Energy Citizenship and Energy Communities for a Clean-Energy Transition

D4.3
Report Correlational Longitudinal Studies

Relations between involvement in energy communities and energy citizenship

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Abstract

In this deliverable, the results of the longitudinal field studies conducted as part of the EC^2 project are provided. We examine the relationships between involvement in energy communities and energy citizenship, over time, and their relation to behaviours supporting broader sustainable goals. We additionally investigate whether the support for and membership in energy communities and energy citizenship are shaped by various individual factors, factors related to the wider local communities in which energy communities are embedded as well as the specific characteristics of the energy communities. Data was collected among 3902 members and non-members of energy communities within 21 countries. First, we introduce the theoretical concepts and development of the surveys. Second, we lay out the method including samples and data collection strategies. Third, we show the main results. We conclude with scientific as well as practical recommendations.

Table of Contents

List of Abbreviations **7**

1 Summary and main conclusions **8**

2 Introduction **12**

2.1 EC^2 outcomes: Energy citizenship and involvement in energy communities 13

2.2 Behaviours supporting broader sustainability goals 14

2.3 Involvement in energy communities 14

2.3.1 Personal factors 14

2.3.2 Local community factors 14

2.3.3 Energy community characteristics 15

3 Method **17**

3.1 Design and procedures 17

3.2 Samples 18

3.2.1 Pilot Study Inishbofin (Ireland) 20

3.2.2 General Population the Netherlands 20

3.2.3 General Population Spain 23

3.2.4 Buurkracht (Netherlands) 26

3.2.5 Global Ecovillage Network (Europe) 27

3.2.6 Energy Communities Europe 29

3.2.7 Housing Cooperative Wroclaw South (Poland) 31

3.3 Measures 32

4 Results **36**

4.1 General Population the Netherlands 37

4.2 General Population Spain 45

4.3 Buurkracht (Netherlands) 51

4.4 Global Ecovillage Network (Europe) 59

4.5 Energy Communities Europe 62

4.6 Housing Cooperative Wroclaw South (Poland) 65

5 Discussion 70
5.1 Main conclusions 70
5.1.1 Diversity and inclusion in energy communities 70
5.1.2 EC^2 outcomes: Energy citizenship and involvement in energy communities 71
5.1.3 Other factors related to involvement in energy communities 72
5.1.4 Other factors related to energy citizenship 74
5.1.5 Behaviours supporting broader sustainability goals 75
5.2 Limitations 75
5.3 Practical implications 76

6 References 77

7 Appendix Item overview 81

8 CRediT author contribution statement 85

9 Declaration of competing interests 85

10 Acknowledgements 85

Table of Figures and Tables

Figure 1. Working model 16
Figure 2. Map of participating countries 17
Figure 3. Overview of the survey 33
Figure 4. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the unaware non-member sample from Panel NL at T1 41
Figure 5. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian, based on the aware non-member sample from Panel NL at T1 43
Figure 6. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from Panel NL at T1 45
Figure 7. Visualisation of partial bivariate scale relationships (r > 0.05) with Gaussian Graphs, based on the unaware non-member sample from Panel SP at T1 49
Figure 8. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the unaware non-member sample from BK at T1 55
Figure 9. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian, based on the aware non-member sample from BK at T1 57
Figure 10. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from BK at T1 59
Figure 11. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from GEN at T1 62
Figure 12. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from EU Ecom at T1 65
Figure 13. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the unaware non-member sample from HCWS at T1 68
Figure 14. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the aware non-member sample from HCWS at T1 70

Table 1. Overview of the samples used in this deliverable 19
Table 2. Descriptive statistics of the background variables (in %) of the sample from the general Dutch population 21
Table 3. Descriptive statistics of the background variables (in %) of the sample from the General Spanish population 24
Table 4. Descriptive statistics of the background variables (in %) of the Buurkracht sample 26
Table 5. Descriptive statistics of the background variables (in %) of the GEN ecovillages sample 28
Table 6. Descriptive statistics of the background variables (in %) EU Ecom 30
Table 7. Descriptive statistics of the background variables (in %) HCWS 31
Table 8. Measures and items central to analyses for this deliverable 33
Table 9. Means and standard deviations per subsample general population the Netherlands at T1 38
Table 10. Correlations EC^2 outcome measures at T1 and individual EC at T2 39
Table 11. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure) 39
Table 12. Correlations unaware non-members NL at T1 40
Table 13. Correlations aware non-members Panel NL at T1 42
Table 14. Correlations member Panel NL at T1 44
Table 15. Means and standard deviations per subsample Spanish general population at T1 46
Table 16. Correlations EC^2 outcome measures at different timepoints 47

Table 17. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure) 47
Table 18. Correlations unaware non-members Panel ES at T1 48
Table 19. Correlations aware non-members Panel ES at T1 50
Table 20. Correlations members Panel ES at T1 51
Table 21. Means and standard deviations per subsample BK at T1 52
Table 22. Correlations EC^2 outcome measures at T1 and individual EC at T2 53
Table 23. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure) 53
Table 24. Correlations unaware non-members BK at T1 54
Table 25. Correlations aware non-members BK at T1 56
Table 26. Correlations members BK at T1 58
Table 27. Means and standard deviations per subsample GEN at T1 59
Table 28. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure) 60
Table 29. Correlations members GEN at T1 61
Table 30. Means and standard deviations per subsample EU Ecom at T1 62
Table 31. Correlations members EU Ecom at T1 64
Table 32. Means and standard deviations per subsample HCWS at T1 66
Table 33. Correlations unaware non-members HCWS at T1 67
Table 34. Correlations aware non-members HCWS at T1 69

