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# Ecological, financial, social and societal motives for cooperative energy *prosumerism*: measuring preference heterogeneity in a Belgian energy cooperative

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## Abstract

**Background** Energy cooperatives in Europe have become more prominent due to the growing interest in and development of renewable energy sources. Cooperatives are often seen as an instrument in the transition to a low-carbon future. The cooperative *prosumer* is gaining importance, taking on the role of both consumer and producer by setting up and joining electricity cooperatives as investors, shareholders and clients. As is the case with other cooperatives and social enterprises, there are tensions and trade-offs to be made between social, ecological and financial goals. To navigate these tensions and to work towards becoming a resilient institution, it is important that cooperatives preserve their support base made up of their members, who are both clients and shareholders. This study investigates the preference heterogeneity and motivations of members of a large energy cooperative in Belgium, by using stated-choice data from a Discrete Choice Experiment in combination with self-reported membership motives.

**Results** Despite the significant presence of member preferences for participation and democratic voting rights, the financial and above all the ecological motives seem to be most important for being a member of the energy cooperative. Based on the stated-choice data, we classify three member types: the financial, the ecological and the social–societal member type. We find a small discrepancy in motives between members who joined early and members who joined later. Where early members care most about ecological aspects, members who joined later have more societal and financial considerations. In terms of effect size and willingness to pay per kilowatt hour, ecological motives prove to be by far the most important factor for cooperative energy prosumers in our sample. In addition, the latent-class analysis shows that over half of the member sample belongs to the ecological motives class.

**Conclusions** Preference heterogeneity is present to an extent, but there is an overarching preference for sustainability. Though, cooperatives should be aware that their legal form may not be the only factor that drives membership. Rather, keeping high levels of renewable energy, competitive pricing and being an interesting investment opportunity may be key to cooperatives' resilience and further development on the energy market.

**Keywords** Energy cooperatives, Prosumers, Motives, Discrete choice experiment, Preference heterogeneity, Ecological motives

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## Background

The increased demand for renewable energy in the transition to a low-carbon future to avoid dangerous climate change has created potential for a new role for citizens on the energy market. Instead of merely taking on the role of consumers, citizens are increasingly taking an active role as energy *prosumers*: they are collective energy producers, traders and consumers of the energy they produce, all in one [1, 2]. Although anyone who produces and uses their own energy could be considered a prosumer, the focus in this paper is on collective rather than individual prosumers, namely the members of energy cooperatives. Whereas electricity markets in the past were less competitive due to centralised production, decentralised production infrastructure is becoming more prominent [3]. The increasing decentralisation of energy means that renewable energy production is now also the domain of community energy initiatives [CEIs]: formal or informal citizen-led initiatives which propose collaborative solutions to facilitate the development of sustainable energy technologies and practices [4–6]. Not all CEIs are cooperatives, but the development of energy cooperatives is strongly related to the broader movement of CEIs in the last decade. CEIs are no novelty in themselves: the first energy communities date back to the 1970s in Denmark. The gradual diffusion to the rest of Northern Europe did not happen until the 2000s [7]. It was only later, however, that the role of citizens as prosumers through investments in and membership of CEIs was recognised by the European Union as an important part of reaching the carbon emission targets. These targets, described in amongst others the Paris Agreement, set out a global framework to avoid dangerous climate change by limiting global warming to well below 2 °C, and pursuing efforts to limit it to 1.5 °C [8]. The Clean Energy Package from 2019 [9] states that “the Directive on common rules for the internal electricity market ((EU) 2019/944) includes new rules that enable active consumer participation, individually or through citizen energy communities, in all markets by generating, consuming, sharing or selling electricity, or by providing flexibility services through demand-response and storage”. A couple of years before, in 2015, the European Commission Communication already stressed the importance of adapting the electricity trading rules and changing the energy market, in order to decentralise the production of electricity from renewable resources to move towards decarbonisation [9, 10]. In addition, the ‘Directive on the promotion of the use of energy from renewable sources’ from 2018 [11] underlined the importance of independent energy producers and renewable energy communities to reduce greenhouse gas emissions and comply with the Paris Agreement and

the Union 2030 energy and climate framework to cut emissions by at least 40% below 1990 levels by 2030.

According to the ‘Collective Action Models for the Energy Transition and Social Innovation’ [COMETS] database, at least two million citizens engage in over 8400 collective energy initiatives in Europe [12]. In the Netherlands alone, a total of 676 energy cooperatives were counted in 2021—a 6% increase relative to 2020. The estimated number of members and project participants approximates 112.000, which is an increase of 15% relative to 2020. In 84% of Dutch municipalities there is an active energy cooperative [13]. Other European countries also saw a rapid increase of collective energy initiatives in the past decade—peaking generally between 2010 and 2018—such as Belgium with 90, Germany with 1550, Denmark with 130 and Great Britain with 363 initiatives as counted in the COMETS database [12].

EIs can take any form of legal entity, such as a partnership, a non-profit organisation, an enterprise, association or a cooperative. The goal of the energy community is to make it easier for citizens to team up and invest together in (renewable) energy. Often, CEIs choose a commons-like form of governance and revert to the cooperative for the legal consolidation of that governance. The International Cooperative Alliance [ICA] defines cooperatives as “autonomous associations of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly owned and democratically controlled enterprise” [14].

A report by CE Delft [15], commissioned by Greenpeace European Unit, Friends of the Earth Europe, European Renewable Energy Federation and REScoop, concludes that by 2050, “about half of all EU households, around 113 million, may produce energy, either individually or through a collective”. All citizens can become a member or co-owner of a renewable energy cooperative by purchasing a share of the cooperative. Members of the cooperative often share in the profits and in some cases, they can buy electricity from the cooperative. Members can actively participate in the decision-making process of the cooperative [16]. In Belgium, the context of this study, cooperatives have to be incorporated by at least three founders, with an authenticated deed, and need to comply with the cooperative values and principles, similar to the principles outlined by the ICA [14].

The relevance of CEIs is marked by amongst others their contribution to energy democracy and “energy citizenship”—a consciousness amongst citizens about energy issues—[17] and energy democracy [4], leading to citizens taking matters into their own hands when it comes to the production and distribution of energy. In addition, CEIs contribute to the local economy by

giving contracts to locally owned contractors, using local banks and providing investment and job opportunities for local citizens [17, 18]. As CEIs are more likely to pursue societal and environmental goals rather than just financial gain, they can improve local responsiveness to energy transition policies, which are needed to address environmental and societal challenges such as fuel poverty and climate change [18, 19]. In a paper conceptualising radical sustainable alternatives for energy, Giotistas et al. [20] suggest that a commons-oriented approach for energy production may be best suited to tackle current issues such as unsustainable socio-economic structures, fuel scarcity and the transition to other sources of energy. In this paper, we focus explicitly on CEIs that take the legal form of the cooperative, as this organisational form brings with it the unique characteristic that members become shared owners of the organisation themselves. This stands apart from other energy providers (large and small) where members may have fewer formal claims on the right to co-decide on the company's policies and decisions. Energy cooperatives are dependent on the loyalty of their members—who are both shareholders and prosumers—to continue their existence, as shareholders can decide to take out their shares of the company. Cooperatives often try to restrict such disinvestments by members in legal ways, but also rely at least partly on their members for additional investments to create new infrastructure. Keeping their member base stable is thus key for allowing cooperatives to plan ahead. Preference heterogeneity amongst members with regard to the cooperative may increase the cost of communication and decision-making processes, and reduce member commitment [21–23]. The current study poses the question: *Which aspects of energy cooperatives are most important for members?* We look at various aspects of energy companies to understand whether it is the specific cooperative nature of the company or other aspects that compel members to be a member of the energy cooperative.

We investigate preference heterogeneity in the context of a large energy cooperative in Flanders, Belgium. We want to understand which aspects of an energy cooperative are most important to its members: the cooperative aspects, low prices, levels of renewable energy or social and societal aspects. Through a Discrete Choice Experiment [DCE] and a post-experimental survey, this study gathers stated-choice and self-reported data on preferences and motives to be a member of an energy cooperative. As urged by Giotistas et al. [3], we take an interdisciplinary approach by combining literature on motivations from social psychological, political and management science with an interdisciplinary behavioural science research approach.

Existing research has focused primarily on motives for involvement in CEIs and endorsement of sustainability policies [24–32]. The current study focuses specifically on cooperatives. Cooperatives may have different legal properties from other community initiatives and thus may attract a different type of member due to their democratic nature and the requirement of co-ownership. Most empirical work studying CEI motives focuses on the willingness and motivations of non-participants to start participating, instead of focusing on the motives of existing participants [see for instance 27, 29–32]. However, focusing on existing participants is important, especially in the case of cooperatives. Members of large energy-providing cooperatives—such as the cooperative that is studied in this paper—have easy access to other, traditional non-cooperative renewable energy providers, making their choice for cooperative membership not self-evident. In addition, large cooperatives in which the local community aspect may be less prevalent, may benefit less from community factors to retain members, as they operate over a wider geographical area. As community factors are suggested to increase member involvement in energy communities [24, 25], energy cooperatives operating on a larger geographical scale may be at a disadvantage. A consistent backbone of the cooperative is vital for resilience and retaining a collective memory and a stable identity. A high turnover of members and a constant need to attract new members may not be sustainable in the long run.

The studies that do focus on existing members of cooperatives mainly focus on self-reported data by the members, gathered through surveys [33–38] or interviews [28], but do not have access to revealed preferences through stated-choice data. The DCE is tailor-made to measure relative preferences. It requires participants to make a choice between hypothetical scenarios with certain characteristics, rather than asking their preference for each individual characteristic. As explained later in this paper, making a choice between two alternatives is in many cases easier for respondents than to rate every alternative separately and may elicit responses that are closer to real-world behaviour [39, 40]. In addition, prompting respondents to reveal their preferences by having them choose between options with many aspects, leads them to prioritise certain attributes over others. In addition to investigating and comparing preferences, the DCE allows us to calculate willingness to pay for each company attribute. This helps us to understand how much members are willing to pay for specific characteristics of the company. As members are still partially customers, we want to know how much cooperative or sustainable aspects of the energy cooperative are worth in the eyes of members. Lastly, the

DCE allows for a classification of cooperative member types to see whether preferences are scattered or whether there is a broader classification of preferences.

We are not the first in applying a DCE for eliciting motives for energy cooperative membership [see amongst others 41–45]. However, to our knowledge, this study is the first to study prosumer motives within a large cooperative, using the combination and interaction of self-reported motives and stated choices. By having both different types of data on preferences, we can crosscheck respondents' reported motives with their preferences revealed by their stated choices.

The rest of the paper is structured as follows. The **Theory** section outlines the current interdisciplinary literature on prosumer motives and preference heterogeneity. The **Methods** section elaborates on the context, method and analytical strategy of this paper. The **Results** section presents the results of the DCE, interaction models and willingness to pay analyses. The **Discussion** section describes the results in a relation to existing literature, addresses limitations and presents suggestions for future research. Lastly, the **Conclusions** section provides broader conclusions based on the found results and the practical implications they may have for energy cooperatives.

## Theory

Although energy cooperatives are often created with environmental and societal purposes in mind, they must take their economic viability into account. Due to the combination of ideological and financial goals, energy cooperatives may experience tension [46–48] and a duality or even paradox in the organisational identity. The organisational identity of the organisation and its members can be thought of in terms of utilitarian (focused on economic gain) versus normative (focused on ideology) identity [49, 50]. Underlying the organisational identity are the intrinsic motivations of the members for being part of the organisation [50]. As members form the backbone of the cooperative, the resilience of a cooperative is greatly decided by their ability to retain a large support base. Existing research suggests that preference heterogeneity amongst members of cooperatives can have a debilitating effect on cooperatives by increasing the cost of communication and by reducing member commitment [21–23, 51–53]. This in turn may reduce the resilience of cooperatives. However, when cooperatives manage to adopt an organisational strategy that minimises transactions costs and conflict due to member preference heterogeneity, the cooperative can succeed [54].

An established theory on citizens' motives to participate in coproduction—such as the coproduction of energy

in energy cooperatives—is developed by the political scientist Sharp [55], building forth on the administrative scientist Salisbury [56] and political scientists Clark and Wilson [57]. She proposed a three-pronged typology of motives existing of material (costs and material benefits), solidary (social aspects) and expressive motives (concern for the environment, concern for society). Similarly, in social psychology, Lindenberg and Steg [58] formulated three goal-frames for environmental behaviour such as investing jointly in renewable energy: the hedonic goal “to feel better, feel comfortable”, the gain goal “to guard and improve one's resources”, and the normative goal “to act appropriately” [58]. Similar findings are presented by Dóci and Vasileiadou [28], who find that it is mostly ‘gain’ and ‘normative considerations’ that play a role in the decision to partake in renewable energy projects. ‘Hedonic’ motivations—matching social motivations in our study—were found to be present but to a lesser extent. Goedkoop et al. [25] find that personal sustainability motivations were strongly related to willingness to participate in CEIs, and that community identification and interpersonal contact with other community members played a big role in the level of individual involvement in the initiative. In addition, Sloot et al. [24] find that financial motives are overrated and communal motives are underrated for involvement in CEIs. In management studies, Arentsen and Bellekom [59] propose environmental motives, economic motives, dissatisfaction with the government and social motives as drivers for local energy initiatives. Lastly, Bauwens [34], also a management scholar, mentions economic, social, environmental and institutional motives to join community renewable energy initiatives.

