Valuation Studies 12(1) 2025: 40–66

Theme issue contribution

Good Economies of Carbon Offsetting: The cyclical dynamics of valuation and critique in voluntary carbon markets

Kamilla Karhunmaa

Abstract
Voluntary carbon markets are based on the idea that the carbon credits sold in markets are both the same, or climatically equivalent to one another, and different, reflecting how, when, where, and by whom they have been produced. This article examines how market actors deal with this tension and value units that are both commensurate and differentiated. Based on existing literature, interviews, and document analysis, I identify and present three instantiations of a good economy of carbon offsetting from the 2000s onwards. Each phase shows how valuation processes iterate between commensuration and differentiation. This is achieved through the development of elaborate sets of complementary valuation practices and tools, such as methodologies for valuing co-benefits, impact scores and overcompensation factors for securing climate impacts, and carbon removal crediting methodologies. While critique is central to driving the move from one good economy to another, this article also shows how the valuation practices of voluntary carbon markets appear locked into repetitive cycles of critique and reform, with recurrent disputes emerging over what to weigh and value and how. This poses new questions concerning how to critique such markets and their valuation practices.

Keywords: carbon offsetting; voluntary carbon markets; valuation; economization; tools of valuation

Kamilla Karhunmaa is a postdoctoral researcher at the Department of Social Sciences, University of Helsinki.

https://doi.org/10.3384/VS.2001-5992.2025.12.1.40-66
Hosted by Linköping University Electronic press
http://valuationstudies.liu.se

Introduction

Voluntary carbon markets work on the assumption that the markets can and should produce units of exchange or carbon credits whose impacts are deemed climatically equivalent to one another. The production of equivalence and the interchangeability of carbon credits works to justify voluntary carbon markets as a good solution to climate change (e.g. Forest Trends' Ecosystem Marketplace 2021). However, units sold in voluntary carbon markets are rarely monetarily valued as the same, but instead differentiated from other seemingly similar units sold and traded in markets. This creates an interesting question for valuation studies to examine: how can carbon credits be valued differently while maintaining that they are producing the same effect on the climate? What creates difference in such units and how is that difference established and valued?

I examine these questions by focusing on voluntary carbon markets, or the unregulated markets where individuals, organizations, businesses, and states may produce, trade, and purchase carbon credits.[1] Voluntary carbon markets are examples of ones to which strong and often clashing expectations and moral underpinnings are ascribed (Ehrenstein and Valiergue 2021; Dalsgaard 2022). From one perspective, voluntary carbon markets can be viewed as examples of a "concerned market" (Geiger et al. 2014) that brings together interested actors to address a public problem that has not received sufficient attention via existing policies and institutions. At the same time, voluntary carbon markets have been discussed as contested markets that do not directly address emission reductions, but allow for polluting actors to continue emitting greenhouse gases (GHGs) (Lohmann 2006; Böhm and Dahbi 2008). As both aspects are evident in voluntary carbon markets, Ehrenstein and Valiergue (2021, 2022) argue that contestation and concern can be understood as two sides of the same coin in a reflexive market.

Voluntary carbon markets function through baseline-and-credit schemes that do not have an upper limit or cap on emissions imposed from outside. Instead, carbon credits are produced by conjuring a hypothetical baseline scenario of how emissions would have evolved without the offset project (Ehrenstein and Muniesa 2013). Offset projects have generally been split into three categories: installing renewable energy technologies (e.g. biogas) to replace fossil fuels,

[1] I use the general term 'carbon markets' when I do not consider it necessary to distinguish between compliance and voluntary carbon markets, and more specific terms when I do find it relevant to make the distinction. Market actors speak of voluntary carbon markets in both the singular and the plural. I have chosen to refer to voluntary carbon markets in the plural, as this better captures the fuzziness and variety of markets where credits generated from voluntary carbon projects are utilized. Credits may be utilized in voluntary, regional, and compliance-based markets as well as over-the-counter trading and broker-led trading (see also Frankel 2018).

implementing energy efficiency measures (e.g. switching to more efficient technologies), or removing carbon dioxide from the atmosphere through carbon sequestration (e.g. improving forestry practices). Offset projects result in purchasable carbon credits once they have passed through a process of monitoring, reporting, and verification that aims to assure the additionality and veracity of the projects' climate impact. Most carbon credits on the market are certified by voluntary standards, the largest being Verra (formerly Verified Carbon Standard) and Gold Standard. Carbon credits have mainly been purchased by corporations (84.5% between 2006 and 2015 (Forest Trends' Ecosystem Marketplace 2017)), which use the credits in order to make claims related to carbon neutrality, climate positivity, or net zero.

Carbon markets in general and voluntary carbon markets in particular have received substantial attention from science and technology studies (STS), political ecology and critical geography, and economic sociology. Several studies have been concerned with market construction, or deliberate and coordinated actions to create a market for trading carbon credits (Callon 2009; MacKenzie 2009). These have shown the substantial scientific, technical, and administrative work going into establishing tonnes of carbon dioxide equivalent (tCO_2e) as authoritative and credible units of exchange (Paterson and Stripple 2012; Cooper 2015). Mackenzie (2009) has argued that creating tCO_2e as a unit of exchange requires 'making things the same' or producing an equivalence between different forms of emitting, avoiding, reducing, and sequestering GHGs. However, this process not only makes different GHGs the same, but it also makes them commensurate with distinct socio-ecological practices, temporalities, geographies, and intangible assets, as scholars of carbon markets have demonstrated (Agarwal and Narain 1991; Knox-Hayes 2013; Dalsgaard 2016; Carton et al. 2021).

In contrast, Doganova and Laurent (2016, 2019) analyse two European initiatives unrelated to carbon markets – the Integrated Pollution Prevention and Control (IPPC) Directive and the Renewable Energy Directive (RED) – both of which adopted a market construction strategy of 'keeping things different' or not producing equivalence between the units traded in markets. In these initiatives, ensuring the circulation of multiple goods in multiple markets becomes a desirable goal, justified as producing results while maintaining flexibility and variance in markets. Doganova and Laurent (2019) contrast this market construction strategy to that of 'making things the

same' in compliance carbon markets,[2] which depend on the circulation of one specific good (an emissions permit) that is detached from its origin as well as its production method. However, as I will discuss in this article, in voluntary carbon markets these two market construction strategies – of making things the same and keeping things different – are not as easily kept apart and viewed as distinct.

Further, while market construction through 'making things the same' and its implications has received substantial attention, links to processes of valuation require more analysis. Dalsgaard (2013) argues that in making distinct qualities commensurate through the common metric of tCO_2e, carbon offers a potentially universal yardstick for value in which anything can be compared through its impact on the climate. However, he also discusses how such practices of 'carbon valuation' have encountered friction: the presupposed universal yardstick of carbon has not been unequivocally translated into practice, where the significance of actions is constructed in relation to multiple cultural and social concerns, of which carbon emissions are but one possible concern (Dalsgaard 2016; Karhunmaa et al. 2023).

Building on previous studies on both market construction and carbon valuation, I approach the question of valuation from another angle. Instead of looking at how carbon markets come to ascribe value to things and actions in terms of their emissions, I examine how the units exchanged in voluntary carbon markets are ascribed value by market actors.[3] In other words, I am not examining how thinking in terms of carbon produces comparisons regarding how to weigh one action against another (Knox 2020). Instead, I want to ask a seemingly more mundane question: how do market actors go about ascribing value to the things they are producing, trading, and selling in the markets? While this might seem to be a simple question, the analysis demonstrates that in markets concerned with both making things the same and keeping things different, ascribing value is not an easy task.

I take the concept of the 'good economy' as my starting point and as an investigative heuristic concerned with the practices that entangle the production of economic and other values (Asdal et al. 2023). The concept is suited to assessing voluntary carbon markets: first, because

---

[2] Compliance carbon markets refer to markets where a regulator sets a limit on the number of emissions each year. The regulatory entity then allocates permits to polluters (e.g. through free allocation or auctioning), who can buy and sell permits among each other. The European Union's Emission Trading System is an example of a compliance carbon market.