List of Abbreviations

BK	Buurkracht
C	Local region
EC	Energy citizenship
Ecom	Energy community
ES	Spain
GEN Europe	Global Ecovillage Network of Europe E.V.
HCWS	Housing Cooperative Wroclaw South
ICLEI	ICLEI European Secretariat GmbH
ISCED	International Standard Classification of Education
M	Member of an energy community
Non-M	Non-Member of an energy community
NL	Netherlands
PL	Poland
REScoop	European federation of citizen energy cooperatives
SD	Standard Deviation
T	Timepoint
UG	University of Groningen
UK	United Kingdom
ULEI	Leipzig University
Uni Graz	University of Graz
WUEB	Wroclaw University of Economic and Business
WP	Work Package

1 Summary and main conclusions

This deliverable investigated the relationship between acceptance of and willingness to join an energy community, actual membership, and energy citizenship, and their conduciveness for behaviours supporting broader sustainability goals among a total of *N* = 3902 participants from 21 countries of which 2701 participants were unaware of an energy community, 564 were aware but not a member of an energy community and 544 were a member of an energy community. Data was collected among various types of energy communities and within different socio-political contexts:

- Representative sample of the Dutch general population via a pre-recruited panel (based on gender, education, income, and age; 3 waves with 6 months in between).
- Gender representative sample of the Spanish general population via a pre-recruited panel (3 waves with 6 months in between).
- Members and non-members of Buurkracht local energy initiatives (which roughly translates to “neighbour power”) in the Netherlands (2 waves with 9 months in between)
- Members of the Global Ecovillage Network (GEN) in Europe (2 waves with 12 months in between).
- Members of various energy communities in Europe (EU Ecom) via REScoop, the European federation of citizen energy cooperatives, and via the Local Governments for Sustainability global network (ICLEI).
- The Polish Housing Cooperative Wroclaw South (HCWS) in which multiple energy community initiatives were initiated such as an initiative among residents to collectively decide to install PV systems on a particular building.

Overall, we find that **relatively few participants were aware of an energy community** in their locality or involved in an energy community, independent of whether energy communities are still a niche (e.g., Poland and Spain), or are more common such as in the Netherlands where energy communities exist in 85% of the municipalities (Lokale energie-monitor, 2022). Furthermore, in line with previous findings among initiative takers in energy communities (Aiken, 2012; Łapniewska, 2019; Fraune, 2015; Warbroek et al., 2019; Yildizet al., 2015), we observe an **imbalance with regard to socio-demographics (e.g., gender, income) in the involvement in energy communities** across most samples. It is important that policy makers and energy communities are aware of and understand potential (existing) inequalities among members and aware and unaware non-members, in order to enable people with less privilege and resource-bound commitments to become involved in energy communities and engage in energy citizenship (see for more tools on how to improve awareness of diversity and inclusion of energy communities also D6.2 Energy Citizenship Empowerment Kit). Furthermore, more research is needed to better understand why certain groups are less (willing to be) involved in energy communities, including potential intersectionalities, within different socio-political contexts.

EC² outcomes: Energy citizenship and involvement in energy communities

First we examined the relation between involvement in an energy community and energy citizenship, over time. We find that **individual energy citizenship remained stable over time** across all samples. In the Dutch panel sample, those aware of an energy community score significantly higher on individual energy citizenship, compared to those unaware and awareness of an energy community was associated with individual energy citizenship at that time and half a year later. Within the Buurkracht sample, we find that members of an energy community score higher on individual energy citizenship than aware non-members, with membership being associated with individual energy citizenship at that time and half a year later. However, we do not find any relations between awareness nor membership and individual energy citizenship in the other samples. We consistently find that **collective energy citizenship at the local community level is higher for those aware of an energy community compared to those unaware**. Mere awareness of energy communities in one's local region may thus already enhance peoples collective energy citizenship, even without being a member, or vice versa, people with higher collective energy citizenship more actively search for ways to enact their energy citizenship such as via an energy community. Importantly, as we find collective and individual energy citizenship to be related in most samples, stronger collective energy citizenship may be a route through which individual energy citizenship may be enhanced. Yet, considering the low proportion of people aware of an energy community in their locality, it is highly recommended to direct policies to raise awareness.

Next, we examined whether energy citizenship was related to acceptance of and willingness to join an energy community. **Among non-members**, **individual and collective energy citizenship were generally related to willingness to join an energy community** but only with acceptability of an energy community within the Dutch panel and the Polish housing (HCWS) samples. Yet, these patterns became less clear, when taking all other factors into account; we only observed positive correlations between individual (but not collective) energy citizenship and willingness to join an energy community in the Dutch and Spanish panels, and between collective energy citizenship and willingness to join in the Buurkracht and HCWS samples, and no relations between energy citizenship and acceptability of an energy community. Thus, overall **energy citizenship seems to be more (often) related to willingness to join than acceptability of an energy community** which may indicate that energy citizenship is more related to action intentions than to attitudes/cognitions. Yet, considering that relations between energy citizenship and acceptability and willingness to join are **weaker when other factors are taken into account**, these other factors may influence energy citizenship and acceptability of and involvement in an energy community, as well as their mutual relation (e.g., energy citizenship only being linked to willingness to join when people think they can actually participate).