Taken all together, the existing literature distinguishes four broad categories of motives, described in various way but roughly corresponding to ecological, financial, social and societal motives to be or become a member of a CEI. We distinguish social and societal motives here to differentiate between personal, social reasons to join a cooperative from joining a cooperative for positive societal impact beyond the environmental impact. Underlying social motives is the literature on social identification, social cohesion, hedonic motivations and the general need to feel part of a community [25, 28, 60]. Societal motives relate to the literature on normative goal-frames and institutional motives [28, 34], where fairness, democracy and transparency play a role in the choice of becoming a member of an energy community.

As mentioned, we are focusing in this study on one specific form of energy community, namely the cooperative, which is an increasingly popular form of organisation in this field. Energy cooperatives are a type of community, but with specific legal properties such as

democratic voting, co-ownership and participation of members [61]. Although cooperatives can be close-knit local communities, they can also operate like a large company with members spread over a large geographical area. In this study, we focus on members of Ecopower in Flanders, Belgium. This is a cooperative that generates and supplies renewable energy, and currently has over 64.000 shareholders [62]. The large number of members makes for an interesting case to study preference heterogeneity, whilst also providing a large enough sample size to be able to conduct statistical analyses. Ecopower has members from all over Flanders. Ecopower was founded in 1991 and started providing electricity to its members in the Flanders region in 2003 [62]. Before that time, Ecopower was a cooperative in which members invested together in the creation of renewable energy, by amongst others restoring windmills and buying wind turbines. The generated renewable energy would be sold to the grid. In 2003, when the energy market in Flanders opened up for cooperatives to start supplying energy to members, Ecopower applied for a supplier license and started providing its own renewable electricity to its own members [62].

The fact that Ecopower was a first-mover energy cooperation, explicitly oriented on green consumer energy, is likely to be of influence on the type of members and preferences of members [33]. Members who joined in the early years—specifically before 2003 when Ecopower started delivering electricity—are likely to have different motivations for being a member than people who only later became a member. Bauwens [33] shows that the early members of Ecopower, who joined the cooperative even in the absence of material benefits, are driven by environmental motives. In a follow-up study, Bauwens [34] shows that financial motives are the main membership drive for members who joined Ecopower after 2003. These results suggest a change in incentive structure from the moment the cooperative started providing—competitively priced—electricity. Ecopower started attracting members who behaved more like customers than members, who wanted the benefits of electricity supply without having to invest too much in the cooperative [33]. Ecopower is not the only example of this shift in motives between “early” and “late” adopters: Sigrin et al. [63] show that early adopters of solar photovoltaics are more driven by environmental values than later adopters. Other research too shows a change in membership motives over time [64, 65].

### Expectations

In line with other papers using DCEs for eliciting preferences from energy consumers [i.e. 41–45], we do not formulate specific hypotheses to test. Instead, our

research design is inspired by expert-interviews with the energy cooperative of interest, and the state-of-the-art research and theory on the topic of cooperative energy prosumerism. Based on the discussed literature, we expect to distinguish ecological, financial, social and societal motives for being a member of an energy cooperative. As ecological motives seem prevalent in all discussed studies, we expect this motivational type to play a big role in members’ choice to be a member of Ecopower. In addition, based on earlier findings on Ecopower and literature on motivational shifts over time, we expect to see differences between members who joined early, and members who joined the cooperative later.

### Methods

The data were collected using an online stated-choice survey, specifically a Discrete Choice Experiment. This is a method to elicit preferences by presenting hypothetical scenarios (called alternatives), goods and services [66, 67]. The DCE was presented to respondents in the form of an online questionnaire. However, the design of the questionnaire depends on the particular properties of the DCE. In this section, we will first describe the context in which this study was conducted and describe the data collection process. Afterwards, we will explain the DCE methodology and outline the method’s roots in Utility Theory. Following that, we will describe in detail the attributes chosen for our study design, after which we describe the process of choice-set creation through an orthogonal array. After that, the self-reported data collection through the post-experimental survey is briefly introduced. Lastly, the analytical strategy for the data analyses is presented.

### Context

During the time in which our study took place (spring 2022) energy prices were much higher than the year before, and still increasing [68, 69]. Ecopower, however, was still offering an average price of around 25 Eurocents per kWh (depending on the network operator) [70] while average commercial electricity prices in Flanders ranged between 44 and 61 Eurocents per kWh for households [71]. Ecopower had to implement a stop in new contracts in January 2021 due to a sudden increase of contract applications straining the renewable energy supply in addition to an unstable energy market. This means that our sample does not include new, probably purely financially motivated members from that time. Responses will thus reflect the preferences and motivations of members profiting from relatively low energy prices in a time during which many other households experienced a steep increase in energy costs [68, 71].

### Data collection process

The DCE was coded in the online survey software Qualtrics, version 2022 [72]. Respondents were recruited through the mailing list of Ecopower. A link was sent by the communications' officer of Ecopower to a random sample of their members, asking them to participate in a scientific research project on the preferences of members of energy cooperatives, which would take approximately 10 min to complete. Written consent was received from all participants before entering the experiment, and participants were made aware that they could stop their participation at any given time by closing the browser window. Participation was completely anonymous. Unique participant codes were provided to the participants, so they could request—through Ecopower—for their data to be removed permanently from our database. Ecopower did not have access to the data at any point, and the researchers did not have access to any personal or sensitive data from participants at any point. Ethical approval for this study was acquired from the Rotterdam School of Management IRB (reference ETH2122-0426). A pilot study was carried out, in which 150 members from the mailing list were randomly selected and invited to participate in the study. Of these 150 members, 11 members filled out the DCE completely. Based on a power analysis with varying hypothetical effect sizes of two variables, we aimed for at least 1000 respondents to participate in the final study. See [Appendix A](#) for the power analysis results. For the main study, the DCE was sent out to 12,793 randomly selected members out of the roughly 64,000 energy cooperative members in total. Members who had previously indicated to not want to participate in any research activities were excluded from the selected sample. The invitations to participate were sent between the 28th of April and the 23rd of May 2022. 1295 members (10.1%) fully completed both the DCE and the post-experimental survey.

### Discrete choice experiment

A DCE can be used to elicit preferences by presenting hypothetical scenarios (called alternatives), without asking the respondent for their preference for each single characteristic of the alternative [66, 67]. The respondents choose between the two alternatives, in several sets of choices, also called “choice sets”. In our case, participants chose between 14 choice sets. See [Appendix B](#) for an overview of the first choice set that the participants encountered in our experiment. Each alternative within each choice set has specific characteristics, called attributes. These attributes have different variations, called attribute levels [67]. The choices of respondents for one of the presented alternatives—each with their own

attribute levels—are analysed to infer the value placed on each of these attribute levels [67].

Stated-choice experiments enable the researcher to overcome the difference between survey questions and the real world, as they mimic actual decision tasks [39, 73, 74]. Hainmueller et al. [39] show in a comparative study that results from paired conjoint designs (such as the DCE) come close to the behavioural benchmark; i.e. subjects' measured behaviour matches their actual behaviour. Hainmueller et al. [39] suggest that stated-choice experiments function best if the subject pool mirrors the population of interest, and if the experimental design is crafted to motivate respondents to engage with the hypothetical choices in a serious manner [39]. Our population of interest is energy cooperative members. Whilst it is not possible to ascertain the generalisability of our sample for all energy cooperative members, we can compare our sample to samples from other research on the same population—which we will do in the [Descriptive results](#) section.

### Utility theory

The DCE is theoretically founded in random utility theory [75] and relies on the assumption of utility maximisation and rationality [66, 67, 76]. An advantage of DCEs compared to for instance surveys, which can also ask for preference ratings of various attributes, is that DCEs present a comparison instead of asking subjects to state their opinion of one item at the time. According to Thurstone [40], humans are a lot better at comparing two alternatives than evaluating them individually.

By making the choice for a specific alternative, the respondent shows which alternative yields the highest individual benefit, or utility, for them. The utility that is gained from an alternative is assumed to be dependent on the utility of the specific attributes and attribute levels within that alternative [66, 77]. This is expressed in the following formula:

$$U_{iq} = V(\beta_q, X_i) + \varepsilon_{iq}, \quad (1)$$

in which  $U_{iq}$  is the utility of alternative  $i$  for individual  $q$ ,  $V$  is a function defined by the attribute levels,  $X_i$  is a vector of attribute levels for alternative  $i$  with weight  $\beta_q$  and  $\varepsilon_{iq}$  is the unobserved variation and measurement errors. As indicated by the individual weights, we theoretically expect individual preference heterogeneity for the attribute levels. As we explain later, however, not all analytical models take preference heterogeneity into account.

Although there are many critics of expected utility theory (see for instance Malecka [78] for a discussion on this topic), the assumption that we make in this study—that participants of the study will choose the alternative

that they prefer most—is one that all who investigate (consumer) preferences, and all researchers who base their data on questionnaires, must make. Indeed, plenty of research points out that humans are not necessarily rational decision-makers [79–82]. However, in our study, utility theory is presented as the founding theory underlying the DCE method, rather than as a normative theory to predict behaviour. Our assumed rationality is reduced to expecting participants to choose the option they like best. Hypothetical bias cannot be ruled out and the decision-making process in an online survey is not the same as decision-making in real life. Nevertheless, by presenting the participants with a clear overview of options, not too dissimilar to a real-life comparison between (cooperative) energy providers one would do online, we hope to capture realistic choices from our participants based on their preferences.

### Attributes

A critical aspect in the creation of DCEs is the choice of relevant attributes and attribute levels. The attributes of our study are based on various sources. First, we identified potentially useful attributes by looking at the available literature and empirical work on prosumer motives and DCEs. A source of inspiration was the work of Sagebiel et al. [43], after which we modelled several of our attributes regarding cooperative aspects of the company and the renewable energy attributes. In addition, we looked at other work using DCEs to elicit preferences in the context of energy and sustainability (amongst others [42, 83, 84]). Second, through an in-depth expert interview and several discussions with a member of the governing body of Ecopower, and written communication with a board member of the national umbrella organisation and interest group of collective sustainable energy and heating initiatives, we reviewed and adjusted our initial selection of attributes (following Coast et al. [85]). Basing our attributes on scientific as well as practitioner sources makes for scientifically valid but also societally relevant research. The attributes and attribute levels used in this study are listed below.

*Participation.* Presented as “consumer participation in the operation of the company” with the options “possible” and “impossible”. This attribute represents a cooperative characteristic, i.e. the possibility for members to take part in the daily operating of the company beyond general assemblies, and is used to measure how members value the cooperative nature of the company relative to other characteristics. We expect prosumers with a higher social and societal motivation to have a stronger preference for the possibility of participation in the decision-making process.

*Voting rights.* Presented as “how does the company make decisions” with the options “one member one vote” and “voting rights proportionate to the number of shares”. Again, this is another attribute that measures the value members award to a cooperative aspect of the company. We expect prosumers with a higher social and societal motivation to have a stronger preference for a democratic ‘one member one vote’ policy.

*Renewables.* Presented as “the share of renewable energy” with the options 0%, 33%, 66% and 100%. This attribute measures the value members award to being environmentally friendly or having a small ecological footprint. We expect prosumers with a higher ecological motivation to have a stronger preference for a larger share of renewable energy.

*Price.* Presented as “price per kWh in Eurocents” with the options 20, 25, 30 and 35 cents per kilowatt hour [kWh]. This attribute is useful on itself to measure the extent to which members are driven by the price of energy, and in addition can be used to measure the WTP for the other attributes. We expect prosumers with a higher financial motivation to have a stronger preference for a lower price. The price categories are based on the range of energy prices at the time of designing the study [86], taking into account the fact that energy cooperatives such as Ecopower managed to retain lower prices during this time. The price per kWh for Ecopower around the time of the study design—between the 1st of January 2022 and the 28th of February 2022—sat in the middle of the specified range with on average 28 cents per kWh, depending on the network operator [70]. The price per kWh during the data collection was on average 25 cents depending on the network operator [70]—thus also in the middle of the specified range of the price attribute.

*Impact.* Presented as “focus on societal impact or members” with the options “focus on members only” and “focus on societal impact and members”. This variable represents the tension that hybrid organisations face between focusing only on their members versus focusing on the potential benefits for society as a whole. As a cooperative, there is always a baseline focus on members, as the cooperative is a result of the goals and values of its members – but whether the cooperative also has an explicit focus on positive societal impact may vary between cooperatives. We expect prosumers with a higher social and societal motivation to have a stronger preference for a company focused on both societal impact and members.

