives. Some of the best-known examples include the two Kyoto Protocol mechanisms mentioned above, the Clean Development Mechanism and Joint Implementation. The CDM in particular has been well-documented. It is widely used by industrialized countries seeking to meet their UNFCCC emission reduction targets and by companies in need of reducing their emissions under the EU ETS. Project applications are handled by the CDM secretariat, with project approval involving a laborious, slow and often expensive process through which applicants need to demonstrate the project's overall social and environmental integrity (Arhin & Atela, 2015; MacKenzie, 2009). In part because of the administrative burden involved, CDM projects are for the most part situated in China and India, rather than in the poorest countries, as was the mechanism's original intention (UNFCCC, 2016). Projects can cover a range of different activities, from the construction of renewable energy facilities to waste management and the destruction of waste greenhouse gases such as HFC-23 and N_2O. Measured in terms of produced credits, industrial waste gas destruction has been the most important sector in the CDM, while renewable energy investments account for the largest number of projects. The CDM currently allows afforestation and reforestation (A/R) activities, but not projects that aim to reduce emissions from deforestation and forest degradation, or those that claim to increase carbon stocks through forest management (together known as REDD+), which has been a constant source of debate in international negotiations. A/R projects tend to be a minor component of the CDM market, accounting for just 0.8% of all projects in 2016 (Corbera & Friedli, 2012; UNEP DTU Centre, 2016). Aside from these official offset markets however, there is also an informal or voluntary carbon market (VCM), which mostly targets individual consumers and businesses seeking to improve their green credentials. Here, forestry projects (including REDD+) make up a far larger proportion of the market, accounting for up to one third of all projects. Since 2013 they have been the single most popular offsetting activity (Arhin & Atela, 2015; Ecosystem Marketplace, 2015).

Trees for Global Benefits is an example of such a VCM forestry project. It was established in 2003 by a local NGO (Ecotrust) and is situated along the Albertine Rift in western Uganda. Launched as a pilot project in the (former)[6] districts of Bushenyi, Rukunguri and Kasese, it has since expanded to Hoima, Masindi, and, most recently, the Mt. Elgon region in the east of the country. The project has over the years received funding and technical support from a number of organizations, including USAID, the British Department for International Development (DFID), CARE International, and the World Agroforestry Center (ICRAF) (Ecotrust, 2009). TFGB is often heralded as a successful example of sustainable carbon offsetting and in 2013 won the UN SEED award for its "entrepreneurship in sustainable development" (SEED, 2013). As a so-called 'community-based' offsetting project, it incentivizes smallholder farmers to take on tree-planting as an extra income activity and claims carbon offsets as an outcome of that. These offsets are then sold to interested buyers in the global North, including Swedish companies like Arla, Tetra Pak, U&We (a carbon broker), Arvid Nordquist, and Max Hamburgare, who use them to compensate for the greenhouse gases emitted during their own production processes (Ecotrust, 2013). The 'carbon farmers' themselves enter into a 25-year contract with one of these buyers through Ecotrust. These contracts specify the amount of trees they need to plant within a certain area (usually 400/ha) and the timeframe within which this needs to happen. The details of this process are specified in Article IV (see also Peskett et al., 2011).

Like other community-based projects, TFGB aims to provide a viable alternative to the oft-criticized, large-scale plantations upon which much forestry-based offsetting relies (Boyd et al., 2007). Industrial tree plantations commonly make use of monoculture stands of exotic tree species like eucalyptus and pine that are fast-growing but also have very high water requirements and are deemed to reduce local biodiversity. They

[6] As a consequence of an administrative reform in 2010, some Ugandan districts have since been broken up into smaller units. Those parts of Bushenyi where fieldwork for Article IV took place are now part of Mitooma district.

are often criticized for their neglect of the socioeconomic implications of tree plantation and have in the past been associated with land-grabbing, forced evictions and conflicts with local communities over access to land and forest resources (Böhm & Dabhi, 2009; Cabello & Gilbertson, 2012; Cavanagh & Benjaminsen, 2014; Lang & Byakola, 2006; Leach & Scoones, 2015a; Lyons & Westoby, 2014a, 2014b; Nel & Hill, 2014). TFGB aims to sidestep these controversies by adopting a small-scale, participatory approach that attaches a number of environmental and community benefits to its offsetting activities. In particular it claims to reduce deforestation and contribute to biodiversity conservation by incentivizing tree cultivation in areas neighboring national parks and by promoting the exclusive use of indigenous species. Ecotrust also argues that its trees provide fuelwood and construction material for local household use and that, by incentivizing the planting of fruit trees or species valued for the quality of their wood, the project is a source of much-needed income diversification (Ecotrust, 2009; Plan Vivo, 2014). The available literature on TFGB however highlights that these purported benefits are anything but self-evident. Concerns have been raised with respect to the exclusive focus on economic incentives to encourage farmer involvement, and with the equity outcomes of the project, i.e. the way that project benefits are distributed between community members (Fisher, 2012; Schreckenberg et al., 2013). It has also been argued that some of the assumptions reflected in the project design, such as the belief that farmers will maintain their plantations for an average of 15 years after initial payments have ceased, as is stipulated in their contracts, are questionable (Peskett et al., 2011). Article IV of this thesis provides an additional layer of critique, the main tenet of which is synthesized in chapter five.

Apart from this, there are a number of broader critiques against offsetting that are relevant to the critique of TFGB as well. Two of them can be mentioned here (see also Böhm & Dabhi, 2009; Gilbertson & Reyes, 2009; Leach & Scoones, 2015a). The first is an ethical concern that puts in question the morality of displacing the burden of climate change mitigation to some of the world's poorest communities, while giving the richest countries – and those most responsible for climate change – the opportunity to avoid taking action themselves (Bumpus & Liverman, 2008; Cabello & Gilbertson, 2012; Caney, 2010; Hyams & Fawcett, 2013). Once the win-win narratives that underpin market-based environmental policies are questioned, as many critics evidently do, outsourcing climate change mitigation activities seems hard to justify. The second concern pertains to the environmental outcomes of project activities, and particularly the ability of offsetting projects to guarantee that carbon credits represent real carbon reductions. More often than not, the actual carbon savings that projects generate are difficult if not impossible to determine, due to concerns over offset permanence, leakage, additionality,… (Galik & Jackson, 2009; Leach & Scoones, 2015a; Sedjo & Macauley, 2012; Spash, 2010). For example, in order to be environmentally sound, an offset project needs to show that it is 'additional' to any emission savings that in the absence of the project (that is, without the funding produced through the sale of offsets) would have happened anyway. Few projects can meet this requirement, not in the least because proving additionality usually involves the creation of counterfactual emission scenarios that inevitably are highly subjective (Lohmann, 2011a). For offsets included in the EU ETS for example, the advocacy group Sandbag (2013) has calculated that there are "significant additionality concerns" (p. 39) for all but 7.4% of offset credits on the market, implying that the emission reduction claims of the vast majority of projects are problematic. These concerns clearly cast a long shadow on the very logic behind carbon offsetting as a viable climate mitigation strategy.

3. Theoretical framework

> *The neoliberalization of socio-nature must [...] be understood as, simultaneously, a disciplinary mode of regulation, and an emergent regime of accumulation that redefines and co-constitutes socio-natures.*
>
> *(Karen Bakker, 2010, pp. 726–727)*

On the choice of concepts

The three cases give concrete expression to an increasing societal trend to base environmental regulation in market-oriented forms of valuation, measurement and governance. In analyzing this mode of climate and energy policy, I have made use of theoretical concepts associated with the fields of critical and environmental geography. For the purpose of the discussion here, I will group these concepts together under the header of the 'commodification literature', even though I recognize that the boundaries of this grouping are fluid and diverging opinions exist about what does and does not constitute commodification (Bakker, 2005; Castree, 2003; Prudham, 2009). In fact, many of the texts cited here situate themselves within a loosely defined 'neoliberal(izing) natures' literature, which is commonly conflated with a focus on commodification and is constituted by boundaries that, if anything, are even more fluid (Castree, 2010b; Fairhead et al., 2012). While one could legitimately frame the diffusion of market-based mechanisms as a form of neoliberalization, as indeed many scholars have done (Arsel & Büscher, 2012; Bailey & Maresh, 2009; Bailey, 2007b; Castree, 2010a; Fairhead et al., 2012; Felli, 2015; Lohmann, 2006b, 2011b; Mansfield, 2004; Nel & Hill, 2014; Osborne, 2015; Pawliczek & Sullivan, 2011; Robertson, 2004), I have here chosen to focus on the concept of commodification instead. Primarily, this is because discussions on the neoliberalization of nature tend to be much broader than the topics that I am primarily concerned with here. In my reading, an analytical engagement with the neoliberalization concept necessarily involves close attention to questions of ownership and distribution, social and environmental justice, governance, etc., that are simply not the main focus of this thesis, notwithstanding their key importance for understanding the political economy of market environmentalism. As specified earlier, this thesis first and foremost aims to scrutinize the way in which carbon is made (or attempted to be made) into a commodity and the implications this process has in direct environmental terms. Even if these environmental concerns only make sense in specific socioeconomic contexts (and are therefore fundamentally social concerns as well), the point is that their political and distributive implications are only indirectly addressed in this thesis. I am convinced that this narrower objective is more fruitfully served by the application of a commodification framework than through the much wider concept of neoliberalization. Moreover, over the course of my research I have become increasingly interested in the materiality of nature/carbon, which I believe is a perspective that can be accommodated for somewhat more directly within the commodification idea. I elaborate on this particular aspect below. That being said, to the extent that the commodification of nature can be seen as an integral part of its ongoing neoliberalization, the findings of this thesis should be consistent with a framing of market-based climate policy as a fundamentally neoliberal process.

In this chapter I clarify my understanding of the theoretical concepts that I have used and elucidate how these concepts underpin the various arguments presented in the articles. To start with, I give a brief historical background to the commodification argument.

The commodity as a concept

To elucidate the relevance of commodification as a theoretical concept, it is useful to start from its historical origin in Marxist critique and some of the assumptions made therein. In *Capital*, Marx (1977) famously begins his analysis with a discussion of the commodity as one of the structuring principles of capitalism. Whereas, he argues, the circulation of commodities in pre-capitalist times can be represented in the format Commodity-Money-Commodity (C-M-C), denoting a system in which money functions as a mere facilitating instrument in the trading of goods on the market, exchange under capitalism is regulated by the relationship M-C-M', where M' > M, indicating that a surplus has been created in the process. In this latter system, the commodity becomes the intermediary stage in the accumulation of money as an end in itself, and as such assumes a form subordinated to the logic of production-for-profit rather than, as was the case before, production-for-use (Marx, 1977). Marx's discussion thereby underscores the importance of a historically specific focus on the commodity, affirming its socially constructed nature, i.e. as a thing that derives its form, meaning and function from the way the socioeconomic system is ordered, while itself also contributing to the reproduction of that order.

The commodity, then, is a key feature of Marxist understandings of the dynamics of capitalism, and as part of Marx's broader conceptual framework becomes a useful tool for criticizing those dynamics. Marx identifies a number of tensions and contradictions that emerge from capitalist commodity production, most famously pertaining to the ownership of the means of production and the specific class relations that arise because of this. It is unnecessary to delve into much detail here (but see Harvey, 2007); for the sake of this overview, it is sufficient to note that the Marxist critique of commodity production is partly grounded in a distinction between two of the commodity's interrelated elements: use value and exchange value, respectively the function that commodities fulfil to meet a social need, and their interchangeability (and mutual commensurability) against a common denominator (money), which enables them to function as vehicles for the accumulation of capital. These two aspects of capitalist value creation don't enter into the commodity on equal terms, however, since the circulation of capital dictates the domination of exchange value over use value, in effect prioritising the commodity's quantitative aspects over its qualitative sides (Best, 1994; Koch, 2012). Exactly *what* is produced under capitalism plays a secondary role to the idea that more value constantly needs to be created, a concern most directly represented in the incessant quest for economic growth. It is exactly this necessary reduction of the commodity to its monetary value, i.e. the abstraction from its social, political, ecological and irreducibly material character in order to enable market exchange, that lies at the basis of the commodification critique described below (and, I should add, of this dissertation's general argument). Indeed, these contemporary critiques are to some extent foreshadowed in Marx's problematization of money and his discussions of commodity fetishism, or the tendency for commodities to "appear as autonomous figures endowed with a life of their own" (Marx, 1977, p. 165) because of the alienating power of exchange value, thereby obscuring the specific social relations that operate through them.

This conceptualization of the commodity is rendered somewhat more complex when introducing Polanyi's notion of the 'fictitious commodity' into the equation. Marx's (1977) value theory notoriously states that only human labour produces economic value, implying that a 'thing' becomes a commodity only when it is created through a capitalist labour process. As Polanyi (2001) however notes, there are a number of factors in the production process that clearly do not fulfil this criteria, despite the fact that they are commonly treated as commodities. Land, labour and money are the examples he puts forward, whereby the category of land is considered a stand-in for nature more broadly. A corollary to this argument can be found in Harvey (2007)'s close reading of Marx, when he states that

> Objects that are not products of human labour (land being one example mentioned) are capable of being offered for sale by their holders and thus acquiring through their price the form of commodities. Commodities that are products of human labour must be distinguished then from 'commodity forms', which have a price but no value (p.18).

This raises a number of interesting questions with respect to the Marxist conceptualization of labour, production, the productive role of nature, etc. that I will not pretend to address here. Strictly speaking though, Polanyi's (and Harvey's) distinction between 'proper' commodities and fictitious ones appears to have consequences for the idea that the *production* of commodities marks a strategic moment in the pursuit of capital accumulation. It suggests that 'nature-based' commodities are not in fact commodities at all and therefore, in a Marxist sense, do not contribute to the creation of surplus value. Felli (2014) indeed makes this argument with respect to emissions rights and concludes that, as a fictitious commodity, these should rather be seen as a form of 'climate rent', in analogy with Marx's theorizations on land rent. The ultimate objective of emissions trading, Felli argues, is not the accumulation of new forms of capital, but the resolution of a potential contradiction between the accumulation of capital and its ecological conditions of production. While it might be true that emissions rights (also) fulfill this function (see also Article I), it is worth noting that Polanyi's distinction between 'real' and 'fictitious' commodities can itself be questioned (Christophers, 2016), and probably should be if we set out to overcome dualist conceptualizations of the nature/society relationship (cf. Bakker & Bridge, 2006; Bakker, 2010; Demeritt, 2002; Moore, 2010, 2011, 2014).[7]

More generally also, I do not think that Felli (2014)'s argument, or any other rigid interpretation of the fictitious/real commodity division, necessarily contradicts the use of the term 'commodification' as it has been applied in much of the literature. Indeed, as Polanyi (2001) argued, and as Harvey's above argument shows, fictitious commodities do take on the commodity *form*, meaning that in important ways they are treated exactly as 'ordinary' commodities are, which indeed is the whole point of their 'fictitious' character and implies that much of the same socioeconomic processes work upon both categories. When we define commodification in a broader sense, then, as the creation of the commodity form for the circulation *and* production of value, or if we recognize that, to some degree, *all* commodities are fictitious commodities, in that their commodification is by necessity an imperfect and incomplete process that incorporates elements not fully circumscribed by capitalist production (see below), then the application of the term to Polanyi's fictitious commodities seems entirely reasonable. I therefore believe the fictitious commodity idea is consistent with the conceptualization of commodification in much of the recent literature, to which I turn now.

Commodifying natures

Commodification, then, can generally be understood as the process by which commodities, as a socioeconomic form, are created, i.e. the process by which "qualitatively distinct things are rendered equivalent and saleable through the medium of money" (Castree, 2003, p. 278). On a more general level, the term is employed to capture a broader societal trend, reflected in

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[7] For example, it would seem that a more 'hybrid' (cf. Whatmore, 2002) understanding of both nature and human labour negates the possibility of a clear distinction between 'fictitious' and 'proper' commodities. Smith's (2008) 'production of nature' thesis effectively shows how nature is in fact, to a very large extent, socially produced, even when it understates the active role of nature in shaping that process. Nor is the social and ecological meaning of 'proper' commodities as easily subsumed to the market framework as Polanyi appears to suggest.

concepts such as the 'commodification of nature'. Commodification in this broader sense can be defined, as Prudham (2009) puts it, as

> [those] interlinked processes whereby production for use is systematically displaced by production for exchange; social consumption and reproduction increasingly relies on purchased commodities; new classes of goods and services are made available in the commodity form; and money plays an increasing role in mediating exchange as a common currency of value. (p. 125)

It follows that commodification entails an increasing role for market institutions in the distribution and management of goods and services. Not only are these goods and services rendered exchangeable, their valuation as well as the socioeconomic meaning that is attached to them becomes determined primarily through market forces (Bakker, 2005).

Exactly what is included in this process, however, is open for discussion. Castree (2003) for example puts forward a typology of commodification that distinguishes between different yet highly interrelated moments of privatization, alienation, individuation, abstraction, valuation and displacement, while for Bakker (2005) commodification is itself quite distinct from privatization and commercialization. For the purpose of my argument, what matters most are not these subtle disagreements on the content of the term but the insight that commodification is a "complex, polymorphous process" (Castree, 2003, p. 283) that can be analysed from a multitude of perspectives. This makes the concept well-suited for examining the multilayered intricacies of market-based climate governance (Osborne, 2015).

In engaging with the commodification of carbon under the three policy instruments outlined above, I have for the most part been occupied with one particular aspect of it, roughly what Castree terms the moment of abstraction, and what I have referred to in some of the articles as the process of commensuration. This is because abstraction/commensuration is foundational to the claim that MBMs make to economic efficiency, which, as I explore in more detail in Articles II and III, has direct and specific environmental implications.[8] Abstraction, Castree (2003) writes, is the "process whereby the qualitative specificity of any individualized thing (a

[8] For an exploration of other moments in the commodification of carbon, notably privatization, individuation and valuation, see for example Osborne (2015).

person, a seed, a gene or what-have-you) is assimilated to the qualitative homogeneity of a broader type or process" (p. 281). One could alternatively describe it as the imperative to standardize goods and services in order to produce fungibility, a key requirement for creating a functioning commodity market (Fairhead et al., 2012). In a factory setting, this objective is to a large degree (though never completely) achieved through the physical production of highly uniform goods. Outside of that, however, it usually requires a degree of selective blindness to the natural variability that exists between, say, individual trees within the same species, or one kilogram of wheat produced by a farmer in one place, and that produced by another farmer somewhere else (Cronon, 1992; Scott, 1999). That being said, the commodification of nature clearly also involves forms of differentiation, as in the emergence of distinct 'Walmart' and 'boutique' carbon offsets in order to cater to different audiences (Paterson & Stripple, 2012), or in the historical construction of different grades of wheat (Cronon, 1992). Abstraction *within* individual commodity categories is thereby accompanied by a proliferation of such categories in order to fulfil (and create) subtly different social needs. While relevant in its own right, this thesis has not dealt with the process of commodity differentiation but exclusively examines the abstractions necessary to create a commodity in the first place.

We can moreover distinguish between different forms of abstraction. Lohmann (2011a, 2011b) provides a useful example of this for the case of emissions trading. Carbon markets, he argues, rely on the creation of equivalence between emissions from vastly different processes and origins and thus divorce greenhouse gas emissions from the social and biophysical contexts within which they are actually embedded. The EU ETS, for example, commensurates different technologies from wide-ranging spatial and temporal settings with one another in order to create an EU-wide trading scheme. Emissions from, say, a coal power plant in Germany are thereby rendered the same as the emissions from a cement-producing facility in Spain, while the inclusion of carbon offsets in the EU ETS guarantees that both are exchangeable against 'avoided emissions' generated through the CDM. On the VCM meanwhile, emissions from a range of activities in the global North are commonly treated as equivalent to the emissions from deforesting tropical rainforests in the global South. Underpinning the functioning of these different MBMs, in other words, is a multiplicity of simultaneous abstractions: geographical (equating emissions from different locations); temporal (equating present emission reductions with future offsets); technological (between different technologies);

chemical (conflation of different greenhouse gases under the tCO_2e category[9]); ecological (equating emissions from biotic and fossil fuel sources), etc. (Bumpus, 2011; Lohmann, 2011a; MacKenzie, 2009; Robertson, 2000).

Once it has been established that processes of abstraction are internal to the creation of commodities, a key question becomes what work these abstractions perform and what their implications are (Robertson, 2012). For many of its critics, the ongoing commodification of nature represents a capitalist dynamic that is inherently contradictory to the objective of a more sustainable future (Foster, 2011; O'Connor, 1997; Polanyi, 2001; Smith, 2006; Stroshane, 1997). Lohmann (2011a), for example, frames the many difficulties that market-based schemes have encountered as a natural outcome of the dynamics of commodification. "In order to be 'internalized'", he writes, "environmental harms of any complexity must be simplified, reformatted, made abstract, quantifiable, and transferrable in a process that obscures many of their characteristics while introducing fresh problems" (p. 112). The commodification of carbon, through the need it creates for abstract and fungible economic categories, is here rendered responsible for the creation of ever new externalities. At the same time however, we should be wary of totalizing conclusions about commodification outcomes. As Bakker (2005) argues for the neoliberalization of water management in England and Wales, critical engagements with market environmentalism need to take seriously their fundamental "ambiguity and potentiality" and recognize that the neoliberalization of nature is "constituted by (and constitutive of) processes of reregulation that may result in improvements in environmental quality" (p. 560). The social and environmental implications of market-based policies will always be contingent on the socioeconomic and ecological contexts in which they are implemented, making it all the more important to understand the reasons behind specific outcomes, when they do occur (Fairhead et al., 2012). In a way, then, this dissertation engages with the arguments of Lohmann and others by scrutinizing the generation of specific commodification outcomes under market-based climate and energy policy.

9 tCO_2e, or tonnes of carbon dioxide equivalent, are a common measure used in carbon markets to express the combined emissions of various greenhouse gases, expressed as a function of CO_2 emissions. Constructing this equation requires that greenhouse gases are weighed against each other according to their differential global warming potentials (Bumpus, 2011).

By examining the dynamics underlying observed outcomes, it aims to elucidate exactly why the process of abstraction produces the outcomes that it does and whether the critique against it can be upheld. Article III on the fossil fuel landscape thus situates the problem with MBMs in the relationship between the commodification of carbon and the geographies of fossil energy use, while Article II sketches the way in which technological abstraction under the Flemish TGC scheme paved the way for the distinctly inefficient use of biomass in (former) coal power plants.

Commodity fictions

In examining how commodification is generative of specific environmental outcomes, it is important to appreciate where exactly its limits are. Fundamentally this requires attention to the "contested, partial and transient" (Bakker, 2005, p. 545) character of commodification and the fact that a commodity is not a fixed 'thing', but a social relation that is always in a state of becoming. This idea invokes Polanyi's (2001) writings on the fictitious commodity, which casts the commodification of nature as a necessarily incomplete and incompleteable process, and the commodity form as an ideological fiction that fails to fully capture the interwoven social, cultural, political and ecological character of living and non-living things. The extent to which commodification constructs different natures as successful bearers of economic value, in other words, is not a priori given but ultimately contingent on a complex process of social and ecological mediation. For Polanyi, the fictitious character of the commodity form is ultimately expressed in the contestations of people spontaneously resisting the economic reduction of complex social and ecological realities, a resistance that constitutes the basis for society's 'double movement'. With respect to the commodification of carbon, and the environmental outcomes it incurs, the crux of the matter, therefore, is to analyze carbon not as an already-existing commodity, but rather to put focus on the ongoing processes of commodity-making and the different obstacles they run into (Article I).

Moving beyond Polanyi, recent scholarship has shed light on 'the matter of nature' as one relevant perspective on (the limits to) commodification (Bakker & Bridge, 2006; Bakker, 2004, 2010; Boyd et al., 2001; Bumpus, 2011; Fairhead et al., 2012; Leach & Scoones, 2015b;

Malm, 2016; Osborne, 2015; Prudham, 2003, 2004). The implicit objective of this literature is to move away from the anthropocentric and dualist framings that have long characterized invocations of the 'construction' or 'production' of nature and attend to the many ways in which the biophysical properties of nature matter for how social processes unfold (Bakker & Bridge, 2006). Apart from recognizing that commodity production is ultimately the "production of exchange-value through nature, with nature being precisely a substratum" (Malm, 2016, p. 283), this literature highlights "how the different materialities of resources may be sources of unpredictability, unruliness and, in some cases, resistance to human intentions" (Bakker & Bridge, 2006, p. 18). Attempts at commodification, in other words, are fundamentally confronted by the fact that nature "possesses an irreducible autonomy" (Malm, 2016, p. 312), hence that its biophysical characteristics have socioeconomic and political consequences (Hornborg, 2016). Nature for this reason might 'resist' attempts to fit it within the restrictive boundaries of capital accumulation and subordinate its irreducible complexity to a predominantly quantitative logic. Bakker (2005) for example shows how the geographies of water as a "life-giving, continually circulating, scale-linking resource" (p. 559) rendered it an 'uncooperative commodity' in England and Wales, essentially resisting its successful commodification. Similarly, Prudham's (2003) engagement with tree cultivation in western Oregon and Washington demonstrates how the biophysical characteristics of the Douglas fir helped shape the organization of forestry in this region and essentially created obstacles to the kind of economic rationalization observed in other sectors. Specifically for carbon, Bumpus (2011) has examined how the materiality of different offsetting technologies plays a central role in determining the stability of the resulting carbon commodity.

For Boyd et al. (2001), the materiality of nature enters the analytical framework by way of a discussion of the real and the formal subsumption of nature, a distinction that largely hinges on the differences between biological and extractive industrial sectors. Using this framework, they explore the multiple and often contradictory ways in which nature enters into capitalist production, that is, both in terms of the obstacles that materiality poses for accumulation, and the subsequent opportunities that accrue to firms able to overcome those obstacles. While their focus has been criticized for reproducing the society/nature dualism that others have problematized (Bakker & Bridge, 2006; Smith, 1996, 2006), it performs useful work in highlighting the material dimensions of capitalist production as a factor to contend with. In Article IV, we put forward a constructive critique of Boyd et al.'s (2001) thesis in order to frame the analysis of the TFGB project in Uganda, and to explore the benefits this approach holds for an understanding of carbon offsetting.

Together then, the commodification framework allows a comprehensive and careful analysis of the proliferation of market environmentalism. It frames MBMs as a specific instance of commodity creation, a process that involves the subordination of environmental regulation to an exchange value relationship, and as such is useful for understanding the inherent abstractions, limitations and complexities involved, including with respect to environmental outcomes. While the literature primarily attends to the political economy of commodification, recent interventions in the field have highlighted ecological processes as key factors for understanding how commodification processes unfold, and why they do or do not succeed. My primary focus on the environmental outcomes of MBMs is in this sense well-fitted to the commodification concept and recent contributions in the field. Underlying this, meanwhile, is a commitment to historical/dialectical materialism as the philosophy of science that has informed my research approach. I briefly discuss this in the next chapter, following a brief explanation of the concrete methods and materials that have been used.

4. Methodology and philosophy of science

Whatever something is becoming – whether we know what that will be or not – is in some important respects part of what it is along with what it once was.

(Bertell Ollman, 2003, p. 65)

Research process and case selection

In choosing to present my work in the format of a compilation thesis instead of a monograph, a number of advantages and disadvantages became evident. One of these – and this could be seen as both an advantage and a disadvantage – is that with every published article the research becomes fixed in time. The compilation format in a sense provides a series of snapshots taken along the way, a sequence of momentary recordings of the thesis process rather than a fully coherent work brought together at the end of the project. For me, this means that in this final text I need to relate to an article (I) from 2014, even though my thoughts on the topics it discusses have evolved considerably and that, if I were to write this article all over again, I would probably end up with a different text. Given the peculiarities of the compilation format it therefore seems useful to start this methodology section with a brief reflection on the thesis process, and why the articles ended up looking the way they did.

As mentioned in the introduction, the entry point for my research was an interest in the work of Karl Polanyi and a desire to explore his 'fictitious commodity' concept as a potential framework for analyzing emissions trading. My idea was to write a fairly theory-oriented thesis. I wanted to scrutinize Polanyi's arguments in detail, engage with the cases he discussed, and then put this material into conversation with the existing literature on emissions trading. At the time, I was only half aware of the extensive body of work on commodification and neoliberal natures, let alone the many ways in which others had made use of Polanyi's work in recent years. Article I clearly reflects this stage in my PhD process. The first draft of this text was prepared for a session on Polanyian geographies at the 2012 meeting of the Association of American Geographers (AAG) in New York, and was written in the first half year after I started my research. While the text was reworked considerably prior to its publication, the general outline and argument of Article I still mirrors my initial focus on Polanyian concepts.

A number of developments led me to broaden the scope of my research in some ways, while narrowing it in others. My initial case study was the EU ETS, which I had chosen because it was, and still is, the largest operating emissions trading scheme anywhere and because it played a pioneering role in the promotion of market-based climate policy both within and beyond European borders. Given my theoretical focus, moreover, I was counting on mostly using secondary data and therefore wanted a case that had already received significant attention and for which a large amount of information could easily be gathered. Yet gradually this focus on theoretical debates started to feel like a constraint, and I became increasingly concerned with finding a more empirical angle into my topic. This led me to the power sector in Flanders, Belgium. This seemed like a suitable case because Flanders, as one of the only regions in Europe, had already under phase II of the EU ETS implemented a fairly restrictive allocation model for the power industry, which meant that the effects of the EU ETS framework on this sector would be more visible/outspoken than they perhaps were in other regions or countries (Vlaamse Regering, 2007).[10]

Following Article I, my aim in adding this empirical dimension to the research project was to examine concrete cases of problem displacement and temporal moderation under the EU ETS. I knew there had been considerable political controversy over the increasing use of biomass in old coal power plants in Flanders, and saw this as an opportunity to examine the extent to which biomass promotion could be linked to incentives created

[10] Flanders was one of the only regions or countries under the EU ETS, for example, not to allocate any EUAs to coal power plants under phase II, which it did mostly because the first draft of its allocation program (which had to be approved by the European Commission) was rejected and it unexpectedly had to 'find' an extra 5m tCO2e (EC, 2007; Vlaamse Regering, 2007).

under the EU ETS. As I set out for the interviews, however, this objective quickly proved untenable. Interviewees expressed the opinion that the EU ETS was at most only of secondary importance as a driver behind the uptake of biomass combustion in coal power plants. The more significant factor appeared to be the Flemish TGC scheme. I was thus faced with the choice of either abandoning the case of the Flemish power sector and finding a case that better fitted my aims, or considerably broadening the scope of my project by taking on board an analysis of the Flemish TGC scheme. By choosing the latter option, I hoped to be able to highlight commonalities between the two cases and perhaps also draw some lessons from the Flemish experiences for the larger debates on the EU ETS.

