Routledge
Taylor & Francis Group

Journal of Environmental Policy & Planning

ISSN: 1523-908X (Print) 1522-7200 (Online) Journal homepage: www.tandfonline.com/journals/cjoe20

Settling an unsettled phenomenon: citizens' views and understandings of voluntary carbon offsetting in Finland

Kamilla Karhunmaa, Saara Salmivaara, Vilja Varho, Mikko J. Virtanen, Tapio Eerikäinen & Annukka Vainio

To cite this article: Kamilla Karhunmaa, Saara Salmivaara, Vilja Varho, Mikko J. Virtanen, Tapio Eerikäinen & Annukka Vainio (2023) Settling an unsettled phenomenon: citizens' views and understandings of voluntary carbon offsetting in Finland, Journal of Environmental Policy & Planning, 25:5, 524-538, DOI: 10.1080/1523908X.2023.2211539

To link to this article: https://doi.org/10.1080/1523908X.2023.2211539

JOURNAL OF ENVIRONMENTAL POLICY & PLANNING
2023, VOL. 25, NO. 5, 524–538
https://doi.org/10.1080/1523908X.2023.2211539

Settling an unsettled phenomenon: citizens' views and understandings of voluntary carbon offsetting in Finland

Kamilla Karhunmaa[a,b], Saara Salmivaara[a], Vilja Varho[c], Mikko J. Virtanen[a], Tapio Eerikäinen[c] and Annukka Vainio[d,e]

[a]Department of Social Sciences, University of Helsinki, Helsinki, Finland; [b]SPIRAL, University of Liège, Liège, Belgium; [c]Natural Resources Institute Finland (Luke), Helsinki, Finland; [d]Department of Forest Sciences, University of Helsinki, Helsinki, Finland; [e]Helsinki Institute of Sustainability Sciences (HELSUS), University of Helsinki, Helsinki, Finland

ABSTRACT

Voluntary carbon offsets are a rapidly growing market and claims related to offsetting and carbon neutrality are visible in citizens' daily lives. Proponents suggest that carbon offsetting offers a cost-effective way to incentivize climate action while critics discuss offsetting as an opaque and dysfunctional practice. Previous studies have examined citizens' perceptions principally through quantitative data, and especially by economic choice experiments. As voluntary carbon offsetting is unsettled in citizen's everyday lives, we argue that such studies overlook the more subtle ways in which this is happening. To address these ways in detail, we conducted a multi-method analysis of a nationally representative survey ($n = 1000$) in Finland. The closed questions of the survey were first analysed quantitatively, and the insights then enriched by a qualitative analysis of the open questions. The combined results highlight citizens' views and understandings as uncertain and ambivalent: despite a widespread willingness to address climate change, there is little unreserved support for voluntary carbon offsetting and distrust towards the sector is high. Our study cautions against placing high hopes in individuals' voluntary carbon offsetting as a form of climate action.

ARTICLE HISTORY
Received 6 July 2022
Accepted 1 May 2023

KEYWORDS
Carbon offset; citizens; survey; voluntary carbon markets; emission reductions

1. Introduction

Voluntary carbon offsetting is a rapidly growing global industry that saw a record level of over 1 billion dollars in transactions in 2021 and an increasing demand for carbon credits, despite the decrease in flying caused by the Covid-19 pandemic (Donofrio et al., 2021). At the same time, compensating for greenhouse gas emissions by purchasing carbon credits – promises of reduced emissions or carbon sequestration elsewhere – has become more available to consumers. What was previously seen largely through offers to offset for one's emissions from flying, is now visible as an option to choose an already compensated product, pay an extra fee when making purchases, or calculate and compensate for emissions from one's whole lifestyle via monthly payments. The range of products and services claiming carbon neutrality or net-zero emissions using offsets have both increased and diversified, ranging from carbon neutral deliveries to festivals and food products.

Amidst this flurry of new products and services, however, recent studies find that most consumers could not explain what a carbon offset is (Ritchie et al., 2021) or found companies' claims regarding carbon offsetting confusing and difficult to understand (Konsumentverket, 2020). Moreover, voluntary carbon offsetting is a

CONTACT Kamilla Karhunmaa Kamilla.karhunmaa@helsinki.fi Department of Social Sciences, University of Helsinki, PO Box 54, 00014, Helsinki, Finland

Supplemental data for this article can be accessed online at https://doi.org/10.1080/1523908X.2023.2211539.

controversial practice that is often discussed through moral claims on the rightness of offsetting and who should bear responsibility for climate action (Dalsgaard, 2022). Offsetting emissions has been presented to citizens both as 'an easy and cheap way to try to alleviate climate shame caused by flying' (Leipola, 2021, p. 4) as well as modern trade in 'indulgences' that allows pursuing a luxurious lifestyle without changing one's own behaviour (Lohmann, 2006). In this contradictory context, it is crucial to study citizens' views in detail to form a more complete picture of the ways in which voluntary carbon offsetting is currently settling and taking shape.

Within a wider body of literature on carbon markets and carbon offsetting (see Wei et al., 2021, for an overview), there is a considerable strain of research that examines citizens, consumers and corporate claims directed towards buyers of voluntary carbon offsets. Much of this research targets consumer preferences to purchase carbon offsets through economic analysis, such as contingent valuation (MacKerron et al., 2009; Ritchie et al., 2021). However, as voluntary carbon offsetting is still unsettled in citizens' everyday lives, we argue that such studies overlook the more subtle ways in which this is happening.

To grasp citizens' own views and understandings of voluntary carbon offsetting, we undertook a combination of quantitative and qualitative analyses on a nationally representative survey of the citizens of a Northern welfare state, Finland, conducted in 2021. The quantitative responses were enriched by a qualitative analysis of the open-ended questions. To avoid pre-organising the richness of citizens' views and understandings conceptually, we utilized a theoretically minimal 'theory–methods package' (Silvast & Virtanen, 2023) of cultural-sociological combined with data-driven analysis techniques (see Virtanen, 2019). Our research questions are: (1) What does voluntary carbon offsetting mean to citizens in their daily life: do they offset themselves; how do they view and understand offsetting, and what kind of attitudes do they express towards it? (2) Do citizens trust the offsetting sector: does it appear reliable for them or not? By answering these questions, our study contributes to a growing research body on voluntary carbon offsetting and builds a nuanced picture of citizen perceptions regarding a complex and morally charged phenomenon that is currently taking shape in an assembly of international markets, environmental policy and planning, business practices, and citizens' daily lives.

2. Literature review

2.1. Background to voluntary carbon offsetting

Voluntary carbon offsetting refers to a practice where the production of greenhouse gas emissions in one place is compensated for, or offset by, reducing emissions or sequestering carbon from the atmosphere in another place. In voluntary carbon markets, carbon credits are created in projects where emissions are reduced, avoided, sequestered or removed in a specific place. These credits are then used by individuals, organizations and businesses in order to meet their carbon neutrality or net-zero targets. The last few years have seen a surge in the demand for carbon credits from voluntary carbon markets. Companies and organizations remain the primary buyers of carbon offsets, accounting for 84.5% of the total customer base in 2006–2015 (Hamrick & Gallant, 2017). How offsets are utilized with regard to carbon neutrality or net-zero pledges remains opaque, however, with only a limited number of companies specifying the relation of offsetting to emission reductions (see also Kreibich & Hermwille, 2021).