[3] By 'market actors', I refer to those actors concerned with the functioning of carbon markets and involved in formulating the problems and solutions that carbon markets produce (Callon 2009). While this formulation also includes critics of the market, my focus is on those actors that criticize the market to reform it – not in order to abandon it fully. Thus, the extensive critique by actors calling to dispose of carbon markets fully (e.g. Lohmann 2006; Böhm and Dahbi 2008) is not dealt with at length in this article.

voluntary carbon markets are rife with declarations of good and bad as well as distinctions made through them (Dalsgaard 2022); second, the concept is appropriate because voluntary carbon markets draw on, but also complicate, the idea that price is always correct and by implication good (Asdal et al. 2023), with constant negotiation taking place on what prices can or cannot capture; finally, it is suitable because voluntary carbon markets constantly produce new methodologies and tools of valuation for enacting different versions of the good.

I contribute to this literature by demonstrating the development and evolution of three specific instantiations of a 'good economy of offsetting' over the course of the 2000s. I show how the move from one good economy to another is spurred by iterative cycles of critique and response, where market actors act on criticisms that have been raised. At times criticism pulls towards making things more the same, whereas at times the response has been to establish differences between carbon credits. These processes are marked by the development of complementary valuation practices and tools, with different tools focusing on the production of commensuration or differentiation.

I build on two sets of empirical materials that have been collected as part of separate research projects examining voluntary carbon markets. The first set of empirical materials includes my previous fieldwork on conceptualizations of co-benefits in voluntary carbon markets. This consisted of 18 interviews conducted in 2013 with experts familiar with voluntary carbon market projects focused on household energy technologies, such as improved cookstoves, biogas digestors, and water filters. Additional material consisted of project documents, publicity materials, and websites (as presented in Karhunmaa 2016). The second set includes documents, websites, online seminars, and videos produced by offset providers, regulators, researchers, and market analysts during 2021–2023.[4] This included attending and taking notes in 21 online seminars and detailed analysis of two Finnish offset-providing companies' websites, videos, and publicity materials. The article is based on an analysis of the materials, reflecting on them through the concepts of equivalence, difference, the good economy, and existing literature on voluntary carbon markets. In the rest of the article, I first present an overview of the literature on making things the same or keeping them different, before moving on to present the three instantiations of a 'good economy of offsetting' in three further sections. I end by discussing the implications concerning valuation.

[4] I present the title and date of the online seminars in the footnotes.

Literature review

A large share of both the critique and acclaim for carbon markets has revolved around the idea that carbon markets 'make things the same' (MacKenzie 2009) and hence also value these things as the same. The next three sections demonstrate how this is not always the case and how valuation and commensuration can be different processes. In this review of existing literature on carbon markets, I want to nonetheless first present the scientific, technical, and legal work that goes into commensuration in carbon markets and the implications this carries. I then proceed to present the critique that commensuration has faced and how it has been countered with calls to keep things different in order to value them in another way.

To be able to value and compare things in relation to one another, an active process of commensuration and a common metric is necessary (Espeland and Stevens 1998; Cooper 2015). In carbon markets, the shared metric is a unit called tonnes of carbon dioxide equivalent (tCO_2e). Paterson and Stripple (2012) give a brief overview on the history of tCO_2e, starting with scientists' desire to develop a single measure, called 'global warming potentials' or GWPs, to compare all GHGs to one another in the late 1980s (Rogers and Stephens 1988). However, GWPs were exchange rates used for conversion, not fungible units in and of themselves. The tradeable units of carbon markets emerged only later, together with the development of the Kyoto Protocol and its market mechanisms (Paterson and Stripple 2012). At the same time, tCO_2e was established as the metrological system used at the expense of other forms of measurement (Cooper 2015).

While tCO_2e functions as the explicit unit of exchange in carbon markets, it is possible to encounter and identify a multitude of things beyond tCO_2e that are rendered commensurate. In such a move, Bumpus (2011: 817) discusses four interrelated forms of carbon (existing emissions, counterfactual emissions, calculated reduced emissions, and commodified emissions) that come together in an offset project, showing how each form must be both calculated as well as legally and technically defined in order to produce a carbon credit. What this demonstrates is how commensuration is always a relative process of creating worth in relation to others (Espeland and Stevens 1998). At stake is not only one process of making things the same (MacKenzie 2009), but also connected processes required to hold that sameness in place.

A large part of the critique of carbon valuation is related to processes of commensuration and their problematic valuations. The first line of critique argues that carbon offsets attempt to commensurate things that morally, socially, politically, or ecologically should not be valued as the same but should be kept different. The

second line of critique argues that carbon offsets fail to produce the commensuration they promise.

One of the earliest critiques of commensuration precedes the current carbon markets. In the early 1990s, Indian scholars and activists Anil Agarwal and Sunita Narain (1991) argued that carbon pricing unjustly equates the subsistence emissions of the poor with the luxury emissions of the rich through creating common metrics. They proposed that carbon pricing and valuation schemes should consider the conditions in and purposes for which emissions are produced, as well as the historical distribution and development of GHG emissions. Their suggestion, which has not prevailed in the design of current carbon markets, can be seen as proposing alternatives to commensuration as a tool of valuation.

Further academic critique concerning commensuration in carbon markets has examined how offsetting produces equivalence across time and across distinct carbon cycles. For example, Knox-Hayes (2010, 2013) argues that carbon markets allow for compressing time by the commensuration of current emissions with future emission reductions. In a similar move, carbon markets have been criticized for placing on a par different biotic and abiotic carbon cycles, even though they operate in dissimilar timescales and their use and non-use have differing implications for climate change (Carton et al. 2021). These criticisms argue that commensuration produces undesirable valuation by eroding important differences. As such, Carton et al. (2021: 5) argue that the logic of equivalence 'serves the interest of simplicity, substitutability, and economic flexibility but introduces important social and environmental concerns that undermine climate justice'. This has been accompanied by calls from academics and civil society to keep things apart via introducing separate targets and policies for different types of emissions (e.g. Carton et al. 2021; Carbon Market Watch 2023).

At the same time, a large part of current media coverage on carbon offsets leverages a different line of critique towards commensuration in carbon markets. A recent piece of investigative journalism on carbon offsets argues that offsets are 'worthless' and produce 'phantom credits' (Greenfield 2023). It outlines how up to 90% of forest carbon offset programmes are failing to deliver the climatic impact they promised. This second line of critique questions whether a carbon credit adequately represents the socio-environmental impact it is supposed to produce (see Chiapello and Engels 2021 for an extensive discussion on this). Unlike the above calls to keep things different, this form of critique suggests that carbon markets *should* result in carbon credits being climatically equivalent no matter where and how they are produced, but currently fail to do so. What has often followed from this second line of critique is calling for better practices and greater transparency to ensure that the promise of equivalence and making

things the same does indeed take place (Integrity Council for the Voluntary Carbon Market 2023).

Uncovering the processes involved in producing a commensurate unit of exchange is a form of critique that gives visibility to the multiple historical, social, and material contexts that are rendered invisible through commensuration, thus aiming to make the practices of valuation discussable (Doganova et al. 2014; Dalsgaard 2014, 2016). Dalsgaard (2016) argues that commensuration is one form of valuation that allows for comparison to take place. This means that different alternative actions (e.g. driving a car, riding a bicycle) become potentially substitutable by one another (Dalsgaard 2016). At the same time, Dalsgaard shows how in the practices of voluntary carbon markets this idealized substitution does not take place: while on paper all credits are treated as the same, in practice they are valued differently and carry different prices (Dalsgaard 2016). To be able to proceed analytically, then, it is important to understand commensuration and valuation as processes that are not necessarily the same: something may be made commensurate and comparable to other things, yet it may still be valued differently.