The inclusion of the third case marks another step in the evolution of my research interests. It was guided by the desire to complement discussions of MBMs in Europe with scrutiny of the implications of those instruments in the global South, and arose out of a concrete opportunity to examine a forestry project in Uganda together with a colleague. We decided on the TFGB project because it is one of the country's oldest and best-established offsetting projects, allowing a historical perspective on its activities as well as enabling a discussion on its evolution over the years. TFGB was interesting also because a lot of the offset buyers are Swedish companies, and because it is a community-based project that has been promoted by various actors as a best-practice example (SEED, 2013). Since this dissertation is an attempt to get at the structural reasons behind the outcomes of MBMs, I wanted to engage with a project that attempted to avoid some of the common pitfalls witnessed in other offsetting projects, most notably oft-criticized, industrial, monoculture-based tree plantations (Cavanagh & Benjaminsen, 2014; Leach & Scoones, 2015a; Lyons & Westoby, 2014a, 2014b; Nel & Hill, 2014). By examining a best-practice example, I could select against the most obvious 'design' failures and instances of fraud, violence and profiteering so common in other projects (Böhm & Dabhi, 2009; Lohmann, 2009b).

As a result of this process, this research project has evolved from a single case study that placed a heavy emphasis on theorizations of the political economy of emission trading, into a multiple case study of different market-based instruments. At the same time, the theoretical component has remained important and might even have benefited from the juxtaposition of the three cases. A multiple case study method facilitates the formulation of generalizations and underlines the exploratory nature of the research (Yin, 2003), and thus the fact that I am ultimately interested in studying a larger phenomenon (the environmental outcomes of market-based mechanisms) through selected cases, rather than in providing an exhaustive description of one or more MBMs. The cases therefore in some way function as ‘critical cases’, that is, cases that are “likely to either clearly confirm or irrefutably falsify propositions and hypotheses” (Flyvbjerg, 2006, p. 231), an approach that Stake (2000) calls the ‘instrumental’ mode of case study research. This exploratory or instrumental approach is reflected in my attention to structural MBM dynamics rather than extreme events or proximate explanations of ‘market failure’.

Materials and methods

This research combines a number of qualitative methods and draws on different source materials. This approach allowed key information to be triangulated and therefore has resulted, I hope, in a deeper exploration of the research topic and more robust findings (Valentine, 2005; Yin, 2003). For the sake of structuring this section, I here want to distinguish between methods of interpretation and reasoning (i.e. analysis and theorization) and methods of data construction. With respect to the first, my work is based on an extensive and iterative literature review and a dialectical mode of inquiry that I explain in more detail in the section below. In terms of primary data collection, I have made use of both available textual data and interviews to complement and verify the written material. The exact choice of methods was driven mostly by the nature of the case, and to some degree by the theoretical framework and my stage in the research process. For the EU ETS, for example, a lot of secondary and published information was available and this ended up providing the majority of the material I needed. For the Flemish TGC and TFGB, far less has been published and interviews were therefore necessary to provide more in-depth understanding and context. In true iterative fashion, these methods in turn had an impact on the design of my research. The choice to examine the Flemish TGC as one separate case, for example, was ultimately the outcome of the interviews I conducted in Flanders. In line with Valentine’s (2005) observation that interview respondents potentially “raise issues that the interviewer may not have anticipated” (p. 111), my interviewees thus led me to the realization that the EU ETS was only a secondary factor in explaining the uptake of biomass combustion in Flanders.

A document analysis of all three market instruments was carried out. For the EU ETS this mostly concerned EU directives, green papers, and communications from the different European institutions, which are readily available online. This complemented a literature review of the various and often extensive analyses that already exist about the EU ETS. For the Flemish TGC, a wealth of useful information was found in the different commentaries, policy analysis, policy advisories and status reports published by the Flemish energy regulator, which is the institution that until recently was responsible for the management and implementation of the Flemish TGC. These documents too can be found online, though I also benefited from access to a few more informal policy documents obtained through my interviewees. The Flemish parliament publishes all of the reports from its parliamentary commissions and hearings online, which was a useful source for reconstructing the evolution of the Flemish TGC and some of the controversies surrounding it. A number of reports and promotion materials from the main electricity producers in Flanders, Electrabel/GDF Suez and E.ON, were also readily available. The analysis of the TFGB project, meanwhile, was aided by the detailed annual reports and project design documents from Ecotrust, available on the Plan Vivo website (Plan Vivo, 2016). To a limited extent, I've also made use of media reports about some of the examined cases, particularly with respect to the Flemish TGC scheme (see e.g. Article II) and TFGB.

Interviews for this dissertation were carried out on two separate occasions. My study of the Flemish power industry and its links to the EU ETS/Flemish TGC involved nine face-to-face interviews and one telephone interview with key informants from different Flemish government institutions, the electricity and biomass industries and various industry associations.[11] These interviews were carried out in March 2013 (in the case of the telephone interview) and during the course of two weeks in December 2013. All face-to-face interviews took place in Brussels in the respective offices of the respondents. Interviews were semi-structured, that is, they had "some degree of predetermined order but still ensure[d] flexibility in the way issues are addressed by the informant" (Dunn, 2005, p. 80). They were based on individual interview guides that I had prepared and shared with the interviewees beforehand, and lasted from one to two hours. All interviews were recorded. While my interview guides initially did not contain any

[11] A full list of interviewees is given in Appendix I.

questions about the Flemish TGC, I made sure to include this aspect after it was spontaneously raised as a topic of concern by the representatives from Electrabel/GDF Suez and E.ON, the electricity producers that own or owned the region's coal power plants.

Interviews for the TFGB case were conducted during two fieldwork periods in September 2014 (for one week) and February 2015 (three weeks). All in all, 62 in-depth interviews with former, current and prospective TFGB project participants were carried out. The selection of respondents was based on a combination of different sampling methods. To start off, we interviewed the local project coordinators and deputy coordinators, who acted as gatekeepers in that they had access to participant lists for their regions and readily suggested further respondents. Though this was helpful as one starting point, we did not rely on this information as our main form of participant selection. As Valentine (2005) notes, the use of gatekeepers in a context that the researcher is unfamiliar with carries the risk that s/he will be directed to a specific group of people and/or discouraged from talking to certain subsections of the target group. We perceived this as a real concern in the TFGB case, since coordinators were usually people with closer ties to Ecotrust, the organization managing the project, and in theory had an incentive to be biased in the information they shared. We therefore supplemented their input with suggestions from our local interpreter, who was acquainted with the history of the project in the region, and with snowball sampling. As a clearer picture emerged of the kind of information that we were interested in, we also used more purposive and theory-driven forms of sampling (cf Valentine, 2005). Throughout we tried to achieve a gender balance in our selection of interviewees, by seeking out single women or widows, or trying to talk to women separately from their spouses. We also consciously selected interviewees from different stages in the project, that is, both those who had been among the first to join the project, and those who joined in various stages after that.

Where possible we tried to interview participants in their gardens, so that they could show the status of their tree plantation as well as any problems they were encountering. These garden interviews proved very valuable because they allowed us to make direct observations of the plantations, ask additional questions and cross-check the information we had read in the Ecotrust documents and that we received from the farmers themselves. Interviews were guided by a list of topics or questions that we had prepared, but we made efforts to allow the interviewee to deviate from this as much as s/he wanted and narrate their own stories (cf Longhurst, 2010). Interviews generally lasted between 30 and 90 minutes and were recorded. For all the interviews we used the help of a local interpreter, who knew the region well and who himself hand no affiliation to, or personal interest in the TFGB project (cf. Smith, 2010).

Historical materialism as philosophy of science

As the theoretical framework in chapter three shows, this dissertation's starting point is situated in Marxist understandings of social and environmental relations. This particular perspective not only bears on the kind of concepts that I engage with, but is also reflected in my method of reasoning and my broader ontological and epistemological assumptions. The linkages between these different elements can be elucidated through a discussion of historical (or dialectical) materialism as the philosophy of science that frames this research. This section elucidates this point, before briefly outlining my understanding and use of dialectics in particular. Clearly, I can't do full justice to the complexity of these issues here; my discussion is meant to be illustrative within the context of my particular research focus.

Though materialist philosophy goes back to philosophers such as Democritus, Epicurus and Lucretius, its manifestation as historical materialism is closely connected to the work of Marx and Engels. Put briefly, historical materialism represents the idea that historical and social processes should be understood through an analytical engagement with the material conditions of capitalist society. As Marx (2012) puts it in his 1859 preface to 'A Contribution to the Critique of Political Economy':

> The mode of production in material life determines the general character of the social, political and spiritual processes of life. It is not the consciousness of men that determines their existence, but, on the contrary, their social existence determines their consciousness. (pp. 11–12)

The materialist component of Marx's philosophy thus asserts the "decisive primacy of the socioeconomic level over juridical, political and cultural phenomena" (Timpanaro, 1980, p. 40). As Harvey (2012) points out however, we should be wary of deriving from this some sort of productive determinism. Marx ultimately saw capitalist production as the historically specific materialization of *social relations*, that is, a dialectical relationship (see below) that is irreducible to causation by physical production practices or specific labour processes. The 'historical' in historical materialism, meanwhile, emphasizes the fundamental historicity of those relations, inherent in which is a direct critique of classical economics and the conception of economic history as "statically naturalist" (Timpanaro, 1980). In other words, while Marx asserted that social and political processes should be examined through an analysis of the material conditions of economic life, these conditions are themselves seen as produced, i.e. they are the result of a historical process and therefore always subject to change and never static.

For all his recognition of the material character of capitalist development and his deep admiration for Darwin's naturalist materialism, however, Marx never fully articulated how nature fits into this philosophical framework (Foster, 2000). As ecological concerns became more pronounced during the latter half of the 20th century, this became a consequential gap in Marxist theory. Timpanaro (1980) for example argues that Marx's failure to conceptualize the role of nature essentially reduces nature-society interactions to a relationship mediated and produced exclusively by human labour. As a particular form of anthropocentrism, this negates the countless other ways in which the 'biophysical' interacts with historically developed social relations to produce specific socioecological outcomes. Against this, Timpanaro (1980) articulates a materialist ontology that asserts

> priority of nature over 'mind', or if you like, of the physical level over the biological level, and of the biological level over the socioeconomic and cultural level; both in the sense of chronological priority […], and in the sense of the conditioning which nature still exercises on man *[sic]* and will continue to exercise at least for the foreseeable future. Cognitively therefore, the materialist maintains that experience cannot be reduced either to a production of reality by a subject […] or to reciprocal implication of a subject and object. We cannot, in other words, deny or evade the element of passivity in experience: the external situation which we do not create but which imposes itself on us. (p. 32).

In doing this, Timpanaro conceptualizes nature as at least partly external to society, an idea later criticized by Neil Smith (2008) and others for invoking an untenable dualism between nature and society. Indeed, Smith's (1996, 2008) attempt to bring nature into Marxist theory starts from an altogether different perspective. It skips past any discussions on the alleged ontological primacy of nature, and instead attends to the many ways in which nature is, and has been, materially produced and reproduced under capitalism. His thesis has proven a forceful way to study the many ways in which nature is qualitatively altered as it becomes enlisted in the accumulation of capital. At the same time however, Smith's approach to some degree risks "squeezing out any productive or generative role for ecological or biophysical processes" (Bakker & Bridge, 2006, p. 9), thereby "reverting to a monism centered on the labor process – *the* production of nature - which tends to exaggerate the transformative powers of capitalism" (Castree, 1995, p. 20). Indeed, nature emerges from Smith's work above all as a social category, rather than simultaneously also a biological, physical and ecological one, which ultimately leaves the co-productive role that nature plays in its own ongoing 'production' unexplored. The 'production of nature' idea in this way overcompensates for the kind of naturalistic and deterministic theorizations on the human-nature relationship against which it is partly a reaction.

As these examples illustrate, the character of the relationship between capitalism and nature has over the past decades spurred intense debates and become the focus of a vibrant body of theoretical literature (e.g. Benton, 1989; Burkett, 1999, 2009; Castree, 1995, 2000; Foster & Holleman, 2014; Foster et al., 2010; Foster, 2000, 1999; Grundmann, 1991; Harvey, 1993, 1996, 2009; Koch, 2012; O'Connor, 1997). If nothing else, these recent reworkings of historical materialism demonstrate that "there is, plainly, nothing anti-ecological about Marx's dialectics" (Harvey, 1993, p. 37) and that, interpreted in a non-dogmatic way, historical materialism provides an unusually fruitful basis for analyzing the society-nature relationship and its particular expression in environmental crisis such as climate change. Applied to my research focus, it allows for a research design that recognizes the socioeconomically constructed nature of market-based instruments and their environmental outcomes. At the same time, it makes it possible to examine the ecological conditions under which these policies must unfold, conditions that essentially co-determine the form these policies take as well as their social and environmental outcomes, including their potential effectiveness.

A commitment to historical materialism in this way allows us to address a key challenge for critical scholarship, namely, how to blur the line between the socially constructed categories 'nature' and 'society' without losing track of either the transformative potential of socioeconomic processes, in ecological terms, or the independent logic of biological and biophysical processes, and the social and economic implications thereof (Bakker & Bridge, 2006). In other words, it allows us to avoid casting nature as *just* a social construction at one extreme, and confusing it for an unmediated causal determinant of social phenomena on the other. In this thesis I have attempted to thread this line by thinking of the biophysical as a dynamic reality that is co-constituted by, but also fundamentally shapes and constrains socioeconomic processes. As such I believe my work reflects a commitment to an ontological realism that assumes the existence of reality independent from our (socially mediated) knowledge claims about it. Contrary to Smith (2008) and many others however, and somewhat inspired by Timpanaro (1980), I also assume a fundamental asymmetry in society-nature interactions, and therefore the existence of some kind of biophysical nature irreducible to processes of social production or construction.

Dialectics

Historical materialism cannot be understood without highlighting its commitment to dialectical thinking, or what can be described as a relational understanding of reality. Dialectics, in the words of Ollman (2003), is a system of thought that attempts to conceive "of all parts [of a system] as processes in relations of mutual dependence (p. 19). It can be employed at different analytical levels. Castree (1996) makes a useful distinction between ontological and epistemological dialectics. Ontologically, he notes, dialectics invokes the idea that reality, particularly the realities of capitalism, can be understood as a dynamic set of interrelated processes rather than a collection of clearly-delineated objects. Every part of reality is in this reading believed to be internally connected to everything else, which means that fully understanding any given social 'fact' requires an inquiry into the way it comes into being, is produced and transformed through its relation with all other parts in the system, and with the system as a whole. As Harvey (1996) describes it, "[e]lements, things, structures, and systems do not exist outside of or prior to the processes, flows, and relations that create, sustain or undermine them" (p. 49). In line with the discussion in the previous section, this necessarily includes socioecological processes, and therefore a recognition that dialectical thinking is applicable to natural as well human history (Harvey, 2012). In this ontological sense then, social and biophysical reality is itself the concrete expression of dialectical processes.

To the extent that this frames reality as a perpetual state of becoming, it conceives of change and transformation as the normal state of any system. Yet this does not imply that we should deny the existence of permanences, entities becoming temporarily fixed in time and space. There is, Harvey (2005) warns, "a serious danger of dwelling only upon the relational and lived as if the material and absolute did not matter" (p. 114), noting elsewhere that

> dialectical argumentation cannot be understood as outside of the concrete material conditions of the world in which we find ourselves; and those concrete conditions are often so set in literal concrete (at least in relation to the time and space of human action) that we must perforce acknowledge their permanence, significance, and power. (Harvey, 1996, p. 8)

This in turn has epistemological implications, since the representation of, and reflection on a complex and changing reality requires a matching conceptual framework, that is, a dialectical method. As Ollman (2003) notes, the insight that reality is fundamentally relational demands careful reflection on "where and how one draws boundaries and establishes units […] in which to think about the world" (p. 13). Importantly, with respect to the arguments of this thesis, such dialectical method therefore requires attention to the history and broader context of concrete events or everyday experiences. "Tomorrow is today extended," Ollman (2003, p. 28) writes, clarifying that

> our environment, taken as a whole, has always had a decisive limiting and determining effect on whatever went on inside it; and "today", whenever it occurs, always emerges out of what existed yesterday, including the possibilities contained therein, and always leads (and will lead), in the very same ways that it has, to what can and will take place tomorrow. (p. 3)

In other words, one cannot expect to understand the present without studying the ways in which the present has emerged from the past, nor for that matter can we make meaningful claims about the future without first deciphering the dynamics constituting the present. The significance of this insight is reflected in the importance that historical materialism attributes to the historicity of its object of analysis (capitalist relations).

In pursuing a dialectical mode of inquiry, I have attempted to make this last point a key focus in my own work. This is reflected for example in Article III, which examines the way that historical investments in the fossil fuel landscape serve to constrain the potentiality of current and future climate policies. More generally, dialectical thinking underlies the kind of analysis that I have pursued in this dissertation, highlighting as it does how 'things', such as MBMs, are more than they seem; that analytical categories need to be understood as relational categories, entirely part of, and conditioned by existing contexts, which often, indeed, can be very real, material, and absolute. My use of "conditioning", here and in the articles, hints at a restraining or determining role of existing social and ecological relations, that is, of the limitations that these existing relations place on the potentialities of social and environmental change (Ollman, 2003). This is meant in the dialectical way described above, rather than in any causal sense. The point I aim to make in the articles is that the materiality of reality (fossil fuel capitalism), as an expression of certain socioecological relations, in a very real sense shapes and delineates processes of socioecological change (decarbonization through commodification), and that this is a concern worth elaborating in more detail. Indeed, the need to analyze the power of social and ecological contexts – historical as well as contemporary ones – is one of the foundational assumptions underpinning this dissertation and is brought out most clearly in Articles I and III. These particular articles also discuss to some degree the social and environmental contradictions contained in market-based regulation, and as such reflect a common attention in the literature to contradictions, as one particular form of the social relations that are internalized in things, structures, systems, etc. (Castree, 1996; Harvey, 1996, 2007; Ollman, 2003).

5. Synthesis of the findings

> *The tendency toward the destruction of nature does not flow solely from a brutal technology: it is also precipitated by the economic wish to impose the traits and criteria of interchangeability upon places. The result is that places are deprived of their specificity – or even abolished.*
>
> *(Henri Lefebvre, 1991 [1974], p. 343)*

Compilation logics

This chapter summarizes the main arguments presented in the articles and elucidates the linkages between them. There are many ways in which one could go about this. I have chosen a structure that is based on the identification of a number of overarching themes (each of which relates to the dissertation's overall aim) rather than, for example, dividing the discussion according to the individual articles. That being said, there is a certain logic to the focus in each of the articles. The first paper provides a theoretical argument that sets the context for the thesis as a whole. While the Polanyian framework *per se* is not followed up in the remaining three articles, the broader debates about the limits of/to commodification return throughout the texts. One can thus read Article I as a theoretical and preliminary exploration on the value of a structural critique with respect to discussions on the environmental outcomes of the EU ETS, and MBMs more generally.

Article II is an attempt to both extend the argument from my initial focus on the EU ETS to a parallel MBM, the Flemish TGC scheme, and to provide a detailed empirical example. In Article III meanwhile I attempt to relate the Flemish TGC scheme more explicitly to the experiences with the EU ETS and link it back to a theoretical discussion. While the theoretical focus of Article III is quite different from that in Article I, there are clear linkages between the two that I bring out in some detail in the text below.

The fourth article, finally, marks a slight evolution in my thinking and therefore stands somewhat separate from the other three. It engages with the question of commodification from a different entry point, expanding the foundations for a structural critique and attributing more importance to the role of biophysical factors in discussing commodification outcomes.

A structural critique of market-based climate policy

One of the overarching points this dissertation makes is that ongoing experiments with MBMs can only be fully understood by taking seriously the broader socioeconomic and ecological contexts within which they are implemented. Whereas a lot of research has focused on the more proximate causes of failing market instruments, i.e. their existing shortcomings in terms of market design, neoliberal governance structures, etc., this dissertation argues that such perspectives should be complemented by a systemic, political economic critique in order to arrive at a comprehensive analysis of the shortcomings and potentialities of market-based climate and energy policy. Article I substantiates this point through a theoretical engagement with the Polanyian concept of the 'double movement', that is, Polanyi's idea that the increasing commodification of labour and nature is balanced by a spontaneous 'countermovement' in society that seeks to limit and restrain commodification as a form of self-protection. By conceiving of the double movement as a dialectical concept, crucial linkages between moments of social and environmental protection on the one hand, and commodification on the other become evident. Article I in a way thereby underscores Bakker's (2005) argument that processes of reregulation should be seen as internal to the neoliberal project. This blurs simplistic distinctions between commodification and social protection and highlights the delimiting role of market society (i.e. capitalism), within which the double movement plays out, as an important focus for analysis. Seen from this perspective, the double movement can be interpreted as a societal mechanism that, through incessant interactions between the contradictory moments of market expansion and market contestation/failures, yields socially acceptable compromises between the socioeconomic imperatives of capitalist society and the concomitant need to protect its social and ecological foundations. With respect to emissions trading, the result is an attempted marriage between the need to mitigate climate change, and the opposing need to avoid the economic upheaval that any radical decarbonization would inevitably entail.[12] In arguing this, I arrive at similar conclusions as Felli (2014), who notes that emission rights "are institutional responses to the threat to accumulation that environmental *regulations* pose" (p. 274) and consequently serve to temporarily demine the contradiction between capitalism's dependence on the conditions of production (e.g. a hospitable climate) and its inclination towards the productive destructions of those conditions for the purpose of capital accumulation (O'Connor, 1997).

Whereas Article I explores the delimiting role of socioeconomic imperatives for understanding the development and outcomes of emissions trading, Articles II and III extend this argument theoretically and empirically. At the theoretical level, Article III puts the focus on the delimiting role of the socioecological and material contexts within which MBMs are deployed. This is captured in the concept of the 'fossil fuel landscape', which is introduced as a way to denote the material and immaterial power that emanates from the historical configuration of society's energy system. This power can be framed as a form of 'landscape inertia' that serves to shape the environmental outcomes that different MBMs give rise to. I suggest that the objective of economic efficiency, which is central to the logic of MBMs, is one of the main factors driving this dynamic, and that this objective is in turn achieved through various forms of commensuration. In empirical terms, Article III shows how the specific environmental outcomes of the EU ETS and the Flemish TGC scheme come out of a dialectical relationship between the prioritization of economic efficiency under those schemes (i.e. the created equivalence between geographically and technologically differentiated forms of emission reductions) and the socioeconomic inertia materialized in Europe's fossil fuel landscape. The same dynamic is explored in more detail for the Flemish TGC in Article II, whereby specific attention is given to the performance of technology neutrality as one particular form of commensuration hence one particular way in which the relationship

[12] While I haven't done so in the article, I believe this argument can be clarified by presenting it in similar terms to those put forward by Harvey (2012), who highlights the importance of analyzing capitalism's other 'moments' [i.e. those falling outside of the 'general laws of motion' of capital, such as the particularities of exchange, consumption, the relation to nature, etc., to which I would add the relation to the state].

between market-based renewable energy policy and Flanders' extant energy landscape is mediated.

Article IV provides a slightly different perspective on the structural dimensions of MBMs. It shows how the need to generate reliable and stable offset credits in the TFGB project resulted in a continuous struggle to subsume forest carbon to the market framework by making the production and monitoring of its credits more predictable, more standardized, and generally easier to measure. Our analysis in this way illustrates how the delimiting conditions within which carbon offsetting projects unfold create a distinctive set of challenges that extend well beyond the boundaries of oft-criticized industrial tree plantations. The nature of these challenges means that they are fundamentally reproduced even in small-scale, community-based projects such as TFGB. The article's focus on the interlinkages between the subsumption of nature and labour furthermore calls attention to the human labour that goes into creating the kind of abstractions that the commodification of carbon is dependent on. By highlighting the production of carbon abstractions in marginal - from a capitalist perspective - spaces, the alleged 'natural' behavior of commodity producers starts to come apart and exposes the extent to which the commodification of carbon depends on successfully enlisting farmers as disciplined capitalist subjects, i.e. as willing commodity producers and consumers (Robertson, 2004) or 'green custodians' (Fairhead et al., 2012). The case of TFGB thus shows how the delimiting dynamics of the global carbon market operate through different forms of abstraction in order to create and condition the carbon commodity as well as its producers.

An environmental critique of market-based climate policy

Much of the critical literature on MBMs opposes the commodification of carbon on normative and ideological grounds. Quite often though, the normative positions that are adopted in this literature – and indeed in some of the wider literature on the commodification and neoliberalization of nature (Castree, 2008) – are left more or less implicit and/or unsubstantiated. It is common for commodification to be seen as inherently 'bad' without elaborating exactly why this is the case or what the underlying dynamics behind its problematic nature are. Such an approach obscures the grounds on which a persuasive commodification critique can be formulated and ultimately forecloses more nuanced discussions on the potentially contradictory outcomes of various commodification processes. Previous work indeed shows that the diffusion of neoliberal environmental regulation need *not necessarily* result in negative social or environmental outcomes (Bakker, 2005; Mansfield, 2007). As I have elaborated in the articles, similar conclusions can be drawn with respect to the commodification of carbon. In an attempt to contribute to a more transparent, nuanced and specific mode of critique, this dissertation has sought to clarify the grounds on which the commodification of carbon can be problematized, and some of the concrete ways in which its problems manifest themselves. This is why I have chosen to make an analytic distinction between the social and environmental dimensions of MBMs, even though the two are in practice hard to disentangle.

Article I contributes to this objective by putting forward a dialectical alternative to common interpretations of the Polanyian double movement as a normative dualism between commodification and social/environmental protection. I argue that the two moments of the double movement can rather be conceived as tightly intertwined processes that feed off one another, and that with respect to the EU ETS might very well result in some level of decarbonization, at least if current efforts to improve the scheme's architecture continue. My discussion specifies why we can think of the EU ETS (or an improved version of it) as environmentally problematic. In contrast to Lohmann's (2012) claim that carbon trading is "not about decarbonization" (p. 1177) in the first place, I argue that the EU ETS could theoretically result in emission reductions, but that it would do so only on the condition that – on a societal level – the accumulation of capital and therewith the productive appropriation of nature remains unimpeded. Put briefly, the problematic environmental outcomes of MBMs can be said to take a distinct spatiotemporal (cf. Castree, 2009; Harvey, 2005, 2009) form. Firstly, the alternative commodity pathways that the EU ETS engenders are likely to displace environmental problems rather than solve them, a process that can be described in terms of a 'spatial fix' (Harvey, 2007). In other words, the constraining of profitable economic activities through market-based environmental regulation is economically feasible only to the extent that it opens up new opportunities for accumulation elsewhere. I want to suggest that this need is internalized in MBMs itself by way of the prioritization of economic efficiency. Secondly, and closely related to the previous point, we can also say that this subsumption of environmental regulation to economic concerns reduces the pace of decarbonization to the rhythms of the market economy, where fixed capital devaluation and technological innovation are everyday processes that come with their own temporal logics and limitations. As such, the specific outcomes of MBMs derive not just from their characteristics as market instruments, but also from the way they reflect and internalize the combined spatial and temporal conditions of contemporary capitalist society. These conditions to some degree appear incompatible with the specific spatiotemporality implied, for example, in the climate change mitigation scenarios produced by the Intergovernmental Panel on Climate Change (IPCC, 2014).

The other three articles make this point more concrete. In Article II, I provide an empirical analysis of displacement and temporal moderation by highlighting the role played by the Flemish TGC in stimulating the uptake of biomass combustion in old coal power plants. This analysis elucidates how the prioritization of technology neutrality, as one form of abstraction, turned out to have specific environmental outcomes. In line with Article I, the Flemish TGC had a clear positive impact on the production of renewable energy and its effects can therefore not only be seen as negative. This however came at the cost of promoting a certain kind of technology, biomass combustion, that itself raised a host of new environmental concerns (e.g. unsustainable resource use and air pollution), and that appears to have facilitated the lifetime extension of existing coal power plants, thus influencing the pace that the phase-out of coal could have taken. One additional dimension of this, which comes forward in Article II but is otherwise not explored further in this dissertation, is the nature of the interaction between policy instruments, that is, the extent to which environmental outcomes are shaped by how MBMs work with or against other policy instruments.