Calls for regulation and oversight of voluntary carbon offsetting have also increased. These demands are set in a novel context of international climate policy following the Paris Agreement, where new challenges have emerged about how international carbon credits can be accounted for, bought, and sold (Blum, 2020). Furthermore, the growth of net-zero pledges has led to increased calls for clarifying and governing how climate claims are used to market products and services.[1]

2.2. Citizens and consumers encounter voluntary carbon offsets

Most studies that examine citizens and voluntary carbon offsetting do so through economic analysis of consumer preferences (e.g. Blasch & Farsi, 2014; MacKerron et al., 2009; Ritchie et al., 2021; Zhang et al., 2022). These rely on hypothetical purchase situations, where respondents' willingness to pay for offsets is gauged

through different choice experiments, the majority of which are set in the context of air travel (Gössling & Dolnicar, 2023). Generally, economic studies present a clear-cut image of offset projects, where the social, economic and environmental impacts of carbon projects can be clearly distinguished, measured, and calculated (Zhang et al., 2022) – a process that is very difficult to do in practice (Frewer, 2021; Karhunmaa et al., 2015).

Consumer choices in hypothetical purchase situations depend on a wide range of factors, demonstrating both the complexity of individuals' decision-making and the frailty of making generalizing statements about consumer preferences. Recent reviews highlight a range of influencing factors, from knowledge, attitudes, and social norms to structural, policy-related and offset project-related factors as well as individual level socio-economic characteristics and psychological factors (Gössling & Dolnicar, 2023; Ritchie et al., 2021). Regarding consumer preferences, recent studies highlight that for air travel, consumers prefer offsets that are local, climatically effective, accredited, transparent, and operated by not-for-profit entities (Ritchie et al., 2021).

Another segment of studies draws largely on psychology and behavioural economics to claim that paying for offsets may either incentivize or disincentivize pro-environmental behaviour. For example, some state that being aware of the environmental consequences of actions leads consumers to decrease consumption (Stern et al., 1993), whereas others posit that offsetting may alleviate feelings of guilt associated with consumption and make associated behaviour seem inconsequential (Günther et al., 2020). In behavioural economics, the theory of mental accounting (Thaler, 1985) states that individuals will keep mental accounts of their behaviour in different contexts, with offsetting in one area, such as flying, potentially leading to overconsumption in another one, such as driving.

While willingness to pay and other stated preference studies may provide insights about consumer motivations and preferences, they are increasingly criticized as poor indicators of actual environmental behaviour (Berger et al., 2022; Bravo & Farjam, 2022; Günther et al., 2020). In willingness-to-pay studies, the number of consumers willing to purchase offsets ranges from near zero to around 30%, with monetary amounts ranging from 1 to 50€ (Berger et al., 2022; Ritchie et al., 2021). However, a recent study of over 60,000 flight bookings finds that only 4.6% of consumers purchased offsets, with a mean willingness to pay of around 1€ (Berger et al., 2022). Likewise, there is scant research on the actual behavioural impacts of purchasing compensated products and services. A novel study exploring behavioural responses to 'carbon neutral showers' in a youth hostel found that knowledge of a service's emissions being offset led to considerable increases in consumption (Günther et al., 2020).

A third line of inquiry related to citizens and consumers examines offset project developers' claims and the relationships they aim to create with potential buyers. The focus is not directly on consumers, but rather on the information, images, and stories that are communicated to appeal to potential buyers (Lovell et al., 2009). Offset projects produce representations of both the imagined buyer in the Global North as well as the intended 'beneficiary' in the Global South (Lehmann, 2019; Wang & Corson, 2015). While such stories and images are encountered by citizens and consumers in marketing and advertising campaigns, there is little research on how citizens respond to the technical, affective, and moral claims produced by such efforts.

3. Context and research design

3.1. Voluntary carbon offsetting in Finland

We conducted our study in Finland, where voluntary carbon offsetting has become more visible in policy, media, and citizens' lives within the last few years. In Finnish media, voluntary offsetting has been presented as a complex issue that is challenging for consumers to understand and follow (Hukkanen & Kanerva, 2020; Pennanen, 2021). Except for general polls regarding support for different forms of climate action, there have been no previous surveys on Finnish citizens' views on voluntary carbon offsetting. The increase in Finnish offset projects and the publicity they have received has resulted both in the publication of a host of reports and an activation of policy efforts. Policy efforts are currently leaning towards informational regulation and

the development of registries and best practice codes for companies and citizens[2] (Ahonen et al., 2021; Laine, Airaksinen, et al., 2021; Laine, Auer, et al., 2021; Niemistö et al., 2021).

3.2. Data sample

The data for this study were collected in 2021 by a commercial marketing research company in Finland, using an online questionnaire directed towards the members of the company's online panel. 6667 participants were invited to participate in the survey, with 1000 responding, resulting in a response rate of 15%. The members of the panel have given their consent to receiving email invitations to consumer surveys on various topics, and participation is always voluntary. The sample was formed using sampling quotas that represented the 18–74-year-old population living in mainland Finland ($n = 1000$). The age and gender distribution corresponded quite closely to that in the general population (Table 1). Highly educated respondents were somewhat over-represented in the data compared to population statistics. Apart from the level of education, the discrepancies between the data and the general population are minor and give reason to conclude that the data is reasonably representative of the Finnish population.

3.3. Measures

The questions analysed in this study were part of a larger questionnaire that explored respondents' perceptions about carbon offsetting, offsetting markets and practices, climate change, and consumption practices. The survey included both closed and open-ended questions. The brief introduction to the survey described voluntary carbon offsetting[3] as activities through which citizens may compensate for their greenhouse gas emissions by reducing or sequestering an equal amount of emissions elsewhere. An example was given of offsetting by paying for emissions resulting from travelling or the consumption of goods. We give an overview of the questions analysed for this study below, with the full questions and response options presented in Annex 1.

To examine personal views and experiences of offsetting, we began the survey by asking an open-ended question about these. Instead of definitions of offsetting, we were interested in respondents' first impressions, general images, and views and understandings related to offsetting. To gauge self-reported offsetting, we then asked whether respondents had compensated CO_2 emissions from their household, and, through an open question, why they did so or why they refrained from doing so. We then surveyed general attitudes towards offsetting with eleven statements that the respondents were requested to evaluate using a 5-point Likert scale. Trust in the offsetting sector and offset providers was measured with three questions, asking about the trustworthiness of (i) Finnish offset providers (ii) international offset providers, and (iii) the offsetting sector. Finally, we assessed the background factors to citizens' offsetting by asking respondents to evaluate different sources of influence on a decision to start offsetting more than they did now.