Herein, a useful concept is what Asdal and Huse (2023) call tools of valuation, referring to the multiplicity of tools, such as maps, surveys, and documents, that can perform valuations. Tools of valuation may work quantitatively through calculations and prices, but they may also work qualitatively, through narrative accounts. Differing from commensuration, tools of valuation do not require making things the same in order to be valued. However, in valuing something, tools of valuation raise questions about the valuations and orderings of society, such as what is a good economy, for whom and why (Asdal and Huse 2023). In the following sections, I draw on extensive work that seeks to open up and make discussable the processes of commensuration and differentiation in voluntary carbon markets. However, I suggest that we address these as iterative processes of valuation that do not stand on their own but require support from complementary valuation practices and tools.

Internalizing externalities and correcting prices

As intentionally constructed markets, carbon markets are an experiment put into place to evaluate whether it is possible to change economies by putting a price on emissions and shifting to valuing and pricing those things previously thought of as external, undervalued, or invaluable (Callon 2009). The rise of carbon markets as a good tool for dealing with climate change has to be situated within the broader turn to markets in order to address public concerns, where previous regulatory approaches based on standards, taxation, and subsidies

were dubbed inefficient and costly by environmental economists (Asdal 2014; Voß and Simons 2018).

A first iteration of the good economy of offsetting argues that to have a decarbonized society, current practices of valuation need to be changed to account for and internalize the externalities, or the indirect costs to third parties, that arise in production processes. This view, drawing on the work of economists like Pigou (1920) and Coase (1960), was widely noted with the publication of the Stern Review on the economics of climate change in 2006, which argued that correct pricing and the benefits of early action on climate change outweigh the costs of inaction (Stern 2006).

However, correcting pricing to account for externalities does not automatically lead to interchangeable tradable units fit for markets. Being able to state that GHG emissions are equal no matter where they are produced requires drawing not only on environmental economics, but also on a particular understanding of how the atmosphere works. Research in STS has shown the elaborate scientific, technical, institutional, and political work going into perceiving of the atmosphere as global, shared, and indifferent to the origin of GHGs (Shackley and Wynne 1995; Jasanoff 2010).

In the context of voluntary carbon markets, understanding the atmosphere as global and shared has often been translated into ideas of a climate that 'does not care' where emission reductions happen, as in this report on voluntary carbon markets: 'It makes no difference to the climate where a certain amount of greenhouse gases are reduced or sequestered as sinks' (Niemistö et al. 2021: 13). Equivalence is described as enabling the targeting of emission reductions to the places in which they are the cheapest and quickest to undertake, thus producing flexibility and efficiency, and decreasing the overall costs of climate change mitigation (e.g. Stern 2006). Climatic indifference to the origin of GHGs is frequently depicted through highly simplified calculations of putting x tonnes of carbon into the atmosphere, as in this excerpt:

> I've been driving around and generating three tonnes of carbon dioxide, which of course I've released into the atmosphere to join all the rest of the greenhouse gases that are already up there. Now, imagine that miles away, maybe on the other side of the world, somebody else takes three tonnes of carbon dioxide out of the atmosphere.
> Now, what's happened?
> Three tonnes in, three tonnes out. Result, zero!
>
> Source: Video explaining carbon offsetting by Shell, aired in Last Week Tonight with John Oliver, 22.08.2022.[5]

[5] Available at https://www.youtube.com/watch?v=6p8zAbFKpW0

Visually, such indifference tends to take the form of scales that weigh polluting activities (such as flying or factories) on the one side with less-emitting or carbon sequestering activities (such as wind power or tree-planting) on the other (Figure 1). In this first instantiation of a good economy of offsetting, economists suggest carbon offsets can provide a solution to the imperfect valuation of goods since they allow for taking externalities into consideration. To be able to do this, they require support from various fields to hold in place the assumption that all carbon credits are of equal climatic worth and indifferent to their place of origin.

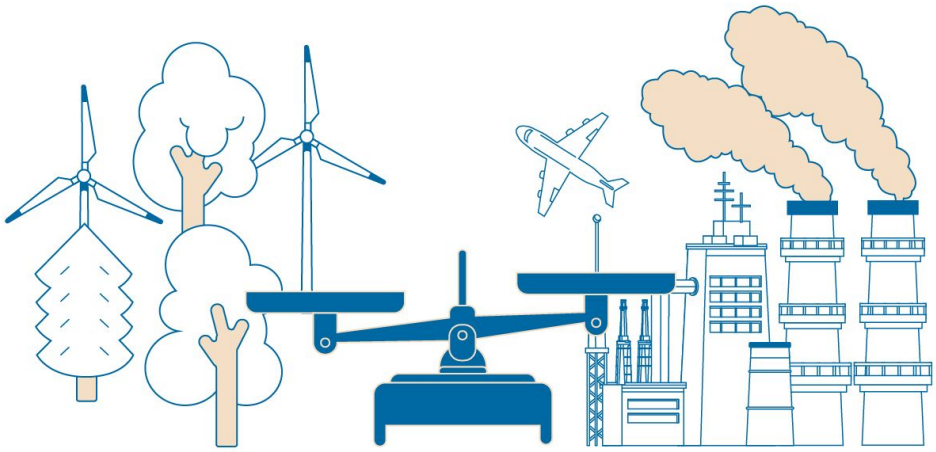

Figure 1: Illustration based on screenshot of BBC educational video: Can carbon offsetting help the planet?[6]
Source: BBC News 2021. Illustration: Kati Peltola.

Differentiation through co-benefits

The shift to a second good economy of offsetting can be described as a shift from economists' textbook visions of carbon markets to the practice of constructing such markets. Developing in the early 2000s, voluntary carbon markets were largely unregulated with no widely used standards to determine what projects should look like, how they should be monitored, how emissions should be calculated, or which technologies to accept (Lovell and Liverman 2010). The majority of offset projects were nonetheless implemented in the Global South as being easier, quicker and more cost-efficient to realize, reflecting economists' ideas that it makes no difference to the climate where emission reductions occur (e.g. Bayon et al. 2007).

At the same time, voluntary offset projects were rather diverse in terms of project type and location (Lovell and Liverman 2010). This

[6] Available at https://www.youtube.com/watch?v=b1xHUwszumw

contrasted with the development of compliance offsetting developed in the Kyoto Protocol's Clean Development Mechanism (CDM), where the aim was to ensure that a large number of uniform carbon credits entered the market for industrialized countries to meet their set emission reduction targets at a low cost. Producing voluntary offset credits that were 'charismatic', 'boutique', or 'niche', in contrast to the 'bulk' of the CDM was presented as a good attribute (Wang and Corson 2015; Lehmann 2019). Voluntary offset projects were promoted as more diverse since they accepted project types that were unwelcome in the CDM; they involved a wider range of acceptable methodologies and technologies, and were typically smaller, had lower transaction costs, and were located in less developed countries (Lovell and Liverman 2010). All of these points were employed by project developers and intermediaries to present carbon credits from voluntary offsetting as something unique and incomparable, which not only did good by offsetting the emissions of the buyer but also by enabling a connection between the buyer and the producer of the credit (Lovell et al. 2009).

The other facet that made voluntary offset projects good in the marketing materials of project developers was their focus on 'co-benefits'. Co-benefits refer to the local sustainable development impacts an offset project claims to produce in addition to emission reductions, such as community development, improved access to services, environmental conservation, improved health, and so on. Co-benefits capture the idea that offset projects have succeeded in the first iteration of the good economy or in accounting for the externality of carbon and creating an equivalence between emissions in one place with emission reductions in another place. The second iteration of a good economy of offsetting suggests that not only are the costs of carbon internalized, but offset projects can create additional, often qualitatively described, positive impacts where implemented. The co-benefits of voluntary offsets were fuzzy things, communicated by project developers to potential buyers via stories and images of underprivileged populations in the Global South doing better because of the offset project (Lehmann 2019).