Article III situates the TGC example in a broader context and connects it to experiences with the EU ETS. As with the Flemish TGC, the kind of solutions that have been promoted through the EU ETS are mostly of a short-term nature. The created equivalence between geographically and technologically differentiated forms of emission reductions lead to the uptake of technological solutions such as fuel switching and energy efficiency investments, both of which require only minimal deviations from existing practices and ultimately fail to set in motion the kind of long-term landscape changes that are needed. The focus in this part of the analysis is mostly on the temporal aspects of critique, that is, on the role that MBMs play in setting the pace of technological transitions and the long-term implications this has for climate change mitigation. Apart from providing two empirical examples (the EU ETS and the Flemish TGC), the article also provides a theoretical argument, namely by discussing the relationship between landscape inertia and the prioritization of economic efficiency in MBMs. In this, it heeds Harvey's (2005) warning on the power of "the material and absolute" (p. 114) and offers a response to Ollman's (2003) call for dialectical research to pay closer attention to the temporality of social change, in other words, to avoid overestimating the speed of change and fully acknowledge the socioeconomic dynamics underpinning relative social stability (i.e. inertia). It is interesting to note, in this context, that Polanyi (2001) understood the socioeconomic and political power of these dynamics well when he remarked on the temporal implications of the double movement:

> Why should the ultimate victory of a trend be taken as a proof of the ineffectiveness of the efforts to slow down its progress? And why should the purpose of these measures not be seen precisely in that which they achieved, i.e. in the slowing down of the rate of change. [...] The rate of change is often of no less importance than the direction of the change itself; but while the latter frequently does not depend upon our volition, it is the rate at which we allow change to take place which well may depend upon us. (pp. 38-39)

Article IV approaches the topic from a different perspective. In this article we are less directly concerned with the kind of environmental outcomes that MBMs produce, and more with the different factors that determine those outcomes. Hence, our discussion on the intended subsumption of carbon in large part revolves around the kind of obstacles and limitations that carbon market actors meet along the way, in the process rendering the supposed 'offsetting' of greenhouse gas emissions a contestable claim. While we are certainly not the first to make this argument (the contribution of this paper mostly lies in its engagement with the subsumption of nature framework), I think our discussion conveys some interesting specifics on the environmental implications of small-scale forestry-based offsetting. Despite an explicit promise to help conserve a range of local tree species, TFGB subtly prioritizes a small number of 'desirable' species such as *maesopsis eminii*, a fast-growing, self-pruning and high-value tree that seems particularly amenable to the project's needs. We could say that TFGB in this way articulates the carbon market's tendency to produce a kind of nature that is specifically well-suited to the commodified sequestration of carbon. On a more general level, our analysis reinforces common concerns in the offsetting literature, e.g. on the measurability, additionality and permanence of offsetting practices, all of which have implications for the reliability of the emission reduction claims that offsetting projects make. In line with the arguments put forward above, however, most of our interviewees did indicate that the trees provide a number of benefits, both social and environmental, and it is clear that participants' general assessment of the project would be much more positive if only payments would come as promised. As with the EU ETS and the Flemish TGC then, the evaluation of projects like TFGB fundamentally needs to take into account the multiple and differentiated outcomes of commodification.

How matter matters in the commodification of carbon

A third aspect that this dissertation focuses on – and that is somewhat of an emergent topic in my PhD work – is the role that materiality plays in delimiting and defining the environmental outcomes of MBMs. With this I am referring both to the material limits of commodification, as discussed in the theoretical section, and the many ways in which matter matters for the specific forms that MBM outcomes end up taking. These issues are most explicitly addressed in Article IV, where we examine how the subsumption of nature and the subsumption of labour come together in the TFGB project to delineate the potentialities of carbon offset production. The linkages between the more general commodification framework of this dissertation, and the subsumption perspective of Article IV can be clarified by thinking of subsumption as the materialization of abstraction, that is, the very material ways in which nature is rendered legible, measurable, exchangeable, … for narrow economic purposes. This idea reflects Scott's (1999) point that abstractions are created to make sense of and 'articulate' complex realities, but that they are subsequently also often materialized. Reality is reworked in order to reflect more closely the abstracted representations that are first made of it. In the case of TFGB, abstractions are produced in the carbon calculations and technical specifications provided by Ecotrust, the project coordinator, in order to provide the sort of information that the carbon market 'can see' (cf Robertson, 2006). At the same time, the gardens of participating 'carbon farmers' are molded to reflect these abstractions. Tree cultivation is submitted to stringent requirements on tree management, on the kind of species to be used, how to prune and thin and when to harvest. Article IV in this way not only shows that the biophysical and socioeconomic 'messiness' of tree cultivation resists abstractions, co-determines project activities, and destabilizes the creation of offsets, but also that reality is to a certain degree reproduced as a concretized abstraction, a process that comes with its own social and environmental implications.

The materiality of market-based policies is also a key focus in Articles II and III, even though the argument in these two texts is not framed as such. Indeed, while writing I had not fully realized the extent to which the findings of these two articles speak to questions of materiality. Yet the point on landscape inertia reminds us that considerations on the matter of nature need not be limited to what we conventionally think of as 'non-human' natures. The fossil fuel landscape is clearly a socially produced landscape; it is the outcome of a specific socioeconomic hence anthropogenic process. Once it has been materialized, however, this produced landscape takes on a conditioning power much like that of the biophysical conditions discussed in Article IV. As Harvey (2005) pointedly suggests, the "sheer materiality of construction in absolute space and time carries its own weight and authority" (p. 114), implying that power emanates from matter, irrespective of whether it is socially produced or biophysically given. The fossil fuel landscape consequently sets the stage for future socioeconomic activity and therewith works as a delimiting factor, leaving its mark on the outcomes that 'weak' climate and energy policies produce. Article II thus shows how historical investments in coal power give biomass a definite economic advantage under the Flemish TGC scheme, while Article III demonstrates that a similar dynamic underpins the EU ETS' bias towards strategies such as fuel switching. While the materiality of the fossil fuel landscape is itself the result of a complex (and historically specific) social, economic and cultural dynamic, hence is reproduced just as much by immaterial as by material processes, it is the materialization of those processes and the power that results from it that is here in focus.

6. Conclusions

> *[Y]ou cannot just say to people who have committed their lives and their communities to certain kinds of production that this has all got to be changed. You can't just say: come out of the harmful industries, come out of the dangerous industries, let us do something better. Everything will have to be done by negotiation, by equitable negotiation, and it will have to be taken steadily along the way.*
>
> *(Raymond Williams, quoted in Harvey, 1996, p. 41)*

> *Freedom's utter frustration in fascism is, indeed, the inevitable result of the liberal philosophy, which claims that power and compulsion are evil, that freedom demands their absence from a human community. No such thing is possible; in a complex society this becomes apparent.*
>
> *(Karl Polanyi, 2001 [1944], p. 266)*

"[T]he best way of implementing a policy is the least costly way," Dales (2002, p. 99) argued in his original treatise on the virtues of emissions trading. Sixty years on this thinking has come to permeate environmental politics, and has propelled the roll-out of market instruments in areas previously thought impossible. Case in point is the implementation of market instruments for climate change mitigation and renewable energy production, where the idea now dominates that economic efficiency is a significant – if not the most significant – quality against which such policies should be evaluated. The graduation of this logic to the global policy arena, including UNFCCC negotiations on future climate change agreements, demonstrates just how naturalized this way of thinking has become since it was first articulated. For many of its newfound proponents, the many challenges that have emerged along the way are thereby largely believed to be of a technical nature, avoidable glitches and imperfections in the implementation of a solid economic theory. If MBMs are seen to have wider social and environmental implications, these are deemed beneficial, irrelevant, or unproblematic at most. The kind of win-win narratives inscribed in ecological modernist thinking, after all, do not allow for potential contradictions and trade-offs; a policy is not qualitatively altered when the cheapest solutions are prioritized, its implementation just becomes more economically efficient.

This PhD thesis situates itself within a body of literature that is outspokenly skeptical of these claims and instead sees market environmentalism as in many ways a problematic endeavor. This perspective, by now expressed by a large community of academics and activists, takes seriously Polanyi's (2001) insistence that the commodification of nature is at heart an ideological project, inevitably accompanied by a host of contestable social and environmental effects. Critics thus argue that the economic reduction of socioecological complexity to an exchange-value relationship – where economic efficiency becomes the ultimate criteria for evaluating a policy – has repercussions far beyond those acknowledged by market proponents. Yet in doing so, it is not always clear on what grounds such criticism is based, how critics believe problems are expressed, or what mechanisms are ultimately behind them. Not uncommonly, market instruments are vilified exactly because of their market character, or because of the empirical shortcomings that they have in the past demonstrated, without any attempt to elucidate the exact dynamics that predispose them to certain outcomes in particular contexts. While theorizations on the 'commodification' or 'neoliberalization' of nature have much to say on these aspects, their applicability to concrete environmental spheres – such as climate policy – and to the specific instance of market-based instruments – such as the three cases that I have examined – isn't always fully developed.

This thesis has aimed to make a contribution to this debate by examining the concrete processes underlying the environmental outcomes of market instruments as one instance of the commodification of carbon. The research findings are synthesized in chapter five and can be summarized by pointing to the distinct spatiotemporal dynamics through which environmental outcomes became expressed in the three cases that I have focused on. In spatial terms,[13] this research has elaborated the economic dynamics that tend to displace environmental problems rather than solve them, as long as environmental policy is inscribed within a logic of accumulation that is ultimately dependent on the appropriation of ever new forms of nature. This dynamic is well-established in the literature, and can perhaps best be captured by ecologizing Harvey's (2007) notion of the 'spatial fix', that is, by contrasting the local and regional resolution of discrete environmental problems with the global reach of the socioeconomic driver behind those problems. In Polanyian terms, we could perhaps say that the tendency towards displacement derives from the dialectical tension between a globalized system of commodity production, hence a globalized appropriation and production of nature, and the less-than-global reach of society's self-protective countermovement. My contribution here lies not with the theorization of this dynamic – which has been extensively demonstrated by others – but with its elaboration for the concrete case of MBMs, and its compatibility with Polanyian understandings of social change.

The contribution of this dissertation primarily lies with its attention to the temporal dynamics of MBMs. A number of authors (cf. Lohmann, 2011a) have previously argued that MBMs serve to delay long-term investments in the decarbonization of industrial society, hence that the application of a market logic has implications for the temporality with which we choose to mitigate climate change. I have sought to substantiate this argument by locating the temporal mitigation of decarbonization in the interface between, on the one hand, MBMs' focus on economic efficiency – which prioritizes the cheapest and easiest solutions – and on the other the inert tendencies of the social and material landscapes of fossil capitalism – which has a concrete conditioning effect on the economics of technological development and therefore helps determine what those cheap and easy technologies are. As such, my argument illustrates how the pace of decarbonization is fundamentally co-constituted by the spatiotemporal

[13] In practice, the spatial and the temporal co-constitute each other and cannot be fully separated, which is why it is more correct to speak of capitalism's spatiotemporality as a unified condition (Castree, 2009; Harvey, 2005). With respect to the temporal dynamics discussed here, for example, it's quite evident that these are at the same time also profoundly spatial. For the sake of structuring the analysis however, I have here provisionally distinguished between a predominant focus on the spatial aspects of this dynamic, and a focus on the temporal.

dynamics of fossil fuel capitalism, i.e. by its spatial ‘fixedness’. In elaborating this dynamic, my analysis moves away from pinpointing the design and functioning of MBMs as the problem, and instead invokes a dialectical argument that scrutinizes the relations through which the spatiotemporality of carbon’s commodification becomes expressed, in this case the relation between MBMs and the broader material and socioeconomic conditions of ‘fossil capital’ (cf. Malm, 2016).

In this, the materiality of nature – constructed or otherwise – and the materiality of the social relations of capitalism emerge as important factors underpinning the geographies of market-based climate policies. Matter matters both for the kind of solutions that market instruments end up promoting (as shown in all three cases) and for the pace at which transformations occur (as shown mainly for the Flemish TGC and the EU ETS). In line with Ollman’s (2003) point that context is an integral part of the analysis of social phenomena, my research therefore demonstrates that a comprehensive analysis of market environmentalism also needs to attend to the historical and material conditions under which market instruments take form. In all three cases, the biophysical properties of nature as well as the material ubiquity of fossil capital have shaped the particular form that market-based climate policy has taken. Following Ollman (2003), we can say that the potentialities of climate policy, in terms of climate and energy gains likely to be delivered, lie at the intersection between these material conditions and the ideological notion of economic efficiency-maximization.

By taking serious the particular materiality/spatiotemporality of fossil fuel capitalism as the context within which MBMs are deployed, we can thus return to Dales’ adage with a concrete argument: the prioritization of economic efficiency, which lies at the heart of the proliferation of market-based climate and energy policy, fails to account for (1) the power of the wider socioecological landscapes within which different mitigation alternatives are inscribed, and (2) the differential temporal effects these alternatives have on long-term greenhouse gas emission reduction. Instead, the abstractions upon which MBMs depend – as a way to compare, equate and trade emissions from different technical alternatives and ultimately arrive at the most cost-effective option – create a flat ontology from which all history, politics and ecology is purged. This indeed is the logical result of the commodification of carbon as a process in which exchange-value has come to dominate social relations, with carbon’s use-value reduced to a singularity: accounting for greenhouse gas *emissions*, detached from more relevant concerns over atmospheric concentrations, fossil fuel combustion or extraction, or from crucial discussions over how, by who, or why emissions are made. In this process, the socioecological complexities of climate change itself are abstracted away, and a deep social, environmental and economic crisis is reduced to a technological problem to be managed by end-of-pipe solutions. This leaves no room for discussions on the socioecological dimensions of emission reduction or the spatiotemporal dynamics of the economic system.

This raises questions far greater than whether MBMs are capable of delivering emission reductions. As I have argued in Article I, there's little *theoretical* reason why capitalism would be unable to find a profitable avenue into delivering emission reductions. Yet the larger question that then needs to be asked is *what kind* of emission reductions it is capable of delivering, and, per Polanyi's comments on the rate of social change, *within which temporal framework* this is likely to happen. What kind of nature is in fact produced through the application of MBMs? Or, to put it slightly differently, what broader functions do MBMs perform? On these last questions, this thesis has no definite answers to offer, but the analysis at least presents some broad and preliminary ideas. The MBMs that I have looked at tend to deliver emission reductions, if and when they do, through the deployment of quick and short-term technologies – fast-growing trees, fuel switching, energy efficiency investments, biomass combustion in converted coal power plants – that are highly attuned to prevailing economic imperatives. Given that MBMs have gained popularity at least in part because of their promised economic efficiency, hence because of their implicit prioritization of quick and short-term solutions, we could say that part of their value, their main function, from a political economic perspective, is that they help steer technological innovation in the direction of solutions that are workable within the spatiotemporality of fossil fuel capitalism. More than a technocratic tool for delivering emission reductions, therefore, market-based climate policies are also a political instrument that asserts the compatibility of climate change mitigation with current socioeconomic practices, and thereby sets about reproducing existing socioecological relations. Politically, MBMs help shore up the legitimacy of existing socioeconomic practices in the face of the challenge that is climate change.

These conclusions are in line with the arguments put forward in much of the critical literature on market instruments, commodification processes, or the diffusion of neoliberal practices. It is very clear that market instruments can and should be problematized on different grounds, both socially, economically, and – as I have elaborated in this thesis – in environmental terms. The aura of neutrality that envelops MBMs obscures ideological choices for certain kinds of technologies, hence certain kinds of alternative futures. It's manifestly clear that much more sustainable, effective, and just ways could be imagined to deal with climate change, and the many other environmental problems for which market solutions are already used or on the drawing table. Yet in taking the perspective that I have taken, I believe the political implications of my analysis are subtly different. I would therefore like to end with some preliminary thoughts on the broader implications of my argument. Amongst other things, my work highlights how the commodification of carbon performs socially useful (from the perspective of fossil capital) work in (re)producing a given socioecological reality; how it serves to temporarily demine the volatile contradiction between a fossil-dependent capitalism, and the urgent need for severe GHG emission reductions. MBMs are particularly well-adapted to the conditions and limitations of fossil capital, probably more so than many of the alternatives that critics have put forward. Indeed, as cost-effective, flexible instruments, that is, after all, part of their fundamental rationale.

The political implications of this become apparent once we recognize that the inertia of capitalist social relations, to take Mitchell's (2005) words out of context, is "made real not only in bricks and stone but also in people's livelihoods and homes" (p. 51). Fossil fuel capitalism is reproduced not only in the sphere of production, but also in the everyday consumptive interactions through which value is realized. To be clear, this is not to say that we are all equally complicit in the problem that is climate change, far from it, the geographies of greenhouse gas emission and climate change vulnerability are tremendously unequal. Yet highlighting the social complexity of fossil fuel dependence is necessary in order to grasp that more sustainable forms of climate change mitigation are likely to go against widespread economic, social, and cultural interests. Indeed, I think there's much to be taken away, for any analysis on the transition away from fossil fuels, from Harvey's (2012) insistence that

> the way that capital has changed our world has implications for our mental conceptions and our psychological make-up, our wants, needs and desires, our self-understanding. When the laws of motion of capital produced suburbanisation as an answer to the persistent problems of over-accumulation, then tastes, preferences, wants, needs, desires and political subjectivities all shifted in tandem. And once all of these become embedded in a culture, then the rigidity of those

> cultural preferences form a serious barrier to revolutionary change. If, for example, it will be necessary to revolutionise and reject suburban ways of life in order to confront questions of global warming, or to open new paths either for capital-accumulation or for the transition to socialism through re-urbanisation, then the fierce attachments of powerful political constituencies to suburban lifestyles and cultural habits will first have to be confronted and eventually overcome. (p. 23)

Because fossil capital has been tremendously successful in making fossil fuels *socially necessary*, that is, because it has succeeded in molding, through its subsumption of labour/nature, a large group of fossil-dependent subjects that have an invested interest in the maintenance of the status-quo, radical mitigation policies would inevitably disadvantage large amounts of people, and not just capitalists. Surely, in other words, the logics of dialectical thinking need to be extended to the individual level as well: as reluctant capitalist subjects, we have all internalized the contradictions of fossil fuel capitalism. The socioeconomic power of policy instruments like MBMs in this sense emanates from their inherently a-revolutionary character, hence their ability to maintain some semblance of relative social stability in the face of climate crisis. Any climate policy that disconnects itself from the spatiotemporality of fossil capital, and that is more in line with the pace of mitigation prescribed by scientists, would not be in this comfortable position. It would have to confront the unpleasant tradeoffs between socioeconomic stability and rapid decarbonization. It is useful bearing this in mind when formulating critiques and weighing alternatives to policies such as carbon trading. Essentially it means that the articulation of more effective mitigation policies needs to account for how social forms are (re)produced and legitimated not *just* in the sphere of capitalist production, and therefore requires either directly confronting the social dependencies, cultures and lifestyles that co-constitute the combustion of fossil fuels; or acknowledging the need for negotiations and compromise with policy visions and instruments that we might fundamentally disagree with. Either of these alternatives merely underscores the importance of recognizing that socioecological change takes form under conditions and power relations not of our own choosing, even when we set out to change them.

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Appendix I: List of interviewees

Respondents for the interviews carried out in Flanders (Belgium), March 2013 and December 2013:

1. Stijn CAEKELBERGH, Beleidsmedewerker Klimaat, Departement Leefmilieu, Natuur en Energie van de Vlaamse Overheid (LNE)
2. Jorre DESCHRIJVER, Beleidsmedewerker Klimaat, Departement Leefmilieu, Natuur en Energie van de Vlaamse Overheid (LNE)
3. Michel GROENEVELD, Commercial Project Manager Biomass, E.ON
4. Niina HONKASALO, Advisor, Energy Policy & Generation Unit, EURELECTRIC
5. Philippe OPDENACKER, Chief Analyst, GDF Suez
6. Vicky POLLARD, Deputy Head of Unit, Unit B1 ETS Implementation, DG Climate Action, European Commission
7. Fanny-Pomme LANGUE, Policy Director, European Biomass Association (AEBIOM)
8. Marc VAN DEN BOSCH, General Manager, Federatie van de Belgische Elektriciteits- en Gas Bedrijven
9. Sara VAN DYCK, Beleidsmedewerker Energie, Bond Beter Leefmilieu (BBL)
10. Karl VAN STAEYEN, Toezichthouder expertisedossiers groene stroom en WKK, VREG

Interviews carried out on the TFGB project in Uganda, in September 2014 and February 2015, have been anonymized and are therefore not listed here.

Article I

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Environmental protection as market pathology?: carbon trading and the dialectics of the 'double movement'

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Abstract. Polanyi's concept of the 'double movement' is frequently interpreted as the opposition between the problematic and unsustainable dynamics of the market and the benign and normatively desirable reaction against this by 'society'. This paper questions this dualistic interpretation of the double movement and undertakes a problematization of the Polanyian idea of social and environmental protection. It does this by revisiting the concept of the double movement in light of the recent proliferation of market-based mechanisms for environmental regulation. Through an exploration of the different interpretations of Polanyi's work, the paper presents a dialectical reading of the double movement that conceptualizes the idea of social protection within a broader capitalist framework. This is then illustrated with the case of emissions trading as a particular form of environmental protection. Carbon trading as a mitigation strategy, it is argued, corresponds to the Polanyian idea of 'social protection' in that its protective potential to reduce emissions is itself constrained by the socioeconomic framework within which it operates. This in turn points to the need for a critique of climate mitigation efforts that goes beyond a focus on current problems with emissions trading schemes.

Keywords: EU Emissions Trading Scheme, Karl Polanyi, climate change, countermovement

Introduction
Recent decades have seen a qualitative change in the role of private actors in environmental regulation and a concomitant transformation in the responsibilities traditionally assumed by the state. This has been evident in such areas as water governance (Swyngedouw, 2005), fishery policy (Mansfield, 2004), forestry (McCarthy, 2005), and wetland conservation (Robertson, 2004), and in the establishment of the 'payments for ecosystem services' framework (Kosoy and Corbera, 2010). One particularly conspicuous example is the recent uptake of market mechanisms for climate change mitigation. Best known from such policy instruments as the Kyoto Protocol's Clean Development Mechanism and the European Union Emissions Trading Scheme (EU ETS), various incarnations of the 'carbon market' now exist or are under development around the world (ICAP, 2013). While many of these schemes have been tainted by delays, controversies, price collapses, and significant setbacks, leading some commentators to depict the future of market-based climate change mitigation as increasingly uncertain (Bond, 2011; Reyes, 2011), the emissions trading approach has so far eluded predictions of imminent breakdown. Indeed, the continued support of European governments for the EU ETS, the world's largest and most ambitious emissions trading scheme, in face of persistent and serious problems, as well as the apparent resolve of the Chinese government to implement its own nation-wide emissions trading system by 2015, suggests that global climate governance in the foreseeable future is set to involve more, not less, carbon trading.

A wide range of concepts are commonly employed to explore the economic, political, and ecological dimensions of these market-based experiments in environmental governance. A recurrent theme is the use of Polanyi's (2001) notion of the 'double movement', developed to describe the 'great transformation' of 19th-century Europe. The concept has become a popular starting point for the critique of contemporary economic trends, not least with respect to socioecological issues (Castree, 2010; Dale, 2010a; Lohmann, 2010; Prudham, 2004). The ongoing neoliberalization of both society and nature is thereby generally seen as evidence of the 'commodification' phase in a new double movement (Peck, 2008; Sandbrook, 2011; Silver and Arrighi, 2003), implying the expectation of its inevitable, if not imminent, replacement by a new social–protective phase (Dale, 2012). In the case of climate change, viable 'countermovements' that could challenge the hegemonic consensus around market instruments and spark this transition to a more sustainable socioeconomic model are generally sought in such civil society initiatives as the 'Climate Justice' network, various grassroots movements to "keep the oil in the soil" (Lohmann, 2011a), the farmer's movement *La Via Campesina*, and the 2010 'World People's Conference on Climate Change and the Rights of Mother Earth' in Cochabamba, Bolivia (Bond, 2012).

The parallels with Polanyi's own analysis of 19th-century liberalism seem clear. Neoliberalism's recent push to extend the realm of the market threatens to undermine the social and environmental foundations of society; therefore, various forms of contestation and regulation have sprung up that contain, expose, and undermine the neoliberal model. At the same time, however, the recent emergence of market-based mechanisms for environmental protection significantly obfuscates any supposedly straightforward distinction between accelerated processes of commodification on the one hand, and a civil-society-driven or government-driven movement towards social protection on the other. Here, after all, are policy instruments that purport to span both sides of the double movement. Carbon markets promise to protect society from the effects of anthropogenic climate change (itself the outcome of the commodification of fossil fuels) by way of the creation and commodification of emission rights. They are based on the premise that the powerful forces of commodification can be fruitfully enlisted as a tool for socioenvironmental protection (Newell and Paterson, 2010). For critics such claims are anathema, and market-based instruments are generally dismissed as 'false solutions' (Bond, 2012; Charman, 2008; Lohmann, 2011b), thereby foreclosing any discussion on the potential challenge they pose to the Polanyian framework. Market mechanisms, it is argued, are not 'real' forms of social protection but merely innovative forms of commodification masquerading as something else. Commodification and socioenvironmental protection are therefore seen as mutually exclusive forces. Examining the case of voluntary food labeling, Guthman (2007), for example, argues that the kind of social and environmental protection that food labels offer is highly uneven. In contrast to the Polanyian type of protection, which is "good for everybody" (page 464), food labeling is in fact nothing more than 'rollout neoliberalization', which, Guthman writes, is "a bit like a patch for a computer operating system—an always partial and incomplete attempt to keep the program from crashing altogether, but with key vulnerabilities left intact, and no one really able to figure out the code" (page 466).

While Guthman's (2007) conclusions about the limited protective potential of neoliberal policy instruments are persuasive enough, I here wish to question the proposed contrast between 'false' countermovements and an allegedly 'true' form of social protection derived from Polanyi's analysis in *The Great Transformation* (TGT). A close reading of Polanyi's work, I argue, does not necessarily support an interpretation of 'the countermovement' as a unifying force striving for the common good. Instead, the concept can be seen as a nebulous category for the collective, politically contingent, and socioenvironmentally conservationist efforts of people attempting to protect and promote their livelihoods, interests, and values, whatever progressive or reactionary form that takes. If the protection offered by food labeling or carbon markets is partial and incomplete, therefore, this might be attributable not so much to the 'false' nature of these instruments as to the socioeconomic limits within which the Polanyian double movement itself operates. The purpose of this paper, then, is to challenge the dualistic interpretation of the double movement commonly found in Polanyian-inspired analysis, and explore how the challenge that market-based environmental governance seems to pose to the Polanyian framework can be resolved without resorting to essentializing typologies of 'true' and 'false' forms of social protection. My objective is decidedly not to question Polanyi's critique of commodification itself. Indeed, the fact that the ongoing commodification of nature, labor, and money is both morally reprehensible and socioenvironmentally unsustainable has been convincingly demonstrated by others and needs no repeating here (Foster, 2011; Kloppenburg, 2004; MacDonald, 2005; Prudham, 2007; Robertson, 2006). Neither, for that matter, do I want to cast doubt on the value that different countermovements have in improving people's environments and safeguarding their livelihoods. Both these processes are real enough, but viewed separately they tell only part of the story. This paper problematizes this normative division commonly inspired by Polanyi's thesis between on the one hand a destructive 'commodification' movement, and on the other a beneficial protective response by society—what Burawoy (2003, page 248) calls a "battle between society and the market [as] a battle of the Gods, between good and evil". Such an interpretation of Polanyi's concept, I argue, eschews the question of the complex and manifold ways in which the two movements can be seen to be coconstituted and thus interdependent. A dualistic reading of the 'double movement' is particularly unhelpful in light of recent attempts to craft an understanding of why market mechanisms have, despite their contradictions and the contestations against them, become so prominent and why alternative policies have so far remained marginal.

The text is structured as follows. I first present a brief review of different interpretations of Polanyi's (2001) 'double movement' thesis as developed in TGT. From this, I develop a dialectical reading of the 'double movement' that interprets Polanyi's countermovement as a potentially problematic and self-limiting force rather than an inherently benign one. The fourth part of this paper provides a substantiation of this argument by way of the case of the EU ETS, thus serving as an example of the complex and sometimes contradictory ways in which the movements of social protection and commodification are intertwined. I conclude by summarizing some of the benefits that a more dialectical Polanyian perspective can bring to the understanding of emissions trading in particular, and, more generally, to the limitations that movements for social and environmental protection are subjected to within market society.

The double nature of the double movement

The idea that a 'double movement' characterizes the historical evolution of market society has been subject to a variety of different interpretations and usages. Dale (2010a) identifies two main sides to the debate. One side constructs a so-called 'soft' Polanyi, arguing that the countermovement—the self-protective reaction of society to the "stark utopia" (Polanyi, 2001, page 3) of the self-regulating market—is a successful instance of reembedding the economy in social institutions. Here, the double movement is seen as a self-balancing system that achieves a " 'great compromise' in which the dialectics of market expansion and political intervention is contained, at least for some time, in a stable equilibrium" (Hettne, 2010, page 37). According to this interpretation, Polanyi can be read as the champion of an 'embedded liberalism', a form of social-democratic welfare capitalism not unlike the post-World War 2 model that relies on a strong regulator to contain the excesses of dogmatic (neo)liberalism (Bernard, 1997; Ruggie, 1982). Against this, the 'hard' reading of Polanyi holds that the very idea of an 'embedded liberalism' is misconstrued, since a market economy is always based on a disembedding logic. 'Reembedding' the economy in this sense does not hinge on the successes of the countermovement but rather demands a complete break with the prevailing market logic. The only achievement that the countermovement can aspire to is a momentary alleviation of the most destabilizing effects of the capitalist contradictions to which society remains subjected. Polanyi's 'hard' alter ego thus advocates nothing less than the supersession of capitalism by a socialist society in which land, labor, and money have been fully decommodified and submitted to an entirely new system for meeting social needs (Lacher, 1999).

Part of this divergence in interpretations can be attributed to ambiguities in Polanyi's own work. It is unclear, for instance, whether TGT was meant as a treatise against capitalism as such or merely against a radically liberal manifestation of it, or even if Polanyi distinguished between the two at all. Dale (2010b) notes that the book actually contains two contradicting narratives on the origins of market society, confounding what Polanyi had in mind when using the term. One narrative corresponds to the mainstream view of the gradual development of markets through the stages of agricultural, mercantilist, and industrial capitalism, and appears to suggest quasi-complete similarity between Polanyi's conceptualization of market society and the orthodox understanding of capitalism. The far more dominant alternative narrative, meanwhile, posits a 'radical break' between mercantilism and the moment of "explosive institutional change" that occurred with "the establishment of an integrated labour market" (Dale, 2010b, page 52), placing greater emphasis on the issue of market self-regulation and therefore seemingly isolating liberalism as a distinctively problematic moment in the history of capitalism. The matter is complicated further by Polanyi's inconsistent use of the term 'self-regulating market'. While his definition of self-regulation generally seems to indicate synonymity with laissez-faire economic policy, some parts of TGT (for example, page 155) point in a completely different direction, suggesting not so much the absence of regulation as the broader idea of economic liberalism as the "institution of supply and demand" (Gemici, 2008, page 15); that is, the institutionalization of the market mechanism as the central organizational principle of society (McCarthy and Prudham, 2004).