Table 1. Socio-demographic characteristics in the survey sample and in the Finnish population (Statistics Finland, 2022).

	Survey sample	Finnish population
Age group		
18–34 years	28.9	28.8
35–54 years	34.8	35.0
55–74 years	36.3	36.2
Gender		
Male	50.3	50.3
Female	49.7	49.7
Level of education		
Basic education	8.8/ 7.9 [a]	17.2 [b]
Secondary education	52.9/ 53.0 [a]	44.9 [b]
Tertiary education	38.3/ 39.1 [a]	36.7 [b]

[a]In the whole sample/ among 20–74-year-olds.
[b]Among the 20–74-year-old population.

3.4. Analyses

The analysis consisted of three intersecting parts. The quantitative responses were analysed first. The distributions of the quantitative responses are reported as percentages. In addition, associations between socio-demographic background, attitudes, trust and offsetting were analysed with multiple linear regression (attitudes and trust) and binary logistic regression (offsetting). The eleven attitude variables were grouped together into a mean score (see Annex 1) (Cronbach alpha between the attitude statements = 0.70). Similarly, three trust variables were grouped together into a mean score (Cronbach alpha = 0.83).

The second phase consisted of qualitative content analysis (Hsieh & Shannon, 2005), conducted by Author1 and 2 as a data-driven process, utilizing a cultural-sociological framework to interpret the data (see Virtanen, 2019). The analysis work began with an inductive coding of the open-ended responses, resulting in over 150 codes. Overlapping codes were then removed and similar codes were merged, resulting in 101 codes (listed in Annex 2). To ensure inter-coder reliability, the two researchers separately coded 10% of the responses and compared and discussed the results. The open-ended responses were then re-analysed by Author1 and 2 based on the formalized set of codes.

In the third phase, the quantitative responses, the code frequencies, and the preliminary interpretations that emerged during the coding process were analysed together to interpret the results. For example, the quantitative responses on the frequency of offsetting were enriched with answers to the open-ended questions, which showed the diversity of what citizens considered carbon offsetting. Example quotes from the open-ended responses, translated by the authors, are presented to support our argument.

3.5. Limitations of the research

Our results should be qualified with the following limitations. First, the answers to open questions were relatively short, ranging from one word up to four or five sentences. The longer responses often reflected more nuanced and ambivalent attitudes towards carbon offsetting, whereas the shorter responses most commonly demonstrated a lack of knowledge (e.g. 'I don't know') or a simple descriptive statement (e.g. 'ecological' or 'distrust'). This constrains the coding and interpretation of some responses. Second, we explored self-reported factors, which are subject to social desirability bias (Chung & Moore, 2003). Therefore, it is possible that those who are concerned about climate change may overestimate how much they have offset. Third, only about 20% of the respondents described their thoughts on carbon offsetting with a level of detail and with expressions that demonstrated that they thought of offsetting in the sense of purchasing carbon credits from the voluntary carbon market. As we did not specifically ask the respondents to define offsetting, in about 70% of responses it was not possible to interpret whether this or an alternative understanding of offsetting was used. The reported percentage figures should therefore be treated as indications of self-reported motivations, rather than indications of actual offsetting behaviour.

4. Results

4.1. Everyday offsetting

We present the results as divided into three sections reflecting our research questions. The answers to the first open question regarding general views and understandings of offsetting revealed that around one fourth of respondents do not know much about the topic or have substantial impressions about it. Few respondents gave more thought-through explanations of what they understand offsetting to be. For example, some (70 respondents, 7%) gave short definitions, such as 'for an extra fee, one can compensate for their carbon emissions'. Typical answers included descriptive statements linking offsetting to climate change and environmental values, emission reductions and decreasing polluting activities, as well as sustainability more broadly: 'something to do with environmental and climate issues'.

Unfamiliarity with the topic also appeared in more subtle terms: as different perceptions of what offsetting means, or what 'counts' as offsetting. While the introduction to the survey defined offsetting as involving

voluntary monetary payments (see Section 3.3), it was unclear whether most respondents thought of offsetting in this way. This was most clearly revealed in the answers to the second open question, which asked for reasons for offsetting from those respondents who had claimed to have offset their emissions. The most common type of answer to this question discussed a broad range of sustainability choices in everyday life. Instead of discussing offsetting in the narrow meaning of buying offsets, respondents referred to everyday environmental action. For example, respondents attempted to reduce emissions and live in an environmentally-friendly manner by stating that 'I ride a bicycle' or 'I recycle'. Some explain this in more detail:

> We use a lot of public transport instead of our own car and we do this to compensate for our own share.

Out of the 278 answers to this open question, 67 (24% of answers to question, 6.7% of whole sample[4]) reflected this kind of understanding of offsetting through other environmentally-friendly choices. In contrast, only 15 (5.4%/1.5%) answers clearly revealed that the respondent had paid for offsetting, for example when flying. 13 (4.6%/1.3%) respondents expressed that they had purchased or come across products or services whose emissions were already offset by the producer.

This contrasts starkly with the responses to the closed questions, which suggest that as much as 28% of respondents to the whole questionnaire had offset the CO_2 emissions of their households. There were statistically significant differences between sociodemographic groups (Table 2, model 1). Women were more likely to offset than men, 18–34-year-olds were more likely to offset than other age groups, and those with secondary and tertiary education were more likely to offset than less educated respondents.

However, based on the open questions, we suggest interpreting these numbers cautiously, as they refer not only to purchasing offsets from voluntary carbon markets. The responses to the closed questions indicate that about 51% had not offset and 20% could not say whether they had offset their emissions. Furthermore, very similar responses regarding the measures already taken to support a climate-friendly lifestyle were given as reasons why offsetting had *not* been chosen. Causing emissions was often understood as engaging in certain polluting activities, such as driving and flying, and offsetting was then framed as unnecessary if the respondent did not own a car or travel by plane. These answers sometimes reflected the idea that reducing one's emissions is a priority, revealing a more critical attitude towards the logic of offsetting. More often, however, refraining from offsetting was linked to a modest lifestyle where there is little room for more reductions, and some respondents even claimed that they 'have no emissions'.

In other cases, the respondents stated that consumption choices, such as buying ecological electricity, were enough, and that they 'do so much already'. In this context, paying for distinct offsets is not viewed as

Table 2. Associations between attitude, trust and offsetting of emissions with positive attitude toward offsetting, gender, age and level of education. Multiple linear regression (models 1 and 2) and binary logistic regression (model 3).