Among members, we examined whether energy citizenship was related to identification with, and level of involvement in the energy community. We find that collective, and to a lesser extent individual, energy citizenship are correlated positively with identification with the energy community (except in the GEN sample), but not with level of involvement. Again, when taking all other factors into account, we do not observe associations between energy citizenship on the one hand and level of involvement and identification with the energy community on the other hand, except for Buurkracht, where the positive relation between collective energy citizenship

and identification with the energy community remained. Thus, **collective energy citizenship seems most relevant for people's identification with the energy community but not their level of involvement.**

Furthermore, we considered acceptability of and membership in energy communities as shaped by various factors related to the individual, the wider local communities in which energy communities are embedded, and by characteristics of the energy communities themselves. In addition, some of these factors may also directly affect energy citizenship.

Personal factors

All personal factors (biospheric values, personal self-efficacy, efficacy to join, and participative efficacy) are related to acceptability of and willingness to join an energy community, although it differed between samples which factors matter most. **Efficacy to join an energy community seems to play a particularly important role for willingness to join** in all samples, also when controlling for all other factors in the model. Overall, we did not find strong associations between biospheric values and acceptability and willingness to join an energy community. Thus, it seems that although biospheric values and motivation to join might be important it is essential that people feel able to join and contribute to an energy community and to a just and sustainable energy transition, as this ability seems to define whether people accept and are willing to join an energy community. Importantly, we also find individual energy citizenship to be strongly associated with these personal factors. As such, they seem to qualify the relation between acceptability of and willingness to join an energy community and energy citizenship at least to some extent. Thus, **policies could be directed at enabling people** to get involved in energy communities and engage in energy citizenship.

Local community factors

Data revealed a less clear picture when it comes to factors related to the local community (injunctive and descriptive norms, and community identification). Overall, we find that community norms seem to play a positive role for acceptability and willingness to join in some of the samples, with injunctive norms being more consistently related to acceptability and descriptive norms to willingness to join. Yet, we find that in some of the samples (Buurkracht and HCWS) descriptive norms have a negative relationship with involvement (intention). This may suggest that in some cases people are particularly likely to join when they think others won't. Contrary to our expectations, we only find identification with the local community to be related to willingness to join in a Buurkracht initiative among those unaware of an energy community in their locality but not in any of the other samples. When taking all other factors into account, we only find the perceived injunctive community norm to be related to acceptability in the Dutch panel and HCWS samples, and community identification to willingness to join for those unaware of an energy community in the HCWS sample.

Among members, local community factors seem more strongly related to identification with the energy community compared to level of involvement. Interestingly, in the GEN sample, both identification with, and level of involvement in, the ecovillage are not related to community factors. This may indicate that the GEN ecovillages represent a different type of energy

community, less embedded in their local region. Yet, when taking all other factors into account, all relations between community factors identification or level of involvement disappeared in all samples. Importantly, we generally find collective energy citizenship to be associated with local community factors, although it differs per sample which factors matter most.

It might therefore **depend on the specific local context in which people and the energy community are embedded how much wider community norms and identification are related to people's acceptance of and involvement in energy communities**. Future research could be directed at testing this.

Energy community characteristics

Next we examined whether perceived collective efficacy (this energy community initiative can advance an energy transition that is just and sustainable) and identity leadership (this energy community represents the inhabitants of the local community) of an energy community relate to its acceptance and willingness to join among aware non-members. In line with our expectations, we consistently find that **perceived collective efficacy and identity leadership of an energy community are positively associated with its acceptability and willingness to join**. Furthermore, we find that, overall, collective energy citizenship is positively related to collective efficacy.

In addition, we examined several energy community set-up characteristics (perceived community and municipality influence, perceived inclusion of the interests of marginalised groups and the diversity of members). As expected, and in line with our findings from D4.1 and D4.2, we find **the perceived influence of the community, and not of the municipality, on the energy community,** is positively correlated with acceptability of and willingness to join an energy community. Furthermore, **the perceived inclusion of interests of marginalised groups and the diversity of members positively correlated with acceptability and willingness to join** across samples. Yet, when taking all other factors into account, results are less clear. In the Dutch and Buurkracht samples acceptability was only related to collective efficacy and identity leadership, while in the HCWS sample the perceived inclusion of the interests of marginalised groups correlated with willingness to join and the diversity of members with acceptability.

Among members of an energy community, **identity leadership was consistently strongly related to both level of involvement and identification with the energy community**, except for the GEN sample. Collective efficacy is only correlated to level of involvement and identification with the energy community in the Buurkracht, EU Ecom, and GEN samples, but not in the other samples. Again, the **energy community characteristics** (the perceived community, and not the municipality, influence, the perceived inclusion of the interests of marginalised groups, and, to a lesser extent, the perceived diversity of members) are **consistently related to the level of involvement and identification with the energy community, and with each other** in most samples. Yet, in GEN, we did not find any of the energy community characteristics to be related to involvement. When taking all other factors into account, only the relation between identification with the energy community and identity leadership remained in the Buurkracht and EU Ecom samples. This seems to imply that mainly the extent to which the energy community represents the local community relates to whether members identify with the energy community, but this effect seems to be dependent on the specific type of energy community or

sample.