These ambiguities are reproduced in the discrepancy between the 'soft' and the 'hard' understanding of Polanyi that Dale (2010a) identifies. Reading Polanyi's work as a critique of capitalist market relations per se leads to the conclusion that the very idea of an 'embedded liberalism' is a contradiction in terms. However, when his thesis is interpreted as an attack on the utopian project of market fundamentalism, and the idea of 'self-regulation' is equated with laissez-faire policies, the countermovement becomes a powerful force for establishing a stable, regulated—albeit capitalist—economy. The subsequent argument builds on a 'hard' interpretation in that I believe Polanyi's thesis presents us with an underdeveloped and potentially fruitful problematization of the countermovement and the idea of the self-protective society.

This paper moves away from an interpretation of the double movement as what Dale (2010b, page 220; 2012) calls a 'pendular' movement, in which Polanyi's concept is read as the alternation of grand "tides of liberalization and commodification on the one hand, and regulation and social protection on the other" (Peck, 2008)—a historical seesaw movement that has manifested itself as "the deregulation of world trade in the nineteenth century, and its reregulation in the twentieth" (Habermas, quoted in Dale, 2010b, page 207). This reduction of the double movement to the historical to-and-fros of moments of regulation and (neo)liberalization in my opinion fails to do justice to the full complexity of Polanyi's argument and partly reproduces the abovementioned dualism between society and market.

Indeed, there are instances in TGT (2001, eg, page 136) that clearly contradict such a historically differentiated interpretation of the concept, with the text instead alluding to the simultaneous existence of both the liberalizing movement and the protectionist countermovement. More than a tool for historical periodization, then, the idea of the double movement can be read as a more fundamental social and political dynamic throughout the development of market society. In what follows I will focus on what I believe to be implicitly present in Polanyi's argument, namely an understanding of the interplay of commodification and social protection as permanent and simultaneous, rather than historically consecutive, features of capitalism.

Rereading the double movement

Polanyi's basic argument is well known. With the rise to dominance of the market mechanism came the demand that all factors of production be subjected to it, including land, labor, and money. However, "the postulate that anything that is bought and sold must have been produced for sale is emphatically untrue in regard to them" (Polanyi, 2001, page 75). This makes the creation of markets for land, labor, and money a dangerous fiction, for it negates the fact that their value to the production process cannot be separated from their broader social functions as the subsistence base of society, human beings, and the social expression of value, respectively. Polanyi is unequivocal about the consequences, maintaining that "To allow the market mechanism to be the sole director of the fate of human beings and their natural environment, indeed, even of the amount and use of purchasing power, would result in the demolition of society" (page 76). It is therefore inevitable that society counteracts this trend by spontaneously protecting itself through interference in the market. This is what he calls the double movement:

> "the extension of the market organization in respect to genuine commodities was accompanied by its restriction in respect to fictitious ones [ie, land, labor, and money]. While on the one hand markets spread all over the face of the globe and the amounts of goods involved grew to unbelievable dimensions, on the other hand a network of measures and policies was integrated into powerful institutions designed to check the action of the market relative to labor, land and money. While the organization of world commodity markets, world capital markets, and world currency markets under the aegis of the gold standard gave an unparalleled momentum to the mechanism of markets, a deep-seated movement sprang into being to resist the pernicious effects of a market-controlled economy" (page 79).

Polanyi's argument, however, does not end there. The impairment of the market mechanism resulting from society's self-protection itself "disorganized industrial life, and thus endangered society in yet another way" (page 4). Polanyi emphasizes that protectionist measures too could drive society into general crisis. "Fascism", he writes, "like socialism, was rooted in a market society that refused to function" (page 248) and ultimately resulted in the disaster of World War 2: "The self-protection of society would prove incompatible with the functioning of the economic system itself" (page 135). Polanyi hence constructs a double argument. In the first instance he defines the self-regulating market as a threat to the very foundations of society, explaining why its institutionalization was such a long and painful process. But, gradually, as the market mechanism becomes the main organizing principle of society, the double movement also shifts into reverse. Whereas the economic system was previously "embedded in social relationships, these relationships were now embedded in the economic system" (Polanyi, 1947, page 114), implying that everything that undermines the proper functioning of the market also puts strains on the social structures that depend on it. To the extent that the concept of the 'double movement' captures both these processes, it allows for the problematization of society's self-protective compulsion as "part of the pathology of market society" (Lacher, 1999, page 325).

This aspect of Polanyi's argument has remained largely unacknowledged in the literature. It is an oversight with far-reaching implications in that it obscures Polanyi's crucial idea that the double movement is situated *within* a market society (Hart, 2001). This means that the countermovement cannot be described in purely abstract terms, as the protection of a set of universal or ahistorical social norms and values. Rather, the protection of 'nature' or 'society' is always the protection of a *certain* nature and a *certain* society; that is, of a socionature that is itself the product of an ongoing historically specific process of socioeconomic development. Polanyi remained mostly silent on these "social and political forces through which the countermovement is constituted in any particular historical–spatial conjuncture" (Hart, 2001, page 650), yet it seems reasonable to conclude that in a society where social institutions have become embedded in economic relations—ie, where norms, values, and interests have become tied in with a generalized market mechanism—those social and political forces constituting the countermovement might in part be consistent with the further expansion of market relations. Expressions of the countermovement should then mostly be seen as contesting the concrete historical and geographical manifestations of commodification (ie, its social and environmental 'externalities') and not the process of commodification per se. The two sides of the double movement can in this way be conceived of as coconstitutive, dialectically related tendencies rather than as a dualism between antagonistic forces.

The potential compatibility between social protection and continued commodification in turn points to the constraints within which the countermovement operates in a market society. This is a point that can be explored more fully by putting Polanyi in conversation with a broader Marxist perspective. Already in the examples that Polanyi uses—for example, trade unions, factory laws (2001, page 81), central banks, social security, labor legislation (page 211), and corn laws (page 213)—it is clear that regulation not only increases the costs associated with the circulation of capital, eating away at profitability (page 227), but also prepares ground for new forms of accumulation to occur. As Harvey (2007, page 56) notes with respect to class struggles over the wage rate and working conditions more broadly, such moves to protect the labor commodity serve as an important tool for the social distribution of value and the redefinition of what constitutes the 'socially necessary' conditions for the continued accumulation of capital:

> " 'the maintenance and reproduction of the working class is, and must ever be, a necessary condition to the reproduction of capital' (Capital, vol. 1, p. 572). Capital must itself limit its own 'boundless thirst after riches' to the extent that it destroys the capacity to reproduce labour power of a given quality. But we also notice that capitalists pay out wages, which they receive back as payment for the commodities they produce. Distribution here functions as a mediating link between production and consumption, or, as Marx prefers it, between the creation of value in production and the realization of value in exchange. The capitalist must, after all, produce social use values—commodities that someone can afford and that someone wants or needs. Individual capitalists cannot reasonably expect to diminish the wages of their own employees while preserving an expanding market for the commodities they produce."

To the extent that capital fails to impose these necessary limits on the exploitation of labor, the Polanyian countermovement can be seen to fulfill this distributive role. In the process it not only 'protects society' by improving working conditions, raising wages, and increasing leisure time, it also creates a demand for new commodities, in effect ensuring that exploitation can continue in a, for capital, sustainable way. The same argument can be made for the exploitation of nature, since the conservation, management, and reproduction of natural resources, too, are necessary conditions for the reproduction of capital (O'Connor, 1997). By alleviating the most acute strains on society and nature, hence preventing the market from collapsing, the countermovement in fact does the market a service. It provides social and political signals that mark the momentary limits to capital's accumulative drive and force market actors to mitigate, abandon, or relocate their most socioenvironmentally disruptive practices. In this sense, regulation does not so much block capital accumulation as check it in certain directions. In weighing the revolutionary potential of social and environmental countermovements within a market framework, we are therefore reminded of Marx's discussion of the organization of labor:

> "[Marx] explicitly warns the workers 'not to exaggerate to themselves the ultimate working of these every-day struggles [over wage levels]. … Instead of the 'conservative motto, "A fair day's wage for a fair day's work!" they ought to inscribe on their banner the revolutionary watchword, "Abolition of the Wages system!'" [S]truggle within the confines of capitalism over the real wage merely serves, in Marx's view, to ensure that labour trades at or close to its value" (Harvey, 2007, pages 53–54).

In other words, the successful 'interference' of social protection in the market is contingent on the continued accumulation of capital, since otherwise the prospect of economic crisis and social misery looms. The constrained nature of the double movement hence arises from the fact that workers have for their sustenance become entirely dependent on wage labor. To paraphrase Mitchell (2005), the fact that in a capitalist system the ideology of the market has become materialized in social reality implies that it has acquired an 'enormous inertia' that resists radical change. "People", he writes, will "work very hard to maintain, to reproduce, the already existent landscape" (page 51) in an attempt to protect their livelihoods, the rights and levels of wellbeing they have acquired. In a socioeconomic system where needs are provided for through the market, attempts to protect those livelihoods in this way also end up protecting the market mechanism itself, even if this effect is in most cases completely unintentional or even undesired. The partial overlap between social and economic interests in a market society effectively collapses the suggestion of a dualist and normative schism between 'market' and 'society'. For this reason, it appears, countermovements need not be 'good for everyone' to be valid examples of the dynamics that Polanyi described. Rather, their impacts are ambiguous in the sense that in improving laborers' working conditions they simultaneously also entrench the market framework that gave rise to exploitative conditions in the first place. While regulation therefore needs to be sufficient to provide adequate answers to concrete social and environmental problems, in concrete places and time, on a societal scale it appears constrained by, and indeed part of, a dynamic that preempts any significant disruption to the socioeconomic status quo.

None of the above is to say that countermovements intentionally or willingly conform to market dynamics. The ambiguous outcomes of social protection do not take away the validity or potential radicalism of these movements' claims and concerns, but merely point to the limitative framework within which those concerns are expressed—that is, to the limits of the articulation between capital and the social and environmental demands of society (cf Robertson, 2006). What this suggests is not that countermovements cannot be radical in their opposition, but that their respective successes in bringing about the changes they demand largely depend on their broader compatibility with capitalist social relations. Similarly, one does not need to subscribe to the idea of capitalism as a "monolithic, cohesive force" (Hart, 2002, page 813) to make the case that market society constitutes a limitative framework for social and environmental protection. As Polanyi (1947) notes, while the idea that humans are driven by 'material' and 'ideal' motives and that social institutions are determined by the economic system has been quite successfully institutionalized in market society, this does not entail the absence of other, noneconomic motives. Capitalism remains entirely dependent on noneconomic institutions (the example of unpaid domestic labor comes to mind), even if these have been effectively enlisted to work for capital. Market society in this sense should be understood as a social system in which power relations are heavily skewed in favor of economic interests, and not as one in which other interests, dynamics, and concerns are altogether absent.

In sum, the limits to the countermovement as a force for structural change are defined by the articulation of social relations within a market framework. The self-protective reaction of society engenders a constant disequilibrium and marks a moment outside of capitalist production where social barriers to capital accumulation are formed and the potential for economic crisis arises. To the extent that it aids in conceptualizing how these obstacles are created and subsequently displaced, Polanyi's double movement may be interpreted as a theorization on capitalism's resilience, ascribing the persistence of the market economy to a constant adaptation of ongoing commodification to the socioenvironmental outcomes of its own destabilizing logic. As a model of capitalist evolution, then, it perhaps does more to explain the reproduction of the contradiction internalized in the concept of the 'fictitious commodity' than to help us understand how that contradiction can be overcome. While this does nothing to diminish the idea that capitalism is ultimately a historically limited system ridden by crises and contradictions, it does highlight the need to take seriously the economy's inherent and dynamic tendency to make creative use of adverse circumstances and turn those into opportunities.

Habitation as improvement? The paradoxical dynamics of carbon trading as climate change mitigation strategy

A dialectical interpretation of Polanyi's argument allows for a problematization of the countermovement and a more nuanced assessment of the role it plays in contesting the social and environmental externalities of commodification. It is in this sense that carbon trading can be conceptualized as an example of Polanyian social protection instead of simply dismissed as a masquerade. To substantiate this point, this section considers two related issues. Firstly, I discuss how commodification and environmental protection come together in the specific case of the EU ETS. Secondly, I expound some of the ways in which problems with emissions trading exemplify the limiting socioeconomic framework within which the Polanyian countermovement operates.

Emissions trading as environmental protection?

Climate change serves as one of the more clear-cut examples of how the market economy, by way of its throughput of ever more energy and resources, threatens to "physically [destroy] man and [transform] his surroundings into a wilderness" (Polanyi, 2001, pages 3–4). The picture painted by scientists in the Intergovernmental Panel on Climate Change Assessment reports is dismal to say the least (IPCC, 2013). Temperatures are likely to increase by well over 2°C over the course of the 21st century, causing a retreat of glaciers and sea ice and a shift in global precipitation patterns, in turn exposing millions of people, particularly in developing countries, to rising sea levels, coastal flooding, and droughts, to name but the more immediate of likely consequences. Insofar as this is attributable to the fetishizing of exchange value over use value—hence to the particularities of the market economy as an ecological regime (Foster, 2009; O'Connor, 1997)—increasing levels of greenhouse gas emissions may be seen as a concrete manifestation of the fundamentally unsustainable nature of commodification that Polanyi identified.

The corresponding need this situation has created for some form of emission regulation is by now widely recognized by all but the most obstinate policy makers. So far, this regulatory response has predominantly focused on the establishment of emissions trading mechanisms. To say that this framework has not been without its controversies would be an understatement.

The mechanisms of the 1997 Kyoto Protocol as well as the EU ETS, still the largest and most ambitious emissions trading scheme, have been heavily criticized by activists, businesses, and carbon traders alike. By far the most important criticism holds that emissions trading mechanisms have failed to deliver any significant reductions in greenhouse gas emissions (Lohmann, 2006; 2011a; 2011c), but the list of other problems is long. For the EU ETS it includes the persistent oversupply of credits; ‘grandfathering’, or the tendency to privilege the largest and generally most polluting industries; free allocation of permits (as opposed to auctioning); the possibility of ‘credit banking’, perpetuating the problem of market oversupply; and the widespread use of dubious offsets (Carbon Trade Watch, 2011; Castree, 2010). As a consequence, the market for EU emission allowances (EUA) has been highly volatile and in recent years failed to deliver the price signal that analysts say is needed to incentivize the rapid decarbonization of industrial production.

In the face of these persistent problems, it might seem naive to claim that emissions trading constitutes a bona fide form of Polanyian-style environmental protection. Indeed, activists as well as scholars regularly refer to the troubled track record of the EU ETS to elucidate the case that carbon trading is unable to help deliver the necessary emission reductions to avert climate change (Gilbertson and Reyes, 2009). Lohmann (2012, page 1177), for example, argues that “Carbon markets are not about decarbonization” at all but instead “help the most fossil-dependent parts of the industrial structure avoid decarbonization, while interfering with other measures that would foster it”. In doing so, he dismisses the suggestion of, for example, Newell and Paterson (2010; 2011) that improved regulation of the market could alleviate current problems with the EU ETS.

While I am sympathetic to Lohmann’s critique of carbon trading, it seems important not to confuse the EU ETS’s lamentable history and the widespread exploitation of its shortcomings with errors in the logic of emissions trading itself (Castree, 2010). Lohmann (2012) seems to insist that current problems with the EU ETS are exemplary of *any* carbon trading scheme (see, eg, also Lohmann, 2011a), but this ignores ongoing attempts by the European Commission to increase allowance prices and assuage the market’s problems. Following the revision of the EU ETS directive in 2009, for example, the Commission has standardized allocation criteria and centralized control over the registry so as to take away the ability of member states to influence quota. It has implemented full auctioning for the power sector and allocation benchmarks for industry, introduced restrictions on the amount and types of international credits that can be used within the EU ETS, and put in place an EU-wide emission cap that is subject to an annual reduction factor (EC, 2009). The Commission is also pushing through a temporary measure to withhold (or ‘backload’) 900 million credits from the market and has launched a proposal for structural reform of the EU ETS that would deal with the problem of oversupply in a more permanent way (EC, 2012; 2013).

While all of these measures come with significant caveats, it does show that a degree of ‘learning’ is occurring in EU climate policy, even if this process is painfully slow and for the time being despairingly inadequate. Dismissing carbon trading on the basis of existing problems therefore underestimates the extent to which this is a *designed* market (Lane, 2012)—or what Callon (2009, page 537) calls “the outcome of genuine processes of experimentation”—that is subject to potential improvements and fine-tuning. To deny this potential for improvement one would in fact need to insist on capitalism’s “inherent and unavoidable dependence on fossil fuels” (Altvater, 2006, page 39), which is an argument that fails to take seriously the resilience of capitalism and its ability to turn crises into opportunities. As Buck (2006, page 65) points out, “capital does not care about what it makes, the machinery used, or the motive source”. Insofar as profitable alternatives to carbon-intensive production and consumption exist, there is in fact nothing ‘anticapitalist’ about a reduction of greenhouse gas emissions—hence nothing impossible about a more properly functioning ETS in which a higher carbon price creates incentives for ambitious domestic investments in low-carbon technology. The unsustainable nature of capitalism's growth imperative in general should not be conflated with an inability to provide responses to individual environmental crises, and indeed to profit from doing so.

Consequently, it is somewhat too easy to brush aside [as does Lohmann (2012)] Paterson and Newell's (2012, page 1172) point that the "potential value of carbon markets in political terms … is to enroll powerful factions of capital in a project of decarbonization". In recent discussions on the reform of the EU ETS it became abundantly clear that supporters of the Commission's proposals to address the issue of oversupply came from the industrial sector as well as from environmental movements. Along with renewable energy companies, the so-called 'backloading' proposal received support from such major energy companies as EON, EDF, GDF Suez, and Shell (Parnell, 2013). The European power sector in particular has emerged as one of the most outspoken supporters of a more ambitious emissions trading system, arguably because it is concerned about regulatory certainty vis-à-vis the future of the EU ETS and the creation of a stable investment climate (EURELECTRIC, 2013). The fact that companies and carbon traders "are interested in emissions caps only insofar as they generate the scarcity needed to sustain a market" (Lohmann, 2012, page 1181) matters very little from a strict emission-reduction perspective. Whether underlying motives are profit-oriented or inspired by environmental objectives, ultimately it is the effective imposition of scarcity in the EU ETS that decides the level of reductions. In creating a tradable commodity and putting a price on emissions, the EU ETS has in fact gone some way to gathering significant business actors behind the idea of a stricter cap.

As Lohmann (2006, page 58) points out, "Pollution trading itself is no corporate conspiracy but rather a joint invention of civil society, business and the state. Non-governmental organisations (NGOs) have been nearly as prominent in its development as private corporations." The EU ETS should therefore above all be seen as a pragmatic instrument, with none of its current characteristics given from the beginning. Indeed, the Commission only gradually warmed to the idea of emissions trading. Its endorsement of the Kyoto Protocol's flexibility mechanisms and the decision to develop its own emissions trading system followed only upon unsuccessful and frustrated attempts to introduce an EU-wide carbon taxation system and oppose the US-led campaign to introduce market-based mechanisms in the Kyoto Protocol (Ellerman et al, 2010). The development of the EU ETS can thus be seen as the outcome of a long, difficult, and ongoing attempt to navigate the objections of industry groups, politicians' concomitant concerns about potentially undesirable economic consequences, and the desire to formulate effective emissions restrictions at the European level.

The 'good' society versus 'bad' market dichotomy is clearly not applicable here. If we face the possibility that capital might find profitable avenues into a low-carbon future, then market mechanisms and a bona fide commitment to climate change mitigation can go hand in hand for the limited purpose of restricting greenhouse gas emissions. As the two sides of the double movement, environmental protection and commodification in this sense serve to reinforce one another. While the profit incentive behind carbon trading creates the potential for a broad political consensus around some degree of emission reductions, we also witness the invention of new markets born of climate change concerns. In this process of "selling nature to save it" (McAfee, 1999) the EU ETS indeed creates new environmental externalities; conflates vastly different practices; reproduces existing inequalities in the use of natural resources; entrenches financially irresponsible behavior; and disproportionally favors some of the most polluting industries in Europe. These are all valid criticisms, and they have been highly instrumental in creating a fuller understanding of emissions trading. But they do nothing to disprove the possibility that a more forceful imposition of sufficiently scarce emission rights might very well result in some degree of emission reduction. If anything, the existing literature on carbon trading clearly shows that it is altogether unnecessary to deny emissions trading's potential role in climate change mitigation to arrive at a powerful critique of the specific form of environmental protection that it engenders.

Emissions trading and the limits to environmental protection

If a comprehensive critique of emissions trading cannot fall back on some inherent inability to reduce emissions per se, then the problematization of the distinctive form of environmental protection that it may in fact provide must be lifted to a different level. A dialectical interpretation of the double movement offers the potential to systematize this critique by focusing on the restrictive framework within which carbon trading operates in a market society. In this subsection I focus on two ways in which these more structural limits to carbon trading as a climate change mitigation strategy are borne out in practice: firstly, the EU ETS's internalization of the need to bring any emission reductions in line with economic imperatives of a market society, and, secondly, its tendency to create new forms of commodification and with them new social and environmental problems.

In parallel with the discussion above we could say that the limits to carbon trading are defined by the broader economic framework within which it operates. As a market-based instrument, emissions trading has fully internalized the economic imperatives of market society, a point that is obvious from the way these schemes are generally promoted as the single most cost-effective way (for companies) to achieve decarbonization. As EU Commissioner for Climate Action Hedegaard has put it, "One of [Europe's] primary concerns is to develop climate policies that are environmentally efficient, in a way that will not hamper economic growth in Europe but which leaves companies maximum flexibility to cut emissions at least cost" (2011). This direct subsumption of emissions trading to economic concerns means that the characteristics of market society are easily read as distinctive traits of emissions trading per se, even if it is ultimately the former that imposes practical limits on the articulation of climate change policy. Hence, while Lohmann (2011a) might be correct in noting that carbon trading incentivizes the cheapest emission reductions while serving to postpone more structural measures, it is not at all obvious that this dynamic is attributable to the carbon market's character rather than to the limitative framework of a market society in which the social provision of needs is (still) mainly dependent on fossil fuels.

The restrictive nature of this broader socioeconomic context should be fully recognized, for it implies that getting rid of carbon trading by itself will not solve the problem. As Smil (2010, page 125) points out, "the oil and gas fields, coal trains, pipelines, coal-carrying vessels, oil and LNG tankers, coal treatment plants, refineries, LNG terminals, … gasoline and diesel filling stations constitute the world's most extensive, and the most costly, web of infrastructures that now spans the globe." Add to this the social and financial capital invested in fossil-fuel-dependent landscapes more broadly, from the proliferation of car use to aviation and industrial agriculture, and it becomes clear that fossil fuels continue to be absolutely central to the process of social reproduction, and that any uncontrolled devaluation of this fixed capital stock in a drive towards a low-carbon future would have major repercussions for the world economy. The airline industry, for example, is a significant emitter of greenhouse gasses that is also worth $618 billion annually, transports almost three billion passengers, and employs millions of workers (IATA, 2011, page 4). Many millions more depend on it for their livelihoods, including workers in the tourism industry, airport infrastructure, and logistics. Any drastic measures to dismantle this high-carbon industry in the name of environmental protection would have major social and political implications. It would be a brave politician that attempts it. Fossil fuels, in other words, have permeated every nook and cranny of industrialized society and acquired an enormous social inertia. In the Global North, and increasingly in developing countries, we seem stuck in a situation where the continued use of fossil fuels has become a socially necessary condition for the reproduction of social relations (Altvater, 2006; Huber, 2009).

Emissions trading needs to be seen in this context. If the EU ETS internalizes the imperative to safeguard a form of economic growth that is currently dependent on fossil energy use, it is not at all surprising that 'protecting society' might very well entail the protection of carbon-intensive industry. The dynamics of the countermovement in this case reflect the inertia of a society trying to safeguard its fossil-dependent social and economic foundations. As I argued above, however, this need not imply that fossil fuels are an *inevitable* or *necessary* condition for the existence of capitalism and, hence, that no emission reductions can occur. Indeed, the point that, for example, Smil (2010) makes is not that the transition to a new energy regime is impossible but that it is bound to be a painful and protracted process. Relating this to the theoretical argument above, the argument I have put forward here is that the limitations imposed by the market framework on climate change mitigation consist in the fact that it subsumes the overall *pace* of emission reductions to the overarching imperative of continued accumulation instead of, for example, to what the Intergovernmental Panel on Climate Change says is necessary to prevent 2°C warming (IPCC, 2013). Carbon trading can be seen as one of the more immediate examples of this condition.

A similar dynamic is discernible in the way that market-based climate change mitigation incentivizes new forms of commodification—hence the continued appropriation of natural resources. Under a well-functioning carbon 'cap' the costs associated with emitting CO_2 are meant to serve as a financial incentive for companies to shift to more efficient or carbon-neutral forms of production. This mechanism supports, for example, technological innovation, the proliferation of alternative energy forms, and emerging industries, and in so doing opens up opportunities for continued economic growth. Pricing carbon helps to define the ecological limits of the framework within which capital operates, thus creating incentives to transform that framework and pursue competitive advantages in 'becoming green' (Buck, 2006, page 63). The existence of climate change and the concomitant need for social and environmental protection is thereby turned into an economic opportunity. As Thornes and Randalls (2007, page 283) put it, "Increasingly as climate change becomes a valuable discourse, being seen to be green or to engage in emissions trading is a marketable asset."

These new forms of accumulation and concomitant social and environmental 'externalities' are well documented in the literature on the proliferation of 'green', 'organic', and 'sustainable' consumer goods and services and on the various controversies in carbon offset markets (Böhm and Dabhi, 2009; Guthman, 2007; Lohmann, 2006; Lovell et al, 2009). One example is the recent expansion of the biomass industry. Under the EU ETS, energy installations using exclusively biomass are exempted because they are considered carbon neutral (EC, 2010), even though this assumption is described by the European Environment Agency as "a serious accounting error" (EEA, 2011, page 1) that neglects the complexities of accounting for carbon in land-use change. Contingent on the EUA price, this situation creates incentives for power companies to shift from conventional to biomass fuels in their energy production units (Schwaiger et al, 2012). Already, there has been a steady increase in imports of wood pellets, the main fuel for biomass power plants, in the UK, Belgium, Italy, the Netherlands, Finland, and Sweden, which is at least partly attributable to the alleged carbon neutrality of biomass under EU climate policy (Carbon Trade Watch, 2012; Junginger et al, 2008). Pellets are currently mainly sourced from production facilities in Canada and the US, but plans exist for biomass plantations in the Global South as well. This raises concerns about land grabbing in Africa and Southeast Asia, with all the detrimental social and environmental consequences this entails for populations that already are vulnerable to environmental degradation, rising food prices, and climate change (IIED, 2011, page 3). More generally, questions have been raised about the environmental impacts of biomass if adopted on a large scale. The EEA has argued that, in a scenario where 20% of energy needs are met through biomass provision, as some projections suggest, the "increase in harvested material would compete with other needs, such as providing food for a growing population, and would place enormous pressures on the Earth's land-based ecosystems" (2011, page 1). The growth of the biomass industry in this way illustrates the contentious dynamics of emission reductions when these take place within a system that is ultimately intent on a growing economic output, with its concomitant demands on energy and resource use.

Conclusion

The recent proliferation of market-based mechanisms for climate change mitigation has been heavily criticized and in some cases dismissed altogether as a misconstrued or even insincere solution to climate change. Some of these critiques fall back on an interpretation of Polanyi's double movement to argue that carbon trading is a form of commodification in disguise and can therefore not be a real form of environmental protection. As I have argued in this paper, however, this critique is somewhat of a simplification. Current problems with the EU ETS need not be proof of some inbuilt inability on the part of emissions trading schemes to induce emission reductions. Indeed, the effectiveness of the EU ETS ultimately depends on the soundness of its emissions cap, which arguably has more to do with political ambition and perceived socioeconomic feasibility than with the EU ETS's character as a market instrument. While contemporary society is characterized by a deep entrenchment of fossil fuel use, this implies that the transition to a new energy regime within capitalism will be a long, painful, and contested process, but not that it is a priori impossible. The larger problem with emissions trading, therefore, is that the conditions under which it can help reduce emissions are those of a market society, most notably the socioeconomic imperative for capital accumulation to continue, implying new forms of commodification, pollution, and socioeconomic inequality.

This partial nature of environmental protection is decisively not a problem of emissions trading alone. There is a broader issue here that is not addressed by isolating market-based mechanisms as distinctively novel and deceptive ways of dealing with environmental regulation. A dialectical reading of Polanyi's concept of the double movement, I have argued, can help us to conceptualize these more structural problems, namely by pointing to the constraints within which attempts at environmental protection necessarily operate in a market society. Rather than being regarded as a mere case of exceptional neoliberalism, the carbon trading framework can thus be seen as a particularly candid reflection of the problematic ways in which market and society are coconstituted in a market society, where too large a disruption to the market framework would itself undermine the economic foundation of society. Political attempts to forge a compromise between these two positions and to reconcile the irreconcilable in the interest of protecting *market society* are just as much a determining factor in shaping market-based climate policy as are the narrow interests of industry. It is in this sense that a dialectical reading of the double movement can go beyond the perceived "purity and innocence of Polanyi's society" (Burawoy, 2003, page 247) and that *The Great Transformation* presumably contains the seeds of a theory on an active but also potentially reactive—even reactionary, and therefore intriguingly problematic—society.

Theorizing on a constrained countermovement thus invokes the idea that the drive for social and environmental protection could figure as an important factor in inducing the spatiotemporal fixes required by capital to temporarily overcome its systemic crisis tendencies (see Harvey, 2007). In the case of climate change, carbon traders as well as high-emitting industries can be seen to seek new profit opportunities—for example, through relocation, investments in biomass, and carbon offsetting—in response to efforts at environmental protection. Insofar as this translates into further commodification, the dynamics of the double movement point to the displacement or substitution of social and environmental problems rather than to their solution. Paradoxically then, as much as climate mitigation policy sets out to protect society from the specific problem that is climate change, it also reproduces the conditions that are the cause of current levels of greenhouse gasses in the first place.