	Dependent variable					
	Model 1. Positive attitude toward offsetting		Model 2. Trust in offsetting actors and practices		Model 3. Offsetting of household emissions [a]	
	B	S.E.	B	S.E.	B	S.E.
Constant	2.88	0.06	1.15 ***	0.32	−4.70 ***	0.57
Positive attitude toward offsetting			0.84 ***	0.09	1.21 ***	0.17
Gender: woman (ref: man)	0.18 ***	0.03	0.35 ***	0.09	0.33 *	0.15
Age (ref: 18–34 years)						
35–54 years	−0.12 **	0.04	0.02	0.12	−0.68 ***	0.19
55–74 years	−0.04	0.04	−0.28*	0.11	−0.45 *	0.18
Education (ref: basic)						
Secondary	−0.18 **	0.06	−0.08	0.17	0.74 **	0.28
Tertiary	−0.33 ***	0.06	0.09	0.18	0.67 *	0.30
Adjusted R^2	0.07 ***		0.10 ***			
Nagelkerke R^2					0.13 ***	

***$p < .001$, **$p < .01$, *$p < .05$.

[a]Response options were 1 = 'yes', 0 = 'no', 'I do not know'.

necessary, as the environment is taken care of through other means. Some elaborated on this argument, suggesting that their individual responsibility is limited, especially in relation to others' activities:

> I don't find it fair that I should have to pay for offsetting, because I feel that I am taking part in the joint effort to combat climate change more than average. I don't want to be the one to both compensate and try my best by, for example, reducing consumption.

While offsetting is generally understood in the data as having something to do with climate change and emission reductions, and further, as a way for an individual to act, the answers show that understandings of offsetting remain rather vague. This was true especially for those who claimed that they have used offsetting. Instead, critical answers and reasons given for not offsetting often seemed more grounded in the narrow meaning of offsetting as monetary payments, as they sought to criticize this logic.

Owing to this ambiguity, the share of respondents who had purchased voluntary carbon offsets through offset providers is likely to be less than 28%. This illustrates how offsetting is currently viewed and understood in a larger frame of an eco-friendly or sustainable lifestyle, market-based action, and attempts to reduce emissions. This framing makes apparent that an individual comes across different possibilities and demands to take part in climate and environmental action, offsetting being only one among many.

4.2. Attitudes towards offsetting

Attitudes towards offsetting are numerous and often ambivalent. When people were asked whether they think offsetting is an effective means to mitigate climate change, a third (33%) agreed, less than a third (28%) disagreed and just over a third (39%) neither agreed nor disagreed (see Figure 1). The open answers conform rather well to the closed responses, revealing a lack of stance or positive, critical, as well as ambivalent attitudes towards offsetting and climate action more broadly. A fifth of the answers for the first open question take a generally positive stance to offsetting, while critical attitudes are expressed by a little over a fifth.

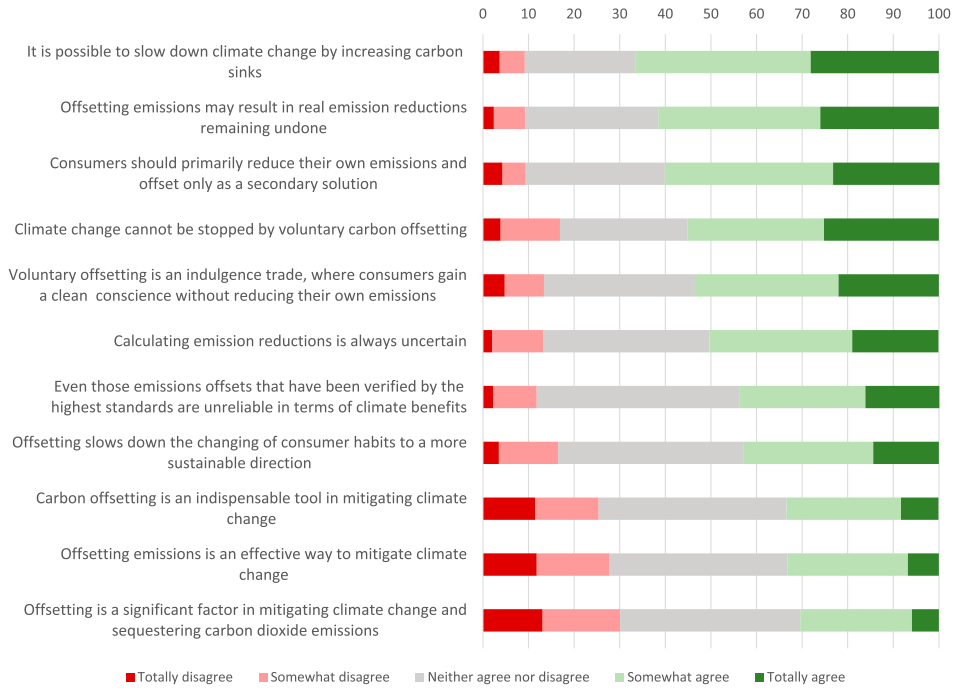

Figure 1. Attitudes towards offsetting (percentages of responses).

The positive perceptions expressed in open answers often involved a 'better than nothing' attitude: it was noted that climate change is a threat, and something needs to be done – and offsetting might work for this purpose by providing a way to react in everyday life. This was often combined with a sense of individual, yet shared, responsibility motivated by an understanding of the intrinsic values of nature and the environment, the future, or the common good: 'because the world will be destroyed if nobody cares'. This sense of responsibility and will to act was often expressed as a short and simple description of a generally positive attitude towards climate action in general, instead of explicitly presenting a positive attitude towards carbon offsetting.

Only a few respondents focused more clearly on the narrow definition of offsetting and discussed its possibilities in more detail. Offsetting was viewed, for example, as a possible tool in the process of developing more climate-friendly technologies and new methods in the future:

> The right solution for the future. Alternative methods to make things better. Possibly reduces the heaviest [emissions] or helps to come up with new [solutions] or even reduce emission-rich enterprises, production, or the whole life span of a product.

In contrast, longer answers reflected more ambivalent views and understandings of offsetting. The complex nature of climate change mitigation, the role and responsibility of individuals in this task, as well as the importance of emission reductions and other issues involved in offsetting were discussed critically, while still often accepting 'better than nothing' thinking. Offsetting was placed within a broader context of climate action and policies and viewed as a small part of a range of methods, rather than a key solution to a complicated problem. The responses to the closed questions also highlight this view, as 60% of the respondents consider that emission reductions are a priority in the attempt to mitigate climate change.

Following this idea of a 'secondary' method, offsetting was sometimes discussed as a good means when no other possibilities exist, especially within fields where emission reductions cannot be achieved through other means: 'a good way to compensate emissions, but problematic if no other means to reduce emissions are utilized'. However, other respondents took a more critical stance, claiming that offsetting represents completely wrong methods, ultimately resulting in more harm than good: 'you cannot take emissions away merely by means of compensation'.

Personal conscience and attempts to alleviate it were sometimes coupled with societal pressure and the pervasiveness of talking about climate change in society:

> I'm not sure I know (why I compensate). Maybe because there is so much talk about climate change and it makes me feel a little better when, for example, you buy climate-friendly products.