*Scaling.* Presented as “focus on “small and local” versus “spread and growth”” with those two foci as the options. This attribute represents the tension and trade-off that cooperatives have to make with regard to their scaling strategies. Knowing which scaling strategy members

**Table 1** Attributes used in the DCE

Attribute	Description	Levels	Coding
Participation	Member participation in the operation of the company	Impossible	0
		Possible	1
Voting rights	Voting rights in decision-making process	Voting rights proportionate to the number of shares	0
		One member one vote	1
Renewables	Share of renewable energy	0%; 33.3%; 66.6%; 100%	Dummy coded per category
Price	Price per kWh in Eurocents	20; 25; 30; 35	Continuous variable (0; 1; 2; 3)
Impact	Whether a company is focused on the societal impact or on its members	Company focuses societal impact and members	0
		Company focuses only on members	1
Scaling	Focus on “small and local” versus “spread and growth”	Focus on small and local	0
		Focus on spread and growth	1
Diversification	The level of diversification in provided goods: only electricity or also other energy-related products	No diversification; Some diversification; Much diversification	Dummy coded per category
Profit	What happens to profit?	Invest profit in production projects;	Dummy coded per category
		Invest profit in societal projects;	
		Return profit to members	

prefer is important to retain the support base of members; members who value being a member of a small and local organisation are likely to leave if the company grows to a national or international size. We expect prosumers with higher social motivations to have a stronger preference for a company that stays small and local—this would foster better social networks amongst the prosumers than a large and consequently more anonymous company. Prosumers with a higher societal motivation can be either expected to have a stronger preference for a scaling focused on spread and growth, as a bigger company can have a greater reach in terms of societal impact, or they may favour a small company with a direct, tangible impact on the local society.

**Diversification.** Presented as “the level of diversification in offered products (next to electricity)” with the options of “no diversification”, “some diversification” and “much diversification”. This attribute measures the interest of members for other energy products that the cooperation could offer next to electricity (for instance heat networks and the provision of wood pellets and briquettes). We expect prosumers with a higher ecological motivation to have a higher preference for diversification of products next to electricity, as they may be more likely to be interested in other sustainable products next to renewable electricity.

**Profit.** Presented as “what happens to profit” with the options “invest in production projects”, “invest in societal projects” and “dividend for members”. We expect

prosumers with a higher ecological motivation to prefer investment in production projects, prosumers with a higher societal motivation to prefer societal projects and prosumers with a higher financial motive to prefer returning the profit as dividend to members. The choice for a broader description of investment options was deliberate, as we wanted respondents to choose between the general purpose for the profit investment rather than mentioning specific project examples that they may or may not have personal opinions about or experiences with.<sup>1</sup>

An overview of the attributes that are used in the current DCE is presented in Table 1.

#### Orthogonal array

The alternatives that are presented in each choice set (set of alternatives out of which a respondent chooses their preferred option) are not randomly composed of attributes. The ideal design would be a full factorial design, in which all attributes and attribute levels are presented in all possible combinations. However, depending on the number of attributes and levels this

<sup>1</sup> This means that we assume that respondents understand the different types of profit investment that are possible. However, even if respondents do not have an idea about specific production or societal investments, it is likely that they will prefer society or production. The results of the analyses show that the preferences for dividend, production projects and societal projects are not random, and fit the self-reported motives.

could lead to hundreds of alternatives, which would not be feasible for an experiment due to time-constraints and respondents' attention span. Our own design has  $2 \times 2 \times 4 \times 4 \times 2 \times 2 = 256$  unique alternatives—too many alternatives to include in one experiment. To solve this issue, an *orthogonal array* is created. This is a design of choice sets which is orthogonal, which means that the attributes are uncorrelated, and balanced, which means that each attribute level appears with similar frequency [43]. For the current paper, the design was created through the R-package *Idefix* [87] which enables users to generate optimal designs for discrete choice experiments. The priors in the prior parameter vector are based on the effects found in Sagebiel et al. [43] for the attributes *Price* and *renewables*. As the study of Sagebiel et al. [43] is very similar in setup, subject and subject pool, the effects from their study with regard to these attributes were deemed very informative—increasing the quality of the orthogonal array. The other priors were set to zero, as we did not have reliable information on the size or direction of their effects in our context.

#### Post-experimental survey

After completing the DCE, each respondent was asked to fill in a survey. Before measuring sociodemographic characteristics of the respondents, we measured respondents' general motivations to be a member of an energy cooperative by asking them to divide 100 points over four types of motivations: ecological motivations, social motivations, financial motivations and societal motivations. The various motives were presented to the subjects as follows: (1) ecological motives (climate, environment), (2) social motives (connectedness, added social value for yourself), (3) financial motives (costs and investments), (4) societal motives (societal impact, unhappiness with governmental policies). As people's motives are subjective, we avoided specifying each motive in too much detail, but rather provided keywords to describe our broad definition of each motivational type.

This typology of four is based roughly on the theoretical typology of Sharp [55] with the exception that the expressive motives are split up between societal motives and ecological motives, as previous research pointed out the relevance of ecological and environmental reasons [34, 59]. All questions in the survey were mandatory to fill out, but included a “would rather not say” and for some questions a “I don't know” option, to prevent participants filling in questions randomly. Appendix C provides an overview of the items included in the survey.

#### Analytical approach

##### Conditional logit model

The dependent variable of interest is the choice variable: did the respondent choose alternative A (and the inverse: did the respondent not choose alternative B)? This type of data, where the dependent variable is a 0 or a 1 is generally analysed using a limited dependent-variable model [66]. A basic limited dependent-variable method to analyse the data is a conditional logit model [CLM]. This model relates the probability of choosing one out of two alternatives to the characteristics of the alternatives. McFadden [88], who was one of the first to apply the logit model to choice behaviour, showed that the conditional logit model is consistent with random utility theory. The CLM regression is a model that relates the choices that participants make to the characteristics of the alternatives presented in each choice set: the attributes [66].

In the CLM with the utility function presented in Eq. (1),  $\varepsilon_i$  is assumed to follow an independently and identically distributed type 1 extreme-value distribution [88]. This assumption of  $\varepsilon_i$  results in a logit model:

$$\Pr(\text{choice} = i) = \frac{e^{V(\beta, X_i)}}{\sum_j e^{V(\beta, X_j)}}, \quad (2)$$

where  $V(\beta, X_i)$  is the observed part of the function for alternative  $i$ , and  $j$  notes the set of alternatives. The probability of choosing alternative  $i$  is dependent on the attribute levels of alternative  $i$  as well as the attribute levels of the other alternatives  $j$ . As there are two alternatives in each choice set in our DCE design,  $j = 2$ . The probability to choose one alternative is 1 minus the probability of choosing the other alternative.

With a DCE being slightly different in data structure than other conjoint analyses, and with our outcomes not corresponding to a specific choice of company (such as “cooperative” versus “traditional company”), our CLM does not lend itself to provide marginal effects.<sup>2</sup>

The main purpose of the analysis is to find out which attribute levels are the most preferred by the participants of the study. However, to gain insights on the possible relation between certain member characteristics and preferences, CLM models including sociodemographic interactions and interactions with self-reported motives are also presented. For the same reason that we cannot

<sup>2</sup> With the outcome just being “company A” or “company B” with varying attribute levels each time, adding individual specific variables such as age, gender or income in a multinomial model will not provide any insightful outcomes. The outcome of interest lies in the impact of attribute levels on choosing a specific company, and the interaction between individual specific variables and preferences.

provide marginal effects, including main effects of sociodemographic variables and self-reported motives does not fit this model, as the dependent variable does not correspond to a certain choice type. Main effects of variables that are not attributes are thus uninterpretable.

The basic CLM model includes dummy variables for the renewable energy attribute. However, for the models including interactions with self-reported motives and sociodemographic variables we include renewable energy as a continuous variable (including its quadratic and cubic effect due to clear non-linearity of the effect) to reduce complexity of the model and to retain statistical power. As the coefficients of the other variables and the model quality in terms of log-likelihood and AIC stay the same, we deem this model of identical quality.

**Split sample analysis**

As mentioned earlier, there is reason to believe that members who became a member right at the start of the company may have different preferences and motives than members who became a member in more recent years [29, 30, 59, 60]. In our study, we can distinguish between the early members who became a member of the cooperative before it started supplying electricity in 2003, and late members who became a member after 2003. A split-sample CLM analysis is performed to understand the preference heterogeneity between early and late members.

**Latent-class model**

There are two drawbacks to the CLM that is used for the main models. Firstly, the model does not account for scale heterogeneity: it assumes that choice questions measure utility equally well across all respondents and choice sets [66, 89]. Secondly, the model does not take into account preference heterogeneity, and produces a single set of preference weights for all respondents [66]. To deal with this last drawback, another model will be used as well: the latent-class model [LCM].

The advantage of the LCM model is that a finite number of groups can be specified, across which it is assumed that the attributes of the alternatives presented in the choice sets can have heterogeneous effects. The model assumes that preference weights *within* classes are the same, and that they differ from preference weights in other classes. The number of classes is specified by the

researcher, and the LCM estimates coefficients for each of the specified classes [66]. The choice probability in the LCM is described as follows:

$$\Pr(\text{choice} = i) = \sum_z \Pr(\text{choice} = i | \beta_z) \pi_z, \tag{3}$$

where  $\pi_z$  is a function describing the probability to belong to class  $z$ . The choice probability within a class  $z$  is:

$$\Pr(\text{choice} = i | \beta_z) = \frac{e^{V(\beta_z, X_i)}}{\sum_j e^{V(\beta_z, X_j)}}. \tag{4}$$

**Willingness to pay [WTP] analysis**

Having DCE data, including a price attribute with various levels of eurocents per kWh, gives us the opportunity to calculate how much each of the attribute levels is worth to our participants. Our WTP analysis is performed using the coefficients of model 1 of the CLM. The WTP for attribute  $k$  is calculated as follows:

$$\text{WTP}_k = -\frac{\beta_k}{\beta_C}, \tag{5}$$

in which  $\beta_k$  represents the coefficient from the attribute as estimated in the CLM and  $\beta_C$  represents the coefficient of price. However, as price is included in our CLM as a continuous variable with levels 0, 1, 2 and 3, the WTP will be calculated as follows to account for the conversion of a 1 cent increase (as the variable is coded) to a 5-cent increase (as represented in the DCE with 20, 25, 30 and 35 cents):

$$\text{WTP}_k = -\frac{\beta_k}{\beta_C / 5} = -5 \frac{\beta_k}{\beta_C}, \tag{6}$$

We also calculate the 95% confidence interval using the delta method, as suggested by Hole [90]. The calculation of the confidence intervals requires calculation of the variance of the WTP, calculated as follows:

$$\begin{aligned} \text{var}(\widehat{\text{WTP}}_k) = & [(\widehat{\text{WTP}}_{\beta_k})^2 \text{var}(\widehat{\beta}_k) \\ & + (\widehat{\text{WTP}}_{\beta_C})^2 \text{var}(\widehat{\beta}_C) \\ & + 2\widehat{\text{WTP}}_{\beta_k} \widehat{\text{WTP}}_{\beta_C} \text{covar}(\widehat{\beta}_k, \widehat{\beta}_C)] \end{aligned} \tag{7}$$

$$= \left[ \left(-5 \frac{1}{\beta_C}\right)^2 \text{var}(\widehat{\beta}_k) + \left(5 \frac{\widehat{\beta}_k}{\beta_C^2}\right)^2 \text{var}(\widehat{\beta}_C) + 2\left(-5 \frac{1}{\beta_C}\right) \left(5 \frac{\widehat{\beta}_k}{\beta_C^2}\right) \text{covar}(\widehat{\beta}_k, \widehat{\beta}_C) \right], \tag{8}$$

**Table 2** Descriptive statistics of key variables

Variable		Mean/%	Min	Max	Total N
Ecological motivations		47.7	0	100	1295
Social motivations		11.6	0	100	1295
Societal motivations		17.2	0	100	1295
Financial motivations		23.5	0	100	1295
Age		57.9	25	89	1295
Male		84%			1281
Education	Lower education	2%			1282
	High school	22%			
	Graduate school (graduate degree or professional bachelor)	33%			
	University: bachelor degree	3%			
	University: master degree	30%			
	Master-after-master or postgraduate degree	6%			
	PhD	5%			
Household income	0–19.999	6%			1164
	20.000–39.999	32%			
	40.000–59.999	34%			
	60.000–79.999	16%			
	80.000–99.999	7%			
	100.000 or more	5%			
Urban level	Big city	12%			1293
	Suburbs of a big city	20%			
	Village or small city	40%			
	Village in the countryside	16%			
	House on the countryside	12%			

where  $\widehat{WTP}_{\beta_k}$  and  $\widehat{WTP}_{\beta_C}$  are partial derivatives of  $\widehat{WTP}_k$  with respect to  $\beta_k$  and  $\beta_C$ , respectively, evaluated at the estimates [90]. The confidence interval can then be constructed as follows:

$$\widehat{WTP}_k \pm z_{\alpha/2} \sqrt{\text{var}(\widehat{WTP}_k)}. \tag{9}$$

**Results**

The following section is structured as follows. Descriptive results based on the post-experimental survey data will show characteristics of the respondents and provide first insights on self-reported motives. In addition, a discussion on generalisability of our sample and some robustness tests to test the potential impact of a non-generalisable sample are presented. This is followed by the results of the CLM, showing the relative preferences of members for the attributes and interactions between revealed motives and member characteristics and self-reported motives. We perform a willingness to pay analysis to show what each of the attributes is worth to the members in terms of Eurocents per kWh. Afterwards, we briefly discuss a

split-sample analysis to understand preference heterogeneity between early and late members. Lastly, the LCM results are presented, showing potential classes and clustering underlying the preference heterogeneity.

**Descriptive results**

Descriptive statistics of some key variables of the post-experimental survey can be found in Table 2. Descriptive statistics on all of the variables from the post-experimental survey can be found in Appendix D.