A dialectical reading of Polanyi's thesis suggests that in weighing the carbon market's legacy it is insufficient to identify those industries and financial actors that have been most successful in pushing their own interests and gaining windfall profits from exploiting the shortcomings in the scheme. While exposing these excesses for what they are is certainly important on its own terms, it can only partly explain why weak climate change mitigation efforts persist. Further answers need to be sought in the degree to which fossil fuel consumption has become a socially necessary condition for the reproduction of social relations, and in the way that broader social norms, values, and perceptions of freedom are tied in with the imperative for continued capital accumulation more generally. Exposing the inherently unjust and unsustainable character of corporate greed is one thing, formulating effective strategies for how people's livelihoods can be successfully disembedded from the hegemonic framework of the market is another altogether, and arguably requires a much more nuanced analysis of commodification processes. Yet such concrete strategies to wean contemporary society from its deeply embedded dependence on continued market expansion, commodification, and the never-ending throughput of energy and natural resources are direly needed if we are to move towards a society where social and ecological considerations take priority in productive engagements between humans and nature. Until then, it should not come as a surprise that we end up with the weak compromises of which carbon trading is such a good example.

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Money for nothin' and coal for free: 'Technology neutrality' and biomass development under the Flemish tradable green certificate scheme

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A R T I C L E   I N F O

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A B S T R A C T

Recent literature has highlighted the creation of multiple equivalences as an important factor underpinning the rise of market-based mechanisms for environmental regulation. Extending these insights into the field of renewable energy policy, this article focuses on one example of this trend – namely the principle of technology neutrality as applied under the Flemish tradable green certificate scheme – and analyzes the concrete ways in which it has shaped the evolution of the Flemish renewable energy landscape. Concretely, the article shows that technology neutrality played a key role in promoting the uptake of biomass combustion in old coal power plants in Flanders, which led to a number of undesirable outcomes and gave rise to significant opposition. Correcting these shortcomings required a number of policy interventions on the part of the Flemish government that fundamentally moved the scheme away from the principle of technology neutrality and towards a more hybrid RE support system, suggesting that the promotion of technology neutrality was fundamentally misguided. Together with similar experiences from related market-based instruments, this suggests that the promotion of technology neutrality has far-reaching implications for the environmental effectiveness of climate and energy policies. In light of the continued promotion of the principle, the article calls for full recognition of the inherent technological choices that are being made through the promotion of policies that purport to be technology-neutral.

1. Introduction

Over the last two decades or so, market-based mechanisms have become the go-to solution for governments and businesses coming to terms with the multifarious manifestations of environmental crisis. Be it wetland banking and biodiversity offsetting for 'nature conservation' (Madsen et al., 2011; Robertson, 2004, 2006), carbon offsetting and emissions trading for climate change mitigation (Peters-Stanley et al., 2014; World Bank, 2014), or fisheries management through individual transferable concessions (Lucchetti et al., 2014), the use of markets to facilitate an environmentally 'virtuous' (Paterson and Stripple, 2012) transformation is now common practice. Justifying this development is an alluring narrative about the fruitful marriage of environmental and economic concerns. Markets, it is argued, are by far the best instruments to put us on the path towards a more sustainable society because they prioritize cost-efficiency and thus allow the achievement of environmental objectives at minimum economic costs. The EU's emissions trading scheme (EU ETS), for example, emerged as the main instrument in the European climate and energy policy framework primarily because it promised to minimize mitigation costs for society and protect the competitiveness of EU businesses, thus shielding the European economy from the most adverse effects of transitioning away from fossil fuels (Ellerman and Joskow, 2008; EC, 2014a; Hedegaard, 2011; Skjærseth and Wettestad, 2008).

Underpinning this development is a belief in the commensurability of different socio-ecological realities across geographical and temporal scales, or what has variously been described by critics as the creation of "performative equations" (Lohmann, 2006a) or the practice of "making things the same" (MacKenzie, 2009). As Castree (2003) puts it, for nature to become a marketable commodity requires a process of rendering "qualitatively distinct things [...] equivalent and saleable through the medium of money" (p. 278). This process relies on different degrees of privatization, contextual abstraction, individuation, monetary valuation and fetishism, that obscure the distinctiveness of environmental objects or services and subsume them under strictly quantitative categories that ultimately enable the creation of value (Castree, 2003, 2009; Robertson, 2012). As a growing body of literature demonstrates, this 'dumbing down' of environmental complexity has potentially far-reaching implications for the socio-ecological integrity of

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policy-making and the legitimacy that follows from this. Lohmann (2011a) for example outlines how carbon markets conflate ontological and functional differences between emission reductions when they equate emissions from abiotic (fossil fuels) with those from biotic (forestry-based) sources, or when they substitute counterfactual reductions from a hydropower project in India for actual emission reductions from a coal power plant in Germany. Similarly, Stephan (2012) shows how the operationalization and continuous broadening of REDD+ involved the commensuration of qualitatively diverse landscapes and their discursive reduction to different manifestations of the "carbonified forest" (p. 632), i.e. to a stock of carbon measured in tons of CO_2-equivalent that is fundamentally blind to the multi-layered meanings of forest landscapes in different social and environmental contexts.

While such commensuration processes have been explored in some detail for carbon (offset) markets (Bumpus, 2011; Lohmann, 2006a; MacKenzie, 2009), for wetland banking (Robertson, 2006), and for various biodiversity markets (Pawliczek and Sullivan, 2011; Sullivan, 2013), they remain relatively underexplored outside of these fields. In part this can be attributed to a predominant focus in the literature on single resources rather than on comparative studies of market schemes across a range of different 'natures' and policy arenas (cf Bakker, 2009). This is unfortunate because the lack of comparative analysis arguably stands in the way of a more general argument on the effectiveness of these new, market-based policies. Empirical studies into the creation of geographical, temporal, technological, ... equivalence under a wide array of market instruments would allow for more substantiated comparisons and thereby help discern general tendencies and dynamics. This exercise could help disentangle, to the extent possible, problems of policy implementation and 'erroneous design' from more structural issues with the logic behind market-based environmental policy, which is a key point of debate, for example, in the literature on emissions trading (Carton, 2014; Lohmann, 2012; Paterson and Newell, 2012). In other words, studies that look at commensuration beyond carbon and biodiversity markets could help to falsify the claims of some critics in those two fields, namely that the difficulties encountered within those markets derive from internal contradictions in the nature of market-based environmental policies, and not just from inadequate policy design or faulty government regulation.

This article seeks to contribute to this debate by extending the analysis of commensuration under 'green neoliberalism' (Bakker, 2010) to the field of renewable energy policy, concretely looking at experiences with the tradable green certificate (TGC) market in Flanders, Belgium. It does this by engaging the claim of technology neutrality, one of the key ideological constructs underpinning commensuration practices in TGC markets. Apart from its centrality to TGC markets, this analytical focus is justified by the continued promotion of technology neutrality in the EU ETS (EC, 2012a, 2014a), suggesting that any lessons from TGC markets would be instructive beyond a narrow energy policy framework. In brief, technology neutrality assumes that different technologies can be unproblematically equated under a single market mechanism, and that the market will then gravitate towards the most cost-efficient renewable energy (RE) technologies. In line with prevailing economic theory, this means that successful technologies are 'selected' on purely economic and therefore politically neutral grounds, which is put forward as the most desirable approach to energy policy. In this article I scrutinize these claims by examining how the application of technology neutrality under the Flemish TGC influenced the emergence of biomass combustion as Flanders' renewable energy technology of choice. By focusing on the concrete 'work' that the principle of technology neutrality performed in the evolution of the Flemish RE landscape, I thereby hope to bring out some of the concrete ways in which the conflictual logics of technology neutrality produced a range of undesirable results and ultimately ended up undermining the objectives of the Flemish government. In so doing this article contributes a case study of technology-neutral policy making while furthering theoretical arguments on the contested dynamics of market-based environmental regulation.

The remainder of this article is structured as follows. In the next section, I briefly introduce the literature on TGC markets and elaborate on the principle of technology neutrality, thereby delimiting the analytical framework and pointing to some preliminary parallels with other market mechanisms. I then introduce the Flemish TGC and summarize its evolution, concretely focusing on the uptake of large-scale combustion of biomass in coal power plants. This focus was chosen because these are the installations which so far have been the greatest beneficiaries of the scheme. Drawing on the available literature and interview material, the experiences with the Flemish scheme are then discussed in terms of the contradictions of technology-neutral climate policy, the impact this had on the uptake of RE energy in Flanders, and the steps that policy makers took to alleviate problems with the scheme. The conclusion summarizes the discussion and also connects back to the critical literature on neoliberal governance and emissions trading in particular, suggesting some insights that a focus on technology neutrality could bring for a generalized critique of market-based environmental policies. The arguments put forward in this text are based on an analysis of selected policy and company documents, complemented with 1 telephone interview and 9 face-to-face interviews with representatives from Flanders' main power companies, different government agencies, European and Belgian industry associations, and the European Commission's Directorate-General for Climate Action. Interviews were carried out between March and December 2013 in Brussels.

2. Tradable green certificates and technology neutrality

While EU governments have put in place a wide range of domestic policies to meet their 2020 (and soon 2030) renewable energy targets and reduce energy dependence, feed-in tariffs (FIT) and tradable green certificate (TGC) schemes are probably the most common choices (Jaraitė and Kažukauskas, 2013). The two represent somewhat opposing approaches to RE policy. Feed-in tariffs provide a fixed (though generally differentiated per technology) price for RE production and thus constitute a form of direct government subsidy to RE producers. TGC policies on the other hand put in place a quota-based trading system in which price levels are ultimately dependent on market dynamics. Under a TGC scheme, the energy regulator establishes an annual RE quota that electricity suppliers (or in some cases consumers) are obliged to meet while simultaneously distributing green certificates, representing a guarantee of the renewable character of electricity, to RE producers. To comply with their RE quotas suppliers are then expected to purchase TGCs from electricity producers (Nielsen and Jeppesen, 2003; Verhaegen et al., 2009), which in turn creates the necessary conditions for a functioning market in green certificates to arise. Essentially therefore, the difference between FITs and TGCs is the difference between a price-driven RE policy and a quantity-driven one that leaves pricing to the market. In practice though, a degree of convergence has been occurring in recent years. Some form of price control is now present in most TGC schemes, including, as will be elaborated below, in Flanders.

The development of TGC schemes has been closely intertwined with the discussions on the Kyoto Protocol's flexible mechanisms and the subsequent emergence of for example the EU ETS (Verbruggen and Lauber, 2012). As such, TGCs are underpinned by the same neoliberal principles that lie at the foundation of other market-based mechanisms, namely the diffusion of new property regimes for nature and its 'derivatives' (here: the sustainable character of RE energy); the increased marketization of biophysical goods and services; the prioritization of market conformity as the organizing principle of environmental policy and a concomitant shift to more dispersed forms of regulation that assigns larger responsibilities to non-state actors (Bailey, 2007; Bailey et al., 2011; Castree, 2010). Concretely, TGCs ascribe the selection of specific RE technologies to the market while reducing the role of the state to that of market facilitator (Nielsen and Jeppesen, 2003; Verbruggen and Lauber, 2012). The overarching objective of this exercise is to internalize cost-efficiency concerns in RE policy and thus reduce the financial burden on both governments and businesses. For most actors indeed, this is by far the most attractive part of a certificate scheme. The Flemish energy regulator (VREG) for examples justifies Flanders' choice for a TGC system by noting that it "allows involved actors to choose the optimal strategy according to their own situation," thereby creating "a clear impulse to produce renewable energy with the cheapest technology and on the most suitable location" (VREG, 2011, p. 14, own translation). The same document also displays the VREG's belief that a TGC scheme provides more financially stable conditions for investors (by making RE support independent of yearly budget considerations) and that TGCs are preferable over FITs because the former passes through RE support costs directly to electricity consumers instead of further straining public funds (VREG, 2011).

A key factor in making this argument plausible is the principle of technology neutrality. As with emissions trading, TGC policies create a uniform support system for renewable energy that only minimally differentiates between technologies. In this way, it is argued, they create a level playing field between technological alternatives rather than favour one over the other, leaving it up to businesses "to decide on how best to reduce emissions" (IETA, 2014), an arrangement that is commonly justified by pointing to the "dangers of public officials 'picking winners'" (Stern, 2006, p. 367). In parallel with the justifications for the Flemish TGC, the Stern Review (2006) for example makes the case that technology neutrality should be "the starting point in most sectors" because "[m]arkets and profit orientated decisions, where the decision maker is forced to look carefully at cost and risk are better at finding the likely commercial successes" (p. 368) than governments are. Or as the European Commission describes it, technology neutrality helps "in driving down prices for renewable generated electricity and, according to economic theory, as a result of the competition, stimulating innovation" (1999, p. 18). The technology neutrality claim, in other words, makes the internalization of cost-efficiency concerns in RE policy possible despite the existence of complex and technologically differentiated energy landscapes.

The practical implementation of this logic has proven anything but unproblematic however, and TGC markets have been the focus of considerable criticism. Assessments of TGC schemes in different European countries conclude that electricity producers participating in TGC markets have been amassing considerable rents and are generally far more profitable than producers operating under FIT policies (Jaraitė and Kažukauskas, 2013). In some cases profits have accounted for more than half of the total turnover on TGC markets, thereby making TGC schemes much more costly than anticipated and undermining proponents' claims of cost-efficiency (Bergek and Jacobsson, 2010; Jacobsson et al., 2009; Verbruggen, 2009). Studies also show that TGC systems "tend to favour incumbent companies (e.g. large utilities)" (Jacobsson et al., 2009, p. 2144); that installed RE capacity tends to be higher in countries under FIT systems (Jaraitė and Kažukauskas, 2013); and that investments tend to gravitate towards technologies that are economically 'mature' and low capital-intensive irrespective of their long-term relevance in driving a transition towards a low-carbon energy system (Kildegaard, 2008; Verbruggen and Lauber, 2012; Verbruggen, 2009). Though these critiques have gone a long way towards problematizing the dynamics of TGC markets, their focus on the market's preference for 'mature' technologies has tended to blackbox some of the socio-economic, historical, and geographical processes that help explain why a certain technology proved successful in any given context. By unpacking the concept of technology neutrality as it has manifested itself under the Flemish TGC, I hope to bring these processes to the fore and therewith demystify some of the abstractions underpinning the performance of TGC markets. Inspired by the commodification literature and Bakker's (2009) call for more comparative work more specifically, my aim is thereby not only to scrutinize the forms of equivalence performed by certificate markets but also to build some bridges between the analysis of TGC schemes and the critical literature on other market-based mechanisms, particularly emissions trading. Indeed, much of the critique put forward against TGCs will sound familiar to readers acquainted with the literature on for example the EU ETS. Like TGC markets, the European trading scheme has been accused of enabling windfall profits (Morris and Worthington, 2010; Pahle et al., 2011; Pearson and Worthington, 2009; Sijm et al., 2006) and favouring short-term 'fixes' over structural solutions (Driesen, 2007; Gilbertson and Reyes, 2009; Lohmann, 2006b, 2012). While an in-depth examination of the commonalities between the two is beyond the scope of this work, I hope that by establishing a common analytical framework this article can facilitate future exchange of experiences from different market-based schemes and therewith contribute to a more inclusive critique of market-based environmental policies. The following analysis focuses on one concrete way in which the contested dynamics of technology neutrality became expressed under the Flemish TGC, namely through the uptake of large-scale biomass combustion.

3. The Flemish TGC: from coal to co-firing, to full biomass conversion

Belgium has long been one of the worst-performing European countries when it comes to the production of renewable energy. While the majority (50.4%) of the country's electricity production in 2010 came from nuclear energy, fossil fuels still accounted for 39.7% of the total, about 5% of which came from coal and over 34% from natural gas. In the same year, renewables took up 8.3% of overall electricity production, up from a mere 0.7% in 2001 (EC, 2012b, 2014b; Verbruggen, 2004). Under the national renewable energy action plan (NREAP) mandated by Directive 2009/28/EC, Belgium is committed to increase the share of renewables in its gross energy consumption to 13% by 2020. With an anticipated 20.9% share of renewable energy sourced-electricity (RES-E) by that date, the electricity sector is expected to be the largest contributor to this objective (Belgian Government, 2009).

Energy is a regional competency in Belgium and the responsibility for achieving the RE target is therefore shared between the three regions. In Flanders, the regional government chose to introduce a TGC system, which entered into force on 1 January 2002 and operates alongside a separate certificate system for combined heat and power (CHP).[1] In short, the Flemish system establishes a minimum amount of renewable energy (a RE quota) that electricity

[1] A combined heat and power (CHP) – or cogeneration – plant is a power plant that produces both electricity and employable thermal energy. Producing electricity through combustion produces large amounts of heat, which in conventional power plants represents wasted energy. A CHP plant captures that heat and puts it to practical use, for example in district heating systems. This significantly increases the energy efficiency of electricity production and heating.

suppliers need to provide. This quota is increased yearly on the basis of incremental steps specified in the Flemish Energy Decree, until it corresponds to Belgium's NREAP objective of a 20.9% share of RES-E in 2020. For 2015 for example, the RE quota was put at 16.8% (Vlaamse Regering, 2009, Art. 7.1.10). To prove that they meet their quota, suppliers need to hand in a corresponding amount of 'green certificates' (or TGCs) every year. These certificates are provided by the Flemish energy regulator to electricity producers, who until 2013 received 1 TGC for every 1000 kW h of electricity produced from solar, water or on-shore wind power, or the combustion of biogas or biomass (including household waste). As specified earlier, electricity suppliers then purchase TGCs from the producers in order to fill their quota.

The total amount of awarded TGCs under the Flemish scheme has steadily increased over the years and for 2013 amounted to 5 473 724 (VREG, 2011, 2014a). Biomass has consistently taken up the largest part of these certificates, and until about 2009 accounted for more than half of all renewable energy produced in Flanders (Fig. 1). For the most part this energy came from biomass co-firing in the region's existing coal power plants, namely Rodenhuize (268 MW), Ruien (542 MW), Mol (131 MW) and Langerlo (516 MW) (Claeys, 2009; Vlaams Parlement, 2010), all of which were constructed before or during the 1970s. Here, biomass was mixed together with conventional fuels (mostly coal), generally in smaller quantities,[2] and combusted in adapted burners. Fuel sources varied depending on installation characteristics and availability of waste flows, but generally comprised a mixture of wood chips and pellets, sewage sludge or agricultural waste products such as olive pulp and coffee grounds (VITO, 2014). Together, the four Flemish coal power plants alone accounted for as much as 2 733 314 or 45% of the 6 051 698 TGCs issued between 1 January 2005 and 1 January 2009 (Vlaams Parlement, 2009; VREG, 2014a).

This focus on co-firing led to a number of controversies and undesirable results (elaborated below), which in turn forced the Flemish government to alter the regulatory framework, in 2009 and again in 2013. This set in motion a gradual transformation of Flanders' energy landscape. The oldest coal power plant in Mol permanently closed down in 2010 because, according to Electrabel – the original owner of the region's coal power plants and historically the largest producer of electricity in Belgium – it had ceased to be profitable. The same happened to the Ruien plant in 2013, when after exploring different conversion options the company decided that operations were no longer economically viable (Snoeys, 2012). In 2009, Electrabel announced that it would convert its Rodenhuize plant to a 180 MW, 100% biomass plant (Electrabel, 2009). The project was completed in 2011 and the plant accordingly renamed 'Max Green'. It currently uses imported wood pellets from North America as its primary fuel source and produces between 20% and 30% of Flanders' renewable energy, therewith being the single largest recipient of TGCs (Ackermans and van Haren, 2013; Bond Beter Leefmilieu, 2014). The Langerlo plant in turn was transferred to E.ON and it, too, was earmarked for conversion to a 100% biomass plant. This conversion needs to be completed by 2016 if the plant is to retain its environmental permit and would add about 400 MW to Flanders' biomass capacity (E.ON, 2014). E.ON has however recently made it known that it is no longer interested in footing investments in the plant alone and is currently looking for a partner or an interested buyer (Het Belang van Limburg, 2015; Souffreau, 2014). Like Max Green, the refurbished Langerlo plant would be fuelled with wood pellets sourced from suppliers in the United States and Canada, though additional supply routes from Latin America are also considered (E.ON, 2011). In other words, when (or if) the biomass conversion at Langerlo is completed, conventional coal-firing will no longer be a major source of electricity generation in Flanders and biomass co-firing will have ceased to take up a significant proportion of RE generation in the region.

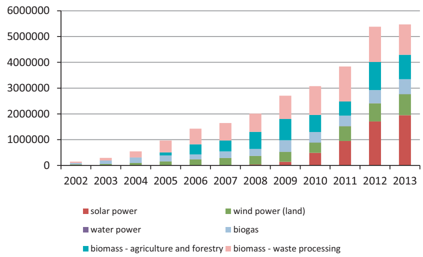

Fig. 1. Flanders 2002–2013 – Awarded TGC per technology (compiled from VREG (2014a)).

4. Biomass, a convenient alternative

From interviews and company documents it is clear that the regulatory framework of the TGC market (and to a far lesser extent the EU ETS) has played a significant role in the particular evolution of the Flemish RE landscape. Both the initial adoption of co-firing in existing coal power plants and the subsequent closure/conversion to full biomass were strongly influenced by the incentive structure of the TGC, and particularly by the degree to which the scheme adhered to the principle of technology-neutrality. This relationship can in part be discerned from existing economic models. TGC markets, much like emissions trading and other technology-neutral market mechanisms, provide a financial incentive that is the same for all low-carbon technologies, in this case 1 TGC per MW h of renewable electricity produced. Yet different RE technologies vary widely in profitability, and therefore also in the amount of support they actually need. Actual technology costs depend on a wide range of variables including the costs of initial investments, raw materials, transport and grid connection, and the technology's energy efficiency. In practice this means that investment costs for wind power for example tend to be significantly higher than that of a coal power plant adopting co-firing, which generally requires only marginal adjustments to the existing energy infrastructure. In 2005, a VITO (the Flemish Institute for Technological Research) study calculated the minimum support that would be needed to make different technologies under the Flemish TGC system competitive. This was based on an estimation of the so-called *onrendabele top (OT)*, or the difference between the actual costs of a technology and the level at which it becomes profitable (Moorkens et al., 2005). The authors arrived at an estimate of €110/MW h for on-shore wind power (>1.5 MW), €99/MW h for a 100% biomass plant, and €68/MW h for the co-firing of biomass in existing installations (Moorkens et al., 2005). Updated figures from 2010 estimate that an on-shore wind power installation of 2 MW would require €94/MW h of subsidies to become competitive, while co-firing would need €58/MW h and a coal power plant fully converted to biomass €75–80/MW h (Meynaerts et al., 2011).

Even though such calculations are a simplification that can't reflect, for example, differences between individual installations, they consistently highlight biomass co-firing (together with biogas in the 2005 calculations) as the cheapest technology in the Flemish

[2] Depending on installation characteristics and the specific period that is examined, the biomass share in the fuel mix could be as high as 25% or as low as 4% (Vlaams Parlement, 2011).

TGC, closely followed by a fully converted coal power plant. Under a market mechanism that does not fully take into account differences in technology costs (i.e. a TGC), this means that biomass and co-firing in particular will accrue the largest benefits and will thus be the most cost-efficient option for companies that need to comply with the Flemish renewable energy targets. A quick calculation for example learns that, at an average TGC market price of €110 in 2005 and €105 in 2010 (VREG, 2014b), companies received a profit of respectively €42 and €47/MW h for every TGC produced through co-firing, while on-shore wind power plants received average surpluses of €0 and €11 respectively. As a 2010 study by the Belgian energy regulator shows, these profits mostly come out of the pockets of consumers. Companies generally pass through 75–100% of the full TGC market price to the electricity price, while themselves only facing the actual (lower) technology costs (CREG, 2010, p. 51). Under these conditions and given the legacy of Flanders' old coal power infrastructure, it seems unsurprising that Electrabel opted for co-firing as its RE technology of choice.

To appreciate the implications of this, it is worth stepping back for a moment to elucidate the broader context within which these dynamics played out. On multiple occasions since 2002, the Belgian government had made clear its intention first to close the remaining coal power plants by 2007 (CREG, 2002), and later, to "reduce the use of coal by 2009" (Belgische Kamer van Volksvertegenwoordigers, 2004) by closing plants and switching to biomass. Arguably the most concrete manifestation of this was the introduction of a federal coal tax in 2004 and subsequent increases in the tax rate (Milieurapport Vlaanderen, 2011). Even if the Belgian government produced little else in the way of a concrete strategy on how and when to bring about a complete phase-out (CREG, 2005; Greenpeace Belgium, 2006), the long-term future for coal in the country seemed increasingly uncertain. Developments in other policy areas compounded the regulatory pressure on the high-carbon, inefficient mode of electricity production persisting in Flanders' coal power plants. For one, Flanders was one of the only places in Europe that already in Phase 2 (2008–2012) of the EU ETS stopped handing out free emission allocations to coal power plants, making them one of the few installations under the EU ETS that faced CO_2 prices as an actual production cost, even if market oversupply meant that this cost remained far below what was originally intended (Vlaamse Regering, 2007). Coal-powered installations were from January 2008 onwards also subjected to stricter, EU-mandated emission ceilings for common pollutants, which implied that these installations could now only produce a fraction of the NO_x, SO_2 and particulate matter that they had been able to emit before (Vlaamse Regering, 2004).

Against this background, the TGC market played a significant role in shaping the evolution of the RE landscape. Under generally adverse regulatory conditions for coal, the generous support for co-firing provided by the TGC gave Flanders' coal power plants a welcome lifeline. By receiving the same level of RE support as other technologies yet being subjected to significantly lower costs, co-firing brought in substantial profits for Electrabel and thus effectively subsidized the continued operation of the company's coal power plants (Claeys, 2009). In essence, the technology neutrality of the TGC thereby allowed electricity producers to capitalize on existing installations, i.e. on historical investments in coal power that had long-since been amortized, as an easy, quick, and low-cost solution to the challenge posed by the government's RE quotas. The irony of this did not escape commentators at the time and the positive incentives for co-firing under the TGC predictably drew heavy criticism. From the onset, the Flemish advisory board on environmental matters (Minaraad) had lamented that "currently, too many resources go into energetically inferior applications of bio-energy such as the co-firing of biomass in coal power plants" (Minaraad, 2005), a situation that according to the organization provided an unnecessary strain on an already tight RE budget and therefore threatened the support for technologies with a higher energetic efficiency hence a higher CO_2 reduction potential. Environmental organizations too criticized the enthusiastic embracement of co-firing by Electrabel and the generous support the company received for this. Not only was co-firing biomass in old and inefficient coal power plants an enormous waste of resources, they argued, its adoption also neglected other environmental externalities, such as the fact that biomass combustion still emitted larger amounts of NO_x, SO_2 and particulate matter than for example a gas power plant would (Claeys, 2009; Greenpeace Belgium, 2006; Minaraad, 2009).

In response to growing criticism, the Flemish government in 2009 decided to adjust TGC market regulations with respect to biomass co-firing. From then on, coal power plants using less than 60% biomass would only be able to use half of the issued TGC credits for compliance with the RE quota (Vlaamse Overheid, 2009). This measure, the government reasoned, would bring support levels for biomass more in line with the co-firing OT and thereby largely do away with windfall profits in the sector (Minaraad, 2009). Even though this move was deemed inadequate by both Minaraad and Flemish environmental organizations (Minaraad, 2009), the effect on the Flemish RE landscape was immediate. Both E.ON and Electrabel in interviews singled out the change in regulation as a key reason for why they changed tactics in 2009 and decided to convert the remaining coal power plants to 100% biomass, and why for example the Ruien plant ultimately needed to be closed. The change in TGC regulation thereby largely erased the economic incentive for co-firing and appears to have made the short-term phase-out of coal all but inevitable.

In doing so however, the problems associated with the TGC's technology neutrality hardly disappeared, but instead shifted from one technology to another. At heart, the decision to fully convert Langerlo and Rodenhuize can be seen a perpetuation of the same impeccable logic that inspired the uptake of co-firing in the first place. Having met regulatory obstacles in pursuing co-firing, electricity producers simply turned to the next logical solution: the conversion of existing plants to use 100% biomass where this was deemed viable. Here too critics pointed to the suboptimal use of biomass (because of the lower energetic efficiency of a converted plant compared, for example, with a new CHP biomass plant) and the waste of scarce economic resources to the detriment of investments in other technologies (Bond Beter Leefmilieu, 2014). As the VREG acknowledged in its 2011 evaluation report, the commensurability of different technologies under the TGC continued to be at the basis of shortcomings in the scheme:

> "Without adequate monitoring and an efficient decision making process, but especially because of the relatively uniform level of support that results from supporting different technologies on the basis of a single certificate, cheap technologies receive too much support for too long in relation to their actual costs. [...] On the other hand, there are technologies that because of this receive insufficient support."
>
> [VREG, 2011, p. 15, own translation]

As previously with co-firing, the full conversion of an old coal power plant was found to be a much cheaper way of complying with the TGC market than the construction, for example, of an entirely new and efficient biomass plant or a wind power park.[3] By converting coal plants to biomass, E.ON and Electrabel are thereby able to prolong the lifetime of existing plants, thus reaping

[3] The conversion costs for both Langerlo and Rodenhuize have been estimated at around €125 million (E.ON, 2011; Electrabel, 2011), while according to interviewees the construction of an entirely new biomass plant would easily cost double even if some of the required transport infrastructure was already in place.

the rent on previous investments and enabling them to outcompete more expensive technologies in the development of Flanders' renewable energy landscape. Then as now, the support that these installations receive through the TGC system is a crucial factor in keeping them economically viable. This was illustrated most dramatically in 2014 when the Flemish government revoked Max Green's eligibility for TGCs because of a dispute with the Belgian wood industry. In response, Electrabel shut down its biomass plant for half a year, only restarting it again when it was assured by the government that it would continue to receive certificates (Mortelmans, 2014). Apart from underscoring the importance of certificate revenues for the operation of Electrabel's biomass installation, the company's reaction also illustrates how contentious the relationship between the regulator and the energy sector had become by that time. In interviews, both E.ON and Electrabel expressed dissatisfaction with the increasingly uncertain regulatory climate within which they needed to operate by 2013, and Electrabel highlighted this as a compounding factor behind their investment decisions. Particularly after the government's 2009 volte-face, increasing concerns in the electricity sector about the future character of RE policy might therefore in fact have strengthened the rationale for 'safe' and comparatively cheap technologies like biomass.