At the same time, one of the most prominent critical points targeted personal conscience and whether offsetting offered a 'too easy' way to solve it. Its suspicious easiness was also connected to the view of ill-suited methods. Offsetting was framed as an easy and hypocritical way to reduce one's guilt over overconsumption, without going to the trouble of reducing one's emissions: 'gimmickry used to avoid actual measures to reduce carbon footprints'. Some respondents drew a parallel to offsetting as an 'indulgence trade', which has been a rather popular framing of the phenomenon in the Finnish media and civil society. This was at times connected to a broader critique regarding unequal opportunities to use offsets, with offsetting seen to offer the rich the opportunity to continue with their environmentally damaging lifestyle:

> It is good that this may be done. However, I am slightly left with an impression that, if you have money, you can behave in a more environmentally polluting way and reassure your conscience (if you have one) by paying.

Put into numbers from the closed questions, more than half of the respondents (54%) agreed completely or somewhat with the statement that carbon offsets are an indulgence trade (see Figure 1). Similarly, 61% of respondents agreed completely or somewhat that offsetting may cause emission reductions to remain unrealized, and 55% of respondents think that climate change cannot be stopped with carbon offsetting. When asked about the means to address climate change, the value of increasing carbon sinks (such as forests) in slowing down climate change was recognized by 67% of respondents.

The questions measuring attitudes where combined into a mean score and the differences between socioeconomic groups were analysed with multiple linear regression (Table 2, model 1). Men were more critical towards offsetting than women. In addition, middle-aged (35–54 years old) were more critical than young and older adults. The more educated were more critical than less educated respondents. However, those with a secondary and tertiary education were more likely to offset than those with a basic level degree when the positive association between attitudes and offsetting was also included in the model (Table 2, model 3).

The individual's possibilities and responsibility in targeting emissions also provoked critical attitudes. While some took their personal responsibility as a starting point, others followed the idea that (their) individual action is, or would be, insignificant in the face of the larger picture, or that responsibility belongs to others. Individuals were contrasted with, for example, the business sector, claiming that climate issues should be considered in the production process, and costs should be covered by the enterprises and included in the prices. In some responses, the entire logic of market-based action was criticized; the logic that places responsibility on individuals rather than actors with more power, such as governments and companies, was framed as flawed: 'I think carbon offsets belong to companies and especially big businesses, not as extra fees to be paid by consumers'.

In addition, the emissions of Finnish citizens, or the aims to reduce them, were contrasted with larger emitters, such as China or the European Union. Offsetting was thus viewed as inefficient in the big picture, again in the context of climate action and policy more broadly. For some, the role of offsetting in the global perspective was 'practically useless in Finland as long as significant changes are not made elsewhere'.

Unsurprisingly, the most critical answers also revealed a highly sceptical attitude towards the entire idea of offsetting: it was viewed, for example, as ridiculous 'nonsense', or simply 'stupid'. These critical attitudes were either not elaborated further or tied, for example, to the above-mentioned ideas on the uselessness of offsetting, or individual action in general. In a small number of critical responses, the idea of offsetting was rejected in conjunction with any other form of environmental action: 'I'm not interested in this climate nonsense. It only becomes expensive for the consumer, – it's sick'. Another strain of crushing criticism rose from suspicion and distrust, to which we turn next.

4.3. Trust in the offsetting sector

Scepticism, suspicion, and general distrust in offsetting were largely visible in the data. According to the closed responses, only 18% perceived the majority of offset providers in Finland as trustworthy. Distrust was even higher towards international actors in the field: only 5.9% perceived that the majority of them were trustworthy. Yet about one third of the respondents were unable to assess whether the companies were trustworthy or not. In addition, there was mistrust in the entire offsetting sector: only 8.5% of respondents trusted the sector a lot or completely.

When these quantitative trust questions were analysed together (mean score, see Table 2, model 2), statistically significant differences were found between socioeconomic groups. Men had less trust than women, older people were less trusting than younger people. However, there was no difference between respondents with different education levels. Moreover, a positive attitude was associated with a higher level of trust (Table 2, model 2).

In the open answers, citizens' trust in the offsetting sector was often not explicitly expressed, but implied rather by expressing general attitudes towards offsetting. In positive responses, a sense of trust in developing offsetting in the near future surfaced. Hopeful expectations concerning the system were expressed, and some respondents stated that they 'wish[ed] it [offsetting] was a working tool' or that despite doubts in the system, there should be more offsets in the future.

Distrust was related to the whole system and logic of offsetting, as well as its actors: offsetting was seen as not efficient enough, and as lacking transparency, making the system unreliable at best. Distrust towards offset providers emerged as repeated doubts regarding 'where does the money go?'. This was tied to scepticism on whether offsetting fulfils its promises and leads to actual emission reductions or whether it is just a way for

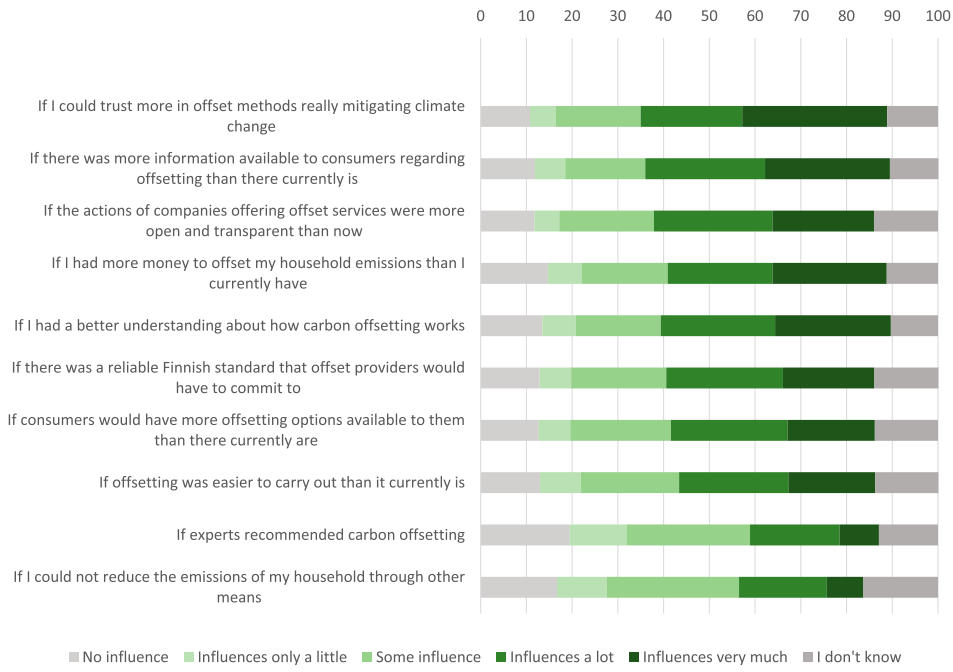

Figure 2. Citizens' perceptions of how much different things would influence their decision to start offsetting their household emissions more than they now do (percentages of responses).

companies to make a profit without true environmental value: '[this is] really hazy, I only think about who is cashing in amidst all the fuss'.