**Generalisability**

It is likely that there is a selection-bias in our respondents: only about 10% of the selected random sample of members participated in our study. To check the generalisability of our results for the entire cooperative, we should check whether our sample is not too dissimilar to the population of members of Ecopower. What stands out is that 84% of the respondents in our sample was male, and that the average age is almost 58. To check to which extent our sample fits the population of cooperative members of Ecopower, we checked our sample

statistics with earlier research using the same population pool. For instance, Bauwens and Eyre [91] find in their research including 4000 members of Ecopower a distribution of 81% men and 19% women.<sup>3</sup> Dudka [92] finds a distribution of 79% men and 21% women in a study of amongst others 5114 Ecopower members.

With regard to age, we seem to capture an on average older audience than Bauwens [34] who reports an average age of 49.12. To an extent the higher average age in our sample could be a result of an aging population of Ecopower, as our research took place several years later, but that would not warrant an almost 10-year difference in average age.

We used data from Ecopower from all individuals and companies who created a “My Ecopower” account from august 2016 to February 2023. Creating such an account became obligatory in 2017 for anyone who wanted to buy shares and become a client. This data includes date of account creation, first name of the client, whether the client is an individual or a company, and the date of birth (optional) of 44,479 members. To gauge the representativeness of our sample for Ecopower, we compared our sample statistics to the “My Ecopower” data.

To estimate the percentage of men and women from this database, we used first name as a proxy for gender and had the most recent language model from Open AI guess the gender of five random samples of 100 first name observations from the entire database (as classification of all observed names would be too time-consuming). To do this we used the ‘*openai*’ package in R and the OpenAI Application Programming Interface [API]. After excluding company names, we calculated the average percentage of female classified names to be 23%, with the percentage of female classified names ranging between 21 and 30% in the five individual random samples.<sup>4</sup> With regard to gender, we conclude that our sample is likely to underrepresent women.

The “My Ecopower” database, including only 7740 date of birth entries out of the 44,479 observations, reports an average age of 48.97 in 2022 (at the time of the study). We thus conclude that our sample overrepresents older people. Lastly, regarding educational level, both our sample and the survey of Bauwens [93] used for data analysis in

Bauwens and Eyre [91] report around 75% highly educated (graduate school and university) members.

Overall, we conclude to capture a relatively representative sample of the total member base of Ecopower, but with a slight overrepresentation of men and older people. As previous research states the impact age may have on prosumer motives [34, 43, 91], the impact of the overrepresentation of older people and underrepresentation of women in our database has to be checked. We use raking to develop weights for the gender and age variables, such that they match the targets provided by the member database. A weighted CLM model and raking summary for weights based on the age target division can be found in Appendix E. A weighted CLM model and raking summary for weights based on the gender category target division<sup>5</sup> can be found in Appendix F.<sup>6</sup> The results of the weighted CLM models is near-identical to the unweighted CLM models, providing confidence in the presented results.

We also looked at the statistics of our sample compared to the general population in Flanders. A discussion on this can be found in Appendix G. We conclude that the cooperative members in our sample are older, higher educated and wealthier than the general population in Flanders.

Lastly, despite randomisation of the participation invites, a selection effect in the recruitment of participants—even within the cooperative member sample—is unavoidable. This may impact our sample to overrepresent members who are more engaged with the cooperative.

To gauge the geographical representativeness, Fig. 1 shows the distribution of respondents over Flanders. The top two municipalities are Ghent (91 respondents) and Antwerp (85 respondents). However, next to these two clusters, we can see a wide spread of respondents over almost all municipalities in Flanders—both in urban and more rural areas.

### Motivations

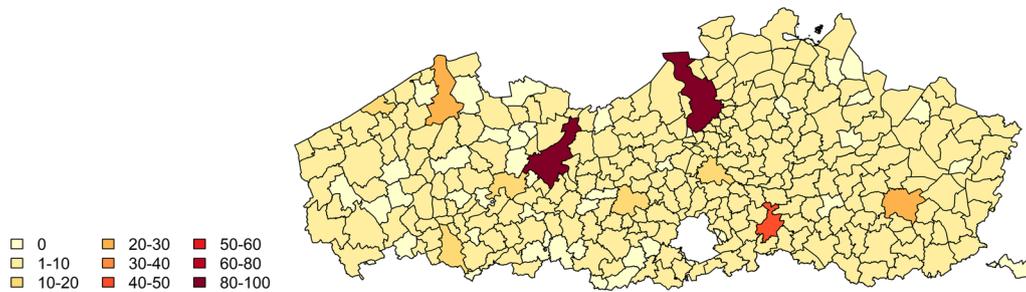
Figure 2 shows the distribution of points assigned to each of the four types of motivations in the post-experimental survey. All 1295 respondents filled out this question of the survey. Each quartile of the boxplot represents 25% of the total points assigned to that motivation. The figure shows that ecological motives are the most prevalent—25% of the respondents assigned between 60 and

<sup>3</sup> It has to be noted that in the study of Bauwens and Eyre [91], all members above 65 were removed from the sample, which may impact representativeness of this sample for the total Ecopower population in terms of gender.

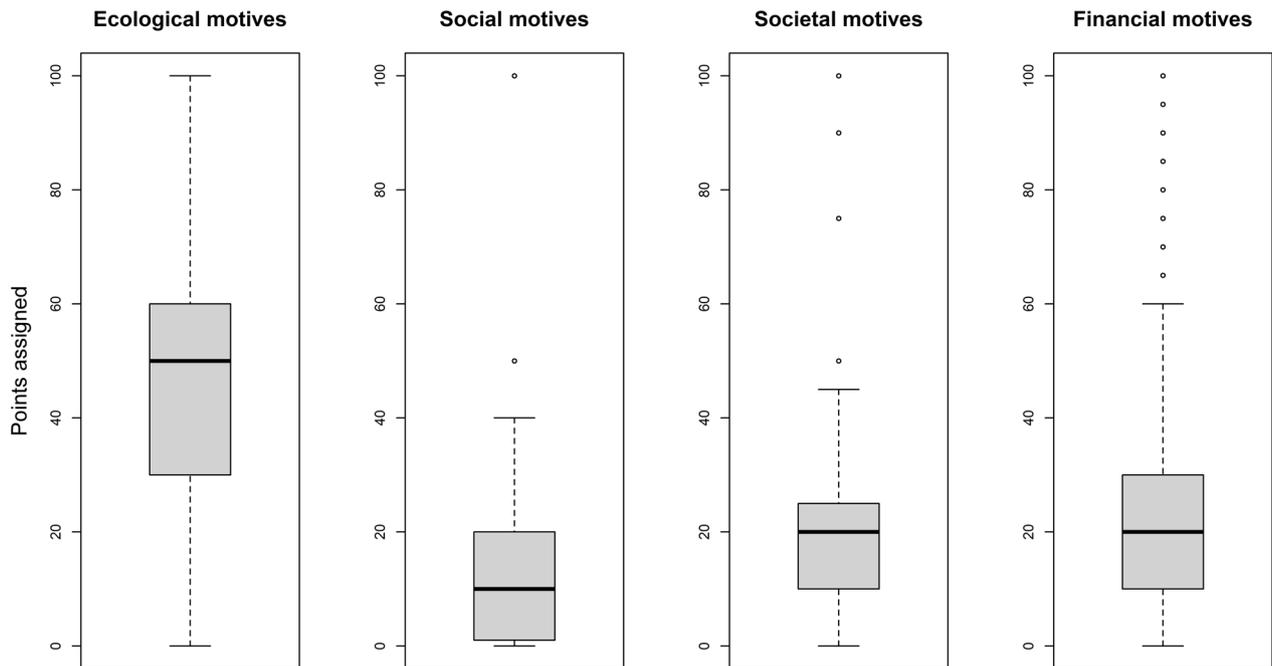
<sup>4</sup> We acknowledge that these classification results are general associations based on cultural norms and may not be accurate for every individual with these names, that gender in many cases cannot be inferred solely based on names, and that dividing names into two genders is a simplification of reality. We view this exercise solely as one of multiple indicators for our sample generalisability.

<sup>5</sup> Based on the proportions of members in age categories of 10 years with the target distribution from the member database.

<sup>6</sup> Due to time- and token-constraints of the gender classification, we chose not to classify the entire member database for gender, resulting in having to perform two separate, independent raking processes for age and gender, and thus having two separately weighted CLM models for age and gender weights.



**Fig. 1** Geographical distribution of respondents



**Fig. 2** Boxplot of the various motives to be a member of an energy cooperative

80 points out of 100 to this motive. Financial motives are in second place, and social and societal motives roughly share a last place in points assigned. Whereas the assigned points for ecological motives range from 0 to 100, this is not the case for the other motivations, except for a few outliers—almost no participants assign 100 or close to 100 points to financial, social or societal reasons for being a member. The figures imply that ecological reasons may be the most important in the motivation to be a member of Ecopower.

**Conditional logit results**

**Model 1: main effects**

The results of the CLM are presented in Table 3. Model 1 includes the main effects of each attribute. Whereas the absolute values of preference weights (the estimated

coefficients) on themselves have no meaningful interpretation, changes between attribute-level estimates and the relative size of those changes across attributes have meaningful interpretations [66].<sup>7</sup> The model shows a marginally significant positive effect of member participation in a firm’s decision-making process ( $B=0.056, p=0.077$ ) and a significant positive effect for a one member one vote policy ( $B=0.263, p<0.001$ ). The model shows a significant effect ( $B=-0.330, p<0.001$ ) of company focus on members and societal impact (0) versus a focus on members only (1). Regarding scaling,

<sup>7</sup> For instance, we can conclude that a change from share-proportionate voting rights (0) to a one member one vote policy (1) is more than four times ( $\frac{0.263}{0.056} \approx 4.70$ ) as important as a change from no member participation (0) to member participation (1) in the operation of the company.

**Table 3** Conditional logit regression results

	Dependent variable: choice		
	(1)	(2)	(3)
Participation	0.056 <sup>†</sup> (0.032)	0.056 <sup>†</sup> (0.032)	−0.093 (0.060)
Voting rights	0.263*** (0.028)	0.263*** (0.028)	0.216*** (0.055)
Renewable energy [RE]			
0% (reference)			
33%	2.244*** (0.075)		
66%	3.607*** (0.083)		
100%	2.388*** (0.060)		
RE		2.116*** (0.126)	1.550*** (0.139)
RE <sup>2</sup>		0.412*** (0.089)	0.129 (0.093)
RE <sup>3</sup>		−0.284*** (0.022)	−0.217*** (0.023)
Price	−0.666*** (0.039)	−0.666*** (0.039)	−0.335*** (0.047)
Impact	−0.330*** (0.024)	−0.330*** (0.024)	−0.283*** (0.051)
Scaling	0.102*** (0.027)	0.102*** (0.027)	0.224*** (0.055)
Diversification			
None (reference)			
Some	−0.083** (0.028)	−0.083* (0.028)	−0.120*** (0.029)
Much	−0.294*** (0.038)	−0.294*** (0.038)	−0.359*** (0.072)
Profit			
To production projects (reference)			
To members	0.773*** (0.056)	0.773*** (0.056)	0.213** (0.071)
To societal projects	0.338*** (0.037)	0.338*** (0.037)	0.232*** (0.060)
Ecological motives × RE			0.021*** (0.001)
Ecological motives × much diversification			0.000 (0.001)
Social motives × participation			0.007** (0.002)
Social motives × voting rights			0.003 (0.002)
Social motives × impact			0.000 (0.002)
Social motives × scaling			−0.005* (0.002)
Social motives × profit to societal projects			0.003 (0.002)
Societal motives × participation			0.003 (0.002)
Societal motives × voting rights			0.001 (0.002)

**Table 3** (continued)

	Dependent variable: choice		
	(1)	(2)	(3)
Societal motives × impact			−0.002 (0.002)
Societal motives × scaling			−0.004* (0.002)
Societal motives × profit to societal projects			0.005* (0.002)
Financial motives × price			−0.016*** (0.001)
Financial motives × profit to members			0.025*** (0.002)
Participants	1295	1295	1295
Observations	36,260	36,260	36,260
Log likelihood	−8576.4	−8576.4	−8100.8
AIC	17,176.85	17,176.85	16,253.64

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ , † $p < 0.1$ , two-sided

a significant positive effect ( $B = 0.102$ ,  $p = 0.003$ ) is found for a focus on spread and growth (1) relative to staying small and local (0).

Regarding ecological aspects, model 1 shows that participants significantly prefer 33% ( $B = 2.244$ ,  $p < 0.001$ ), 66% ( $B = 3.607$ ,  $p < 0.001$ ) and 100% ( $B = 2.388$ ,  $p < 0.001$ ) renewable energy over 0% renewable energy. The effect of renewable energy on preference is thus non-monotonic; respondents are satisfied with 66% renewable energy, and would not necessarily pick 100% over 66%. For diversification of products (i.e. providing more products than just electricity) the model shows a significant negative effect for both some ( $B = -0.083$ ,  $p = 0.003$ ) and much ( $B = -0.294$ ,  $p < 0.001$ ) diversification relative to no diversification.

Regarding financial aspects, model 1 shows a significant negative effect of higher prices per kWh ( $B = -0.666$ ,  $p < 0.001$ ). The model shows that respondents put significant positive weight to returning the profit to members as dividend ( $B = 0.773$ ,  $p < 0.001$ ) and investing profit in societal projects ( $B = 0.338$ ,  $p < 0.001$ ) relative to investing company profit in production projects.