5. Nothing neutral here – Ideological versus actually existing technology neutrality

What emerges from the Flemish case, then, is a clear picture of how the TGC scheme as it was originally designed institutionalized a RE support policy that disproportionately favoured biomass combustion in old coal power plants. In light of the discussion above, this inbuilt bias cannot be reduced to an unforeseen hence unintended consequence of the TGC scheme. As Bergek and Jacobsson (2010) also point out in their analysis of the Swedish system, the subsumption of RE policy to the principle of technology neutrality amounts to the deliberate internalization of the "basic principle that investment should be made "at a rate that is economically justified and not prematurely"" (Bergek and Jacobsson, 2010, p. 1265), in other words, that the desirability of technological investments should be evaluated first and foremost on narrowly economic grounds. Fundamentally this means that the *de facto* higher support for technologies like biomass should be recognized as an inherent characteristic of 'technology-neutral' market schemes and therefore as a conscious decision on the part of policy makers. In the case of the Flemish TGC, this is evident for example from the 2011 evaluation report by the VREG, where it is acknowledged that

> "The principle of uniform compensation entails that the most (cost-)efficient technology receives a higher netto-compensation from the support mechanism than the least cost-efficient technology. *This was a conscious choice to steer the market towards the most cost-efficient technologies*."
>
> [VREG, 2011, p. 12, own emphasis]

The point that needs to be stressed here, therefore, is not just that technology-neutral policy tends to favour certain technologies over others but that it does so *purposely*. For Bergek and Jacobsson (2010), this implies that TGC's are "*deliberately designed to avoid forming nursing and bridging markets*" (Bergek and Jacobsson, 2010, p. 1265, emphasis in original), that is, that they actively lock out new technologies on the basis of cost-considerations and are therefore generally unable to bring about structural change. In the TGC literature, this dynamic is commonly explained in terms of the market's apparent bias towards incumbent players and 'mature' technologies. As Azar and Sandén (2011) point out, market actors tend to be wary of investing in completely new and innovative technologies because of the risks involved and the time it takes before new technologies become profitable. In the absence of some form of incentive structure they will thus tend to prioritize those technologies that are most commercially viable, which indeed seems to be what happened in Flanders. Essentially this means that significant infrastructural investments such as those required in the energy and transport sectors are unlikely to occur without technology-specific measures or other forms of directed government engagement. This is a point that is recognized even amongst authors generally supportive of the idea of technology-neutrality. The Stern Review for example states that

> "[...] the process of learning means that longer-established technologies will tend to have a price advantage over newer technologies, and untargeted support will favour these more developed technologies and bring them still further down the learning curve. [...] This concentration on near-to-market technologies will tend to work to the exclusion of other promising technologies, which means that only a very narrow portfolio of technologies will be supported, rather than the broad range which [...] are required. This means technology neutrality may be cost efficient in the short term, but not over time."
>
> [Stern, 2006, p. 368]

The Flemish case however sheds light on what exactly goes on behind categories such as 'near-to-market' and 'mature' technologies. In a scheme that is first and foremost concerned with cost-efficiency, the legacy of the historical energy landscape becomes an important factor explaining why certain technological choices are being made. In other words, by putting in place a system that steers investors towards the cheapest technologies, TGC schemes embody a choice for technologies such as biomass and co-firing, which tend to face lower costs by being able to make use of the existing energy landscape and long since amortized investments therein. As Nadaï and van der Horst write, "the past casts shadows on our future options, which are written into existing landscapes and energy infrastructures" (Nadaï and van der Horst, 2010). Shrouding this dynamic behind the idea of the market's supposed technology neutrality is, in this sense, misleading, obscuring an ideological choice for a well-defined set of cheap and available technologies.

By problematizing the outcomes of this dynamic for the Flemish case I do not wish to suggest that biomass is a problematic technology by itself, even if concerns about the technology's broader sustainability (Evans et al., 2010; Janowiak and Webster, 2010) or the contestation of its alleged carbon neutrality (EEA, 2011) do suggest reasons to believe so. Rather, experiences with the TGC system in Flanders put focus on the way in which biomass was used and the broader implications for other technologies under the scheme. As critics pointed out, the TGC's inbuilt preference for biomass combustion in old coal-power plants raised concerns about resource use efficiency (because of lower energy efficiencies in old plants compared to state-of-the art installations) and about the role of the TGC in extending the lifetime of these installations. With respect to the latter, this means that the TGC's initial support for co-firing might very well have played a role in prolonging the phase-out of coal in Flanders, thus undermining the ultimate objectives of RE policy. While it is difficult to ascertain that Electrabel would have closed down its coal power plants earlier in absence of the TGC market's preferential treatment of biomass, the prospect of increased costs from carbon pricing, coal taxes, and stricter emission ceilings for common pollutants might have provided the necessary incentives to think of alternative strategies earlier.

The subsequent conversion of Max Green and possibly Langerlo raises similar issues. In the case of Langerlo for example, E.ON estimates that the full conversion to a biomass plant will mean a lifetime extension of about 10 years (E.ON, 2011). In terms of the energy transition deemed necessary to mitigate climate change, this is a fairly limited timeframe. Essentially this means that significant RE support has been channelled into investments with relatively short-term perspectives that have only limited relevance for the more structural transition towards a low-carbon future that will eventually be needed. Indeed, in early 2015 the investment company behind Max Green was voicing concerns over the long-term economic viability of the power plant due to a combination of high pellet prices, low TGC prices, and low electricity prices (De Morgen, 2015). If the plant were in fact to close, the green certificates that facilitated the conversion from coal to biomass in 2011 and brought about the plant's lifetime extension would have had virtually no impact on Flanders' long-term RE objectives. This observation connects to a larger concern with the Flemish TGC's focus on biomass. As biomass became the technology of choice under the Flemish TGC, first as a complement to coal in existing power plants, and then as its preferred substitute, it essentially crowded out adequate support for other RE technologies. As one interviewee readily noted, much stronger action could have been taken in Flanders to support for example wind power, if only this technology path would have been prioritized, as indeed it is in other European countries (VREG, personal communication, December 2013). Instead the government chose to implement a support mechanism that was clearly oriented towards the full development of the region's biomass potential, even if this choice was shrouded in a discourse of supposedly neutral market dynamics.

Over time however, the TGC's preferential treatment for short-term solutions such as co-firing faced significant opposition and seems to have undermined the scheme's long-term environmental effectiveness, thereby directly contradicting its key objectives as a broad-based RE support mechanism. As one interviewee noted, the government's implicit prioritization of biomass never made sense in the long-run, since there were only 4 installations in Flanders that could be converted to biomass plants (of which 2 were subsequently closed), and there has been little interest from installation operators to construct brand-new biomass plants.[4] As changes in the scheme's regulatory framework demonstrate, these shortcomings were gradually acknowledged by the Flemish government. To overcome the inbuilt biases of the TGC system, then, a whole set of complementary regulatory provisions were needed that counteracted or eroded the system's technology-neutral foundation. As early as 2004 the Flemish government intervened in the TGC's price mechanism by setting minimum price levels, effectively guaranteeing that producers could choose to sell their certificates at a fixed price to the network operator instead of putting them on the market. Until 2013 these minimum prices were differentiated per technology and thus in theory could have eroded the technology-neutral character of the TGC. In practice though, minimum prices did little to level the playing field between low and high-cost RE technologies. For one, minimum support levels did not adequately reflect the widely differing profitability margins of RE technologies (LNE, 2005). More important still, minimum prices were unnecessary as long as certificate prices remained high, which they did, at an average market price of 100–110 euro/MW h for the period 2004–2013 (VREG, 2014b). This effectively meant that, until 2011, no certificates were sold at the minimum price for any of the eligible technologies (VREG, 2014c).

The single exception to this was solar power, for which in 2006 a minimum price of 450 euro/MW h had been introduced, far above the going market price for TGCs. This greatly stimulated the installation of photovoltaic (PV) panels by households and thus explains the sudden explosion in the number of awarded TGC for this technology (Fig. 1). The soaring demand for PV together with rapid cost decreases in the sector took the Flemish government by surprise and led to unexpectedly high costs for the network operator, which quickly passed on the burden to electricity consumers. Burdened by the high demand for solar TGCs, the Flemish government has gradually brought down the minimum price for this technology and as of June 2015 no longer hands out certificates for PV installations smaller than 10 kW (Vlaamse Overheid, 2015). In other words, the sudden success of PV is entirely attributable to the government's intervention in the TGC market and the implementation of a minimum price for solar power that far exceeded the market price, thereby in effect generously subsidizing that technology.

Similarly, and as already outlined above, Electrabel's abandonment of co-firing after 2009 was inspired for the most part by the government's decision to half the amount of certificates for this technology. In other words, to achieve Flanders' RE objectives and move away from the initial focus on co-firing in both cases required the abandonment of the principle of technology-neutrality. The Flemish government has since gone even further in this and in 2013 introduced banding factors for all technologies. Instead of 1 TGC for every 1000 kW h produced, the number of certificates that companies receive now depends on a multiplication factor that is determined according to a technology's specific OT. While this further erodes the principle of technology-neutrality, it does not actually take away the advantage for biomass completely since the system 'caps' the amount of certificates any technology can get per 1000 kW h at 1, even if the OT would warrant otherwise (VREG, 2013, 2014d). Nevertheless, the ongoing evolution of the scheme clearly demonstrates a gradual departure from the original TGC market design in response to mounting criticism and a growing recognition that the scheme was not producing the desired results. Ironically, this means that the Flemish government to some extent has had to abandon exactly those aspects that in the beginning were heralded as the TGC's main advantages. As the VREG (2011) puts it, the Flemish TGC is now no longer a 'pure' market mechanism but something of a hybrid between a feed-in system and a TGC. This means that "support policy is increasingly drifting away from the principles of market conformity, which were an important reason for opting for a certificate-based support system" (p. 13). With the principle of technology neutrality eroded, the justification for choosing a TGC market over a feed-in system in Flanders seems deeply weakened.

6. Conclusion

This article has scrutinized technology neutrality under the Flemish TGC as a concrete manifestation of the "performative equations" (Lohmann, 2006a) underlying the development of market-based mechanisms, which is here understood as the commensuration of different technologies under a single price mechanism. It bears repeating that this principle is not just a design choice but is commonly put forward by proponents as a foundational aspect of the economic theory underpinning quota-based market instruments and its benefits. Technology neutrality was one of the main reasons why the Flemish government opted for a TGC scheme over a FIT (VREG, 2011) and it continues to be one of the arguments that the European Commission uses to legitimize the EU ETS as the main component of its climate change mitigation strategy (EC, 2012a, 2014a). This makes it all the more relevant to bring the idea of technology neutrality to the forefront and highlight it as an interesting lens through which to analyze quota-based mechanisms and their shortcomings.

[4] The only exception is a plan by Belgian Eco Energy (BEE) to construct a new biomass plant in the harbour of Ghent, just downstream from the Max Green power plant.

In the Flemish case, the implementation of a technology-neutral TGC led to the rapid uptake of biomass combustion in old coal power plants. This happened soon after the scheme was implemented and is directly attributable to the disproportional support that a uniformly-priced TGC generated for this technology. This development was seen as problematic by critics and eventually also by the Flemish government because it essentially subsidized the suboptimal use of biomass resources, contradicted the intended phase-out of coal-powered electricity generation and diverted significant financial resources away from the support of other RE technologies. Correcting these shortcomings necessitated a gradual but continuous move away from technology neutrality, first through the implementation of minimum prices, provisions to disincentivize co-firing, and finally full-scale technology banding. At each of these steps the RE landscape in Flanders was significantly affected, illustrating the influence that technology neutrality holds over RE investment decisions.

This suggests that the promotion of technology neutrality has potentially far-reaching implications for the environmental effectiveness of climate and energy policies. It is on this point that it is briefly worth exploring the commonalities between experiences with TGC markets and those in emissions markets such as the EU ETS. In the emissions trading literature, critics argue that the commensuration of emissions from different technologies works against the kind of structural change that is really needed (Driesen, 2007; Gilbertson and Reyes, 2009). Lohmann (2011a) for example is quite clear that it "makes it possible, indeed necessary, to make climatically wrong choices [...] for example, to use routine, cheap efficiency improvements to delay long-term non-fossil investment, or to build destructive hydroelectric dams that do nothing to displace coal and oil" (p. 108). A similar case can be made for the Flemish TGC, to the extent that it too prioritized investments in short-term solutions such as co-firing and the adaptation of end-of-life coal power plants that do not reflect a long-term structural transition away from fossil fuels and might in fact postpone the latter. In this, the dynamics of the TGC not only seem to contradict its own objectives as a RE support mechanism but potentially also work against climate, resource efficiency and air pollution policies. When combined with similar critiques of different carbon markets (e.g. Driesen, 2007; Gilbertson and Reyes, 2009; Lohmann, 2011a, 2011b, 2012), this suggests a more general tendency in technology-neutral market instruments to be not merely ineffective but inherently contraproductive, negating the effects of other climate and energy policies and delaying the urgent socio-economic transition that the IPCC suggests is needed (2014). Yet insofar as this conundrum is explained by the process of commensuration itself, it also opens up for policy interventions that fundamentally keep market mechanisms in place yet take away much of the original price uniformity. This is one aspect that is hardly recognized by critics of emissions trading yet emerges as a concrete possibility from the discussion in this article. The introduction of technology-specific components in the Flemish TGC can be interpreted as an attempt of regulators to test the limits of technology neutrality, that is, to reduce price uniformity while still attempting to maintain a functioning market. While it is too early to assess the results of this for the Flemish TGC in any conclusive way, it seems clear that recent changes have managed to mitigate at least some of the negative outcomes associated with the promotion of the scheme.

Ultimately the Flemish case illustrates that there is nothing neutral about a uniform, technology-neutral price system. The prioritization of cost-effectiveness that forms one of the foundational principles of market-based instruments per definition implies a choice for a very specific set of technologies. The disproportionate financial benefits for biomass in coal power plants was an expected outcome of the TGC and should therefore be seen as a conscious choice on the part of policy makers. Extrapolating from this, we could say that technology-neutral policies come with inherent technological biases that should be fully recognized in order to understand the often contradictory outcomes these policies generate. Crucially, these biases derive at least in part from a given technology's compatibility with the existing energy infrastructure, i.e. in the Flemish case with the production facilities, supply chains, distribution networks and logistics of coal power. Here, biomass was a viable option for the most part because of its ability to appropriate the investments that have historically been made for coal-powered electricity production. Ultimately, this is what made it feasible for Electrabel and E.ON to adopt co-firing and biomass conversion projects in response to increasingly more ambitious RE policies. In other words, there is an important historical component to a technology's costs that is all too easily overlooked when market dynamics are shrouded behind abstractions such as technology neutrality and market maturity. The increasing insistence on technology banding in the TGC literature as well as in existing TGC schemes, including the Flemish one since 2013, in effect amounts to some kind of recognition of this. While this is a commendable development in itself, it tends to fall short of a full acknowledgement of the contradictions of technology neutrality hence of the fallacies contained in the theory behind quota-based market instruments. The latter, however, is direly needed if the shortcomings of TGC schemes are not to be repeated elsewhere, including in the EU ETS or any of the future mitigation instruments currently being explored by governments around the world.

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Article III

Dancing to the Rhythms of the Fossil Fuel Landscape: Landscape Inertia and the Temporal Limits to Market-Based Climate Policy

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Abstract: This article makes a contribution to the critique of market-based mechanisms for climate and energy policy. It explores the environmental effectiveness of market instruments by engaging a broadly conceived "fossil fuel landscape", or the material, social, and political inertia of fossil energy dependence, as a factor delimiting policy outcomes. The argument is developed through a focus on the idea of economic efficiency as a key ideological construct underlying market-based policy, and draws on examples from two different market instruments, namely the EU Emissions Trading Scheme, and the Flemish tradable green certificate scheme. I argue that an understanding of the shortcomings of these, and similar, policies requires acknowledgment of the political and socio-economic power that emanates from the temporal dynamics of fossil fuel capitalism, which are reproduced when economic efficiency becomes the key focus of climate policy.

Keywords: market-based mechanisms, EU ETS, tradable green certificates, fossil fuel landscape, landscape inertia

Introduction

In formulating responses to climate change, policy makers are primarily relying on market-based mechanisms (MBMs) such as emissions trading and carbon offsetting. Proponents of this approach hold that this minimizes the costs of emission abatement and therefore reconciles environmental objectives with economic ones in a way that would be hard to achieve with other policies (Hedegaard 2011; IETA 2015). For all the political currency that has been expended on MBMs, however, the results so far have been far from positive. The world's largest emissions trading scheme, the EU ETS, has been mired by controversies right from its inception in 2005 and continues to battle with a host of problems, including the widespread overallocation of emission rights; a crashed carbon price; and windfall profits for some of Europe's most polluting industries (Bailey 2010; Elsworth et al. 2011; Morris 2012; Reyes and Gilbertson 2010). More sobering still is the track record of various carbon offsetting markets, providing as it does ample evidence of the inequitable, environmentally dubious and sometimes outright violent outcomes that are produced when emission reductions are relegated to developing countries (Bachram 2004; Böhm and Dabhi 2009; Leach and Scoones 2015; Lohmann 2006; Spash 2010).

Critical scholarship has been instrumental in theorizing why market-based environmental regulation has tended to fall short of desired outcomes. In part, this literature scrutinizes MBMs as the latest manifestation of an ongoing, neoliberal turn in environmental governance that by itself is likely to produce "predominantly environmentally undesirable and socially regressive political and economic outcomes" (Heynen et al. 2007:2). Hence, scholars have shed light on the many ways in which carbon markets encourage speculation and profiteering to the sole benefit of financial and industrial interests (Bond 2012; Coelho 2012; Reyes and Gilbertson 2010). Others have shown how market-based policies depend on a form of commodification that fetishizes the creation of exchange value by unduly simplifying socio-ecological reality (cf. Castree 2003). Robertson's (2006) examination into wetland mitigation banking, for example, vividly demonstrates how the creation of new environmental markets often has more to do with rendering nature legible to capital than with an accurate representation of ecological complexity. Similarly, Lohmann (2011a) elaborates on how the production of carbon credits hinges on a process of technological, temporal, spatial, and chemical abstraction that sidesteps political choices about how, when, and where emission reductions are to be made. Apart from having clear social and economic consequences, the internal logics of market-based instruments are thereby believed to have far-reaching ramifications for the claims these instruments make to environmental effectiveness (Lohmann 2012).

In the face of the intensifying roll-out of MBMs, critiques such as these mark an important effort to lay bare the contradictions of market-based environmental policy and therefore warrant increased attention. This article seeks to make a contribution to this debate. In line with the literature cited above, it aims to examine the concrete dynamics that predispose market-based mechanisms to undesirable environmental outcomes. However, where much of the existing critique has scrutinized the discrete dynamics of MBMs in terms of their faulty architecture or the internal contradictions inherent in the process of commodification itself, I here want to adopt a slightly different perspective. I want to argue that an understanding of the socio-ecological significance of market instruments also calls attention to the way these instruments relate to the broader dynamics of a (for the time being) fossil fuel-dependent capitalism, that is, the historically specific socio-ecological relations that have shaped the economic system as it exists today. As I elaborate below, this relationship is characterized by a temporal dimension that has far-reaching implications for the environmental outcomes that MBMs generate. Put differently, the intention with this article is to shift focus from the contested production and consumption of new commodities under MBMs per se, to the role(s) that these markets perform within the broader context of fossil fuel capitalism, in order to then make a theoretical point on the alleged environmental effectiveness of market instruments.

In doing so, my emphasis is on the relationship between one of the key ideological constructs underpinning market instruments—the idea of economic efficiency—and what I here choose to call the fossil fuel landscape, or the historical, socio-ecological legacy of fossil capitalism. In line with recent work elaborating the relationship between fossil energy use and the historical development of capitalist social relations (Altvater 2006; Huber 2008; Malm 2016), my aim is to shed light on the dialectical relationship that exists between the energy base of contemporary capitalism and the production of concrete outcomes under market-based climate policy. As I elaborate below, this relationship is usefully analysed through the concept of the fossil fuel landscape, in that the latter allows a theorization of fossil energy dependence as a socio-economic (and historically specific) condition and consequently avoids the potential pitfalls of "fossil fuel-fetishism" (cf. Moore 2014). At the same time of course, this focus enables only a partial explanation of why MBMs tend to result in certain environmental outcomes. Critical scholarship has demonstrated that the interface between socio-economic structures and concrete policy outcomes is a complex, contingent and multifaceted one, and I have no intention of contesting that here. What I do want to argue, however, is that the legacy of fossil capitalism exerts tremendous political power, often in ways that are not always immediately obvious, and that this power should be fully reckoned with when evaluating the performance of MBMs. The environmentally deleterious outcomes of market-based climate policy can therefore in part be seen as a concrete expression of the power relations with which the fossil fuel landscape is imbued. By elucidating this dynamic, I hope to provide an alternative perspective on the determination of MBM outcomes and thereby contribute to existing critiques of market-based regulation. At the very least, I believe this approach adds analytical clarity to the exact conditions that render market instruments environmentally ineffective (if and when they do), and promises to shed light on the way these problems become expressed.

The remainder of this article is structured as follows. In the following section the notion of the "fossil fuel landscape" is developed as a conceptual tool for studying the structural relations between on the one hand market-based climate and energy policy, and on the other the fossil fuel dependence of contemporary society. This discussion is based on a selective reading of literature in landscape and energy geography and specifically focuses on the temporal dimensions of landscape change, or the idea of landscape inertia, as a relevant analytical framework. In the third section I briefly introduce the idea behind MBMs and give a short overview of the two market schemes that I use as examples throughout this text: the EU emissions trading scheme (ETS) and the Flemish tradable certificate (TGC) scheme. I then connect recent experiences with these two schemes to the discussion on the fossil fuel landscape, by engaging with one of the main ideological components underpinning any MBM, namely the focus on economic efficiency, materialized in MBMs through the multiple abstractions and equivalences (cf. Lohmann 2011a) that these trading schemes construct. My argument here is that the prioritization of economic efficiency within current climate and energy policy is mediated through a broadly conceived fossil fuel landscape and as a result tends to produce outcomes with specific environmental characteristics. The conclusion summarizes the argument and underlines the value that a broader, structural perspective on market instruments can bring to existing debates. Examples from the EU ETS are based on a selected literature review, while the analysis of the Flemish TGC system came out of a study of relevant policy and company documents and 10 interviews with key informants, all of which were carried out between March and December 2013.

On the Capitalist Temporality of the Fossil Fuel Landscape

The history of industrial capitalism is, to a large extent, the history of fossil fuel extraction and consumption (Foster et al. 2010). This has been true for much of the 19th and 20th centuries, and to a large extent it is still true today. Despite the prevalence of discourses on decoupling and decarbonization, and despite a steady increase in the share of renewables, global primary energy consumption in 2014 was still composed of 86.3% fossil fuels (BP 2015). Even in the EU, arguably one of the most outspoken promoters of renewable energy technologies, energy consumption remains fundamentally reliant on the combustion of conventional fuels. For 2013 for example, the energy mix in the EU-28 consisted of 23% natural gas, 33% petroleum products, and 17% coal, or a total of 73% fossil fuels, a number that admittedly masks large discrepancies between individual member states (EC 2015).

To analyse the implications of this condition in more detail, fruitful use can be made of the "landscape" concept and the various literatures that engage with it. With respect to my concrete focus, this idea most directly invokes the various energy landscapes that have been produced in the wake of increasing fossil fuel extraction, production, transportation and consumption. From oil wells and coal mines to road networks, harbours, airports, power stations, manufacturing facilities and the landscapes of industrial agriculture, the omnipresent hardware of contemporary capitalism is distinctly representative of its carbon-intensive "lifeblood" (cf. Huber 2013). Scholars working on energy and landscape geography have long highlighted this. Pasqualetti (2013) for example describes how the physical spaces around us have been transformed by our mining of coal, our drilling for oil, our hydrofracturing and oil refining, our construction of fuel storage, transportation and combustion facilities. This literature demonstrates how the extant mode of energy use has "a particular spatiality" that not only shapes many of our everyday activities, but that is also radically different from the spatiality that a full-blown commitment to renewable energy would entail (Bridge et al. 2013; Pasqualetti 2011).

At the same time of course, society's fossil fuel dependence runs deeper than a mere focus on the physical landscapes of energy production conveys. It is also forcefully reflected in the geographies of everyday life. Much of what people in the industrialized world now take for granted—from the globalization of leisure, work, and trade, to current levels of labour productivity, consumerism, and urbanization, to such everyday consumables like electricity and plastics—became possible only through the expansive use of fossil energy, a process that was neither natural or straightforward (Huber 2008). Understanding the root causes of our current predicament therefore requires an analytical perspective that also takes seriously, as Huber puts it, the "social relations, politics, and struggles over how life is lived that stretch far beyond the wells, pipelines, and refineries immediately stained with oil's toxic residues" (2013:xii). It requires that the particularities of our energy use are expounded as deeply embodied in the "everyday processes of social reproduction" (2013:7) and the prevalence of fossil energy recognized as simultaneously a material and ideological condition, the implications of which extend far into the realm of norms, beliefs and values. Bridge et al. (2013) in this context speak of the "spatial embeddedness" of fossil fuels, meaning the extent to which the specificities of the energy system have become internalized in the cultures and social practices of consumers. Huber's (2013) account of the way in which ideas about freedom and a specifically "American way of life" have been constructed around a discourse of access to (cheap and "secure") oil, or Timothy Mitchell's (2011) thesis on the relation between fossil energy and democratic politics, are revealing examples of this. I argue below that the prioritization of economic efficiency in climate change policy is another example of how the dialectical relationship between energy use and socio-economic organization takes on this more-than-material dimension.

The landscape concept captures both these material and ideological aspects of fossil fuel dependence and thereby serves as an analytical window onto the energy-specific organization of society. Indeed, the use of the "landscape" concept to describe and analyse broader socio-economic processes has long been a key feature in geographical literature. Amongst Marxist geographers in particular, the focus on concrete landscapes has proven useful for studying the morphological, representational and signifying processes involved in the production of space. Don Mitchell (2005:49) for example describes the landscape as "actively incorporate[ing] the *social relations* that go into its making", implying that the landscape idea connotes more than the materiality of specific places, indeed, more than that which is immediately observable. Landscapes can therefore be seen as "power materialized" (Mitchell 2012:399). They constitute the concrete representation of the historical labour relations through which space (or nature) is continuously produced, thus offering crucial insights on the way society is structured.

But more than a mere reflection of social relations, landscapes also fulfil an important normative function. As the materialization of existing social relations they easily become evidence of the "natural" state of things, and thus of how society *should* be organized in the future (Duncan and Duncan 1988). The mere material existence of specific landscapes in this way infuses them with a certain authority over "what is "natural" or "right" in a particular place" (Mitchell 2005). In contemporary society the landscape thus reflected and naturalized is a specifically capitalist one, incorporating moments of commodity production, labour struggles, exploitation, resource extraction, ecological degradation, etc. (Mitchell 2012; Walker 2004). With respect to climate change and the use of fossil fuels, this argument can be extended to account for the historically specific socio-ecological metabolism that the landscape embodies and the social and political power that emanates from it. The 21st century energy landscape, in other words, embodies and therefore legitimizes a particularly fossil fuel-dependent mode of commodity production, resource extraction, ecological degradation, etc. through which historically specific socio-economic relations are reproduced. It is this that I here choose to call the "fossil fuel landscape".

The persistence of fossil energy use can thereby be seen through the lens of what Don Mitchell (2005) calls the "enormous inertia" that characterizes landscapes, or the power commonly embedded in landscapes to withstand action and resist change. The world "inertia" is important here because it does not connote the impossibility of change, but rather asserts the delimiting role that material representations of power play in shaping processes of transformation. The notion of landscape inertia, in other words, establishes "what is already there" as a social, material and economic factor to contend with in discussing transformational processes (Mitchell 2012:166). With respect to the focus of this article, it allows for an understanding of the social and material ubiquity of fossil energy in itself, as a significant obstacle to the rapid transition away from fossil fuels. As Nadaï and van der Horst (2010:153) put it, "the past casts shadows on our future options, which are written into existing landscapes and energy infrastructures", meaning that past investment choices delimit the kind of energy technologies that currently seem appropriate or socio-economically feasible. Presumably this dynamic becomes more protracted the greater the socio-economic reliance on a given energy source has become. A society dependent on fossil energy for its most basic socio-economic functions will therefore have all kinds of internalized mechanisms that tend to work against a radical energy transition (Smil 2010).

This understanding of inertia is perhaps more commonly summoned through concepts such as path dependency and carbon lock-in (Unruh 2000; Unruh and Carrillo-Hermosilla 2006). The advantage of enlisting the landscape literature in this debate, however, is that the latter pays attention not just to technological and institutional dynamics (as tends to be the focus on the transition literature) but also to the socio-economic and political dimensions of lock-in. As Don Mitchell notes, "[p]eople work very hard to maintain, to reproduce, the already existent landscape", meaning that landscape inertia is "made real not only in bricks and stone but also in people's livelihoods and homes" (2005:51). In a broader sense then, the landscape concept puts the focus on the historically specific set of socio-economic relations within which energy systems are embedded. In doing so it facilitates a reframing of landscape inertia as fundamentally the inertia of the capital that circulates through that landscape and allows us to see these processes as distinctively capitalist rather than universally applicable ones.