Interestingly, participants consistently rated the perceived influence of the community on the energy community as lower than the influence of the municipality. Yet, we find that the perception that the local community is represented by the energy community (identity leadership), and that the community influences the energy community are both positively related to acceptability of and involvement in an energy community. This suggests that citizens' influence on organising and managing their own energy communities is essential. Furthermore, we find that the perceived inclusion of interests of marginalised groups and the diversity of members are positively related to acceptability of and involvement in an energy community, while we also observed an imbalance in involvement between socio-demographic groups. Thus, policies could be directed at **strengthening citizens' involvement and representation in setting up and organising energy communities** and communicating this to the wider local region.

Behaviours supporting broader sustainability goals

Finally, we find those aware of an energy community compared to those unaware in the Dutch and Spanish panel samples, and members compared to non-members in the Dutch Panel and Buurkracht samples, engage in more private an civic behaviours supporting broader sustainability goals. We did not find any differences between groups in the HCWS sample. Overall, civic behaviours seem to be mostly related to willingness to join, whereas private behaviours mainly seem to relate to individual energy citizenship. **Yet, future research is needed to specify the direction of relationships between energy community involvement (intentions) and energy citizenship on the one hand and support for broader sustainability goals on the other hand** before we can give clear recommendations.

2 Introduction

The global challenge of achieving a sustainable energy transition demands more than just technological progress—it requires societal change (Sovacool, 2014; Perlaviciute et al., 2021). It signifies a **shift from a centralised energy market to a decentralised one** and hinges on converting passive energy consumers into proactive energy citizens. The inclusion of citizens has become a fundamental component of growth strategies and future visions within the EU, as emphasised in documents such as Europe 2020 and the EU roadmap for 2050 (cited in Hadjichambis et al., 2020). The underlying assumption is that citizens will actively engage in shaping this transition as energy citizens. As part of WP2, we have conceptualised energy citizenship from a psychological perspective as "people's belief that they as individuals and as collectives have rights and responsibilities for a just and sustainable energy transition, and their motivation to act upon those rights and responsibilities" (Hamann et al., 2022, 2023, p. 47). Yet little is known about whether and when people want to participate in shaping the energy transition (Perlaviciute, 2022), and what predicts such psychological energy citizenship. If left unaddressed, this gap could lead to a scenario where only elites or a selected few take part in the sustainable energy transition, intensifying societal disparities and jeopardising the principle of justice.

Energy communities offer one way of involving citizens in the sustainable energy transition and increasing citizen participation and energy citizenship (and vice versa) (e.g., Hamann et al., 2023). In recent EU directives, the transformation of consumers from passive to active customers is emphasised as the right to participate in energy communities (Directive (EU) 2019/944; Directive (EU) 2018/2001). Yet, recent research suggests that only a small number of people are actually involved in such energy communities (Schwanitz et al., 2023). This raises the key question of what motivates people to become active energy citizens.

A key question in EC^2 is whether and how support for and involvement in energy communities is related to energy citizenship and vice versa, over time. The aim of this deliverable is to identify the key barriers and facilitators influencing involvement in energy communities and explore, across different European countries, the **relationship between acceptance of and willingness to join an energy community, actual membership and energy citizenship, and their conduciveness for engaging in behaviours which support broader sustainability goals.** It hereby integrates inter- and transdisciplinary perspectives on energy citizenship (WP2) and studies what motivates people to join energy communities and under which conditions energy citizenship and participation in energy communities can be strengthened.

While Deliverable 4.1 addressed the question under which conditions people want to participate in energy communities and Deliverable 4.2 focused on what motivates energy citizenship, using an experimental design, in Deliverable 4.3 correlational field studies were conducted to examine the relationships between involvement (intention) in energy communities and energy citizenship. Follow-up longitudinal studies were used to examine the development of energy citizenship over time among members and non-members of energy communities. This method provides higher external and ecological validity by including bigger cross national and cross-cultural samples.

2.1 EC^2 outcomes: Energy citizenship and involvement in energy communities

From a psychological perspective, energy communities can be viewed both as antecedent and consequence of energy citizenship. It is a vital question whether and how energy communities can promote energy citizenship, and vice versa, as it prompts specific paths of a just and sustainable energy transition (see also Deliverable 2.1, subsection 4.5). **Energy citizenship can potentially both strengthen involvement in energy communities, and be enhanced as a result of involvement in energy communities.** Taking part in energy communities can be a way for people to exercise their rights and responsibilities for a sustainable and just energy transition. Citizens with stronger beliefs and motivation regarding their energy citizenship may therefore be more likely to participate in energy communities than citizens without those beliefs and motivation. Energy communities might be especially attractive to people actively searching for possibilities and spaces to develop and act upon a broad range of their prior individual and collective beliefs and motivations, as substantiated in more detail below. Next to potentially being a predictor of energy community involvement, energy communities can also become and shape relevant social identities, affecting members' and non-members' beliefs and motivations (Jans, 2021), thereby potentially enhancing energy citizenship within individuals. As such, in this deliverable, we take both individual and collective energy citizenship into account (see Deliverable D2.3 for an overview of the different dimensions of energy citizenship).