While some viewed the system as a pure scam operated by unreliable businesses, worries about the functioning of the system and the actual impact of offsetting were also visible in more subtle terms. The validity of emission calculations was questioned, and unresolved questions and complexities involved in offsetting were pointed out. The calculative processes and knowledge required to determine emissions were addressed as complex, and complexity was connected to questioning the credibility of offsetting: 'because we don't know all the (cumulative) effects of emissions, offsets are in part just made up, and as such not the best way to take action'. Some respondents expressed criticism by pointing out that there is insufficient external supervision for offsetting:

> It's easy for fraudsters to swindle money from people. Controls are quite non-existent and the same offsets can even be used twice. We must get it to work, supervised and right. Otherwise it increases emissions.

Altogether, trust was perceived to be a significant factor in increasing offsetting (see Figure 2). A majority (54%) stated that their willingness to offset would be influenced much or very much if they could *trust more in the offset methods really mitigating climate change*. Increasing trust is difficult, however, as offsetting stood out as largely remote and incomprehensible in the data. The respondents stated in their open answers that they had not come across offsetting, do not know much or have impressions about it, or had not found a suitable or easy way to offset. These answers also revealed a lack of interest or subtle resistance to the topic: the respondents did not show a significant interest in acquiring more information or understanding the phenomenon more thoroughly.

When specifically asked, changes that were perceived as influencing the willingness to offset (much or very much) were (see Figure 2): *having more information available to consumers regarding offsetting* (54%), *better understanding how offsetting works* (50%), and *if the actions of offset providers were more open and transparent than now* (48%). The least impact was thought to come *if offsetting was recommended by an expert* (28%) or if

the respondent *could not reduce the emissions from their household through other means* (27%). This indicates that while increased information and understanding as well as trust in methods could lead to a higher propensity to offset, it is unclear how to communicate that information. Respondents were not keen on expert recommendations or acquiring more information in general. Some of the unwillingness to increase offsetting seems to stem from an overall lack of interest in (reducing) greenhouse gas emissions.

5. Discussion

Hype around voluntary carbon offsetting has been prominent in recent years, sparked by companies' increased net-zero pledges and the ensuing purchase of carbon offsets (Donofrio et al., 2021; Kreibich & Hermwille, 2021). While carbon offsets are also available for citizens to purchase directly, citizens largely encounter carbon offsetting through products that have been offset and their climate-related marketing claims (Konsumentverket, 2020). Regulatory efforts have also woken up to this issue, with initiatives at different scales currently putting into place best practice guidelines for companies' climate claims.[5] Despite recent increases in information, citizens have trouble defining carbon offsets and are confused by climate-related claims.[6] While previous research has looked at detailed consumer preferences, we contend it is necessary to explore citizens' understandings in a more open-ended manner to gauge everyday meanings, areas of interest and disinterest as well as subtle forms of trust and distrust. Our results, based on an integrated analysis of open and closed questions in a nationally representative survey, point to caution against current hypes of market growth for four interlinked reasons.

First, the results of our study show that carbon offsetting is still a widely unknown and unsettled phenomenon. Around a fourth of our respondents did not know what carbon offsetting means or had no impressions of it, which resonates with previous studies (Konsumentverket, 2020; Ritchie et al., 2021). Our qualitative analysis enriched the picture by revealing multifaceted and ambiguous understandings regarding offsetting. While the responses often reflect a 'better than nothing' attitude, there is relatively little unreserved support for offsetting and most positive responses also bring up uncertainty and opacity related to it.

Second, our results highlight important questions regarding responsibility for climate action at different levels. Many respondents viewed voluntary offsetting as placing responsibility for climate action on the wrong entity, i.e. individual citizens. Echoing previous studies in the context of air travel, respondents want polluting companies and governments to be principally responsible for bringing about climate change mitigation (see also Gössling & Dolnicar, 2023). While citizens have a general willingness to address climate change, often also in their individual lives, this rarely translates into a decision to offset their emissions. Instead, respondents primarily discuss other sustainability-related life choices, such as transport choices and reducing consumption. This is associated with the fact that respondents regard emission reductions as primary, signalling also to companies that they cannot offset their way out of climate action responsibilities.

Third, the results highlight serious distrust in the offsetting sector. Reasons for distrust range from questioning the technicalities and processes of offsetting to scepticism towards its whole logic in climate change mitigation. In their responses to the closed questions, citizens identified several factors that could increase their trust, such as more trustworthy methods, transparency in the process, and increased knowledge about how the system works (see Figure 2). However, the open answers demonstrate less interest in and even subtle resistance towards acquiring new information on offsetting methods and systems. Further, it remains unclear how to act to increase trust, as our analysis point to doubts about expert recommendations.

In the past, criticism and claims of greenwashing have led carbon market actors to further legitimize their activities by developing morally loaded narratives and images on the co-benefits of carbon markets (Karhunmaa, 2016; Lehmann, 2019; Wang & Corson, 2015) as well as more certification, standards, and best practice guidelines (Howard et al., 2015). Such processes aimed at improving market effectiveness and increasing trust are currently underway with multiple initiatives at different scales.[7] Whether such moves will increase citizens' trust in the offsetting sector remains to be seen, however, especially as they are coupled with increasingly critical media coverage and civil society voices.

Hence, and fourth, our study cautions against placing high hopes in individuals' willingness to offset, as in addition to the above-mentioned issues, we document rather low offsetting rates. About 28% of respondents estimated to have offset their emissions, which is similar to amounts found in willingness-to-pay studies in Australia and Switzerland that range from 10 to 28% (Blasch & Farsi, 2014; Zhang et al., 2022). However, even for those who claim to have offset their emissions, the meanings of this were multiple and diverged from a narrow understanding of offsetting as monetary payments. This means that the number of respondents purchasing offsets from voluntary carbon markets is likely to be lower than 28%, concurring with previous studies that have found the actual purchase of offsets much lower than those found in stated preference studies (Berger et al., 2022; Bravo & Farjam, 2022).

Current regulatory efforts concerning voluntary carbon offsetting have focused largely on voluntary measures, in particular increasing information to possible buyers and citizens to increase trust and transparency in the sector. While it seems a needed response to concerns and lack of knowledge expressed by citizens, our results cast some doubt on the effectiveness of this approach, as purchasing carbon offsets from voluntary carbon markets does not appear to be a priority for citizens' climate action. Furthermore, several of the concerns and doubts raised by citizens, such as who is responsible for climate action and offsetting in the first place, and whether the technicalities and logics behind carbon offsetting are flawed, are not solved by merely increasing information.

6. Conclusions and areas for future research

This study has examined citizen views and understandings of voluntary carbon offsetting through a nationally representative survey ($n = 1000$) in Finland with both open and closed answers. From a citizen perspective, carbon offsetting remains rather unsettled and ambiguously understood, potentially beneficial, yet conditioned by severe doubts and distrust. There are also significant differences between sociodemographic groups in offsetting, attitudes, and trust. Currently, offsetting appears to attract especially women and young adults: they expressed the most positive attitudes, highest level of trust and engagement in offsetting. Moreover, highly educated citizens were more likely to engage in offsetting even if they had more negative attitudes than others.