How this relates to price as an indication of value is trickier, though. Development of prices in voluntary carbon markets has been tracked by the industry's State of the Voluntary Carbon Markets reports, published yearly since 2006. In general, these reports show high variance in offset prices. In 2011, for example, prices ranged from less than $1/ton to over $100/ton, with an average of $6.2/ton (Ecosystem Marketplace and Bloomberg New Energy Finance 2012). Projects that claim to produce more co-benefits have tended to receive a higher price in the markets (Ecosystem Marketplace and Bloomberg New Energy Finance 2012). The main variance in prices is due to different project types, locations, and standards, and thereby is compatible with the

idea that the market can value how, where, and by whom emissions reductions are made. However, there is also high variance in prices between projects of the same type, such as between cookstove projects (Forest Trends' Ecosystem Marketplace 2017). Further, while prices were seen as indicative of a better project, they were also acknowledged to be influenced by 'an infinite number of factors' (Forest Trends' Ecosystem Marketplace 2017: 8), leading to the conclusion that voluntary markets do not resemble compliance carbon markets or commodities markets where trading occurs by favouring the lowest price.

As voluntary carbon markets began to expand, they also faced a first round of critique. In media coverage, offset projects were criticized for being driven by unruly 'carbon cowboys' operating in a 'Wild West' where anything goes (Harvey 2007). Focusing on lacking – or insufficient – monitoring and regulation, criticism was concerned with the ability of offset projects to deliver on the promise of climatic equivalence as well as with the lack of evidence on the part of co-benefits (Ecosystem Marketplace and Bloomberg New Energy Finance 2012). Issues that had first been viewed as good attributes of voluntary carbon markets, such as the ability to be more diverse than the CDM, turned into sources of critique that necessitated a response and a degree of standardization. I interviewed a project developer working on 'charismatic' carbon offsetting in 2013 who, when asked whether the co-benefits of carbon projects should be measured and monitored, commented:

> Yes, it's quite obvious. Especially in the voluntary markets everyone claims to be social and you've got projects, which are very social, you've got projects which are average social … and you've got projects which are not social at all, making heaps of money, it's just business-oriented … but in the end nothing is there to monitor that. (Project developer, interview, 2013).

The voluntary offset project developers I interviewed in 2013 linked the formalization and measurement of co-benefits to a process of correcting what is valued in voluntary offset projects. Demonstrating a degree of reflexivity on how commensuration condenses information (Espeland and Stevens 1998), project developers viewed carbon offsetting as having the potential to narrow projects to focus solely on the emission reduction potential, failing to see, value, and account for the other socio-ecological aspects that projects alter (such as health, biodiversity, local economic impacts, etc.). Project developers also wanted to correct existing information asymmetries in the markets and enhance the comparability of projects (Karhunmaa et al. 2015). Price, and the ability to fetch higher prices for 'more sustainable' projects, was not seen as a sufficient indication of the added value produced by projects, because while some buyers valued 'charismatic' projects,

buyers were generally seen as unable to make clear distinction between what counts as a social or sustainable project. Therefore, what was needed were additional tools and means of valuation together with more standardized and comparable evidence that could aid in distinguishing offset projects from one another. The good economy of carbon offsetting thus evolved from the environmental economists' vision of internalizing externalities to demonstrating and proving the additional value of co-benefits in a more standardized way.

How to define what the additional value of co-benefits are and how they should be measured and monitored raised questions. To illustrate this, I draw on the example of improved cookstoves. Improved cookstoves are a household technology that can increase energy efficiency and decrease fuel usage. The technology has a long history in development cooperation and the first improved cookstove projects date from the 1970s (Urmee and Gyamfi 2014). Improved cookstoves have high technological variance, ranging from high-tech cookstoves to locally manufactured terracotta cookstoves (Urmee and Gyamfi 2014). In the 2010s, improved cookstoves became an increasingly popular project type for voluntary carbon markets due to their 'charismatic' features of addressing several concerns at once: reducing emissions, improving livelihoods, focusing on women and children, and so forth (Wang and Corson 2015).

During 2013–2015, I followed a debate that was unfolding over how to value the co-benefits produced by improved cookstoves: what types of technologies, supply chains, and local development impacts could and should be accounted for and how (Karhunmaa 2016). The debate is exemplary of a situation wherein concerned market actors enter into a dispute over how to relate the multiplicity of what is traded into a standard, what are the relevant judgment devices, what criteria should be used, and what weight to give to different qualitative assessments (Chiapello and Godefroy 2017). Some larger organizations advocated focusing on efficient, most often imported, technologies and their health benefits in terms of reduced indoor air pollution. In contrast, smaller organizations favoured focusing on long-term market construction with locally produced, less efficient technologies that have not been proven to reduce indoor air pollution as effectively. A project developer advocating building local supply chains contested focusing on indoor air pollution as a more readily quantifiable and abstracted health impact that provided quicker results, asking: 'But what is the health impact of a family that loses its income?' (interview, Project developer, 2013). By asking such questions, the project developer sought to show the troubles that arise when quantifying and comparing dissimilar things and opting to give value to those things that are more readily measured. The interviewed project developers saw the formalization of certain co-benefits as bringing about a market-altering potential, with the possibility of

influencing technology design, supply chains, project management practices, and so forth.

On a wider scale, criticism that voluntary carbon offsets had limited proof of their sustainable development impact was followed by a rapid proliferation of carbon offset standards as well as updates to existing standards' methodologies. The number of standards for voluntary carbon offsets expanded from 18 in 2009 to over 170 standards in use now[7] (Dalsgaard 2016). Catering to ever more specific desires resulted in the creation of specialized standards, such as Social Carbon, Women's Carbon, Fair Trade Carbon, and so on. Further, already existing standards, such as the Gold Standard, revised and updated their methodologies in the 2010s to better account for co-benefits. The ensuing competition between different standards has been described in positive terms by market actors as creating space for innovation and experimentation in markets (Chartier and Tsayem Demaze 2022), thus turning a criticism of the market into a driver of innovation. The situation is also indicative of no single standard managing to accumulate enough power to surpass others, resulting in market fragmentation and actors using a variety of ways to assess co-benefits (Chiapello and Godefroy 2017).

Reforms demonstrate how market actors juggle between the pressures to both standardize and differentiate carbon credits. On the one hand, the purpose of creating standards that take co-benefits into account was to respond to the criticisms raised about 'carbon cowboys', demonstrate concern, and set up corrective measures in the form of standardization, monitoring, and reporting (Valiergue and Ehrenstein 2022). On the other hand, the proliferation of different standards and methodologies shows the need to deliver a unique product that can be differentiated from other seemingly alike products on the market (Brill 2021). The reforms demonstrate how the good economy of carbon offsetting evolved dynamically in response to criticisms.

Novel ways of ensuring climatic equivalence in offset projects

This section outlines a move to a third iteration of a good economy, where the good economy of offsetting loops back from focusing on the co-benefits of carbon credits to questioning and seeking to demonstrate the ability of carbon credits to ensure the ideal of climatic equivalence. While in the previous section standardizing co-benefits arose as a response to critique of overly qualitative or unsubstantiated valuations of sustainability impacts, focusing on the realization of

[7] Notes, Nordic Environmental Finance Corporation seminar "Nordic Approach for Ambitious Carbon market cooperation under the Paris Agreement", 12 October 2022.

climate impacts in offsetting is also a response to critique. This critique needs to be situated in the context of the heightened attention in the 2020s to the urgency of climate change action. The market actors that I followed during 2021–2023 were always careful to state that emission reductions come first and are the 'most important tool in the toolbox'.[8] Nevertheless, this quickly proceeded to discussing how to enlarge the voluntary carbon market, without specifying a more prescriptive relation between emission reductions and offsetting. In general, voluntary offsetting was justified as a less-than-ideal, but necessary mid-term solution for addressing climate change.

As such, the 2020s saw the emergence of several proposals for reforming voluntary carbon markets. The proposals have the same starting point of characterizing current carbon credits as heterogeneous and the market as having 'low liquidity, scarce financing, inadequate risk-management services and limited data availability' (Blaufelder et al. 2021). Opinions differed about how or whether this should be dealt with.

A first set of proposals comes from the industry's own self-governance initiative, the Integrity Council for the Voluntary Carbon Market (ICVCM).[9] Released in March 2023, a key suggestion has been to divide the valuation and pricing of carbon credits into two separate parts: the 'core carbon principles' (CCP) or the verified ton of CO_2e produced by the project, and the 'additional attributes', including how the project aligns with the framework being built under the Paris Agreement as well as the quantified positive sustainable development goal (SDG) impacts. Providing this information allows buyers 'to purchase carbon credits that match their preferences' (Integrity Council for the Voluntary Carbon Market 2023: 45). Prior to the release of the CCP documents, additional attributes were characterized by the following diagram (Forest Trends' Ecosystem Marketplace 2020: 11) (see Figure 2).