Overall, model 1 shows that the most important factors in terms of increasing utility of respondents have to do with renewable energy—something that aligns with the descriptive analysis of the reported motivations to be a member of an energy cooperative in the previous paragraphs. Respondents also have substantial preferences for lower prices and for profit to go to members. Lastly, respondents have preferences for specific cooperative aspects such as participation and a one member

one vote policy, but these preferences are small in comparison with the preferences regarding ecological and financial aspects of their membership.

**Model 2: model adaptation**

Model 2 of Table 3 shows the main effects of the attributes including a continuous version of renewable energy and its quadratic and cubic effects. Changing the renewable energy variable from dummy entries to continuous has advantages for the interpretation of subsequent interaction effects, and allows us to include interactions with the main effect of renewable energy instead of having to include interactions with each of the three dummy entries. None of the main effects change substantially, and a likelihood-ratio test and AIC point out that there is no significant difference between the two models in terms of quality. Hence, we deem this model appropriate to use for the next step in adding interactions with self-reported motives in Model 3, keeping the model as simple as possible to avoid reducing statistical power.

**Model 3: interaction effects**

The interactions of attributes with self-reported motivations are chosen based on theoretical relevance; the social and societal motives are interacted with the cooperative attributes, the ecological motives with the ecological attributes and the financial motives with the attributes with financial relevance. A sidenote for the interpretation of this model is that the effect sizes seem very small—however, the motivations were measured on a scale from 0 to 100. Hence, for a respondent with societal motives of 40 out of 100, the coefficient would be multiplied by 40 and may become quite substantial after all.

Model 3 shows that respondents with higher ecological motivations place even more weight on a higher percentage of renewable energy ( $B=0.021, p<0.001$ )—and considering the effect size per 1 unit increase on this motivation scale, this effect is very substantial for members with a high ecological motivation. Higher social motivation is related to a stronger preference for participation ( $B=0.007, p=0.004$ ) and a preference for a company scaling strategy of staying small and local ( $B=-0.005, p=0.016$ ). Higher societal motivation is related to a preference for staying small and local ( $B=-0.004, p=0.029$ ) and a preference for profit to be invested in societal projects ( $B=0.005, p=0.017$ ). Lastly, financial motivations are related to a strong preference for lower prices ( $B=-0.016, p<0.001$ ) and for profit to be returned to members as dividend ( $B=0.025, p<0.001$ ) rather than being invested in production or societal projects.

**Sociodemographic interactions**

Motives to be involved with renewable energy initiatives have been shown to vary between people with different sociodemographic characteristics—especially age, ‘urban level,’ and educational level have been shown to play a role [34, 94–96]. The CLM including interactions with the sociodemographic characteristics age (in years), educational level and urban level (i.e. a five-point scale from ‘living on the countryside’ (1) to ‘living in a big city’ (5)) is shown in Table 4. As there is no clear theoretical prediction of the relevance and direction of interactions between sociodemographic variables and the attributes, this model includes all (rather than a subset of) interactions between the attributes and the three sociodemographic variables age, urban level and educational level.<sup>8</sup> Model 1 in Table 4 is the basic CLM model with continuous variable for renewable energy, to compare with the model with interactions.

Model 2 shows that older members have a significantly lower preference for a higher share of renewable energy ( $B=-0.006, p<0.001$ ), a marginally significantly lower preference for profit to be invested in societal projects relative to production projects ( $B=-0.006, p=0.060$ ), a lower aversion for higher prices ( $B=0.005, p=0.014$ ) and a preference for a company focus only on members relative to a focus on both members and societal impact ( $B=0.008, p<0.001$ ). More urban members have a marginally significant preference for a higher percentage of renewable energy ( $B=0.027, p=0.071$ ) and a marginally significant aversion for profit to be returned to members as dividend relative to profit being invested in production projects ( $B=-0.084, p=0.060$ ). Lastly, higher education

**Table 4** Conditional logit regression incl. sociodemographic interactions

	Dependent variable: choice	
	(1)	(2)
Participation	0.056 <sup>†</sup> (0.032)	0.007 (0.206)
Voting rights	0.263*** (0.028)	0.294 <sup>†</sup> (0.176)
Renewable energy [RE]	2.116*** (0.126)	2.100*** (0.173)
RE <sup>2</sup>	0.412*** (0.089)	0.375*** (0.091)
RE <sup>3</sup>	-0.284*** (0.022)	-0.275*** (0.022)
Price	-0.666*** (0.039)	-1.140*** (0.175)
Impact	-0.330*** (0.024)	-0.676*** (0.162)
Scaling	0.103*** (0.027)	0.108 (0.186)
Diversification		
None (reference)		
Some	-0.083* (0.028)	0.104 (0.196)
Much	-0.294*** (0.038)	-0.337 (0.242)
Profit		
To production projects (reference)		
To members	0.773*** (0.056)	1.531*** (0.353)
To societal projects	0.338*** (0.037)	0.680*** (0.250)
Age × RE		-0.006*** (0.002)
Age × profit to society		-0.006 <sup>†</sup> (0.003)
Age × price		0.005* (0.002)
Age × impact		0.008*** (0.002)
Urban × RE		0.027 <sup>†</sup> (0.015)
Urban × profit to members		-0.084 <sup>†</sup> (0.045)
Education × voting rights		-0.048** (0.018)
Education × RE		0.093*** (0.013)
Education × profit to members		-0.080* (0.037)
Participants	1295	1281
Observations	36,260	35,868
Log likelihood	-8576.4	-8359.4
AIC	17,176.85	16,802.8

\*\*\* $p<0.001$ , \*\* $p<0.01$ , \* $p<0.05$ , <sup>†</sup> $p<0.1$ , two-sided

All interactions between education, urban and age with the attributes are included in the model, but only the significant interactions are represented in the table

<sup>8</sup> All interactions between education, urban level and age with the attributes are included in the model, but only the significant interactions are represented in the table.

**Table 5** Willingness to pay analysis

Attribute	WTP (cents/kWh)	Lower CI	Upper CI
Participation	0.421	-0.072	0.915
Voting rights	1.977	1.439	2.516
Renewable energy 0% (reference)			
Renewable energy 33%	16.840	15.564	18.115
Renewable energy 66%	27.075	24.642	29.509
Renewable energy 100%	17.921	15.496	20.346
Profit to production projects (reference)			
Profit to members	5.802	5.145	6.460
Profit to societal projects	2.535	2.037	3.034
Impact	-2.474	-2.863	-2.085
Scaling	0.768	0.389	1.145
Diversify none (reference)			
Diversify some	-0.626	-1.038	-0.215
Diversify much	-2.204	-2.682	-1.727

is related to a lower preference for democratic voting rights ( $B = -0.048$ ,  $p = 0.008$ ) relative to share-proportionate voting rights, a substantially stronger preference for a higher percentage of renewable energy ( $B = 0.093$ ,  $p < 0.001$ ) and a marginally significant aversion for profit to be returned to members instead of being invested in production projects ( $B = -0.080$ ,  $p = 0.030$ ).

The model shows that sociodemographic variables play an important role when investigating cooperative member motives. A clear divide can be seen between younger and older members, who seem to have different priorities in terms of price and renewable energy levels. Another divide can be seen between higher educated and more urban members versus the less educated and less urban members, in terms of prioritising renewable energy and investing profit in societal projects rather than dividing profit amongst members. With a positive correlation between educational level and urban level ( $\rho = 0.178$ ,  $p < 0.001$ ) this divide illustrates a possible demographic faultline between higher educated urbanites and lower educated people in more rural areas, as also pointed out in literature on the urban-rural educational gap [97–99].

### Willingness to pay analysis

Table 5 presents the estimated WTP and the lower and upper confidence interval [CI] for each attribute. The coefficients in the table are directly translatable to a willingness to pay a certain amount of eurocent per kilowatt hour for the increase of a specific unit. For instance, respondents are willing to pay about 0.42 eurocent per kWh extra for a change from no participation possible to participation possible in the decision-making process of a company. Compared to the average price of 28 cents per kWh at

the time of this study, this is negligible. The most striking numbers are shown for renewable energy. Respondents are willing to pay about 17, 27 and 18 eurocents per kWh extra for, respectively, 33%, 66% and 100% renewable energy compared to 0% renewable energy. The non-monotony between preference and percentage of renewable energy that is shown in the CLM analysis is again visible in the WTP outcomes: members are willing to pay most for having two-thirds renewable energy relative to none, but are not necessarily willing to pay more money for every higher percentage. In addition, respondents are willing to pay substantially more per kWh if profit is returned to members, if the company focuses on members *and* societal impact, democratic one member one vote voting rights, the company focuses on spread and growth and low diversification of products besides electricity.

The calculated WTP is only an estimation of participants' actual willingness to pay extra eurocents per kWh. In this regard, the results and their confidence intervals should be interpreted as indicators of the relative amounts that participants are willing to pay for certain attributes, rather than the actual amounts to the cent.

### Split sample analysis

In our study, we can distinguish between the early members who became a member of the cooperative before it started supplying electricity in 2003, and late members who became a member after 2003. In our sample, there were 69 members that indicated to be a member since before 2003, versus 957 members that indicated to have been a member since after 2002.<sup>9</sup> A split-sample analysis of self-reported motives, revealed preferences and

<sup>9</sup> 269 members indicated not to remember when they became a member.

willingness to pay is presented in Appendix H. Some preference heterogeneity can be seen between early and late members, although the differences are not as large as one would expect based on previous research. In terms of self-reported motives, early members assign a minimum of 15 points to ecological motives, whereas the minimum for late members is zero. Financial, social and societal motives are slightly more reported by late members than early members. On top of that, the willingness to pay for renewable energy levels is substantively higher for early members than late members, whereas late members have a higher willingness to pay for participation in the operation of the company, a company focus on spread and growth and investing profit in societal projects. These results fit the earlier results on early-versus late-joiners for energy cooperatives.

**Latent-class model results**

As the CLM analysis does not take into account preference heterogeneity of the members, we use a latent-class model analysis to distinguish different types of preference classes amongst cooperative members. The LCM is fitted using the attribute variables to divide the participants of our study into three classes based on their preferences. This is done by the LCM model: the model tries to create a set number of member-classes based on the similarity of participants. The researcher decides how many classes to divide the participants in, but the algorithm decides how best to divide the data over the number of classes, taking into account similarity in attribute preferences. The choice for the number of classes is a difficult one—when basing the decision solely on goodness-of-fit measures such as AIC and BIC one may be lead to overfit or underfit the model [66, 100]. Our choice of a three-class model is based on interpretability of the results; a model with four classes provided a less clear distinction between classes in terms of preference effect sizes than a model with three classes. In addition, Model 3 of Table 3 presenting the CLM model including motive interactions showed similarity between higher social and societal motivations, leading us to believe that these motivations are related and may be part of the same class. The specification of the LCM using three classes resulted in the models presented in Table 6.

When looking at the estimated coefficients for each attribute, the model shows that all classes put positive weight on levels of renewable energy—this seems to be an overarching preference for all respondents. Class 2, however, puts lower weight on this compared to class 1 and 3, with class 3 putting by far the most weight on renewable energy. Class 2 has significant preferences for participation and democratic voting rights, as well as a preference for a company focus on members and society,

**Table 6** Latent-class conditional logit model regression results

	Dependent variable: choice		
	Class 1	Class 2	Class 3
Participation	−0.617*** (0.089)	1.271*** (0.134)	−0.342*** (0.077)
Voting rights	−0.086 (0.115)	0.778*** (0.101)	0.162** (0.052)
Renewable energy			
0% (reference)			
33%	2.701*** (0.287)	0.515 <sup>†</sup> (0.280)	3.890*** (0.168)
66%	2.488*** (0.275)	1.211*** (0.318)	6.363*** (0.227)
100%	2.546*** (0.166)	1.215*** (0.198)	3.669*** (0.178)
Price	−1.960*** (0.192)	−0.272+ (0.152)	−0.893*** (0.073)
Impact	−0.296*** (0.064)	−0.178* (0.086)	−0.533*** (0.054)
Scaling	1.050*** (0.152)	−0.282*** (0.084)	−0.153* (0.064)
Diversification			
None (reference)			
Some	0.324** (0.100)	−0.237* (0.117)	−0.017 (0.055)
Much	−0.317*** (0.087)	−0.350* (0.155)	−0.706*** (0.091)
Profit			
To production projects (reference)			
To members	3.046*** (0.322)	0.784*** (0.159)	0.486*** (0.133)
To societal projects	0.908*** (0.146)	0.401*** (0.103)	0.325*** (0.094)
Class-probability	0.21	0.12	0.67
Participants		1295	
Observations		18,130	
Log likelihood		−7890.4	
AIC		15,856.7	
BIC		16,153.3	

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ , <sup>†</sup> $p < 0.1$ , two-sided

and a scaling strategy of staying small and local. This class fits our understanding of the socially and societally motivated members, who value the social and distinctively cooperative aspects of the company. Class 1, on the other hand, has an aversion for participation, and has a substantive preference for lower prices, for profit to be returned to members, for some diversification and for a scaling strategy focused on spread and growth. This class corresponds with financially motivated members, who place less value on cooperative aspects but more value on a growing company with low prices and opportunities for dividend. Class 3 stands out for its substantive effect

**Table 7** Willingness to pay analysis per class

Attribute	Class 1 WTP (cents/kWh)	Class 2 WTP (cents/kWh)	Class 3 WTP (cents/kWh)
Participation	-1.575	23.395	-1.913
Voting rights	-0.221	14.317	0.906
Renewable energy 0% (reference)			
Renewable energy 33%	6.888	9.472	21.777
Renewable energy 66%	6.346	22.287	35.624
Renewable energy 100%	6.493	22.350	20.540
Profit to production projects (reference)			
Profit to members	7.768	14.433	2.719
Profit to societal projects	2.315	7.375	1.819
Impact	-0.755	-3.282	-2.986
Scaling	2.677	-5.185	-0.858
Diversify none (reference)			
Diversify some	0.827	-4.370	-0.096
Diversify much	-0.809	-6.446	-3.952

sizes for renewable energy preference, and places less value on other aspects. This class represents ecologically motivated members. Class 3 has the highest class-probability—about 67% of respondents is expected to belong to this class. 21% of respondents is likely in the first class, and 12% of respondents is likely to fall in the second class. Based on insights of Bauwens [34], we may interpret the classes in terms of how they see the cooperative: as a community of place, or a community of interest. The social and societal class is motivated by regarding the cooperative as a community of place: they want to participate in the working of the company, they want the company to stay small and local, focus on the members, and invest members and societal projects. The ecological and financial classes, on the other hand, consider the cooperative as a community of interest: they are interested in low costs, high sustainability, but less in active participation or—in the case of the financial class—staying local.