Citizens perceive voluntary offsetting in multiple ways, also beyond monetary payments for offsets, and the attitudes towards offsetting reflect that while many view it as 'better than nothing', there is limited unreserved support for offsetting and several concerns about its use. Ensuing, distrust towards the sector is high amongst citizens. In a wider perspective, our results raise questions about the contribution of voluntary carbon offsetting to climate change mitigation. Whether such a practice that receives wary citizen support and is riddled with doubts and distrust can significantly contribute to climate change mitigation is uncertain.

Our findings suggest that citizens' views about offsetting are heterogeneous and contradictory and call for more research with a more extensive set of socio-demographics. For example, we did not study the role of household economic situations: a poor economic situation was probably acting as a barrier to offsetting among those with a lower level of education even if they had a more positive attitude toward offsetting. Also the question of how purchasing offsets, or products that have been offset, affects consumption practices remains largely unstudied (for an exception, see Günther et al., 2020). There is a need for more research on both the quantitative effects of offsetting on consumption choices as well as the more qualitative influences offsetting can have on attitudes and motivations regarding climate action and the distribution of responsibility. Future research could focus on citizen perceptions of offsetting vis-à-vis other climate activities as they are experienced in daily life and address also questions of perceived responsibility regarding consumption and climate action. We suggest elaborating on these for example by interviews and focus groups with citizens.

Notes

1. E.g. by the European Commission: https://environment.ec.europa.eu/topics/circular-economy/green-claims_en.
2. E.g. https://hiilikompensaatioinfo.fi/ and https://ym.fi/vapaaehtoiset-hiilimarkkinat.

3. The survey was conducted in Finnish and a Finnish term 'päästökompensaatio' was used to discuss carbon offsetting. This term has been established in the country and translates literally as 'emissions compensation' but is commonly used with reference to greenhouse gas emissions. We have used the term 'offset' in this article because of its use in carbon offsetting literature, but acknowledge that the Finnish word 'compensation' might have a slightly wider connotation on some occasions.
4. We report here the absolute figures and the percentages with regard to the responses to the particular question as well as the full sample.
5. In Europe: https://environment.ec.europa.eu/topics/circular-economy/green-claims_en and in Finland: https://julkaisut.valtioneuvosto.fi/handle/10024/164732.
6. See e.g. recent reports from the UK (https://www.asa.org.uk/resource/climate-change-and-the-environment-consumer-understanding-of-environmental-claims.html) and the Netherlands (https://www.acm.nl/en/publications/acm-publishes-behavioral-research-co2-compensation-when-purchasing-airline-tickets).
7. E.g. globally https://icvcm.org/ and in the Nordic countries: https://nordicdialogue.com/.

Acknowledgements

We thank participants at the Finnish Society for Environment Social Science yearly colloquium in November 2021 for their comments.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

We gratefully acknowledge funding by Natural Resources Institute Finland (Luke) for 'Soil carbon concepts' (SOCOS) project and by Kone Foundation for the 'Making do with climate change' (Climakedo) project. Kamilla Karhunmaa acknowledges funding from Säätiöiden post doc –pooli, Emil Aaltonen foundation.

Notes on contributors

Kamilla Karhunmaa is a postdoctoral researcher at SPIRAL, University of Liège and at the University of Helsinki. She has a PhD from the University of Helsinki and works at the intersection of environmental policy and science and technology studies. She studies how we collectively make sense of environmental concerns and act on them.

Saara Salmivaara has a Master's Degree in Sociology from the University of Helsinki. She has researched vaccination perceptions and citizens' views on climate change.

Vilja Varho has a PhD in environmental science and policy from the University of Helsinki, Finland, and holds the title of Docent (futures research) at the University of Turku, Finland. She studies a wide range of societal ways to combat climate change.

Mikko J. Virtanen is an Adjunct Professor of Sociology at the University of Helsinki and works as a Senior Lecturer in the discipline. His scholarly expertise extends from social theory, social science methodology, and qualitative research methods to hands-on studies of topical phenomena, including environmental knowledge and climate marketization, health ethics, and vaccination.

Tapio Eerikäinen has Master's Degree from Trinity College Dublin. He works at Natural Resources Institute Finland coordinating international projects related to sustainability issues and climate change.

Annukka Vainio is a social psychologist, and she works as an associate professor at University of Helsinki, Finland. She leads the Behavioural Changes and Sustainability research group. Currently, she is also a member of the Finnish Climate Change Panel.

Data availability statement

The data that support the findings of this study are available from author VV, upon reasonable request.

References

Ahonen, H.-M., Möllersten, K., & Spalding-Fecher, R. (2021). *Voluntary compensation of greenhouse gas emissions: International guidance and intiatives*. https://pub.norden.org/temanord2021-541/#

Berger, S., Kilchenmann, A., Lenz, O., & Schlöder, F. (2022). Willingness-to-pay for carbon dioxide offsets: Field evidence on revealed preferences in the aviation industry. *Global Environmental Change*, *73*, 102470. https://doi.org/10.1016/j.gloenvcha.2022.102470

Blasch, J., & Farsi, M. (2014). Context effects and heterogeneity in voluntary carbon offsetting – A choice experiment in Switzerland. *Journal of Environmental Economics and Policy*, *3*(1), 1–24. https://doi.org/10.1080/21606544.2013.842938

Blum, M. (2020). The legitimation of contested carbon markets after Paris – Empirical insights from market stakeholders. *Journal of Environmental Policy & Planning*, *22*(2), 226–238. https://doi.org/10.1080/1523908X.2019.1697658

Bravo, G., & Farjam, M. (2022). Actions speak louder than words: Attitudes, behaviour, and partisan identity in a polarised environmental domain. *Energy Research & Social Science*, *90*, 102547. https://doi.org/10.1016/j.erss.2022.102547

Chung, J., & Moore, G. S. (2003). Exploring social desirability bias. *Journal of Business Ethics*, *44*(4), 291–302. https://doi.org/10.1023/A:1023648703356

Dalsgaard, S. (2022). Tales of carbon offsets: Between experiments and indulgences? *Journal of Cultural Economy*, *15*(1), 52–66. https://doi.org/10.1080/17530350.2021.1977675

Donofrio, S., Maguire, P., Myers, K., Daley, C., & Lin, K. (2021). *Markets in Motion: State of the Voluntary Carbon Markets in 2021*. https://www.forest-trends.org/publications/state-of-the-voluntary-carbon-markets-2021/

Frewer, T. (2021). What exactly do REDD+ projects produce? A materialist analysis of carbon offset production from a REDD+ project in Cambodia. *Political Geography*, *91*, 102480. https://doi.org/10.1016/j.polgeo.2021.102480

Gössling, S., & Dolnicar, S. (2023). A review of air travel behavior and climate change. *WIRES Climate Change*, *14*(1), 1–11. https://doi.org/10.1002/wcc.802