---

[8] Notes, Nasdaq and puro.earth seminar "The Role of Carbon Removal in Achieving Net Zero", 8 March 2023.

[9] The initiative commenced in 2021 and was then called the Taskforce on Scaling-up Voluntary Carbon Markets (TSVCM). It was first led by former Bank of England head, Mark Carney. The initiative soon changed its name to the ICVCM in response to criticisms that the Taskforce should focus on quality and integrity, not quantity and scaling-up.

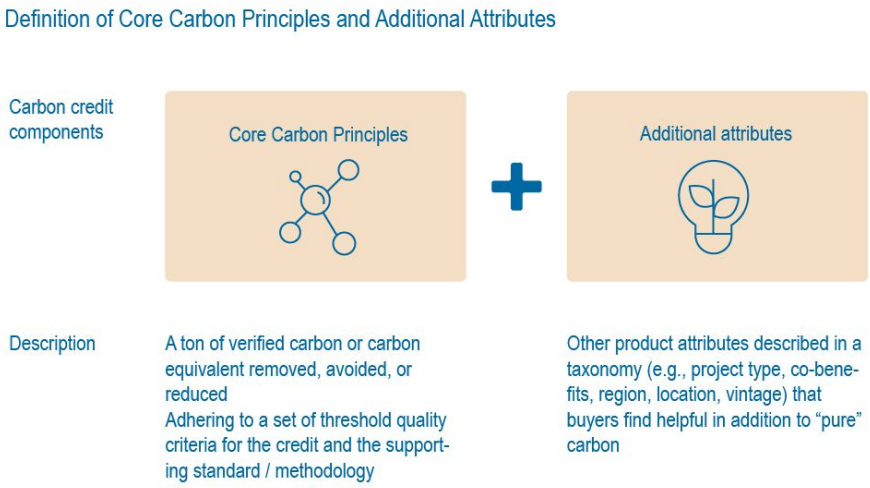

Figure 2: Core carbon principles and additional attributes as depicted in the Taskforce on Scaling Voluntary Carbon Markets.
Source: Forest Trends' Ecosystem Marketplace 2020, p. 11. Illustration: Kati Peltola.

The suggestion centres on maintaining the equivalence of carbon dioxide intact and producing standardized criteria for ensuring that all offsets deliver the 1 ton = 1 ton climatic equivalence on which they are premised. This was described as setting a 'threshold standard for all, so that we can separate the wheat from the chaff, know what the best of the best is'.[10] At the same time, the ICVCM suggested that valuing a unit of tCO_2e also entails valuing things that are not quite as easily thought of as equivalent, or for which constructing a common metric is more difficult. In allowing more variance in the 'additional attributes' that are compiled into a carbon credit, the ICVCM suggests making this part of offsets only somewhat standardized through a taxonomy that would allow for comparability between carbon credits generated from different types of projects. The ICVCM has maintained that carbon markets should be able to price the 'additional attributes' separately from the 'core carbon', thus continuing to allow for projects deemed better in terms of their sustainability impacts to be rewarded by higher revenues.

Other market actors contested whether this was possible. As a carbon trader commented in an online seminar: 'All projects are unique. There won't be a fully functional, liquid, commoditized market.'[11] The view was that offset projects are not created equal and

[10] Notes, Nordic Environmental Finance Corporation seminar "Nordic Approach for Ambitious Carbon Market Cooperation under the Paris Agreement", 12 October 2022.

[11] Notes, Ecosystems Marketplace seminar "State of the Voluntary Carbon Markets 2021: Carbon Offset Prices and Corporate Claims", 15 September 2021.

that the market price should reflect that. Further, information intermediaries described the trouble of disclosing specific information on offset projects in a 'commoditized and standardized way', noting that very specific and tailored information on offset projects is precisely what offset buyers want: 'buyers want to know what they are getting.'[12] This view suggests that the strength of voluntary carbon markets lies in their ability to create unique and differentiated products that rely on additional tools valuation.

While following proposals for market reform, I also encountered a small segment of actors who went beyond expressing doubts on the ability to create liquid markets to questioning even the basic assumption that the market is based on, namely the climatic equivalence between carbon credits and emission reductions. I focus on two Finnish-based offset providers to elaborate how market actors are dealing with this question. The Finnish carbon offset retailer Compensate has sought to carve out a position for itself as a novel market actor through ardent critique of the existing market. In 2021, Compensate published a white paper in which it claimed that 90% of credits in voluntary carbon markets were dubious and would not pass their stringent assessments (Compensate 2021). Existing valuation tools aimed at ensuring climatic equivalence, such as voluntary carbon standards, were described as insufficient, and the market was characterized as 'flooded with millions of essentially worthless credits. Still, these credits have the stamp of approval of the leading international standards, and offsetters keep buying them with no knowledge of the fact they're engaging in a lie' (Compensate 2023).

Compensate questions the valuation process behind standard carbon credits, claiming it is a 'poor metric' of climate impact due to a market design that promotes over-inflating impacts. Their solution to the problematic commensuration is to add another layer of evaluation to ensure that credits deliver the equivalence they are intended to produce. This is provided by a novel valuation tool, developed by Compensate, which produces tailored evaluations of CO_2 impacts (Compensate 2023):

> For instance, for a project with an impact score of 0.7, one credit is equivalent to 0.7 tonnes of CO_2. In order to provide a robust offsetting claim, Compensate overcompensates by purchasing enough credits to reach a real impact equivalent to one tonne of CO_2.

The process involves creating project-specific climate impact scores that allow one to determine the 'real' climate impact of projects. This leads to defining an overcompensation factor for each project, or the amount of carbon credits that must be bought from the project to

---

[12] Notes, Ecosystems Marketplace seminar "State of the Voluntary Carbon Markets 2021: Carbon Offset Prices and Corporate Claims", 15 September 2021.

ensure that the 1 ton = 1 ton equivalence is delivered. The final product is a new carbon credit established in 2022, called the Compensate Credit. The whole process of estimating impacts is done by Compensate and is guided by their scientific advisory panel, consisting of well-known Finnish academics. Compensate's business model[13] is based on distancing themselves from other actors in the market and assuring potential buyers that its products are better than others in producing the climatic equivalence of 1 ton = 1 ton on which the first instantiation of a good economy of offsetting is based.

The other example is from the emerging field of carbon removal and its use in voluntary offsetting. Carbon removal refers to practices that remove GHGs from the atmosphere and store them permanently[14] in specific materials, minerals, or sites. While carbon removal does not necessitate a relation to carbon markets, there are ongoing attempts to formalize carbon removals into carbon credits and thus enable their use for voluntary offsetting as well.

One of these attempts is by the Finnish-based carbon removal crediting platform, puro.earth. puro.earth focuses on creating crediting methodologies for engineered carbon removal and formalizing these into a standard unit, called a CO_2 Removal Certificate (or a CORC). Currently, it focuses on five methodologies: biochar, carbonated building materials, enhanced rock weathering, geologically removed carbon, and woody biomass burial. Of these, biochar is by far the most popular methodology. puro.earth describes itself as a standard and registry; it does not directly sell CORCs but leaves this interaction to take place between suppliers and buyers. Nor does it regulate how CORCs are used by buyers to make climate claims, limiting itself to reporting the purchase of all CORCs via a registry.

Combining the Latin word *purus*, meaning cleansed or purified, with the Finnish word *puro*, meaning a stream, puro.earth refers to itself through a 'metaphor of the flow of capital towards carbon net-negative companies' (Puro.earth 2023a). While the reference to cleansing is not further explicated, puro.earth refers elsewhere to turning 'a paradigm [i.e. voluntary carbon markets] that was not working on its head' (Puro.earth 2022). In this way, the company seeks to distance itself from most carbon credits on voluntary carbon markets based on avoided emissions. The main distinction that they seek to create is between avoiding emissions as compared to a baseline (i.e. the majority of current credits in voluntary carbon markets) versus

---

[13] After research for this article had been conducted, Compensate announced in summer 2023 that it is filing for bankruptcy. The primary reason was that the company had not secured sufficient financing (through sales, investments, loans) to meet its expenses.