2.2 Behaviours supporting broader sustainability goals

In a similar way both involvement in energy communities and energy citizenship could spill over to behaviours which support broader sustainability goals. Past research indicates that environmental collective action and private energy-related behaviour typically correlate positively (e.g., Alisat & Riemer, 2015; Lee et al., 2014; Sweetman & Whitmarsh, 2016). More specifically, previous research suggests that those involved in energy communities generally behave more sustainably with regard to several types of pro-environmental behaviours than people not involved in an energy community (Middlemiss, 2011; Sloot et al., 2018). Thus, in a final step we examine the relationship between involvement in energy communities, energy citizenship and both private energy-related behaviours and other energy-related collective (civic) action behaviours (see Figure 1).

2.3 Involvement in energy communities

We consider support for and membership in energy communities as shaped by various individual factors, factors related to the wider local communities in which energy communities are embedded as well as the specific characteristics of the energy communities. In addition, some of these factors may also directly affect energy citizenship.

2.3.1 Personal factors

First, we focus on people's motivations, namely their values, and their perceived ability to join, efficacy beliefs, as factors related to the willingness to participate in an energy community and energy citizenship (see Figure 1). As energy communities aim to benefit the environment, involvement in those communities can be conceptualised as a type of pro-environmental behaviour (Stern, 2000). **Personal pro-environmental motivations (e.g., biospheric values)** are important for understanding sustainable energy behaviours (see Steg et al., 2015 for a review), including involvement in energy communities (Bamberg et al., 2015; Bouwens, 2016; Dóci & Vasileiadou, 2015; Kalkbrenner and Roosen, 2016; Sloot et al., 2019). In addition, **efficacy beliefs** have been shown to be relevant to a range of both private (e.g., Cleveland et al., 2012; Fielding & Head, 2012; Huang, 2016; Hunter & Röös, 2016; Jugert et al., 2016; Lubell et al., 2007) and collective environmental behaviours (e.g., Cleveland et al., 2012; Doherty & Webler, 2016; Lubell et al., 2007; Roser-Renouf et al., 2014; see Hamann et. al., 2023 for an overview). In this deliverable we examined three types of personal efficacy beliefs; i) people's personal self-efficacy beliefs (aim-related) that they are able to contribute to a sustainable and just energy transition, ii) their personal efficacy belief that they are able to join an energy community, and iii) whether people think that if they participate this will help the energy community reach its sustainability goals participative efficacy (see van Zomeren et al., 2013; Bamberg et al., 2015).

2.3.2 Local community factors

Second, besides individual factors, collective factors shape people' pro-environmental behaviour (Fritsche et al., 2018; Jans et al., 2019). Both citizens and energy communities are embedded in **wider local communities. As such, one's local community can be a relevant social group, affecting people's behaviour** (e.g., Bouman and Steg, 2019; Jans, 2021). Previous research suggests that people do not only want to become involved in energy communities because of

environmental motives (wanting to protect the environment) but also because they are or want to be involved in the community (communal motives), and because they identify with their community (**community identification;** Goedkoop et al., 2022, Sloot et al, 2019). Thus, we expect that the more strongly people identify with their local community, the more they are (willing to be) involved in an energy community. Furthermore, community norms might influence people's involvement in an energy community. (Fritsche et al., 2018; Jachimowicz et al., 2018; Goedkoop et al., 2022). Specifically, involvement in a community energy initiative may be more likely when people believe that other community members are approving of the energy community (**injunctive norm** as this indicated what they think is the correct and good behaviour (Cialdini et al., 1990) and/or are already involved in an energy community (**descriptive norm**), as this indicates the typical actions of a group's majority (Cialdini et al., 1990). People are often motivated to act in line with such **group norms** because they perceive these actions as effective, normal, or appropriate in a given situation, because they want to avoid social sanctions from others, and/or because they internalise these group norms as their own (see Turner, 1991; Fritsche et al., 2018).