To further illustrate differences between the three distinguished member classes, Table 7 shows a WTP analysis for each class. The 95% confidence intervals for each class WTP can be found in Appendix I. Note that due to the higher uncertainty of the estimation of price for Class 2 (see the estimates of Table 6) the confidence interval of WTP for Class 2 is broad. From the WTP analysis it is clear that the financially motivated members in class one are not willing to pay much for their preferred attributes, and their most valuable attribute is for profit to be divided amongst members. For the social-societally motivated members of Class 2 it is clear that they value participation and democratic voting more than the other classes. Lastly, the ecologically motivated members in Class 3 have an extraordinary willingness to pay for higher levels of renewable energy, compared to the other classes.

## Discussion

Our findings from the DCE suggest that energy prosumers value the cooperative aspects of the hypothetical energy companies presented in the choice sets, but they value financial and especially ecological aspects more. On average, members showed preferences for higher percentages of renewable energy, lower prices, member participation, democratic voting rights, a company focus on members and societal impact and for the company to grow. The percentage of renewable energy was, by far, the most influential attribute for all members. However, preferences were not homogeneous for the other attributes, as shown by the interactions with sociodemographic variables: younger, higher educated and urban members have a larger preference for renewable energy and for profit to be invested in societal projects—fitting the patterns found in literature on the urban–rural educational gap. In addition, older members prefer a company focus on members only rather than a focus on members and societal impact.

Three overall motivation classes can be distinguished. The first class is the social–societal class, containing members mostly concerned with the social and cooperative aspects of the company such as participation, democratic voting rights and investing company profit in societal projects. The second class is the financial class, containing members who have a strong preference for low prices and for company profit to be returned to members as dividend. The last class, containing 67% of members, is the ecological class, mostly concerned about receiving high levels of renewable energy. Whereas the preferences between these classes can be clearly distinguished, all classes have a base-level preference for high levels of renewable energy and have a high willing to

pay for this. Ecological motives thus seem to be a factor important for all member types.

### Literature

Our results on preference heterogeneity fit the general pattern of motives found in the literature in which financial (“material”, “economic”, “gain”), ecological (“expressive”, “environmental”, “normative considerations”), societal (“dissatisfaction”, “institutional”) and social (“community”) motives are specified by a broad range of interdisciplinary scholars [24–26, 28, 33, 55–57, 59]. Ecological motives are most prevalent in all studies, and this proved to be true for our study as well: a majority of cooperative members was confirmed to be predominantly ecologically motivated. In our study we find little empirical difference between members with social and societal motives. We still believe there is a theoretical distinction between these two motives, belonging to different literatures. However, these motivations seem to coincide and form the basis of the same “class” of cooperative members.

The split-sample analysis in which we distinguish between early and late members shows a small difference in motivations. Early members are more driven in their membership by the percentage of renewable energy, whereas late members have a higher willingness to pay for participation, scaling of the company and investing in societal projects. Although the differences are small, these findings are in line with general findings on shifting membership motives depending on when members joined [64, 65]. Specifically, the match findings of Bauwens [33, 34], who finds that early members focus more on social and ideological aspects whereas member who joined later focus mostly on financial goals.

Our results contribute to the further development of the interdisciplinary body of research by looking at prosumer motives of a large cooperative using a combination of revealed stated-choice and self-reported data. Whereas previous literature emphasises the underrated role of community aspects of member motivation for energy communities, we find that for a large cooperative, the social and societal motivations may not play as big of a role. Aspects that do play a large role—ecological and financial motives—may also be found in non-cooperative energy providers. The implications of these findings for energy cooperatives will be discussed in the conclusions.

### Limitations

This study has some limitations. First, there is a selection effect in our sample: from the many members we have randomly selected to invite for participation, there may be a bias in who answered the call. A meta-analysis of response rates by Wu et al. [101] states that response

rates are best under younger participants relative to older participants, women relative to men and students relative to non-students. This seems contrary to the descriptive statistics of our sample, which contains a large proportion of older men. As stated earlier, the population of cooperative members is very dissimilar to the general population of Flanders in terms of income, educational level, gender and age. To gauge the generalisability of our results for the population of Ecopower we applied raking to weigh our data using proportions for age and gender out of an Ecopower member-file. The weighted analyses provided near-identical results to the unweighted ones. An important fact to keep in mind is that usually only one person of the household is the contact person for an energy contract, and it is possible that in many households this would be men. In addition, other studies on the sociodemographic characteristics of energy communities point out a major imbalance between participation of men and women, with—especially older—men making up for the majority of investors and members [93, 102, 103]. An overrepresentation of older men compared to population statistics in any sample of energy community members may thus be unavoidable. In addition, members with certain motives may be more likely to be represented in this study. As all participants are members of Ecopower, it is expected that the results reflect preferences of company characteristics that match the characteristics of Ecopower. As is shown by the results, however, not all members care equally about all characteristics. Lastly, Whitehead [104] points out in a study of behaviour of general samples versus environmental interest samples, people with an environmental interest are significantly more likely to respond to surveys. Although it is likely that all members of Ecopower care about renewable energy, as they specifically chose Ecopower for their electricity supply, it is possible that particularly ecologically motivated members are overrepresented in our sample.

Second, our study is limited to the members of only one energy cooperative. The energy cooperative in this study may be representative of other larger energy cooperatives in Europe, but it may not be representative for energy cooperatives that are smaller or operate more locally as a community of place rather than a community of interest as suggested by Bauwens [34]. The same will hold for our results. In addition, this research was conducted in a strange time: a time right before the price of energy skyrocketed. As shown, Ecopower managed to maintain low prices per kWh relative to other energy providers. However, as Ecopower was not taking on any new members due to a contract stop since January 2021, our research results were not affected by new members looking for the cheapest energy prices regardless of the organisational

identity, ideology or legal form. Nevertheless, the motivations of existing members could have altered during this period. The results, showing the importance of predominantly ecological motives speak against this notion. Our results fit the broad findings in the body of literature on motives for energy community membership.

Third, due to constraints of statistical power we had to analyse the interaction effects of the attributes with sociodemographic variables and the interaction effects of the attributes with the self-reported motives separately. This means we could not test the effects of sociodemographic variable interactions while controlling for self-reported motives and vice versa. However, including all possible interactions would have increased the complexity of the models dramatically and reduced the ease of interpretability of the results compared to the presented results in this paper.

### Future research

Our suggestion for future research is to continue investigating the motives and principles underlying citizens' choice to be or become collective prosumers, in different contexts. Energy cooperatives of a smaller size may experience less preference heterogeneity, or may experience different issues to maintain resilience. In addition, cooperatives generating other resources than electricity may face other challenges when trying to reduce tensions between ideology and financial security. Studies with larger sample sizes may be less limited in their modelling possibilities and may increase complexity of the models while retaining statistical power to gain new insights on interactions between revealed preferences, sociodemographic variables and self-reported motives. However, given the nature of energy cooperatives—often local, small organisations in origin—getting a larger sample size may prove difficult. Lastly, this research was focused on motives of people who are already a member of an energy cooperative—but what about people who are not a member yet? Fischer, Gutsche and Wetzel [29] show in a study of non-members that for them, the most important drivers for participation intention are favourable returns, environmental values, perceived peer expectations and prior volunteering experience. Combining insights on collective prosumer motives in combination with motives and participation intentions from non-members from various contexts may lead to generalisable insights useful for scientists, policy makers and cooperative practitioners alike.

### Conclusions

Overall, we conclude that the interaction of self-reported and stated-choice data provided us with valuable insights in the needs and wants of energy prosumers. Our results propose that the cooperative aspects of a company

matter, but that financial considerations and above all the share of renewable energy matter more to the large majority of prosumers. Renewable energy is the single most important factor in our respondents' willingness to pay for electricity and for over two-thirds of the members in our sample this is the single most important reason to be a member of the energy cooperative. Showing three-member classes representing social–societal, financial and ecological motives, this paper does suggest there is some preference heterogeneity amongst the members of the energy cooperative in question. However, for each of these three classes the baseline preference for renewable energy was present. This attribute thus forms a common thread keeping members of the cooperative together and united for a similar goal: green energy.

The flip side of this result is, however, that only a small percentage of members was distinctly interested in the cooperative aspects of the company, such as democratic voting rights and member participation in the operations of the company. This could mean that as soon as non-cooperative energy companies start providing green energy for similar prices, a part of the member base may be swayed to switch to whatever company offers the highest percentage of renewable energy for the lowest price. This may put extra pressure on the trade-off of energy cooperatives, who started out with the ideology of sustainability and cooperative values with first-mover members, but are now attracting members who see them as an attractive option in a field of energy-providing competitors.

Our findings imply that in order to become or remain resilient, cooperatives should be aware that their legal form may not be the only thing that drives membership. Rather, keeping high levels of renewable energy, competitive pricing and being an interesting investment opportunity may be key to their existence and further development on the energy market.

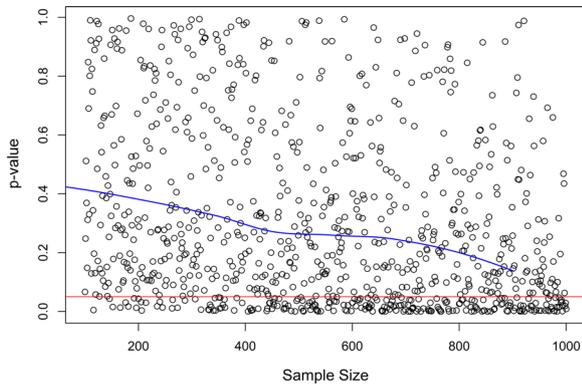
With the changing market environment in which energy cooperatives all over Europe operate, and the promising role they can play in improving the social and economic well-being of local communities as well as in the transitioning of the energy market and the achievement of recent EU climate policy targets, understanding member and preference heterogeneity of energy prosumers is more important now than ever in order for energy cooperatives to retain resilience.

### Appendices

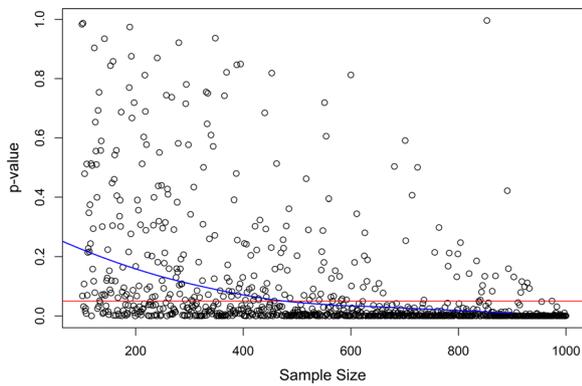
#### Appendix A: Power analysis

For the attribute variables '33% renewable energy' [Renewable33] and 'profit goes to members as dividend' [Profitmembers], we plotted the sample size for several

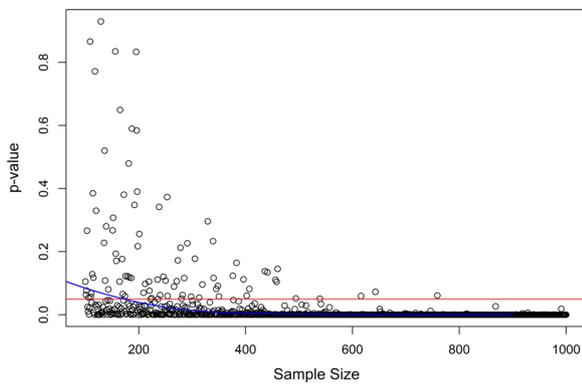
possible effect sizes, shown below. The red line indicates the  $p$ -value of 0.05 (used in this paper as a benchmark for significant coefficients). The blue line indicates the average of the plotted effect sizes simulated per sample size on the x-axis (Figs. 3, 4, 5, 6, 7, 8).