[14] Debates are ongoing as to how to classify the permanence of emission removals and what sort of timescales should be adopted (Meyer-Ohlendorf 2023).

a process of removing and permanently storing emissions (i.e. puro.earth's CORCs).

Visually and formulaically, puro.earth has sought to represent this distinction by contrasting the now familiar 1 ton = 1 ton to another formula: 1 ton emitted – 1 ton removed = zero tonnes emitted (Figure 3). The aim is to show how carbon removal contributes to building a net-negative society as emissions are removed from the atmosphere and permanently stored, not only avoided as with offsetting. As with Compensate, puro.earth seeks to differentiate from current market practices, but has to create novel tools of valuation and registries in order to standardize and formalize the ways in which it is producing a good solution to climate change that can be distinguished from others.

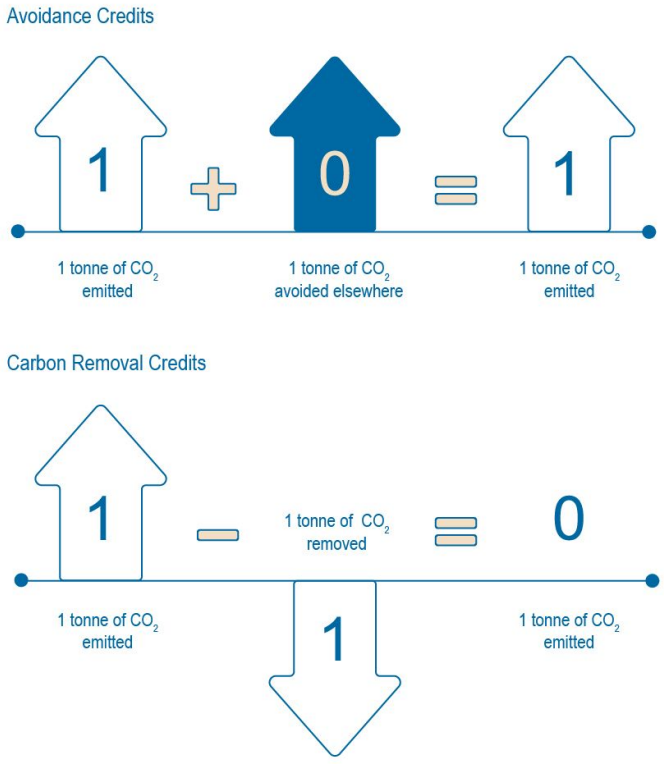

Figure 3: Difference between avoidance credits and carbon removal credits.
Source: Puro.earth 2023b. Illustration: Kati Peltola.

Both Compensate (€35/ton) and puro.earth (varying from €80–140/ton for biochar projects) have higher prices than average carbon credits in the voluntary carbon market (just above $3/ton in 2021 (Forest Trends' Ecosystem Marketplace 2021)). However, the two actors' views differed on prices, and how these shape markets. Both companies criticize existing market practices and are trying to create a tighter relationship between a carbon credit as an intangible asset and its intended environmental impact in the biophysical world (Dalsgaard

2016; Chiapello and Engels 2021). To ensure this, Compensate states that 'simply staring at prices is illogical: Increasing prices of terrible credits will not magically make them better' (Compensate 2023). They maintain that prices are currently a poor indicator of the quality of a unit of tCO_2e, and other valuation tools are necessary to measure and demonstrate the good of offset projects. In contrast, puro.earth sees their high prices as pushing companies away from purchasing credits towards focusing more on internal emission reductions: 'At the moment, our price index shows that durable biochar credits cost 125 euros per ton removed. If corporates see that price, I think they would be very highly incentivized to reduce their own emissions more radically than they have been doing until now' (Trendafilova 2023). puro.earth's approach is thus more akin to the first instantiation of a good economy of offsetting, where internalizing the externalities of carbon leads to the price being correct and by default good (Asdal et al. 2023). In contrast, Compensate argues that prices alone cannot capture the goodness of carbon offset projects and hence additional valuation tools are required to be able to make distinctions, which is more in line with the approach developed to value co-benefits in the second good economy of offsetting.

Discussion and conclusion

This article has examined how actors working within voluntary carbon markets come to value the things being bought, sold, and traded in those markets. As a contribution to studies on the good economy, I have explored how processes of valuation move through cycles of commensuration and differentiation and how new tools of valuation are created to support these. While commensuration and differentiation have previously been addressed more as market construction strategies (e.g. MacKenzie 2009; Doganova and Laurent 2016), I address commensuration and differentiation as valuation processes that seek to establish voluntary carbon markets as a good solution to climate change. The cyclical development of commensuration and differentiation shows how economization varies and changes over time (Asdal and Huse 2023); the good economy of carbon offsetting is constantly evolving in response to critique.

The valuation processes examined in this article rely on a back-and-forth movement between the technical and calculative aspects of carbon credits and the qualitative and social ones that produce value for the credits. This relates to Callon et al.'s (2002) argument that in an economy of qualities, market actors are engaged in reflexive activity and devote a significant share of their resources to position the products they create in relation to other goods. As shown by Brill (2021), this leads to a double movement of singularizing carbon credits while simultaneously making them comparable. In voluntary

carbon markets, this involves creating valuation tools that seek to establish that carbon credits can be both climatically of equivalent worth and different from other credits sold on those same markets. This positions voluntary carbon credits in the general frame of environmental intangibles, which according to Chiapello and Engels (2021) struggle to straddle the dual demand to be both detached from their place of origin to circulate in markets as well as attached to a specific location to guarantee the promised environmental impact.

Less explored has been the question of how this double movement relates to valuation in general and the development of price as one form of valuation. In voluntary carbon markets, the role of price as a tool for valuing the good is under constant negotiation. On the one hand, market actors are keen to hold on to the idea that markets are adept at valuing things through price and should be left to do so. On the other hand, market actors view it as a perpetual danger that the market might fail to see, account for, and price the correct things. This necessitates the development of an elaborate set of complementary valuation practices and tools (Chiapello and Godefroy 2017), such as methodologies and standards for evaluating co-benefits, impact scores, and overcompensation factors for securing climate impacts, or carbon removal crediting methodologies, just to name some of those discussed in this article. Market actors themselves seem to acknowledge the necessity of qualculation in valuing carbon offsets – or combining qualitative and quantitative assessment to determine what a good carbon credit is (Cochoy 2002; Callon and Law 2005). At the same time, this combination is not frictionless and settled; instead, in a concerned market shot through with values, disagreement constantly emerges over how to weigh and value such processes (Chiapello and Godefroy 2017). In voluntary carbon markets, this has led to iterative cycles through which the markets are positioned as good solutions to climate change.

As a contribution to understanding the development and evolution of good economies, I have outlined three instantiations of a good economy of offsetting from the 2000s onwards. In the first, voluntary carbon markets are proposed as a solution to the imperfect valuation of goods that enables taking into account externalities by maintaining that all emissions are of equal value. In the second good economy, a move from economic theory to market practices demonstrates that offset projects are actually more diverse and differently valued than imagined, with market actors calling for the acknowledgement of the additional benefits of offset projects. This in turn necessitates the development of new tools to value offset projects and their co-benefits. In the third good economy of offsetting, there is a return to focusing on the connection between carbon credits and their climate impacts, combined with the advancement of novel tools and practices to ensure the fulfilment of climate impacts. Analysing the evolution of voluntary

carbon markets through the lens of valuation shows how carbon credits were first proposed as a solution to problematic valuation (i.e. not accounting for externalities), but later developed into things that required valuation in and of themselves. In other words, what was first meant to enable valuation turned into something that had to be valued in and of itself, and which turned out to be rather problematic to value.