2.3.3 Energy community characteristics

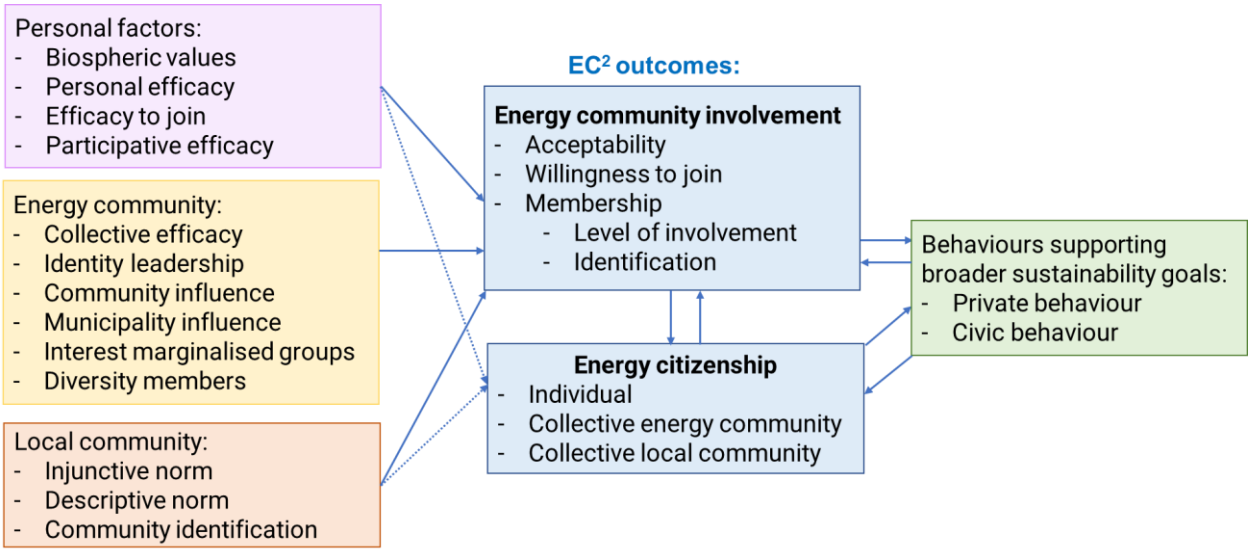
Third, **energy communities themselves are one of the key *collective* contexts influencing people's beliefs and motivations to act** (e.g., Hamann et al., 2023), and the (perceived) characteristics of these energy communities may affect people's willingness to participate in an energy community. As people are likely to be involved in energy communities because of environmental and/or community-related motives (see above), the extent to which they think a specific energy community supports these motives will likely influence their willingness to join. Specifically, we expect it is important whether people believe the energy community, as a group, can contribute to a sustainable energy transition, i.e. **collective efficacy** beliefs (Bandura, 1997; Hamann et al., 2023[1]), and whether the initiative is perceived as representing the inhabitants of the local community (i.e. **identity leadership**).

In addition, the extent to which people support and want to join energy communities may depend on (social, economic, and legal) **set-up features of energy communities,** such as how the energy communities are organised, who takes the lead, the composition of energy communities, and whose interests are taken into account. First, earlier work in the EC^2 project (D4.1 and D4.2) showed that who initiates and manages the energy community (i.e., citizens, the municipality or both) is an important factor for support for and willingness to join an energy community. While bottom-up formation is one of the key features of energy communities, they are often initiated in cooperation with external institutions such as the local government (Bertel et al., 2022, Hamann et al., 2022). Experimental research from D4.1 and D4.2 shows that particularly community involvement is more relevant than municipality involvement for acceptability and willingness to join an energy community in Germany, the Netherlands and in Poland. As such, we expect that the extent to which people perceive citizens to have influence

[1] A distinction can be made between action-focused efficacy beliefs ("we can perform an action") from aim-focused efficacy beliefs ("we can achieve an aim") (Hamann, et al., 2023). We mainly focus on aim related collective efficacy beliefs as this has been found to be a key factor associated with environmental collective action (Fritsche et al., 2018; Fritsche & Masson, 2021; Hamann & Reese, 2020; see for an overview Hamann, 2022).

on the energy community (**community influence**) is important for people's involvement (intention) in an energy community, and compare this to the perceived influence of the municipality (**municipality influence**) which from an economic or legal perspective has the potential to enhance the likely success of an energy community (Bertel et al., 2022). Second, we examine whether the **group composition** of the members of an energy community in terms of the extent to which the energy community represents different groups in society, matters for involvement. We examine both the extent to which energy communities are perceived to exist of members from different backgrounds within society (**diversity of members**) and/or whether they are perceived to explicitly consider the **interests of marginalised groups**. The exclusion of groups of citizens from the energy transition was flagged as a key barrier to energy citizenship and active involvement in energy communities in WP3 (Bertel et al., 2022). Initial evidence shows that energy communities tend to be led by wealthy, well-educated and older white men (Aiken, 2012; Fraune, 2015; Łapniewska, 2019; Warbroek et al., 2019; Yildiz et al., 2015), while experimental research from both D4.1 and D4.2 indicate that generally diversity of members with regard to their socio-demographic backgrounds positively affects people's support for and willingness to join an energy community. We therefore expect that both of our indicators of group composition are positively related to involvement (intention) in energy communities. Figure 1 gives an overview of how the factors as they have been described can be embedded in a working model.