In this context it is worth highlighting a number of distinctly capitalist dynamics that (re)produce and reinforce the observed tendency towards landscape inertia. Interpreting Marx's (1977) notion of "fixed capital", Harvey (2007) for example notes that in their drive for competitive advantage and technological innovation, capitalists need to take ever more capital out of circulation and invest it into fixed capital, i.e. in the commodities, machines, infrastructures and larger "built environment" that enable the production of surplus value and the circulation of capital. This imperative results from increases in labour productivity and from the fact that fixed capital formation is an appealing if temporary solution to reoccurring problems of overaccumulation. In the process, capitalists commit themselves "to use [this fixed capital] until its value is fully retrieved" (Harvey 2007:220), otherwise financial losses would be incurred and profitability undermined. But this also means that "production and consumption are increasingly imprisoned within fixed ways of doing things, and increasingly committed to specific lines of production" (Harvey 2007:221). As Prudham (2004:13) puts it, "the stickiness or inelasticity of spatial configurations acts as a constraint on the circulation of capital", meaning that the fixedness of capital within existing landscapes checks future investments in certain directions and hampers others. Harvey notes that this is a concern particularly for large-scale and durable forms of fixed capital, such as those that make up the built environment. Applied to the current case we could say that, by having invested in the construction of road infrastructure, oil and gas production and transportation facilities, fossil fuel-driven power plants, etc., a capitalist society is economically committed to utilize these assets. It has a vested interest in the endurance of the fossil fuel landscape, indeed even in the reproduction of that landscape to the extent that the current trajectory of technological change entails a lesser risk of capital devaluation than any more radically low-carbon alternatives.

By itself, however, processes of fixed capital formation and landscape inertia do not preclude the possibility of an energy transition. While the current condition can be interpreted as an "inherent and unavoidable dependence on fossil fuels" (Altvater 2006:39) that frames fossil energy as a "necessary aspect of capitalist production and circulation" (Huber 2008:105), the contradictory and dynamic nature of capitalist development also points in a different direction. The tendency for ever more capital to become "fixed" in commodities, machinery and infrastructure is counteracted by the system's in-built need for flexibility and continuous technological innovation. Despite the landscape's deep inertia, therefore, some degree of fixed capital devaluation is inevitable for innovation and subsequent capital accumulation to occur. As Buck (2006:67) points out, "economic landscapes are frequently swept away in periodic rounds of creative destruction [a process that is] internal to the dynamisms of capitalism itself". This process is determined in part by the material limitations (i.e. the physical lifetime) of fixed capital items, but for the most part arises from the creation of socio-economic obsolescence. In other words, if inertia is defined as an inherent resistance to change (and not its impossibility), then that resistance can be overcome through a socially mediated process of devaluation, i.e. a process dependent on revolutions in technological innovation, capitalist competition, changing social needs and norms, etc. (Harvey 2007).

In this way, a focus on landscape inertia moves the debate away from questions about the respective (in)ability of capitalism to bring about the decarbonization of society, and towards considerations on the temporality within which such a decarbonization process can occur. From this perspective, the deep socio-economic entrenchment of fossil energy in industrialized society does not so much block the uptake of renewable technologies, as it provides an argument for why the transition is likely to be a protracted and drawn-out process. Ultimately this is because a rapid and uncontrolled decommissioning of the fossil fuel landscape would entail a "mesh of contradictory forces associated with technological change, disequilibrium, crisis formation, overaccumulation and devaluation" (Harvey 2007:222), all of which would have significant negative social and economic consequences for society at large. To relieve this tension between on the one hand the necessary devaluation of fixed capital (here externally induced by the desire to mitigate climate change) and on the other the imperative to fully retrieve the value "fixed" in the fossil fuel landscape, the obsolescence of that landscape can be planned and the pace of technological change regulated to some extent. This creates a degree of predictability and security with respect to future technologies that allows capitalists to "manage the circulation of fixed capital according to some rational plan" (Harvey 2007:221). As Harvey points out, this can be done at the level of the individual firm, or it could occur through monopoly formation, but for some forms of fixed capital it is likely to involve government interventions in research, taxation, patenting laws, etc. In what follows I argue that market-based mechanisms fulfil a similar role.

A Market-Based Approach: The EU ETS and the Flemish TGC System

The following sections draw on experiences with the EU ETS and the Flemish tradable green certificate (TGC) scheme, two examples of market-based climate and energy policy. The EU ETS is by far the best known of the two. It is one of the main pillars of the EU's climate change mitigation efforts and currently the largest operational emissions trading scheme anywhere in the world, covering the greenhouse gas emissions from Europe's large industries and power plants or about half of the EU's total emissions (EC 2012). Its history and *modus operandi* is well documented in the literature (Bailey 2010; Convery 2009; Ellerman et al. 2010; Skjærseth and Wettestad 2009). The Flemish example on the other hand is probably less well known. It is a regional example of a tradable certificate scheme, a popular incentive instrument for renewable energy production, and was introduced by the Flemish government in 2002 as a way to dramatically increase investments in renewable energy in Flanders (Belgium). It has since become one of the region's key instruments for meeting the objectives of the Belgian renewable energy action plan (Belgian Government 2009). A TGC scheme is similar to emissions trading in that it is a quota-based system in which a regulator creates the initial demand but pricing is left to the market. In short, under the TGC scheme the Flemish government sets a yearly renewable energy quota that energy suppliers must meet and at the same time hands out tradable green certificates to all renewable energy producers. In order to meet their quota, electricity suppliers then need to purchase certificates from producers, which creates the conditions for the actual certificate trading. By increasing the total quota every year, the Flemish government guarantees a gradually increasing demand for renewable energy while companies are at liberty to decide how that demand is filled.

In many ways of course, the EU ETS and the Flemish TGC are very different. One is an attempt to directly internalize the social and environmental costs of greenhouse gas emission, while the other is an incentive scheme that promotes renewable energy and thus only indirectly discourages those emissions. The EU ETS is a Europe-wide system covering multiple sectors, while the Flemish TGC is a relatively small regional scheme only focused on electricity production. An exhaustive description of the peculiarities of each scheme, and indeed of the problematic track records that has characterized both, is beyond the scope of this paper (but see Bailey 2010; Carton 2016; El Kasmioui et al. 2015; Ellerman et al. 2010; Morris 2013). What matters here is that, beyond clear differences in design, proximate objectives and implementation, significant commonalities exist in the broader context, central logic and ideological assumptions underpinning both schemes. Most obviously, both the EU ETS and the Flemish TGC have been operating within a fossil fuel landscape, the transformation of which is part of the justification behind the two schemes. When the EU ETS was implemented in 2005, the primary energy mix in the EU-27 consisted of 79.3% fossil fuels, while the European electricity sector in that year was 54.4% dependent on fossil energy sources (EC 2015; EEA 2012). Similarly, at the start of the Flemish TGC in 2002, electricity production in Belgium was divided more or less equally between nuclear energy and fossil fuel combustion, with renewables taking up a mere 0.7% of the total (Verbruggen 2004). Importantly also, both schemes share a commitment to the economic efficiency of environmental policy, a concern that can be traced back to the work of economists such as Coase (1960), Crocker (1966) and Dales (1968), and that has become increasingly prominent since debates in the context of the Kyoto protocol

(Hepburn 2007; Shields 2007). As Dales (2002:99) famously puts it in his classic treatise on the value of emissions trading, “the best way of implementing a policy is the least costly way”. One could say that this focus on cost-effectiveness/economic efficiency is the common thread that ties different market instruments together, and indeed one of the main reasons why they have become so ubiquitous in the first place (Bailey et al. 2011; Lane 2012; Voß 2007). The EU ETS and the Flemish TGC are good examples of this. The European Commission (EC 2003) expresses the need to “promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner” in the very first paragraph of the EU ETS Directive, while the opportunity to “steer the market towards the most cost-effective technologies” (VREG 2011:12, own translation) is repeatedly mentioned as a key reason for why the Flemish government chose to adopt a TGC scheme in the first place. I argue below that the implications of this focus on economic efficiency, as reflected in a market-based approach to environmental regulation, can partly be understood in the context of the tendential inertia of the fossil fuel landscape.

The Inertia of Economic Efficiency

The idea of economic efficiency is internalized in market-based mechanisms through the opportunities they create for participating companies to trade permits or credits irrespective of the geographically, technologically and ecologically differentiated nature of the “externality” they represent (Lohmann 2011a, 2011b). For the EU ETS for example, the argument is that trading redistributes emission abatement to where this is least expensive. A company that is able to make carbon-saving investments in its own production chain for a cost lower than the EUA[1] market price can thus choose to do so and then sell its excess permits on the market. Other companies meanwhile could find that it makes more economic sense for them to buy EUA’s than to implement their own measures. The alleged overall result is a climate policy that is more economically efficient than when emission reductions would be spread evenly and everyone would simply implement mitigation actions of their own (cf. Coase 1960; Dales 2002; Montgomery 1972). This mechanism is justified by the idea that, for a global problem defined in terms of excessive atmospheric greenhouse gas concentrations, it does not matter how or where emission reductions are made, as long as the end result is an overall decrease in emissions. Within this logic, prioritizing the cheapest emission savings makes perfect economic and ecological sense.

As critics have pointed out, however, economic efficiency is not the neutral aim that it is often made out to be. The long-term mitigation effects of any given carbon-saving measure can vary widely, depending on the kind of technology that is used, the timeframe over which it is implemented, and the kind of market dynamics it sets in motion (Lohmann 2011a). Efficiency improvements to existing coal combustion installations for example might do a lot to decrease emissions in the short run, but they simultaneously also ensure the continued economic viability of coal as an energy source and thereby actually prolong the lifetime of fossil energy use. Paradoxically, this might even lead to an overall increase in the consumption of coal as a consequence of the technology's improved efficiency hence its renewed attractiveness (Alcott 2005; Clark and York 2005). By contrast, investments in renewable energy stimulate the demand for, and research in, alternative technologies and therefore help to incentivize the long-term structural transformation of the fossil fuel landscape. These crucial nuances between different abatement techniques are lost in the quantitative equivalences created as a consequence of the commodification of emission rights (Gilbertson and Reyes 2009; Swyngedouw 2011).

Concerns over the kind of incentives that a focus on economic efficiency prioritizes are to different degrees borne out in the experiences with existing market-based mechanisms. For the EU ETS, determining the abatement choices that have been made as a result of the scheme is not altogether straightforward, mostly because the consistently low carbon price on the European market and the persistent EUA surplus has largely failed to induce emission reductions (Morris 2013). Studies evaluating the EU ETS' first phase (2005–2008)—when EUA prices were initially higher (Ellerman and Joskow 2008)—nevertheless do provide some evidence for the prioritization of certain types of emission reduction. In the power sector, the main strategy that companies employed was so-called "fuel switching", or the prioritized use of installations with lower emission rates over installations with comparatively higher emissions. A country's electricity supply is made up of a network of power plants that are operational to various extents depending on fluctuations in energy demand. The order in which these plants are brought online depends on a host of factors, including fuel costs, differences in energy efficiency and—with the launch of the EU ETS in 2005—CO_2 intensity. An easy way for companies to respond to CO_2 prices is therefore to change the order in which certain power plants are brought online, which indeed is largely what happened (Ellerman et al. 2010). The initial implementation of a CO_2 price led to the widespread reordering of installation priority, in which gas-fired capacity was brought online before coal power plants (Delarue et al. 2008). This makes sense from an economic perspective because natural gas produces only about half the carbon emissions of coal and thus incurs only half the CO_2 cost. As Ellerman et al. clarify, fuel switching "requires no investment and no change in normal operating procedures, and the obvious differences in emission rates among existing power plants would seem to leave plenty of scope for this form of abatement" (2010:175). They go on to show that this logic was most pronounced in those countries with the highest levels of coal and natural gas in their energy mix and that it was probably responsible for the majority of emission reductions in the EU ETS as a whole during phase I.

Insofar as the capacity for increased gas combustion is already in place in many countries, therefore, fuel switching proved to be by far the cheapest way of responding to EU ETS quota. But this strategy also implies that the corresponding carbon emission savings can easily be reversed by switching back to coal when conditions (fuel prices, fluctuations on the EUA market ...) change, as was indeed the case in Europe after 2011 (US Energy Information Administration 2013). A somewhat related concern can be raised for the other major strategy pursued under the EU ETS' first phase, namely the pursuit of energy efficiency investments in both the power sector and various industries. This approach has the advantage that it not only reduces the carbon intensity of energy use but also decreases overall operating costs, therefore fitting in well with companies' general business logic. Ellerman et al. (2010) give the example of ČEZ, the largest electricity provider in central and eastern Europe, and describe how the company speeded up a number of already-planned energy efficiency investments in its power plants as a result of the introduction of the EU ETS. While the overall results of this kind of investment can be framed as a reduction in emissions, it hardly challenges the deep socio-economic embeddedness of fossil fuel dependence. Together then, the legacy of fuel switching and energy efficiency investments suggest that the EU ETS did indeed incentivize abatement during its first few years, but that it did so primarily through activities that required little or no additional efforts on top of what would have made sense for many companies to do anyway. To the extent that companies moved away from high-carbon mode of production, they did so entirely on their own conditions and in a way that was compatible with broader economic imperatives. It is to be expected that any efforts to shore up the presently dysfunctional European carbon market would lead to the re-emergence, in different forms, of exactly this logic.

Given the current difficulties with the EU ETS, it is useful to draw parallels with other market-based instruments to confirm the kind of dynamics that a pre-occupation with short-term and easy solutions gives rise to. The Flemish TGC scheme is one such parallel example. Much like the EU ETS, proponents of this system hold that it "allows involved actors to choose the optimal strategy according to their own situation", thereby creating "a clear impulse to produce renewable energy with the cheapest technology and on the most suitable location" (VREG 2011:14, own translation). Over 10 years of experience with this scheme allows some conclusions to be drawn about the kind of strategies it has incentivized. By far the most successful technologies have been those based on biomass and biogas derived from waste-flows, agriculture or forestry, accounting for well over half of all certificates issued between 2002 and 2013 (Carton 2016; El Kasmioui et al. 2015). Of these, the vast majority went to Flanders' (then) four coal power plants to support the co-firing of biomass (mixed in with coal) or, after 2009, the combustion of 100% biomass in fully converted coal power plants. Economically, this made perfect sense since co-firing and the full conversion of old coal power plants are some of the cheapest technologies under the scheme (Meynaerts et al. 2011; Moorkens et al. 2005, 2010). From a long-term RE investment perspective, however, this focus can be seen as problematic because it revalorizes old and inefficient coal infrastructure and, for co-firing, in a sense subsidizes the continued use of coal. Environmental organizations thus complained that the disproportional incentive for biomass under the scheme was extending the lifetime of Flanders' coal power plants and therewith counteracting phase-out policies and diverting resources away from more sustainable alternatives (Claeys 2009; Greenpeace Belgium 2006; Minaraad 2009).

The popularity of biomass in Flanders, and of fuel switching and efficiency improvements under the first phase of the EU ETS, points to a trade-off between economic efficiency and environmental effectiveness that is negotiated through the existing fossil fuel landscape. Put simply, certain technologies are more cost effective than others not just because of their often-mentioned "market maturity"

(IEA 2008; Verbruggen and Lauber 2012), but also because they are more compatible with the existing energy infrastructure. This was an important reason for why biomass became the technology of choice in Flanders:

> We are talking about an installation [i.e. a coal power plant] that is already there, that has been written off, since Rodenhuize, E.ON, Ruien,[2] those were already there in the 70s, they have been amortized long ago, and yes, you have to make some investments to burn wood pellets in these plants, but I would have to see how much that really is ... Maybe you need to put in place some cylinders ... But god, the oven stays, the turbine stays, the electricity line stays, the workforce stays, what do you actually have to do ... OK, there are sure to be some costs, but crudely speaking, none, at least not compared to building a new wind mill (interview with J. (VREG)).

Underlying this competitive advantage of biomass is a resemblance to fossil fuels that is particularly convenient for energy companies. Fossil fuels can be easily stored and transported, are generally employable independent of weather variations and thus provide a reliable and predictable source of energy that can be easily adjusted to market demand (Huber 2008). These biophysical properties of fossil fuels are reflected in the highly centralized and steerable forms of electricity generation that dominate the existing energy landscape. As a combustible fuel, biomass (and particularly the use of wood pellets) fits many of these characteristics, as of course does the natural gas used in fuel switching. Other renewable technologies meanwhile reflect radically different geographies, often much more dependent on environmental factors such as weather and location (Calvert and Simandan 2010; Nadaï and van der Horst 2010), and therefore tend to require more substantial up-front investments. By themselves, these differences need not make the uptake of renewables impossible, indeed there are plenty of examples to illustrate that they do not. The point, rather, is that the characteristics of the existing fossil fuel landscape, historically constructed as it is, have an inert materiality that plays an important role in determining why a certain renewable energy investment is cost effective while another is not. A company's investment choices, overall energy prices, research and development costs, etc. are all significantly influenced by the ubiquity of a distinctively fossil fuel-oriented energy infrastructure and the centrality of fossil energy use to processes of socio-economic reproduction. In other words, the inertia of the fossil fuel landscape is fundamentally reproduced in the economics of technological development. This need not be a problem as long as politicians make policy choices that consciously confront and counteract landscape inertia. Market instruments that subsume climate policy to the goal of economic efficiency, however, deliberately refuse to do so. The choice for a MBM is a choice for the cheapest technology, which in a world burdened by landscape inertia implies a choice for technologies that are largely compatible with the prevailing fossil fuel landscape.

The apparent ineffectiveness of MBMs that critics highlight can thus partly be explained through a focus on the landscape–policy relationship, which demonstrates how market-based policy outcomes come to be influenced by historical fossil fuel investments. But the inert dynamics of landscape change can also be traced further back, into the policy-making process itself. Also from a political perspective, it is far less disruptive to come up with solutions that are compatible with "what is already there" (Mitchell 2012:166) than to force through radical landscape change. The interlinked material and immaterial aspects of landscape inertia are here in full play. The political logic behind the prioritization of economic efficiency have already been hinted at above, and come out clearly in accounts of how the European Commission attempted to craft support for emissions trading among key stakeholders in response to a failed carbon tax proposal, which had encountered severe opposition from businesses and member states (Ellerman et al. 2010; Skjærseth and Wettestad 2009). Largely because of its apparent compatibility with the existing fossil fuel landscape, in other words, the EU ETS was welcomed as a more politically and economically feasible approach to emission reduction. The Flemish example as well illustrates that political considerations were an important reason behind the choice for a TGC scheme, and consequently, for the prioritization of biomass:

> You can implement that [technology] today, and that is also important from a political perspective, you can get political advantage out of it today: "look, we have this amount of green energy." You don't have to offend anyone by building a windmill in their street, because people will see that, but you can just say: "we are 'green' because we burned wood pellets in that coal power plant" (interview with J. (VREG)).

The prioritization of biomass was constructed through the Flemish TGC system as a cheap and easy solution that was necessary for the achievement of Belgium's renewable energy targets. In part because of this, Electrabel, the operator of Max Green—Flanders' largest converted coal power plant—has been highly successful in securing favourable conditions for its biomass operation. The company has consistently stressed that the TGC support system is a crucial part of making its biomass plant economically viable. When the Flemish government in 2011 decided to reduce the amount of TGCs awarded for converted coal power plants to 70%, thereby taking a step back from the prioritization of economic efficiency it had been advocating, Electrabel managed to secure an exemption for its Max Green plant (Electrabel 2010; Vlaamse Regering 2009). Similarly, when a conflict erupted with the Belgian wood industry in 2014 over the use of wood pellets in biomass plants, and the Flemish government was forced to retract Max Green's eligibility for TGCs, Electrabel shut down its biomass plant for half a year, arguing that its continued operation was no longer economically possible. The plant was restarted only after the government changed TGC regulations, reducing the power of the wood industry to block TGC hand-outs and allowing Max Green to continue receiving certificates (Mortelmans 2014). Asked why the company had been able to push through its interests on these occasions, one interviewee hinted at the legacy of the historical relationship between Electrabel—long the country's main electricity producer—and different government institutions. The Flemish biomass case, in other words, shows how an incumbent energy operator was able to insert its own interests, which for historical reasons are closely tied up with the reproduction of the fossil fuel landscape, into the design of the Flemish TGC. It thereby illustrates the different levels at which the political complicity with the fossil fuel landscape is found to operate.

Conclusion

The challenges industrialized countries are faced with in order to achieve, by 2050, the 80–95% emissions reduction target that the IPCC (2014) says is needed are momentous. They imply nothing less than the radical transformation of an energy landscape that has co-evolved together with modern society itself, and that is therefore deeply entwined with capitalist social relations and with the reproduction of socio-economically and culturally embedded material ecologies. In this article I have argued that any critique of existing climate and energy policy should fully account for these broader socio-economic conditions as a factor delimiting policy outcomes. The conundrum can be thought of in terms of the persistence of the fossil fuel landscape, that is, the combined material landscapes through which fossil fuels circulate as well as the complex socio-economic, cultural and ecological processes that continuously bring them into being. It is exactly this, the produced materiality of fossil energy, embodied in the built environment and in the "lived geographies" (Huber 2013) of people, that gives fossil energy its "enormous inertia" (Mitchell 2005) and invests it with political and socio-economic power.

Market-based mechanisms such as the EU ETS and the Flemish TGC scheme confront this inertia through a focus on economic efficiency. Enshrined in the cost-saving rationale of such instruments is an imperative to contend with that which is already there, simply because the least-costly approach to emissions reduction commonly follows the path of least resistance. The solutions that MBMs incentivize, from standard efficiency improvements, to fuel switching, to technologies such as biomass co-firing, clearly attest to this. They require minimum change to the existing fossil fuel landscape and therefore align well with the broader social and economic realities of the historical energy system. This, indeed, seems to be part of their appeal to policy makers—or to companies whose opinions are of concern to policy makers. While this might seem obvious, I believe the crucial point here is to situate the problem not just in the nature of market instruments, or indeed in the tendential inertia of the fossil fuel landscape itself, but in the peculiar relationship between the two. The market-based approach becomes problematic to the extent that it fails, indeed refuses, to confront the temporality and historicity inscribed in the fossil fuel landscape. As a policy framework, it purports to operate on a historical blank slate rather than within the actually existing energy landscapes that we have inherited from the past and that in very significant ways continue to influence the socio-economic relations of 21st century capitalism. In this sense inertia is a good term here, because it connotes the necessity for some kind of external force to be applied in order to instigate change, something that MBMs explicitly avoid doing. Instead, by subsuming technological choices to a cost-saving rationale, the temporality of the inert landscape is transferred to climate policy and internalized in it. This puts the prioritization of cost effectiveness directly at odds with the reality that the most cost-effective option is also the one that leaves the existing energy landscape largely unaltered.

Clearly this is not an innocent development. As critics have pointed out, the current focus on the low-hanging fruits of emission reduction risks postponing the more radical transformations that will inevitably be needed in the long run. Fuel switching is fully reversible and ultimately only replaces one fossil fuel by another.

Experiences in the Flemish TGC scheme meanwhile demonstrate that even an ostensibly "renewable" technology such as biomass combustion has the potential to prolong the lifetime of existing coal power plants and therewith divert investments away from other renewables. The alleged position of biomass as a carbon neutral and therefore sustainable source of energy, moreover, is highly contested and casts a long shadow on the enthusiastic embracement of this technology (EEA 2011). The market-led prioritization of "cheap and easy" technologies in this way acts as a barrier to the uptake of more benign and long-term alternatives and gives a decisively undesirable expression to policy makers' preference for seemingly neutral categories such as economic efficiency. To be clear, this does not preclude the possibility that MBMs could drive *some* degree of emissions reduction. As proponents are wont to point out, switching to natural gas or biomass[3] still entails a decrease in emissions compared for example to the combustion of coal. The conclusion that can be drawn from the critique of MBMs is therefore not so much that emissions trading is an altogether ineffective climate policy, as that it is a climate policy that is designed to function within a socio-economically restrictive framework that is out of sync with the pace of change that scientists say is needed. In other words, the problem is not that a scheme such as the EU ETS cannot, given a higher carbon price, incentivize decarbonization, but that it incentivizes a kind of decarbonization that is necessarily slow and gradual, and that is ultimately determined by inert socio-economic imperatives rather than environmental concerns. In this it is reminiscent of processes of planned obsolescence that Harvey (2007) deems necessary in order to resolve the tension between the contradicting demands of technological innovation and fixed capital devaluation. The immediate appeal of this approach, in political economic terms, is that it promises the decommissioning of the fossil fuel landscape through a measured and gradual process that avoids the social and economic upheavals that more radical climate change policies would inevitably spur (see also Carton 2014).

Taking account of the concrete power of the fossil fuel landscape, in dialectical terms, thus sheds light on the geographical dimensions of policy makers' preoccupation with economic efficiency. It helps to bring out why exactly concerted attempts to reconcile environmental ambitions with the temporal logic of fossil fuel capitalism turn out to be problematic and what implications this has for the effectiveness of climate and energy policy. Reflecting on Marx's dictum that social and political choices are made not under conditions of one's own choosing but "under circumstances directly encountered, given and transmitted from the past" (Marx 1959), one could argue that these circumstances are not merely socio-economic but pertain also to the character of historic energy use, hence to the socio-ecological relations that are materialized in the contemporary landscape. Due recognition of the temporal dynamics of capital accumulation as they operate through the existing energy landscape and through allegedly neutral market-based mechanisms in this sense can help formulate an answer to the timely question of why weak climate and energy policies persist.

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Endnotes

[1] EUA stands for EU Allowance, or the emissions right unit that is used under the EU ETS. 1 EUA corresponds to 1 tonne of CO_2-equivalent emissions.
[2] These are three of Flanders' coal power plants.
[3] Though for biomass this ultimately depends on the overall sustainability of the resource that is used (EEA 2011).

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Article IV

Where forest carbon meets its maker…

Forestry-based offsetting as the subsumption of nature

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ABSTRACT

Research on the subsumption of nature has traditionally focused on productivity increases and extractive innovations in nature-based industries. In this article, we argue that it can also be employed beyond that context in order to capture the convoluted dynamics of market environmentalism. To substantiate our argument, we draw on recent fieldwork on 'Trees for Global Benefits', a forest-based offsetting project in western Uganda. Much like industrial tree plantations, this project relies on the subsumption of carbon to market imperatives in order to guarantee the quality of its carbon offsets. The various difficulties this process engenders, both natural and socioeconomic, give rise to a host of environmental consequences and set in motion the progressive disciplining of the carbon offset producers themselves. The article concludes that the application of the subsumption framework to non-industrial sectors calls attention to the interlinked dynamics involved in subsuming both nature and labour.

Key words: subsumption of nature, subsumption of labour, carbon offsetting, carbon forestry, Uganda

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Introduction

In a 2001 article for this journal, Boyd et al. introduce the idea of the 'subsumption of nature' as a framework for analyzing the multiple and often contradictory ways in which nature enters into capitalist production. Despite the resonance of their argument to ongoing debates on commodification, market environmentalism, and neoliberalizing natures (Arsel & Büscher, 2012; Bakker, 2010; Castree, 2010; Heynen et al., 2007; Robertson, 2012), few scholars have so far engaged with it in detail. This is surprising given that Boyd et al.'s main point revolves around the material obstacles and opportunities that nature poses to capital accumulation, an issue that is directly relevant to continued discussions on the role of materiality, non-human agency, and nature's 'unruliness' in commodification processes (Bakker & Bridge, 2006; Fairhead et al., 2012).

This article revisits the subsumption thesis and argues that it can be fruitfully applied beyond the contexts focused on by Boyd et al., including for the analysis of market environmentalism. Based on 62 interviews and a document analysis of a carbon forestry project in western Uganda – 'Trees for Global Benefits' (TFGB) – we connect the subsumption thesis to recent debates on carbon offsetting and the multiple abstractions that are needed to 'force' natural processes into a market framework that demands predictability and calculability (Bumpus, 2011; Lohmann, 2011; MacKenzie, 2009; Osborne, 2015). Doing so, we propose, sheds light on the ways in which the materiality of carbon forestry shapes and impedes the creation of offsets, as well as the kind of strategies that market actors adopt to overcome the resulting challenges. It demonstrates how the production of carbon offsets is fundamentally underpinned by the subsumption of carbon to capital, a contentious and problem-riddled process that is always both social and ecological. As such, we suggest that the application of the subsumption framework beyond the boundaries of capitalist industry helps highlight the fairly unexplored relationship between the subsumption of nature and the subsumption of labour. Our overall intention is thereby to constructively broaden Boyd et al.'s arguments in order to build a bridge between the subsumption thesis and ongoing debates on the neoliberalization of nature.

The next section gives a concise literature review of the subsumption of nature thesis and clarifies our interpretation of it. We then briefly elaborate on the relevance of the subsumption framework for understanding (forestry-based) carbon offsetting in general before introducing the TFGB project as the focus of our analysis. In the discussion we present the project's attempts to subsume tree carbon to the demands of the carbon market as well as the obstacles encountered in doing this. The conclusion summarizes the argument and underlines the importance of recognizing the intertwined relationship between the disciplining of labour and the subsumption of nature.

On the subsumption of nature

By analogy with Marx's (1977) arguments on the subsumption of labour, Boyd et al. (2001) propose that the evolving relationship between capital and nature can be conceptualized as a dual process involving the formal and real subsumption of nature. The former, they argue, is characterized by a fundamentally extractive relationship that "confront[s] the biophysical world as an exogenous set of stocks or flows, biophysical processes, and material characteristics" (p. 562), that is, a process by which nature-based industries enlist resources and ecosystem services as factors in the production process without any attempt to "control, intensify, manipulate or otherwise "improve"" (p. 562) upon them. The real subsumption of nature on the other hand directly attempts to "(re)make [nature] to work harder, faster, and better" (p. 564), for example by engineering the genetic code of species in order to increase yields or turnover times. Since the latter revolves around increases in the biological productivity of natural systems, the authors argue, it exclusively applies to biologically based industries. The formal subsumption of nature by contrast can be found in both biologically based and extractive industries.