Taken episodically, each instantiation of a good economy of offsetting is a response to extant critiques of voluntary carbon markets and at the same time each response serves to further enable another good economy of offsetting to arise by showing how concerns are acted upon. The presentation of three phases of the markets thus shows how voluntary carbon markets appear entrenched in cycles of concern and contestation (Ehrenstein and Valiergue 2021). This produces an unresolved paradox of circularity, where new valuation schemes intended to value a good carbon credit need to be constantly tested and refined in practice (see also Voß and Simons 2018). This poses serious questions for the critique of voluntary carbon markets, as to exit from such cycles would require forming a critique in another manner.

Thereby, while voluntary carbon markets are on paper supposed to be highly simple, and good because of that simplicity, their transformation over recent decades has shown how they also require an excessive amount of scaffolding to hold that simplicity in place. Further, I have demonstrated that the valuation processes that occur in environmental economics and educational videos about offsetting, of a climate to which addition, subtraction and equalization can be applied, are constantly confronted by other forms of valuation. Taking the question of critique seriously could therefore involve rephrasing the question as one of who cares for a shared climate, how and with what consequences, instead of making all climate action equal in a climate that is indifferent to such matters.

Acknowledgments

This article has benefited from generous comments at the Interdisciplinary Market Studies Workshop (Edinburgh 2023), the 4S conference (Toronto/online, 2021), the Spiral Research Centre at the University of Liège and the Centre for the Sociology of Innovation at Mines Paris – PSL University. I would like to further thank Pierre Delvenne, Tapio Reinekoski, Olli Tiikkainen, and Mikko J. Virtanen as well as the theme issue editors, workshop participants, and anonymous reviewers for our conversations and their comments on the manuscript.

Funding

Kamilla Karhunmaa acknowledges funding from Säätiöiden Post doc–pooli, Emil Aaltonen Foundation and from the Kone Foundation project CLIMAKEDO (Making do with climate change. Undoing the makings and moralities of voluntary carbon offsetting practices).

References

Agarwal, Anil, and Sunita Narain. 1991. *Global Warming in an Unequal World*. New Delhi: Centre for Science and Development.

Asdal, Kristin. 2014. "From Climate Issue to Oil Issue: Offices of Public Administration, Versions of Economics, and the Ordinary Technologies of Politics." *Environment and Planning* A 46(9): 2110–2124.

Asdal, Kristin, and Tone Huse. 2023. *Nature-Made Economy: Cod, Capital and the Great Economization of the Ocean*. Cambridge, MA: MIT Press.

Asdal, Kristin, Béatrice Cointe, Bård Hobæk, Hilde Reinertsen, Tone Huse, Silje R. Morsman, and Tommas Måløy. 2023. "'The Good Economy': A Conceptual and Empirical Move for Investigating How Economies and Versions of the Good Are Entangled." *BioSocieties* 18(1): 1–24.

Bayon, R., A. Hawn, and K. Hamilton. 2007. *Voluntary Carbon Markets: An International Business Guide to What They Are and How They Work*. London, UK: Earthscan.

BBC News. 2021. "Can carbon offsetting help the planet?". Available at https://www.youtube.com/watch?v=b1xHUwszumw. Accessed 8.10.2024.

Blaufelder, Christopher, Cindy Levy, Peter Mannion, and Dickon Pinner. 2021. "A Blueprint for Scaling Voluntary Carbon Markets to Meet the Climate Challenge." https://www.mckinsey.com/capabilities/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge.

Böhm, Steffen, and Siddhartha Dahbi. 2008. *Upsetting the Offset: The Political Economy of Carbon Markets*. London, UK: MayFly Books.

Brill, Saskia. 2021. "A Story of Its Own: Creating Singular Gift-Commodities for Voluntary Carbon Markets." *Journal of Cultural Economy* 14(3): 332–343.

Bumpus, Adam G. 2011. "The Matter of Carbon: Understanding the Materiality of tCO_2e in Carbon Offsets." *Antipode* 43(3): 612–638.

Callon, Michel. 2009. "Civilizing Markets: Carbon Trading between in Vitro and in Vivo Experiments." *Accounting, Organizations and Society* 34(3–4): 535–548.

Callon, Michel, and John Law. 2005. "On Qualculation, Agency, and Otherness." *Environment and Planning D: Society and Space* 23(5): 717–733.

Callon, Michel, Cécile Méadel, and Vololona Rabeharisoa. 2002. "The Economy of Qualities." *Economy and Society* 31(2): 194–217.

Carbon Market Watch. 2023. "Does Carbon Offsetting Do More Harm than Good?" 2023. https://carbonmarketwatch.org/2023/07/06/does-carbon-offsetting-do-more-harm-than-good/.

Carton, Wim, Jens Friis Lund, and Kate Dooley. 2021. "Undoing Equivalence: Rethinking Carbon Accounting for Just Carbon Removal." *Frontiers in Climate* 3 (April): 1–7.

Chartier, Angéline, and Moïse Tsayem Demaze. 2022. "Hybridizations and Reconfigurations in the Roles of Actors in Voluntary Carbon Offsetting." *Local Environment* 27(8): 1007–1028.

Chiapello, Eve, and Anita Engels. 2021. "The Fabrication of Environmental Intangibles as a Questionable Response to Environmental Problems." *Journal of Cultural Economy* 14(5): 517–532.

Chiapello, Eve, and Gaetan Godefroy. 2017. "The Dual Function of Judgment Devices. Why Does the Plurality of Market Classifications Matter?" *Historical Social Research / Historische Sozialforschung* 42(1 (159)): 152–188.

Coase, R.H. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 56(4): 837-877.

Cochoy, Frank. 2002. *Une Sociologie Du Packaging Ou l'âne de Buridan Face Au Marche¨ [A Sociology of Packaging, or Buridan's Donkey in the Face of the Market]*. Paris: Presses Universitaires de France.

Compensate. 2021. "Reforming the Voluntary Carbon Market." https://www.compensate.com/reforming-the-voluntary-carbon-market.

Compensate. 2023. "Frequently Asked Question." 2023. https://www.compensate.com/reforming-the-voluntary-carbon-market.

Cooper, Mark H. 2015. "Measure for Measure? Commensuration, Commodification, and Metrology in Emissions Markets and Beyond." *Environment and Planning A* 47(9): 1787–1804.

Dalsgaard, Steffen. 2013. "The Commensurability of Carbon: Making Value and Money of Climate Change." *HAU: Journal of Ethnographic Theory* 3(1): 80–98.

Dalsgaard, Steffen. 2014. "Carbon Value between Equivalence and Differentiation." *Environment and Society* 5(1): 86–102.

Dalsgaard, Steffen. 2016. "Carbon Valuation: Alternatives, Alternations and Lateral Measures?" *Valuation Studies* 4(1): 67–91.

Dalsgaard, Steffen. 2022. "Tales of Carbon Offsets: Between Experiments and Indulgences?" *Journal of Cultural Economy* 15(1): 52–66.

Doganova, Liliana, and Brice Laurent. 2019. "Carving out a Domain for the Market: Boundary Making in European Environmental Markets." *Economy and Society* 48(2): 221–242.

Doganova, Liliana, and Brice Laurent. 2016. "Keeping Things Different: Coexistence within European Markets for Cleantech and Biofuels." *Journal of Cultural Economy* 9(2): 141–156.

Doganova, Liliana, Martin Giraudeau, Claes-Fredrik Helgesson, Hans Kjellberg, Francis Lee, Alexandre Mallard, Andrea Mennicken, Fabian

Muniesa, Ebba Sjögren, and Teun Zuiderent-Jerak. 2014. "Valuation Studies and the Critique of Valuation." *Valuation Studies* 2(2): 87–96.

Ecosystem Marketplace and Bloomberg New Energy Finance. 2012. Maneuvering the Mosaic: State of the Voluntary Carbon Markets 2012. Washington, DC, and New York: Ecosystem Marketplace and Bloomberg New Energy Finance.

Ehrenstein, Véra, and Fabian Muniesa. 2013. "The Conditional Sink: Counterfactual Display in the Valuation of a Carbon Offsetting Reforestation Project." *Valuation Studies*. 1(2): 161–188.