Figure 1. Working model

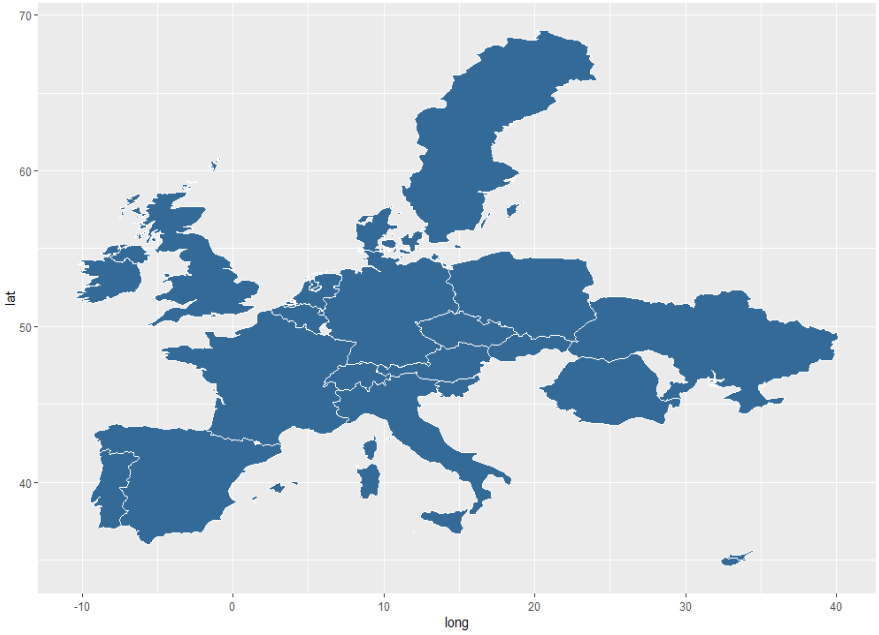


Note. Solid lines represent the expected relations, dashed lines are more explorative.

In order to understand the relationships between, on the one hand, personal, local community factors and energy community characteristics and, on the other hand, support for and willingness to (actively) participate in energy communities and people's actual membership and people's energy citizenship as derived from WP2, a survey was developed encompassing all of these concepts. Data was collected among members and non-members of different energy communities coming from **21 countries** in Europe (see Figure 2). In total, **3902** participants participated, of which **2701 participants were unaware** of energy communities, **564 were aware but not a member and 544 were members** of an energy community. In total we collected data

among six different samples. In the following section, we will present the methodology of these different samples, after which the main results will be presented per sample. We conclude with a general discussion including the main conclusions, limitations and practical implications.

Figure 2. Map of participating countries



3 Method

3.1 Design and procedures

All expected relations were pre-registered on OSF (https://osf.io/f2exd). All studies described below were reviewed and approved by the Heymans Institute Ethics Committee at the University of Groningen (PSY-2122-S-0148 & PSY-2122-S-0374). The data was collected using the online survey software Qualtrics (https://www.qualtrics.com/), unless otherwise specified. The longitudinal studies consisted of two or three waves targeting the same participants, over a time span of 6-9-12 months (depending on the sample and the number of measurements; see more details on all samples below). The participants provided their written consent to participate in the study and to the use of their personal information as provided in the research information form. Survey data across different waves was linked via participants' pre-specified ID code as generated by the online panel platform or from a self-generated unique ID, based on the indicators as in the example below:

> *"You are left-handed (1), you live at number (125), you are a man (1), your last name is De Groot (DE) and you were born on (15) March. This leads to the following anonymous identification code: 11251DE15".*
>
> [Example Unique ID]

As a general rule, as a first criterion we excluded respondents who failed to correctly answer both attention checks items where applicable with which we made sure that no participants randomly clicked through the survey (participants were explicitly made aware of the check and

instructed to answer a specific answering category such as “completely agree”). We additionally checked and removed respondents who filled in nonsensical answers (for example noting “xfhsejdghf” in the open text boxes). Fully anonymized data will be openly available on ZENODO and Dataverse upon project completion as much as possible given the ethical and privacy requirements. All analyses for this deliverable were conducted in R (R Core Team, 2017) and SPSS (scripts are available upon request). In the following subsections, we provide an overview of each specific sample detailing how the data was collected, and give a brief overview of the sample socio-demographic characteristics.

3.2 Samples

First, a pilot study was conducted on the island of Inishbofin, Ireland, to refine the EC^2 questionnaire, based on the results and the comments made by the participants. Afterwards data was collected among:

- Representative sample of the Dutch general population via a pre-recruited panel (based on gender, education, income, and age; 3 waves with 6 months in between).
- Gender representative sample of the Spanish general population via a pre-recruited panel (3 waves with 6 months in between).
- Members and non-members of Buurkracht local energy initiatives (which roughly translates to “neighbour power”) in the Netherlands (2 waves with 9 months in between)
- Members of the Global Ecovillage Network (GEN) Europe (2 waves with 12 months in between). An ecovillage is defined by GEN as “an intentional, traditional or urban community that is consciously designed through locally owned, participatory processes and aims to address the Ecovillage Principles in all four areas of regeneration (social, culture, ecology and economy)” (https://ecovillage.org/about/about-gen/).
- Members of various energy communities in Europe (EU Ecom) via REScoop, the European federation of citizen energy cooperatives, and via the Local Governments for Sustainability global network (ICLEI).
- The Polish Housing Cooperative Wroclaw South (HCWS) in which multiple energy community initiatives were initiated such as an initiative among residents to collectively decide to install PV systems on a particular building.

This way we ensured to have both members and non-members from various types of energy communities in different socio-political contexts and include the perspective of the general population via our representative panels (see for an overview of the number of participants per sample Table 1 and see below for further details about the samples).