In many ways, Boyd et al. continue, the real subsumption of nature allows biologically-based industries to overcome the obstacles posed by a nature that is subsumed only formally, including the spatiality and scarcity of resources, natural reproduction rates, perishability, etc. As much as the subsumption process thereby introduces solutions to existing biophysical obstacles however, it also raises new ones. Alterations in species' genetic code for example pose risks in terms of "the potential escape and proliferation of novel life forms, the creation of super weeds or new virulent strains of virus and pathogenic bacteria, and the disruption of larger ecological processes" (p. 566), all of which may manifest themselves as new barriers to capital accumulation. In other words, the subsumption of nature here appears as a necessarily incomplete process, marking a continuous attempt by capital to control or 'discipline' nature for the purpose of accumulation, and a concomitant 'response' by nature that escapes human intentionality (Smith, 2006).

Smith (2006) puts forward an alternative interpretation of the subsumption thesis. Problematizing Boyd et al.'s "external conception of nature" (p. 30), he argues that the analytical distinction between extractive and biologically-based industries is altogether too simple. "Even the formal subsumption of nature," he notes, "always deployed biological systems as forces of production, as with industrial agriculture, and today's real subsumption of nature, while crucially biological, is not entirely so" (p. 31). Instead, Smith elaborates on his own 'production of nature' thesis (2008) to suggest that the transition from formal to real subsumption can also be thought of as the move from an extensive production of nature, characterized primarily by the geographical spread of extractivism, to an intensive one, that is, a "vertical integration of nature into capital". "Capital", Smith puts it, "is no longer content simply to plunder an available nature but rather increasingly moves to produce an inherently social nature as the basis of new sectors of production and accumulation" (Smith, 2006, p. 33).

Smith furthermore draws attention to the seeming absence in Boyd et al.'s (2001) argument of the relationship between the subsumption of nature and human labour. Marx, he argues, insisted on the cooperative character of labour, organized by technological and organizational innovations, as the driving force behind the production of relative surplus value hence the transition towards the real subsumption of labour. If, as Smith (1996, 2008) argues, we recognize that the production of nature is ultimately the result of human labour, hence that the intensified search for relative surplus value changes the way in which labour produces nature, then full recognition of the relationship between the increased technological and social organization of labour on the one hand, and the deepening integration of nature into capital seems in order. Ultimately this opens up for a theory that considers the subsumption of labour and the subsumption of nature as dialectically related, rather than merely parallel developments.

For the purpose of this paper, we here broadly follow Smith's (2006) broadening of the subsumption thesis. Smith's reinterpretation of subsumption as the extensive/intensive production of nature usefully captures ongoing developments with carbon trading and offsetting, in which the circulation of capital has become associated with the intensive commodification of nature in the name of climate change mitigation (Lohmann, 2011). Crucially, this process involves not just the appropriation or 'grabbing' of an 'already-existing' nature (Fairhead et al., 2012), but also the combined discursive and material reworking of nature so as to make it more amenable to carbon market imperatives, for example by reshaping historical landscapes, applying particular offsetting technologies or prioritizing certain species over others (Bumpus, 2011; Leach & Scoones, 2015; Osborne, 2011, 2015). A similar trend can be discerned in other examples of market environmentalism, including for biodiversity and wetland conservation (Robertson, 2006; Sullivan, 2013). Smith's (2006) broadening of the concept in this way allows subsumption to be recast as one particular moment in the commodification and neoliberalisation of nature. It goes beyond a mere focus on industry and industrial production as the space where nature is subsumed and thus mirrors evidence from the 'neoliberal natures' literature that the nature-capital relationship is increasingly negotiated outside the sphere of traditional industrial production (Arsel & Büscher, 2012; Castree, 2010; McCarthy & Prudham, 2004). To the extent that "the fictitious capital of ecological credits and environmental derivative markets [has become] integral to socializing the real subsumption of nature" (Smith, 2006, p. 31), it indeed makes little sense to try and fence off particular industries as the sole locus of subsumption. At the same time however, there is something valuable in Boyd et al.'s (2001) attention to the obstacles and opportunities provided by biophysical nature. This recognition of nature's materiality as a socio-ecological force to reckon with, indeed of some form of natural agency independent of human labour, is largely lost in Smith's (2006) argument yet seems a crucial part of understanding the limits to the production and commodification of nature (Bakker & Bridge, 2006). A number of scholars have engaged with this question in recent years, with Bakker (2005) for example examining the 'uncooperativeness' of water as a commodity, and we believe this perspective needs to be at the forefront of any discussion on the subsumption of nature. The challenge, then, and the line that we try to tread in this paper, is to take seriously Smith's (2006) point on the socialization of the real subsumption of nature, while recognizing the fundamental materiality of natural processes as key obstacles that capital seeks to overcome.

Carbon forestry as subsumption of nature

Carbon offsetting – or the 'compensation' of greenhouse gas emissions by funding carbon reduction projects, primarily in developing countries – has emerged as one of the most fiercely contested issues in climate policy debates. While a full review of this literature is beyond the scope of this paper, it is useful to highlight some of the main controversies that have surfaced, bearing in mind that particular outcomes will always be contingent on the socio-economic contexts within which projects unfold (Bakker, 2009). Amongst others, offset projects have been linked to land grabbing; the violent displacement of rural communities; the unequal distribution of, and access to resources; a particular propensity for corruption; and a range of deleterious environmental side-effects (Böhm & Dabhi, 2009; Leach & Scoones, 2015; Nel & Hill, 2014). Offsetting practices have also been criticized for displacing the burden of mitigation to some of the world's poorest communities while giving the richest countries - and those most responsible for climate change - the opportunity to avoid taking action themselves (Bumpus & Liverman, 2008).

Their alleged climate change mitigation effects, meanwhile, are often difficult to determine (Sedjo & Macauley, 2012; Spash, 2010). Forestry-based projects are particularly controversial in this respect. In order to make a reliable calculation of the amount of offsets that a forestry project can claim, developers need to provide detailed information about the project's sequestration activities that is hard if not impossible to come by. Proving that offset claims are genuine for example fundamentally demands that projects develop a baseline of how much carbon would have been sequestered without the project's activities, in order to prove that these are 'additional' to what would have happened otherwise. Because of the counterfactual nature of this exercise, its accuracy is hard if not impossible to ascertain (Lohmann, 2011). Similarly, establishing accurate carbon sequestration rates requires reliable data on the biomass production in forests, which tends to be highly variable depending on tree species, climate, geography, tree density, etc. and needs to take into account hard-to-measure factors such as carbon deposits in the soil and root growth (Nair, 2011). This is a degree of detail that is challenging for even the richest countries to provide, let alone those generally lacking the financial and technical capacity to carry out consistent monitoring of remote areas. Guaranteeing the permanence of sequestered carbon, meanwhile, comes with its own challenges, given the long timescales involved in growing trees and the often precarious ecological, socio-economic and political conditions at project locations (Galik & Jackson, 2009). Because of the importance of forest resources to rural livelihoods in much of the global South, forest projects seem perpetually at risk of being challenged and contested (Leach & Scoones, 2015).

Many of these problems relate to the variability and socio-ecological complexity of forests and therefore reflect challenges in the forestry sector more widely. As Prudham's work (2003, 2004) illustrates, forestry companies have long been confronting nature as a particularly uncooperative partner, providing obstacles to the economic rationalization of industrial tree growth in the form of decades-long growth rates and species and age diversity in natural forests. As companies sought to overcome these obstacles, they increasingly embarked upon the real subsumption of nature, i.e. the control of biological time and space through intensified plant breeding, the selection of faster-growing species, and a general tendency towards standardization and monoculture plantation in order to facilitate management and harvesting (Boyd et al., 2001). The same concerns apply to forestry-based offsetting in that many afforestation/reforestation projects take the form of large-scale monoculture plantations of fast-growing species where tree densities and growth rates are carefully controlled to maximize carbon sequestration. In such projects, fast-growing species such as pine and eucalyptus are popular choices because they can typically be harvested on a shorter rotation than most other trees. Since biomass accumulation and carbon sequestration go hand in hand, improvements in biological productivity and plantation management benefit the production of both carbon offsets and timber. This effectively aligns the subsumption of tree growth to capital with what could be called be called the subsumption of carbon, or attempts to increase the biosphere's carbon sequestration rate through interventions in land use and the species composition of forests.

The above, 'intensive' carbon forestry model has been extensively criticized for creating new environmental problems (biodiversity loss, soil moisture depletion by eucalyptus plantations, …) and neglecting the social and economic impacts of projects on rural communities (Cavanagh & Benjaminsen, 2014; Lyons & Westoby, 2014; Nel & Hill, 2014). Partly in response to this, there has been a recent surge in interest for more small-scale, participatory offset projects that promote an active concern with the ecological aspects of forestry and its environmental justice implications, and therewith promise a sustainable alternative to large-scale monoculture plantations. In what follows we argue that the subsumption framework can in fact be extended to these non-industrial projects as well, and that doing so helps elucidate the contentious relationship between the subsumption of nature and human labour.

The subsumption in 'Trees for Global Benefits'

As one of the oldest offsetting projects in Uganda, Trees for Global Benefits (TFGB) has been producing carbon offsets for the voluntary carbon market since 2003. The project engages smallholder farmers to plant trees on their land and then provides the resulting carbon credits to buyers, mostly companies in Europe seeking to 'green' their products (Ecotrust, 2009a). Participants thereby enter into a carbon contract through a Ugandan NGO called Ecotrust, which manages the project. In doing so, they agree to plant a given number of trees on a specified area (mostly 400/ha) and in return receive 5 payments spread out over a 10-year period. After this, farmers are expected to keep the trees for another 10 to 25 years (dependent on tree species) before they can harvest, sell the timber and use the proceeds as desired. Tree growth is evaluated by field monitoring, which is important to ensure the project's environmental integrity and in theory happens ahead of each of the five milestones outlined in participants' contracts. Project officials visit the farms and, depending on what stage in the project farmers have reached, count the number of trees or tree diameters. If the result matches the objective stated in their contracts, farmers are then qualified to receive the corresponding payment.

TFGB aims to go beyond mere carbon sequestration and envisages tree cultivation to create a number of environmental and community co-benefits, including biodiversity conservation, the provision of fuelwood and construction materials, and income diversification (Ecotrust, 2009a; Plan Vivo, 2016). A self-proclaimed 'community-based project', TFGB is thereby commonly framed as a best-practice example and a role model for other projects in the country to follow. In recognition of this, the project in 2013 won the SEED Low Carbon award for its role in "supporting entrepreneurs for sustainable development" (SEED, 2013). TFGB has grown significantly over the years and now spans multiple districts in the east and west of the country. To date, it has issued nearly one million carbon credits and has approximately 5000 ha under management, involving over 4600 participants (Plan Vivo, 2016). For this study, we have focused on one of the project areas, Mitooma (formerly part of Bushenyi) district, in western Uganda, where TFGB's original pilot study took place and participants have the longest experience with the project.

On the face of it, TFGB moves away from the subsumption of nature (and the attendant prioritization of economic efficiency) witnessed at industrial tree plantations. The project prides itself on the use of native species and fruit trees, which are meant to offer biodiversity benefits and alternative income opportunities to participating 'carbon farmers' (Ecotrust, 2009a), but which also entail a comparatively lower yield and a lower rate of carbon sequestration than fast-growing eucalyptus and pine stands. Strong emphasis was put on the development of agroforestry-style forest gardens, in which different species are planted together and intercropping with common food and cash crops such as plantain (*matooke*), tea and coffee is practiced. In the areas that we visited nearly all participating farmers had what Ecotrust describes as a 'mixed native woodlot', containing a mixture of different indigenous trees and fruit trees. Initially also, the project envisioned a fairly individualized approach to offsetting that would increase both farmer involvement and the reliability of calculated offsets. TFGB's first annual report, published in 2004, describes how carbon sequestration rates would be estimated based on available data for the different tree species and then "adjusted based on the specific species combinations that each farmer has planted" (Ecotrust, 2004).

Closer scrutiny of the project, however, reveals interesting parallels with the kind of 'nature production' that occurs at large-scale forest plantations. For example, the choice for indigenous trees hence for a slower rate of carbon sequestration makes perfect sense on the voluntary carbon market, where carbon credits that promise biodiversity conservation and community benefits command a higher price than offsets from the cultivation of exotic tree species (Bumpus, 2011). As Ecotrust acknowledged in response to questions from farmers on why they could not grow pine and eucalyptus, "carbon from trees such as eucalyptus is not attractive to buyers" (Ecotrust, 2007, p. 21). Rather than accumulating capital by way of the mere expansion of material production and concomitant increases in biological productivity, TFGB here taps into a growing market for what Paterson and Stripple (2012) call 'boutique' carbon credits, which more than 'ordinary' carbon credits rely on the production of attractive narratives about the added ecological and developmental virtue of offset projects. The cultivation of native tree species in this sense should be interpreted not as a step back from the intensive production of nature witnessed in tree plantations, but rather as a subtle change in the type of accumulation that nature is enlisted in. As such, TFGB serves to illustrate how the subsumption of carbon forestry occurs not just through the appropriation/reworking of nature's material qualities but also through its discursive construction.

Within the boundaries of this 'boutique' market meanwhile, biological productivity has emerged as an important factor shaping project design as well as the composition of farmers' gardens. The project's initial intention was to help protect native trees by diversifying the species grown by farmers, whereby "special attention will be given to those species, whose populations and genetic variety has been greatly reduced by the overexploitation of forest resources in this area" (Ecotrust, 2009a, p. 24). In practice however, and from the very beginning, particularly the fastest growing indigenous trees have been promoted by TFGB. During the project's pilot phase in Bushenyi for example, just four species accounted for nearly 80% of all trees planted during the first year of the project, namely *Maesopsis eminii, Funtumia elastica, Terminalia spp.* and a tree known only by the local name Omuyuvu (Ecotrust, 2004). *Maesopsis eminii* and *Terminalia spp.* are both short rotation trees that can be harvested after 15-18 years, while *Funtumia elastica* is a medium rotation (25-30 years) species that can also be harvested after 10-15 years for use as construction poles.[1] Long rotation trees, including such high-value and ecologically vulnerable hardwoods as *Khaya spp.* (African mahogany), are clearly underrepresented in Ecotrust gardens.

This choice for fast-growing species is driven by farmers themselves as well as by the project design. On the one hand, Ecotrust states that "most farmers seem to prefer fast growing tree species" (Ecotrust, 2004, p. 15), a conclusion that was confirmed by our field visits. In fact, the vast majority of farmers we interviewed stated that they would prefer to grow eucalyptus instead of indigenous trees. This can be seen as a reflection of the fact that farmers are given a direct financial stake in the production of nature, since they are the ones that stand to benefit from the harvested timber, while the benefits of biodiversity conservation are far more elusive. Eucalyptus cultivation, in addition to tea, coffee, and *matooke*, is a common land use in the area and participants are therefore well aware of the commercial benefits of fast-growing trees. On the other hand, Ecotrust has itself moved away from its initial focus on agroforestry to rely more heavily on the cultivation of *Maesopsis eminii*. To estimate carbon sequestration rates and monitor progress, TFGB makes use of so-called 'technical specifications' that outline the species to be used, rotation periods, required tree densities, spacing, thinning and pruning practices, etc. and thus serve to standardize cultivation practices and make them legible to the requirements of the carbon market (cf. Osborne, 2015). While farmers in the pilot phase seem to have had a high degree of freedom with respect to tree choices and plantation systems, Ecotrust subsequently converged on two possible technical specifications, namely a 'mixed native species woodlot' composed of 80% fast/medium-growing species (<25 years) and 20% slow-growing species (>40 years) (Ecotrust, 2016), and a 'sole species woodlot' existing of 80-100% *Maesopsis eminii*. The choice for this species was motivated by "its popularity in terms of fast growth, germplasm

[1] The rotation period and growing characteristics of Omuyuvu could not be determined.

availability, ease of propagation, compatibility with most agricultural crops, and superior timber products" (Ecotrust, n.d.). In other documents, the organization also mentions *Maesopsis*' benefits as a self-pruning (hence lower-maintenance) species and the fact that it is one of the few indigenous trees for which some data with respect to growth characteristics and biomass accumulation is available. Until recently, most farmers appear to have been recruited on the basis of the *Maesopsis* system.

Obstacles to the subsumption of forest carbon

In order to ensure the credibility, hence the marketability of its offsets, TFGB needs to guarantee a certain degree of carbon sequestration to its buyers. Apart from choosing fast-growing trees and standardizing the composition of gardens across its participants, it does this by demanding a specific tree management regime that is enforced by monitoring and the conditionality of payments. According to the technical specifications, farmers are expected to plant trees at 5x5m, 7x7m, or 8x8m depending on the system that is used (Ecotrust, n.d., 2016). They are required to thin their trees when they reach 5 and 10 years to respectively 300 and 200 trees/ha, to properly weed their plantations at least twice a year, to keep the trees pruned and to postpone harvesting for at least 15 years. All this is to ensure optimal tree growth so that the carbon sequestration profile of the trees matches that described in the technical specification.

Our fieldwork shows that implementing this management regime has been anything but straightforward, and TFGB has had to contend with a wide range of obstacles over the years. The choice for *Maesopsis* as the main species, for example, has posed recurring problems, including sudden dieback of shoots, stunted tree growth and high pest pressure. Participants therefore commonly complain that

> [t]hey do not have many benefits, these carbon trees. They are not easily grown and they take time. I had to replace so many of them because they dried out. They started to dry from the top and then they refused to grow (Interview, 150131).

These problems are acknowledged by Ecotrust and are attributed to *Maesopsis*' maladaptation to the variety of growing conditions and soil types found across the project area, as well as to inadequate tree management practices (Ecotrust, 2007, 2009b). In Kasese district, in the east of Uganda, the scale of the problem spurred the organization to start using fast-growing *Grevalia spp.* as a replacement (Ecotrust, 2012a, p. 8), even though this is not an indigenous species and there was no technical specification to support this. Other common reasons for tree stunting and dieback include droughts, fires, a variety of pests including termites, and damage by livestock. Trees that die at any stage of their growth need to be replaced by the farmers themselves if they are to meet their targets, which given the sometimes high rate of replacements has led to discontent amongst participants:

> A farmer plants 300 trees, and 100 die. So when he is monitored, he is not paid. So you find people opting out. For me, now, I think I would do eucalyptus (Interview, 150122).

What is abundantly clear from the TFGB case, however, is that the project's efforts to produce a viable commodity not only run into nature's biophysical 'uncooperativeness' (cf. Bakker, 2005), but fundamentally also involved a struggle to discipline the labour of the participating 'carbon farmers'. While in the project's early years nearly all participants reached their planting objectives, these numbers have declined considerably in recent times. Both in 2013 and 2014 for example, nearly one third of all monitored farmers did not reach their targets (Ecotrust, 2013, 2014). In some districts, as much as half of all participating farmers currently fail to achieve the planting objective for which they are monitored. This evolution is explained primarily by the fact that Ecotrust has over the years moved towards a more rigorous implementation of the technical specification(s) and the carbon contract, reflecting an increasing orientation towards the requirements of the voluntary carbon market (cf. Osborne, 2015). The organization's decision to seek verification from the Rainforest Alliance (2013), which raised TFGB's prestige but also required that a certain standard be upheld, likely provided additional incentives in this direction.

This in turn has brought to light a mismatch between Ecotrust's ambitions and how the project is understood and experienced by farmers on the ground. One of the major complaints by the organization, for example, is that farmers do not follow spacing and thinning requirements and therefore "end up with the required number of trees but not the required acreage to meet the conditions within their respective contract" (Ecotrust, 2014, p. 13), implying that trees are crowded in and lack the space they need to achieve optimal growth rates. Ecotrust reports as well as our interviews suggest that this is a significant problem, explaining the majority of cases where farmers do not qualify for payments. Farmers on the other hand repeatedly highlight that the project's spacing guidelines were unclear from the beginning, that they have changed over time, and that the Ecotrust officials who monitor the trees do not communicate the reasons for disqualifying participants from payments, making corrective action all but impossible:

> In the beginning they could tell people to plant trees without telling the distance, the spacing. But today you must plant a tree with spacing of 10 meters. That consumes a lot of land! When monitors could come… it has been giving people headache. If someone had planted 500 trees they could calculate that they can keep only 200 because they are too dense. The rest must be eliminated. [...] I don't know… maybe because they changed the monitors. In the beginning they didn't care that much about spacing (Interview, 150202).

This is confirmed by the project's 2013 verification report, which raises concerns over unclear spacing guidelines and the failure of Ecotrust officials to consistently monitor spacing during field visits (Rainforest Alliance, 2013). When farmers after a number of years are then finally requested to thin their gardens and plant additional land to make up for the missing trees, they have already invested significant amounts of time and money in their plantations. Often, they then also don't have the required extra land to plant new trees and continue meeting their contract obligations.

Problems with spacing are compounded by the fact that, as Ecotrust puts it, "[f]armers cannot correctly estimate the size of their land" (Ecotrust, 2012a, p. 14), which they attribute to low literacy rates and a "lack of appropriate tools to measure their land" (Ecotrust, 2012a, p. 14). Our fieldwork however shows that many farmers are not fully aware about the contents of the contracts they signed in the first place. Contracts are written in English, which hardly any of the project participants speak, and often farmers indicated that they did not have a copy in their possession. Land sizes in the contract are indicated in hectares even though this is not a common land measurement in Uganda, where farmers commonly talk about land in terms of acres instead:

> When we were planting we were told acres. Acres! They knew we are measuring our land in acres. But when we had already planted and they brought the GPS, they started the business of hectares (…) All of us are getting confused (Interview, 150205).

Some of our interviewees had actually planted the requested number of trees on 1 acre instead of the prescribed hectare and when prompted confirmed that they were not aware of the difference between the two. If nothing else, this can be seen as a major disparity between the abstract, calculable relationship to land and tree management that the production of forestry offsets requires, and the lived geographies of participating farmers.

Our interviews revealed ample other examples of how farmers' actions conflict with how Ecotrust believes the project should be managed. Some interviewees for example expressed their intention to harvest trees whenever they were mature, irrespective of the rotation periods specified in their contracts, or told of how they had felled existing trees (usually eucalyptus) on their land in order to make space for the TFGB trees. In response to this, and in order to guarantee the production of reliable offsets, Ecotrust continuously attempts to 'correct' the behavior of its project participants. This takes its most benign form in the organization of training workshops, where farmers are educated about appropriate disease, pest and tree management, or in the drafting of a planting guide to clarify, amongst others, that "felling existing trees in order to plant trees for carbon payments is not encouraged" (Ecotrust, 2006, p. 6). Similarly, the 2011 annual report describes how the organization began telling farmers to be more thorough with weeding and planting trees in rows, after it had become frustrated with the difficulties that badly weeded and haphazardly planted trees posed to its monitoring visits (Ecotrust, 2012b). More coercive actions are hinted at in the 2014 monitoring report, which lists various "cases of indiscipline" (p. 16) and recommends working "with the farmers to develop penalties for unacceptable behavior" and cooperating "with local leaders to penalize errant farmers" (Ecotrust, 2014, p. 16).

In all of this, the objective is clearly to discipline project participants into adopting the kind of tree management practices that carbon markets prescribe. Ecotrust's interaction with farmers fundamentally aims to implement a mode of behavior that is conducive to TFGB's offsetting activities, the viability of which depends on reliable and predictable rates of carbon sequestration. As the project's history demonstrates however, this process has not been without problems and conflicts. Participants simply don't always follow the instructions they are given at training workshops, as one the local coordinators also pointed out:

> We leave the workshop as if we understand, but just after two days you see that everyone has their own way (Interview, 150122).

Making project participants into compliant 'carbon farmers' has therefore proven difficult, in part because they are not tied into the kind of labour relationship that typifies fully industrialized economic sectors. As with most farmers (cf. Henderson, 2003), their labour is not (yet) subsumed to capital in the way discussed by Marx, where the labourer confronts the means of production and the means of subsistence "as capital, as the monopoly of the buyer of his [sic] labour-power" (1977, p. 1026). This makes communication about, and implementation of appropriate project methods difficult. Even if participants are generally motivated to join the project for economic reasons, their land use and management decisions take form on the basis of considerations that are not easily reduced to the carbon stewardship logics that offsetting prescribes. This mismatch becomes apparent particularly when farmers feel that incentive payments no longer meet their expectations, as is increasingly the case in Mitooma district. Nearly all farmers that we interviewed had concerns about payments, noting that these were commonly delayed for months, were inexplicably lower than expected, or simply that they were left in the dark about why payments did not come at all. Mounting frustrations have driven some participants to leave the project, while some others have *de facto* done so by removing their trees in order to make other use of the land. This in turn raises questions about Ecotrust's ability to enforce its management regime for 5-25 more years after farmers have received all their initial incentive payments, as is envisaged by the project. When farmers leave the project they take their trees with them, thereby undermining TFGB's efforts to produce a stable commodity out of forest carbon.

Conclusion

This article has extended the subsumption of nature thesis beyond the industry-oriented framework that Boyd et al. (2001) originally proposed in order to help understand emerging forms of capital-nature interactions in offsetting markets. Inspired by Smith (2006), we thereby interpreted the real subsumption of nature as an increasingly prevalent strategy for the circulation and accumulation of capital in all kinds of economic spheres. As our case study illustrates, this includes the many ways in which the cultivation of indigenous trees is being mobilized in the production of 'boutique' carbon credits that relies not only on the material production of trees but also on discursive constructions of how, where, why, and by whom trees are cultivated (Paterson & Stripple, 2012).

As part of this intensive production of nature, many of the processes that Boyd et al. (2001) describe can be identified. For the TFGB case this includes attempts to attain a high, reliable carbon sequestration rate by designing standardized technical specifications, giving preferential treatment to short rotation species like *Maesopsis eminii*, and enforcing a spacing and tree management regime aimed at optimizing tree growth and reducing monitoring costs. As Osborne (2015) has argued for the Scolel Té project in Mexico, which makes use of the same Plan Vivo methodology as TFGB, the ultimate result is a simplification of forestry practices that serves to reduce transaction costs and creates a form of carbon sequestration 'that capital can see' (cf. Robertson, 2006). Much as in Robertson's classic study of wetland banking however, this subsumption of tree carbon to the requirements of the voluntary carbon market does not come about easily. Nature, as various scholars have noted, does not lend itself willingly to the constraining power of capital (Bakker, 2005; Boyd et al., 2001; Castree, 2003, 2008). Attempts to produce reliable, tradeable forest carbon run into difficulties when preferred tree species turn out to be maladapted to the range of soils and growing conditions prevalent in the project, making the trees vulnerable to pests, diseases and droughts and therefore negatively affecting carbon sequestration rates. The performative abstractions put forward in the technical specifications thereby stands in direct conflict with the complex and environmentally variable conditions under which actual tree growth occurs.

More than merely natural though, obstacles to the subsumption of nature are in the case of TFGB also profoundly socio-economic. Under the community-based framework that Ecotrust relies on, the subsumption of nature is effectively outsourced to participating communities and farmers, who assume a stake (and the corresponding risks) in the project by benefitting from installment payments and the value of the timber. To ensure that tree carbon is sequestered in a way that enables the production of tradeable offsets, farmers are thereby expected to live up to a specific planting, thinning and pruning regime, to keep track of exact land sizes and tree numbers, to combat pests and diseases and to base their involvement in the project on a cost-benefit estimation of tree cultivation compared to a range of alternative land uses. They are, in other words, submitted to a disciplining exercise that enforces the same logic employed in the subsumption of tree carbon, a logic that prescribes utility maximization and the rationalization of tree management for sequestration purposes. To all intents and purposes therefore, they are enlisted as 'green custodians' (Fairhead et al., 2012), as labourers in the new carbon economy. This is not to say that the project does not bring potential benefits to participants, or that it does not contribute to afforestation. Indeed, a detailed assessment of the positive and negative outcomes of TFGB project would need to attend to the multiple and contingent social and ecological dimensions of the project, which falls outside of the scope of this article. The point we here want to make, rather, is that the management practices of carbon forestry are fundamentally shaped by the requirements of the carbon market, which for all sorts of socio-economic reasons (not least widespread poverty) are often far from the reality on the ground. TFGB participants have their own priorities, time constraints and livelihood concerns that partly conflict with Ecotrust's ideas about 'boutique' offset production. To the extent that this puts them into conflict with the organisation's objectives, this has led to substantial misunderstandings and frustrations, causing large numbers of farmers to fall short of their contract requirements, with some even removing trees and leaving the project.

Apart from the implications this has for carbon offset claims, these dynamics raise an important point with respect to the subsumption of nature framework. As Smith (2006) notes, any analysis of the subsumption of nature ultimately requires recognition of the pivotal role of "labour as the fulcrum of the production of nature" (pp. 30-31) if we are to avoid an "external conception of nature" (p. 30). The characteristics of the labour process thereby become fundamental to understanding the dynamics of, and obstacles to, the production of nature. Ultimately this underlines the need for an analysis that considers the subsumption of nature *and* labour as dialectically related and closely entwined processes that prove hard to disentangle. As such, the subsumption framework actually provides a potentially constructive framework for structuring recent debates on the combined 'unruliness' of nature and labour in commodification process (Bakker, 2005; Bumpus, 2011; Fairhead et al., 2012; Leach & Scoones, 2015). With respect to carbon offsetting, such concerns seem particularly relevant for community-based projects. The disciplining of labour in these contexts arguably presents a greater challenge than in industrial sectors, where labourers are arguably more easily 'persuaded' of the prerogatives of specific production processes and therefore a more cooperative actor in the making and remaking of capitalist natures. One could perhaps expect forms of 'resistance' or 'unruliness' to take a more subtle or less pronounced form, the more the labour process itself has been subsumed to capital. Ultimately, this merely underlines the value of extending the subsumption framework beyond the spaces of industrial production, demonstrating as it does the fundamentally co-constituted character of the subsumption of nature and labour.

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The last few decades have seen the mainstreaming of a particular form of climate policy that puts a lot of faith in the mechanisms of the market. But do these mechanisms deliver what they promise? And what are the broader environmental implications of the choice for market-based policies?

This dissertation argues for the need to take seriously the social, economic and ecological contexts within which such policies are deployed. Market mechanisms are not neutral instruments but in fundamental ways interact with the historical legacy of fossil fuel development and the broader socioecological conditions of capitalist society. Their outcomes cannot be understood outside of these contexts. Recognizing this offers insights on the conditions for improving current policies, or the formulation of alternatives.

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