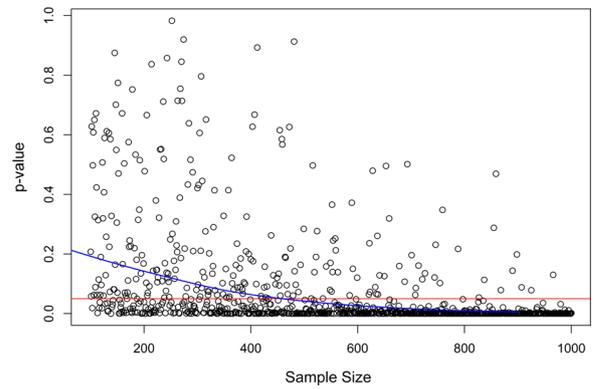
**Fig. 3** Power analysis for Renewable33, effect size 0.1



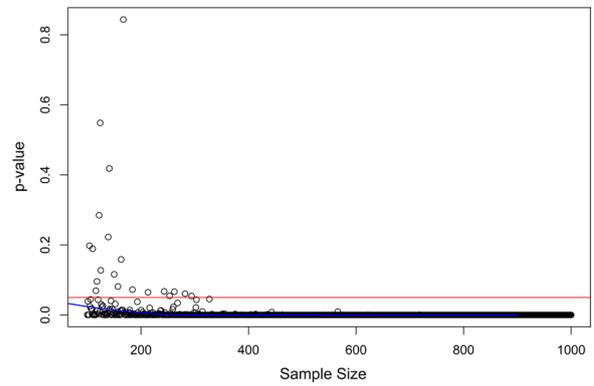
**Fig. 4** Power analysis for Renewable33, effect size 0.2



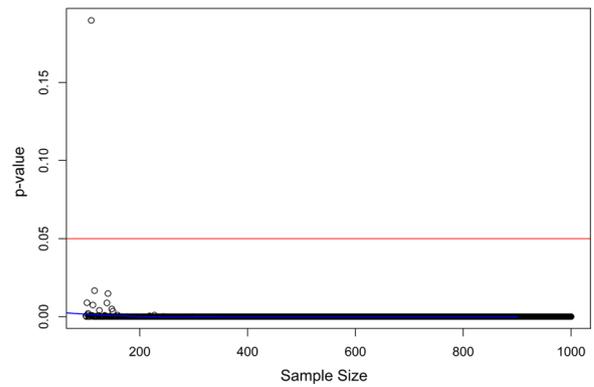
**Fig. 5** Power analysis for Renewable33, effect size 0.3



**Fig. 6** Power analysis for Profitmembers, effect size 0.1



**Fig. 7** Power analysis for Profitmembers, effect size 0.2



**Fig. 8** Power analysis for Profitmembers, effect size 0.3

**Appendix B: Screenshot from first choice-set**

Participants were asked to choose between company A and company B. See below a stylised version of the choice presented to the participants in Qualtrics (Table 8).

Company A  
Company B

**Table 8** Example of the first choice-set that participants saw in the experiment

Choice 1	Which energy company do you prefer?	
	Company A	Company B
Member participation in the operation of the company	Participation possible	Participation not possible
Voting rights in decision-making process	One member one vote	Voting rights proportionate to the number of shares
Share of renewable energy	100% renewable energy	0% renewable energy
Price per kWh in Eurocents	30 cents	30 cents
Whether a company is focused on the societal impact or on its members	Focus only on members	Focus only on members
Focus on “small and local” versus “spread and growth”	Focus on spread and growth	Focus on spread and growth
The level of diversification in provided goods: only electricity or also other energy-related products	Much diversification	No diversification
What happens to profit?	Invest in societal projects	Invest in production projects

**Appendix C: Post-experimental survey items**

See Table 9.

**Table 9** Description of post-experimental survey items

Variable	Description	Levels
Motives	For this question you are asked to divide 100 points over 4 motives to become member of an energy cooperative: ecological, social, financial and societal <i>Ecological motives</i> include climate change, the environment and ecological footprint <i>Social motives</i> include connectedness with other cooperative members, social cohesion and group membership <i>Financial motives</i> include minimalising costs of electricity, or interesting investment opportunities <i>Societal motives</i> include dissatisfaction with current government policy on electricity, or the impact that energy cooperatives can have on society	0–100 for each level (must sum to 100)
Age	What is your age?	18–100
Gender	What is your gender?	Male; Female; Other; Prefer not to say;
Years member	In what year did you become a ‘cooperant’ at X? (when you bought your share)	1991–2022; I do not remember;
Years client	In what year did you become a client at X (for the supply of electricity)	2003–2022; I do not remember;
Number shares	How many shares do you own?	1–20; More than 20; I do not know; Prefer not to say;
Income	What is your combined net yearly household income?	0–19.999; 20.000–39.999; 40.000–59.999; 60.000–79.999; 80.000–99.999; 100.000 or more; Prefer not to say;

**Table 9** (continued)

Variable	Description	Levels
Education	What is your highest level of education?	Lower education; High school; Graduate school (graduate degree or professional bachelor); University: bachelor degree; University: master degree; Master-after-master or postgraduate degree; Doctorate / PhD; Prefer not to say;
Living area	Do you live in a city, village or a more rural area?	Big city; Suburbs of a big city; Village or small city; Village in the countryside; House on the countryside; Prefer not to say;
House type	What type of house do you live in?	Apartment; Terraced house; Semi-detached building; Detached building; Other; Prefer not to say;
Municipality	In which municipality do you live?	Municipalities of Flanders; Prefer not to say;
Household size	How many members are there in your household? (incl. children)	1–20;
Electricity use	How many kWh per year do you consume?	Less than 1500 kWh; 1500–1999 kWh; 2000–2499 kWh; 2500–2999 kWh; 3000–3499 kWh; 3500–3999 kWh; 4000 kWh or more; I don't know; Prefer not to say;
Payment type	Do you pay your electricity bill advance from X per one, two or three months?	1–3; Prefer not to say;
Payment amount	How much is your one- two- or three-monthly electricity bill advance from X?	0–50 Euros; 51–100 Euros; 101–150 Euros; 151–200 Euros; 201–250 Euros; 251–300 Euros; 301–350 Euros; 351–400 Euros; 401–450 Euros; 451–500 Euros; 501–550 Euros; 551–600 Euros; 601–650 Euros; 651–700 Euros; More than 700 Euros; I don't know; Prefer not to say;
Cooking	Do you use electricity for cooking?	No; Yes; Prefer not to say;
Car	Do you have an electric car?	No; Yes; Prefer not to say;

**Table 9** (continued)

Variable	Description	Levels
Heat pump	Do you have a (hybrid) heat pump?	No; Yes, hybrid heat pump Yes, heat pump; Prefer not to say;
Solar panels	Do you have solar panels?	No; Yes; Prefer not to say;

**Appendix D: Descriptive statistics of the post-experimental survey**

See Table 10.

**Table 10** Descriptive statistics of post-experimental survey items

Variable	Mean/%	Mode	Min	Max	Total N
Ecological motivations	47.7		0	100	1295
Social motivations	11.6		0	100	1295
Societal motivations	17.2		0	100	1295
Financial motivations	23.5		0	100	1295
Age	57.9		25	89	1295
Male	84%				1281
Education	Lower education				1282
	High school				
	Graduate school (graduate degree or professional bachelor)				
	University: bachelor degree				
	University: master degree				
	Master-after-master or postgraduate degree				
	PhD				
Household income	0–19.999				1164
	20.000–39.999				
	40.000–59.999				
	60.000–79.999				
	80.000–99.999				
	100.000 or more				
Membership shareholder	2009	2003	1991	2022	1026
Membership client	2009	2003	2003	2022	1027
Number of shares		1 to 5	1 to 5	More than 20	1229
Urban level	Big city				1293
	Suburbs of a big city				
	Village or small city				
	Village in the countryside				
	Farm on the countryside				
Household size	2.6		1	20	1295
Electricity use	Less than 1500 kwh				1142
	1500–1999 kwh				
	2000–2499 kwh				
	2500–2999 kwh				
	3000–3499 kwh				
	3500–3999 kwh				
	4000 kwh or more				

**Table 10** (continued)

Variable		Mean/%	Mode	Min	Max	Total N
Electricity bill per month	0–50 Euros	27%				684
	51–100 Euros	34%				
	101–150 Euros	17%				
	151–200 Euros	11%				
	201–250 Euros	4%				
	251–300 Euros	2.6%				
	301–350 Euros	1.5%				
	351–400 Euros	0.75%				
	401–450 Euros	0.75%				
	451–500 Euros	0.58%				
	501–550 Euros	0.17%				
	551–600 Euros	0%				
	601–650 Euros	0.17%				
	651–700 Euros	0.17%				
	More than 700 Euros	0.42%				
Electric car		11%				1293
Electric cooking		69%				1293
Heat pump	No	88%				1295
	Yes, hybrid heat pump	1%				
	Yes, heat pump	11%				
Solar panels		64%				1295

In calculation of the descriptive statistics the “would rather not say” and “I don’t know” observations are excluded

**Appendix E: Weighted CLM for age categories**

See Tables 11, 12.

**Table 11** CLM analysis weighted for age categories

	Dependent variable: choice		
	(1)	(2)	(3)
Participation	0.064 <sup>†</sup> (0.034)	0.064 <sup>†</sup> (0.034)	−0.071 (0.062)
Voting rights	0.247*** (0.029)	0.247*** (0.029)	0.177** (0.056)
Renewable energy [RE]			
0% (reference)			
33%	2.351*** (0.077)		
66%	3.776*** (0.086)		
100%	2.546*** (0.065)		
RE		2.237*** (0.129)	1.633*** (0.142)
RE <sup>2</sup>		0.402*** (0.092)	0.066 (0.096)
RE <sup>3</sup>		−0.288*** (0.022)	−0.209*** (0.023)
Price	−0.721*** (0.040)	−0.721*** (0.040)	−0.369*** (0.049)
Impact	−0.403*** (0.025)	−0.403*** (0.025)	−0.358*** (0.052)

**Table 11** (continued)

	Dependent variable: choice		
	(1)	(2)	(3)
Scaling	0.120*** (0.028)	0.120*** (0.028)	0.314*** (0.056)
Diversification			
None (reference)			
Some	-0.096*** (0.028)	-0.096*** (0.029)	-0.134*** (0.030)
Much	-0.320*** (0.040)	-0.320*** (0.040)	-0.473*** (0.073)
Profit			
To production projects (reference)			
To members	0.776*** (0.059)	0.776*** (0.059)	0.202** (0.073)
To societal projects	0.414*** (0.039)	0.414*** (0.039)	0.321*** (0.061)
Ecological motives × RE			0.022*** (0.001)
Ecological motives × much diversification			0.002 (0.002)
Social motives × participation			0.009*** (0.002)
Social motives × voting rights			0.001 (0.002)
Social motives × impact			0.003 (0.002)
Social motives × scaling			-0.007** (0.002)
Social motives × profit to societal projects			0.001 (0.002)
Societal motives × participation			0.001 (0.002)
Societal motives × voting rights			0.004* (0.002)
Societal motives × impact			-0.005* (0.002)
Societal motives × scaling			-0.007*** (0.002)
Societal motives × profit to societal projects			0.006** (0.002)
Financial motives × price			-0.018*** (0.001)
Financial motives × profit to members			0.028*** (0.002)
Participants	1295	1295	1295
Observations	36,260	36,260	36,260
Log likelihood	-8326.4	-8326.4	-7806.9
AIC	16,676.82	16,676.82	15,665.89

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ , † $p < 0.1$ , two-sided

**Table 12** Raking summary details (age)

Target	Unweighted N	Unweighted %	Weighted N	Weighted %
0.095	11	0.008	55.00	0.042
0.243	87	0.067	333.417	0.257
0.240	246	0.190	329.345	0.254
0.174	396	0.305	238.332	0.184
0.160	373	0.288	219.917	0.170
0.066	155	0.120	90.481	0.070
0.021	27	0.021	28.508	0.022
1	1295	1	1295	1

**Appendix F: Weighted CLM for gender variable**  
See Tables 13, 14.

**Table 13** CLM analysis weighted for gender

	Dependent variable: choice		
	(1)	(2)	(3)
Participation	0.054 <sup>†</sup> (0.032)	0.055 <sup>†</sup> (0.032)	-0.108 <sup>†</sup> (0.061)
Voting rights	0.263*** (0.028)	0.263*** (0.028)	0.221*** (0.055)
Renewable energy [RE]			
0% (reference)			
33%	2.272*** (0.076)		
66%	3.663*** (0.085)		
100%	2.415*** (0.061)		
RE		2.128*** (0.127)	1.568*** (0.140)
RE <sup>2</sup>		0.437*** (0.090)	0.156 <sup>†</sup> (0.094)
RE <sup>3</sup>		-0.293*** (0.022)	-0.227*** (0.023)
Price	-0.662*** (0.039)	-0.662*** (0.039)	-0.329*** (0.048)
Impact	-0.343*** (0.024)	-0.343*** (0.024)	-0.306*** (0.051)
Scaling	0.092*** (0.027)	0.092*** (0.027)	0.203*** (0.055)
Diversification			
None (reference)			
Some	-0.085** (0.028)	-0.085** (0.028)	-0.124*** (0.029)
Much	-0.300*** (0.038)	-0.300*** (0.038)	-0.365*** (0.072)
Profit			
To production projects (reference)			
To members	0.763*** (0.056)	0.763*** (0.056)	0.198** (0.071)
To societal projects	0.349*** (0.038)	0.349*** (0.038)	0.223*** (0.060)

**Table 13** (continued)

	Dependent variable: choice		
	(1)	(2)	(3)
Ecological motives × RE			0.021*** (0.001)
Ecological motives × much diversification			0.000 (0.001)
Social motives × participation			0.007** (0.002)
Social motives × voting rights			0.002 (0.002)
Social motives × impact			0.000 (0.002)
Social motives × scaling			−0.005* (0.002)
Social motives × profit to societal projects			0.003 (0.002)
Societal motives × participation			0.004 <sup>†</sup> (0.002)
Societal motives × voting rights			0.002 (0.002)
Societal motives × impact			−0.002 (0.002)
Societal motives × scaling			−0.004* (0.002)
Societal motives × profit to societal projects			0.005** (0.002)
Financial motives × price			−0.016*** (0.001)
Financial motives × profit to members			0.026*** (0.002)
Participants	1295	1295	1295
Observations	36,260	36,260	36,260
Log likelihood	−8421.1	−8421.1	−7955.7
AIC	16,866.18	16,866.18	15,963.31

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ , <sup>†</sup> $p < 0.1$ , two-sided

**Table 14** Raking summary details (gender)

Target	Unweighted N	Unweighted %	Weighted N	Weighted %
0.23	208	0.16	294.63	0.23
0.77	1073	0.84	986.37	0.77
1	1281	1	1281	1

**Appendix G: Notes on representativeness of the sample  
Relative to energy cooperative members**

It is difficult to gauge the representativeness of our sample relative to the population of all energy cooperative members. Regarding the distribution of age and gender, however, we can at least establish similar statistics

compared to another energy cooperative in Flanders, namely BeauVent. BeauVent is a production cooperative, which means that it does not supply electricity to its members as Ecopower does. In the sample of BeauVent members gathered by Bauwens [93], the average age is 51.52. The sample consisted of 84% men and 16% women.