Ehrenstein, Véra, and Alice Valiergue. 2021. "Studying a (Contested/Concerned) Market in the Making: Voluntary Offsetting, from UN Climate Talks to Corporate Sustainability Departments." *Economic Sociology_the European Electronic Newsletter* 22(2): 4–9.

Espeland, Wendy Nelson, and Mitchell L. Stevens. 1998. "Commensuration as a Social Process." *Annual Review of Sociology* 24: 313–343.

Forest Trends' Ecosystem Marketplace. 2017. *Unlocking Potential: State of the Voluntary Carbon Markets 2017*. Washington DC: Forest Trends Association.

Forest Trends' Ecosystem Marketplace. 2020. *The Only Constant is Change. State of the Voluntary Carbon Markets 2020, Second Installment Featuring Core Carbon & Additional Attributes Offset Prices, Volumes and Insights*. Washington DC: Forest Trends Association.

Forest Trends' Ecosystem Marketplace. 2021. *'Market in Motion', State of Voluntary Carbon Markets 2021, Installment 1*. Washington DC: Forest Trends Association.

Frankel, Christian. 2018. "The 's' in Markets: Mundane Market Concepts and How to Know a (Strawberry) Market." *Journal of Cultural Economy* 11(5): 458–475.

Geiger, Susi, Debbie Harrison, Hans Kjellberg, and Alexandre Mallard (eds.). 2014. *Concerned Markets: Economic Ordering for Multiple Values*. Cheltenham, UK: Edward Elgar.

Greenfield, Patrick. 2023. "Revealed: More than 90% of Rainforest Carbon Offsets by Biggest Certifier Are Worthless, Analysis Shows." *The Guardian*, 18 January 2023. https://www.theguardian.com/environment/2023/jan/18/revealed-forest-carbon-offsets-biggest-provider-worthless-verra-aoe.

Harvey, Fiona. 2007. "Beware the Carbon Offsetting Cowboys." *Financial Times*, 26 April 2007.

Integrity Council for the Voluntary Carbon Market. 2023. "Core Carbon Principles, Assessment Framework and Assessment Procedure." 2023. https://icvcm.org/the-core-carbon-principles/.

Jasanoff, Sheila. 2010. "A New Climate for Society." *Theory, Culture & Society* 27(2–3): 233–253.

Karhunmaa, Kamilla. 2016. "Opening up Storylines of Co-Benefits in Voluntary Carbon Markets: An Analysis of Household Energy

Technology Projects in Developing Countries." *Energy Research and Social Science* 14: 71–79.

Karhunmaa, Kamilla, Outi Pitkänen, and Visa Tuominen. 2015. "Assessing the Co-Benefits of Household Energy Technology Carbon Offset Projects." http://urn.fi/URN:NBN:fi-fe2019052116304.

Karhunmaa, Kamilla, Saara Salmivaara, Vilja Varho, Mikko J. Virtanen, Tapio Eerikäinen, and Annukka Vainio. 2023. "Settling an Unsettled Phenomenon: Citizens' Views and Understandings of Voluntary Carbon Offsetting in Finland." *Journal of Environmental Policy and Planning* 25(5): 524–538.

Knox, Hannah. 2020. *Thinking Like a Climate: Governing a City in Times of Environmental Change*. Durham and London: Duke University Press.

Knox-Hayes, Janelle. 2010. "Constructing Carbon Market Spacetime: Climate Change and the Onset of Neo-Modernity." *Annals of the Association of American Geographers* 100(4): 953–962.

Knox-Hayes, Janelle. 2013. "The Spatial and Temporal Dynamics of Value in Financialization: Analysis of the Infrastructure of Carbon Markets." *Geoforum* 50: 117–128.

Lehmann, Ina. 2019. "When Cultural Political Economy Meets 'Charismatic Carbon' Marketing: A Gender-Sensitive View on the Limitations of Gold Standard Cookstove Offset Projects." *Energy Research and Social Science* 55 (September): 146–154.

Lohmann, Larry. 2006. "Development Dialogue. Carbon Trading: A Critical Conversation on Climate Change, Privatisation and Power." https://www.osti.gov/etdeweb/biblio/20838312.

Lovell, Heather, and Diana Liverman. 2010. "Understanding Carbon Offset Technologies." *New Political Economy* 151 (2): 255–273.

Lovell, Heather, Harriet Bulkeley, and Diana Liverman. 2009. "Carbon Offsetting: Sustaining Consumption?" *Environment and Planning A: Economy and Space* 41(10): 2357–2379.

MacKenzie, Donald. 2009. "Making Things the Same: Gases, Emission Rights and the Politics of Carbon Markets." *Accounting, Organizations and Society* 34(3–4): 440–455.

Meyer-Ohlendorf, Nils. 2023. *Making Carbon Removals a Real Climate Solution. How to Integrate Carbon Removals into EU Climate Policies*. Berlin: Ecologic Institute.

Niemistö, Johanna, Jyri Seppälä, Jaakko Karvonen, and Sampo Soimakallio. 2021. "Päästökompensaatiot Ilmastonmuutoksen Hillinnän Keinona Suomessa –Nyt Ja Tulevaisuudessa Selvitys Vapaaehtoisen Päästökompensaation Käytön Nykytilanteesta Ja Odotuksista Eri Toimijoiden Ilmastonmuutoksen Hillintätyössä." http://urn.fi/URN:ISBN:978-952-361-233-4.

Paterson, Matthew, and Johannes Stripple. 2012. "Virtuous Carbon." *Environmental Politics* 21(4): 563–582.

Pigou, A. 1920. *The Economics of Welfare*. London: Macmillan.

Puro.earth. 2022. "Puro Standard." 2022. https://puro.earth/puro-standard-carbon-removal-credits/.

Puro.earth. 2023a. "Frequently Asked Question." 2023. https://puro.earth/faq/.

Puro.earth. 2023b. "Why Puro.Earth." 2023. https://puro.earth/carbon-market/.

Rogers, J.D., and R.D. Stephens. 1988. "Absolute Infrared Intensities for F-113 and F- 114 and an Assessment of Their Greenhouse Warming Potential Relative to Other Cloroflurocarbons." *Journal of Geophysical Research* 93(D3): 2423–2428.

Shackley, Simon, and Brian Wynne. 1995. "Global Climate Change: The Mutual Construction of an Emergent Science-Policy Domain." *Science and Public Policy* 22(4): 218–230.

Stern, Nicholas. 2006. *Stern Review: The Economics of Climate Change*. London, UK: HM Treasury.

Trendafilova, Petya. 2023. "'There Is Value When Each Carbon Removal Project Is Rated The Same Way' – Co-Founder Marianne Tikkanen, Puro.Earth." *Carbon Herald*, 2023. https://carbonherald.com/value-carbon-removal-project-rated-same-way-co-founder-marianne-tikkanen-puroearth/.

Urmee, Tania, and Samuel Gyamfi. 2014. "A Review of Improved Cookstove Technologies and Programs." *Renewable and Sustainable Energy Reviews* 33: 625–635.

Valiergue, Alice, and Véra Ehrenstein. 2022. "Quality Offsets? A Commentary on the Voluntary Carbon Markets." *Consumption Markets and Culture* 26(4): 218–230.

Voß, Jan Peter, and Arno Simons. 2018. "A Novel Understanding of Experimentation in Governance: Co-Producing Innovations between 'Lab' and 'Field.'" *Policy Sciences* 51(2): 213–229.

Wang, Yiting, and Catherine Corson. 2015. "The Making of a 'Charismatic' Carbon Credit: Clean Cookstoves and 'Uncooperative' Women in Western Kenya." *Environment and Planning A* 47(10): 2064–2079.

Kamilla Karhunmaa is a postdoctoral researcher at the University of Helsinki. She obtained her PhD from the University of Helsinki in 2021 and works at the intersection of environmental policy and science and technology studies. Her research examines the politics and practices of understanding environmental problems and solutions. She is currently researching the construction of environmental markets, such as markets for biodiversity, carbon offsetting and novel food technologies.