Günther, S. A., Staake, T., Schöb, S., & Tiefenbeck, V. (2020). The behavioral response to a corporate carbon offset program: A field experiment on adverse effects and mitigation strategies. *Global Environmental Change*, *64*, 102123. https://doi.org/10.1016/j.gloenvcha.2020.102123

Hamrick, K., & Gallant, M. (2017). *Unlocking potential: State of the voluntary carbon markets 2017*. https://www.forest-trends.org/publications/unlocking-potential/

Howard, R. J., Tallontire, A., Stringer, L., & Marchant, R. (2015). Unraveling the notion of "fair carbon": Key challenges for standards development. *World Development*, *70*, 343–356. https://doi.org/10.1016/j.worlddev.2015.02.008

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), 1277–1288. https://doi.org/10.1177/1049732305276687

Hukkanen, V., & Kanerva, J. (2020). Toimittaja hyvitti kesälomamatkansa päästöt kolmen eri palvelun avulla – hyvitys jäi epävarmaksi, koska alalta puuttuvat säännöt. *YLE News*. https://yle.fi/uutiset/3-11525289

Karhunmaa, K. (2016). Opening up storylines of co-benefits in voluntary carbon markets: An analysis of household energy technology projects in developing countries. *Energy Research & Social Science*, *14*, 71–79. https://doi.org/10.1016/j.erss.2016.01.011

Karhunmaa, K., Pitkänen, O., & Tuominen, V. (2015). *Assessing the co-benefits of household energy technology carbon offset projects*. http://urn.fi/URN:NBN:fi-fe2019052116304

Konsumentverket. (2020). *Klimatpåståenden. Svåra att förstå för konsumenter*. https://www.konsumentverket.se/globalassets/publikationer/hallbarhet-och-miljo/klimatpastaenden-i-marknadsforing-2020-konsumentverket.pdf

Kreibich, N., & Hermwille, L. (2021). Caught in between: Credibility and feasibility of the voluntary carbon market post-2020. *Climate Policy*, *21*(7), 939–957. https://doi.org/10.1080/14693062.2021.1948384

Laine, A., Airaksinen, J., Yliheljo, E., Ahonen, H.-M., & Halonen, M. (2021). *Vapaaehtoisten päästökompensaatioiden sääntely*. http://urn.fi/URN:ISBN:978-952-361-408-6

Laine, A., Auer, J., Halonen, M., Horne, P., Karikallio, H., & Kilpinen, S. (2021). *Esiselvitys maankäyttö sektorin hiilikompensaatiohankkeista*. https://mmm.fi/documents/1410837/22876822/Esiselvitys+maankäyttösektorin+hiilikompensaatiohankkeista_julkaistava+raporttiversio_27.1.2021.pdf/485cb89f-6c7a-b1a8-bb88-200021861238/Esiselvitys+maankäyttösektorin+hiilikompensaatiohankkeista_julkaistava+rapor

Lehmann, I. (2019). When cultural political economy meets 'charismatic carbon' marketing: A gender-sensitive view on the limitations of Gold Standard cookstove offset projects. *Energy Research & Social Science*, *55*, 146–154. https://doi.org/10.1016/j.erss.2019.05.001

Leipola, L. (2021). *Anekauppaa vai ilmastotekoja? Vapaaehtoisen päästökompensaation kysyntä, tarjonta ja laatu Suomessa*. https://finnwatch.org/images/reports_pdf/Anekauppaa_vai_ilmastotekoja_small_size.pdf

Lohmann, L. (2006). *Development dialogue. Carbon trading: A critical conversation on climate change, privatisation and power*. https://www.osti.gov/etdeweb/biblio/20838312

Lovell, H., Bulkeley, H., & Liverman, D. (2009). Carbon offsetting: Sustaining consumption? *Environment and Planning A: Economy and Space*, *41*(10), 2357–2379. https://doi.org/10.1068/a40345

MacKerron, G. J., Egerton, C., Gaskell, C., Parpia, A., & Mourato, S. (2009). Willingness to pay for carbon offset certification and co-benefits among (high-)flying young adults in the UK. *Energy Policy*, *37*(4), 1372–1381. https://doi.org/10.1016/j.enpol.2008.11.023

Niemistö, J., Seppälä, J., Karvonen, J., & Soimakallio, S. (2021). *Päästökompensaatiot ilmastonmuutoksen hillinnän keinona Suomessa – nyt ja tulevaisuudessa*. https://julkaisut.valtioneuvosto.fi/handle/10024/162987

Pennanen, R. (2021). Hiilineutraalius Hyvitätkö lomalentosi päästöt rahalla? Vapaaehtoisissa päästöhyvityksissä on mahdollisuus todellisiin ilmastotekoihin, mutta myös viherpesuun. *YLE News*. https://yle.fi/uutiset/3-11926169

Ritchie, B. W., Kemperman, A., & Dolnicar, S. (2021). Which types of product attributes lead to aviation voluntary carbon offsetting among air passengers? *Tourism Management*, *85*, 104276. https://doi.org/10.1016/j.tourman.2020.104276

Silvast, A., & Virtanen, M. J. (2023). On theory–methods packages in science and technology studies. *Science, Technology, & Human Values*, *48*(1), 167–189. https://doi.org/10.1177/01622439211040241

Statistics Finland. (2022). *Population structure*. Statistics Finland's PX-Web Databases. https://pxdata.stat.fi/PxWeb/pxweb/en/StatFin/

Stern, P. C., Dietz, T., & Kalof, L. (1993). Value orientations, gender, and environmental concern. *Environment and Behavior*, *25*(5), 322–348. https://doi.org/10.1177/0013916593255002

Thaler, R. (1985). Mental accounting and consumer choice. *Marketing Science*, *4*(3), 199–214. https://doi.org/10.1287/mksc.4.3.199

Virtanen, M. J. (2019). What kind of 'a girls' thing'? Frictions and continuities in the framing and taming of the HPV vaccine in Finland. *Sociology of Health & Illness*, *41*(4), 789–805. https://doi.org/10.1111/1467-9566.12853

Wang, Y., & Corson, C. (2015). The making of a 'charismatic' carbon credit: Clean cookstoves and 'uncooperative' women in western Kenya. *Environment and Planning A: Economy and Space*, *47*(10), 2064–2079. https://doi.org/10.1068/a130233p

Wei, J., Zhao, K., Zhang, L., Yang, R., & Wang, M. (2021). Exploring development and evolutionary trends in carbon offset research: A bibliometric perspective. *Environmental Science and Pollution Research*, *28*(15), 18850–18869. https://doi.org/10.1007/s11356-021-12908-8

Zhang, B., Ritchie, B. W., Mair, J., & Driml, S. (2022). Air passengers' preferences for aviation voluntary carbon offsetting: A co-benefits perspective. *Journal of Travel Research*, *61*(6), 1437–1457. https://doi.org/10.1177/00472875211030340