Other studies, too, point out the gender imbalance with men taking up the majority of memberships in energy communities: Yildiz et al. [103] report 80% men and 20% women in their study of energy cooperative members in Germany, a result that is also found by Fraune [102] in her research on gender imbalance in renewable energy investment in Germany. This is not too different from our Ecopower sample.

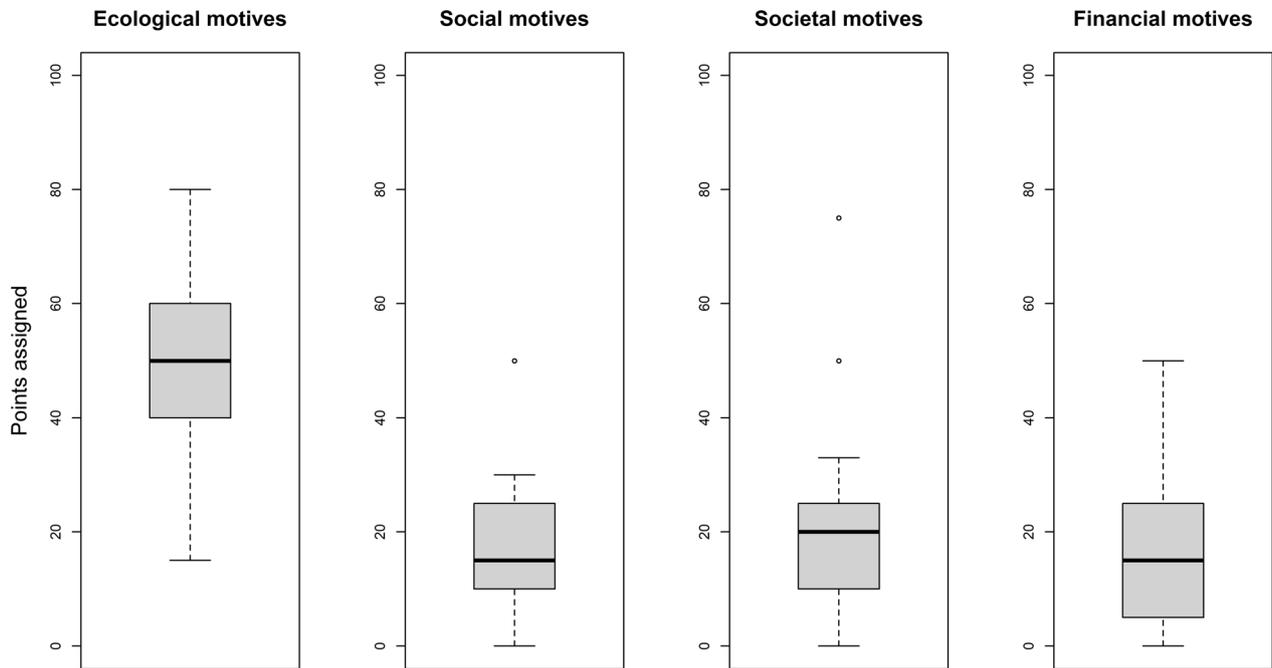
**Relative to the general population of Flanders**

When comparing the sociodemographic characteristics of our sample to the general population of Flanders, several differences stand out. Firstly, whereas our study and similar studies on Ecopower find 84% men, the distribution of men and women in Flanders was almost exactly 50/50 in January 2022 [105]. The overrepresentation of men in the energy cooperative is also pointed out by Bauwens and Eyre [91] and is consistent with

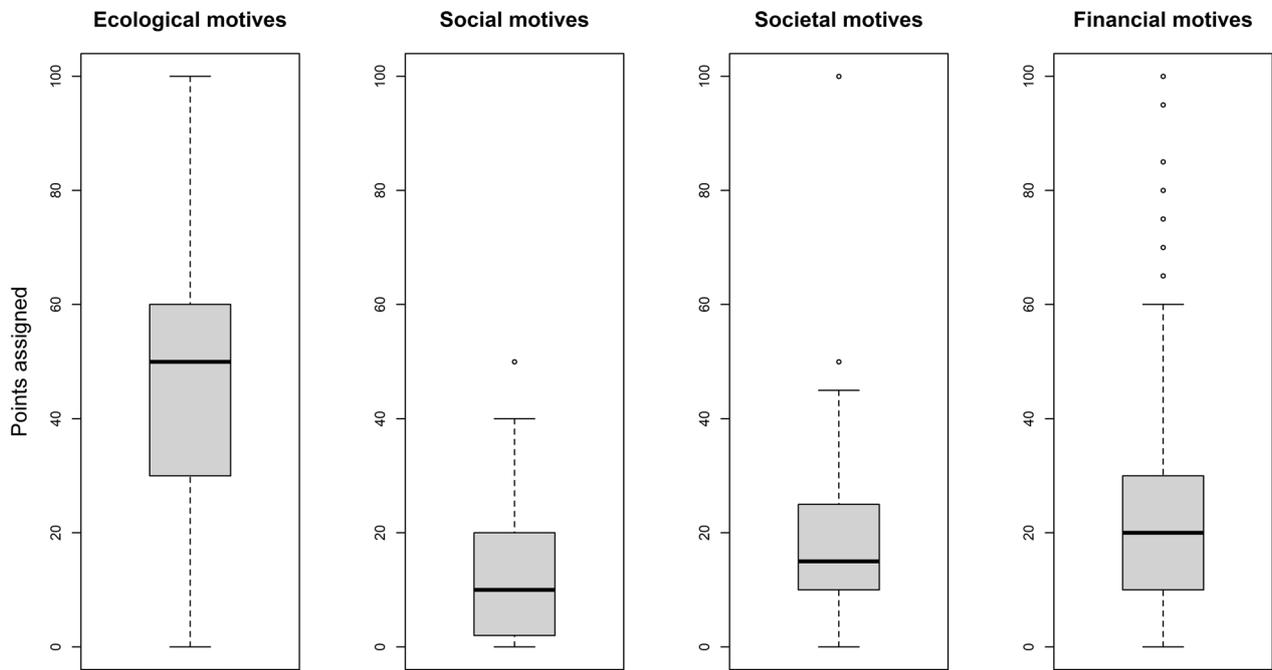
the findings of amongst others Fraune [102] on gender imbalance in community renewable energy engagement in Germany. In addition, whereas our sample consists of about 30% subjects age 65 or older, the percentage of people over 64 in the general population of Flanders was only 21% in January 2022 [105]. Regarding educational level, our sample of cooperative members contains about 77% highly educated people (graduate school or university), whereas Flanders counted only 45.5% highly educated people in the general population in 2021 [106]. Lastly, the average net income per household per month in Flanders in 2021 was 2622 Euros [107] (which falls in category 2 of our survey-item on yearly income), whereas 62% of our sample reports an income higher than this.

**Appendix H: Early vs late member analysis**

See Figs. 9, 10; Tables 15, 16.



**Fig. 9** Boxplot of various motives to be a member of an energy cooperative—early members (pre-2003)



**Fig. 10** Boxplot of various motives to be a member of an energy cooperative—late members (post-2002)

**Table 15** Conditional logit split-sample analysis: Early (pre-2003) vs. late (post-2002) members

	Dependent variable: choice	
	Early members	Late members
Participation	-0.063 (0.144)	0.052 (0.037)
Voting rights	0.455*** (0.121)	0.259*** (0.032)
Renewable energy		
0% (reference)		
33%	2.334*** (0.329)	2.240*** (0.087)
66%	3.934*** (0.378)	3.589*** (0.096)
100%	2.528*** (0.274)	2.390*** (0.069)
Price	-0.617*** (0.164)	-0.675*** (0.045)
Impact	-0.338** (0.112)	-0.335*** (0.028)
Scaling	-0.008 (0.117)	0.110*** (0.032)

**Table 15** (continued)

	Dependent variable: choice	
	Early members	Late members
Diversification		
None (reference)		
Some	-0.056 (0.124)	-0.097** (0.033)
Much	-0.398* (0.168)	-0.304*** (0.044)
Profit		
To production projects (reference)		
To members	0.652** (0.234)	0.769*** (0.065)
To societal projects	0.163 (0.166)	0.326*** (0.045)
Participants	69	957
Observations	1932	26,796
Log likelihood	-436.82	-6349.1
AIC	897.65	12,722.18

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ , + $p < 0.1$ , two-sided

**Table 16** Willingness to pay analysis for early (pre-2003) and late (post-2002) members

Attribute	Early WTP (cents/kWh)	Early Lower CI	Early Upper CI	Late WTP (cents/kWh)	Late Lower CI	Late Upper CI
Participation	-0.509	-2.673	-1.654	0.388	-0.172	0.948
Voting rights	3.691	0.537	6.844	1.917	1.305	2.529
RE* 0% (reference)						
RE 33%	18.924	12.014	25.835	16.595	15.162	18.447
RE 66%	31.903	18.315	45.492	26.590	23.858	29.321
RE 100%	20.501	7.829	33.172	17.707	14.956	20.457
Profit to production projects (reference)						
Profit to members	5.286	2.220	8.352	5.695	4.944	6.447
Profit to societal projects	1.319	-1.129	3.767	2.418	1.847	2.988
Impact	-2.742	-4.700	-0.784	-2.486	-2.933	-2.039
Scaling	-0.064	-1.929	1.802	0.819	0.386	1.251
Diversify none (reference)						
Diversify some	-0.450	-2.413	1.512	-0.716	-1.189	-0.244
Diversify much	-3.225	-5.534	-0.916	-2.255	-2.800	-1.709

\* Renewable energy

**Appendix I: LCM model WTP confidence intervals**

See Table 17.

**Table 17** WTP confidence intervals per LCM model class

Attribute	Class 1 Lower CI	Class 1 Upper CI	Class 2 Lower CI	Class 2 Upper CI	Class 3 Lower CI	Class 3 Upper CI
Participation	-1.927	-1.222	-4.428	51.217	-2.603	-1.222
Voting rights	-0.764	0.323	-2.107	30.741	0.258	1.554
RE* 0% (reference)						
RE 33%	6.326	7.450	2.785	16.159	19.181	24.374
RE 66%	5.484	7.207	2.743	41.831	31.144	40.104
RE 100%	5.332	7.654	-7.173	51.874	16.762	24.318
Profit to production projects (reference)						
Profit to members	7.091	8.445	1.485	27.381	1.457	3.981
Profit to societal projects	1.837	2.794	-0.731	15.481	0.904	2.734
Impact	-1.126	-0.385	-6.934	0.370	-3.566	-2.405
Scaling	2.251	3.103	-11.588	1.219	-1.585	-0.131
Diversify none (reference)						
Diversify some	0.363	1.290	-8.708	-0.031	-0.716	0.519
Diversify much	-1.185	-0.432	-11.693	-1.199	-4.892	-3.013

\* Renewable energy

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**Author contributions**

FK contributed to the conception, design, execution, analysis, data interpretation and writing of the work. TM contributed to the conception and substantive revision of the work. All authors read and approved the final manuscript.

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### Availability of data and materials

All data and code will be made available open access on the corresponding author's GitHub upon acceptance of publication.

### Declarations

#### Ethics approval and consent to participate

Written consent was received from all participants before entering the experiment, and participants were made aware that they could stop their participation at any given time by closing the browser window. Participation was completely anonymous. Unique participant codes were provided to the participants, so they could request—through Ecopower—for their data to be removed permanently from our database. Ecopower did not have access to the data at any point, and the research team did not have access to any personal or sensitive data from participants at any point. Ethical approval for this study was acquired from the Rotterdam School of Management IRB (reference ETH2122-0426).

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

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