Table 1. Overview of the samples used in this deliverable

	T1				T2				T3			
	Total	Unaware	Aware		Total	Unaware	Aware		Total	Unaware	Aware	
			Non-M	M			Non-M	M			Non-M	M
Panel NL	1566	1273	219	69	739	606	104	29	400	331	53	16
Panel ES	1043	921	93	29	712	603	88	20	402	345	47	10
BK (NL)*	827	418	215	115	141	50	45	46	-		-	-
GEN (EU)	180	-	-	180	37	-	-	37	-	-	-	-
EU Ecom	132	-	-	132	-	-	-	-	-	-	-	-
HCWS (PL)	154	89	37	19	-	-	-	-	-	-	-	-
Total	3902	2701	564	544	1629	1259	237	132	802	676	100	26

Note. Unaware = respondents who were unaware of an energy community in their local region at the time of data collection, Aware = respondents who were aware of an energy community in their local region at the time of data collection, Non-M = Non-member of an energy community, M= Member of an energy community. Panel NL = Dutch panel sample; Panel ES; Spanish panel sample; BK (NL); Buurkracht sample; GEN (EU) = Global Ecovillage Network Europe sample; EU Ecom = Energy communities Europe sample; HCWS (PL); Polish Housing Cooperative Wroclaw South sample. In the case of the panel data, the total number of participants is based on finished surveys as it was a requirement for participants' remuneration. For other samples, the total number of respondents is based on those who started the questionnaire (filled in the survey after giving informed consent). This approach can result in a variance in the total number of respondents per sample, depending on whether they filled in the relevant questions.
*For the Buurkracht sample, membership at T1 only refers to membership in a Buurkracht initiative, whereas at T2 participants could also indicate that they were aware of or a member of any other type of energy community.

3.2.1 Pilot Study Inishbofin (Ireland)

A pilot study was run on the island of Inishbofin (Ireland) in April-May 2022, in collaboration with the local project initiators Inishbofin Development Company CLG, and consultancy company KRA Renewables, who investigated the possibilities for energy usage reduction and cleaner energy generation on Inishbofin. The questionnaire was distributed among inhabitants of Inishbofin, both online and via postal mail, with the help of Inishbofin Development Company, and additionally, in paper form at a workshop organised by KRA renewables. The questionnaire was completed by 30 residents of Inishbofin, out of 178 inhabitants of Inishbofin. The Inishbofin survey served as a pilot study to refine the EC^2 questionnaire, based on the results and the comments made by the participants.

3.2.2 General Population the Netherlands

Data was collected among a representative sample of the Dutch adult population (based on gender, level of education, income, and age). Participants were recruited through Panel Inzicht (https://panelinzicht.nl/). This is a Dutch pre-recruited online participant panel and included Dutch-speaking individuals who were at least 18 years old. Data was collected online using the online survey software Qualtrics. Respondents received 2.50 euro for their participation in this study. Data was collected at three different time points with approximately 6 months in between.

Data for the first measurement (T1) were collected between June 20th and September 12th, 2022. A total of 1887 participants participated at T1 of this study. We removed 212 respondents who did not finish the survey and 109 who filled in nonsensical answers (e.g., noting “Hhhb” in the open text boxes), which reduced the sample to a total of 1566 participants (see Table 1). Data was collected among the same participants in a second measurement between January 25th and March 2nd, 2023. A total of 751 participants participated at T2. After removal of duplicates of respondents and those who failed both attention checks, 739 respondents remained in the dataset. Data for a third measurement was collected between July 3d and July 10th, 2023, again among the same participants. A total of 400 participants participated in T3 of this study (participations already screened based on attention checks).

Table 2. Descriptive statistics of the background variables (in %) of the sample from the general Dutch population

Variable Name	T1				T2				T3			
	Total	Unaware	Aware		Total	Unaware	Aware		Total	Unaware	Aware	
			Non-M	M			Non-M	M			Non-M	M
Gender												
Male	47.8	44.6	58.4	72.5	50.9	48.1	62.0	71.4	51.9	49.4	58.8	81.2
Female	51.3	54.6	40.6	26.1	48.7	51.4	38.0	28.6	47.8	50.3	41.2	18.8
Other	0.9	0.8	.9	1.4	0.4	.5	0	0	0.3	.3	0	0
Ethnic minority												
No	92.3	92.4	94.1	85.5	93.8	93.8	95.0	88.9	93.1	92.7	98.0	87.5
Yes	7.7	7.6	5.9	14.5	6.2	6.2	5.0	11.1	6.9	7.3	2.0	12.5
Income												
Less than 1000€ per month	3.3	3.4	4.1	0	3.6	4.0	1.0	3.4	3.6	3.7	3.8	0
€1000 - €1999	19.5	20.8	13.7	13.0	19.8	21.1	12.9	17.2	19.5	20.9	11.5	18.8
€2000 - €2999	13.7	14.4	9.6	14.5	19.0	19.1	18.8	17.2	20.8	19.3	28.8	25.0
€3000 - €3999	21.9	20.6	27.9	27.5	17.9	17.8	17.8	20.7	19.8	21.2	13.5	12.5
4000€ or more	22.1	20.7	26.5	34.8	20.9	19.5	27.7	27.6	19.8	18.1	28.8	25.0
Prefer not to say	19.4	20.2	18.3	10.1	18.7	18.5	21.8	13.8	16.5	16.8	13.5	18.8
Education												
Low	20.8	21.9	18.3	8.8	26.8	28.4	18.8	20.7	28.1	30.3	19.2	12.5
Medium	38.8	38.4	40.8	39.7	37.4	37.0	35.6	51.7	37.0	35.2	42.3	56.3
High	40.4	39.7	40.8	51.5	35.8	34.6	45.5	27.6	34.9	34.6	38.5	31.3
Living situation												
Alone	25.1	26.4	21.2	13.0	27.9	30.1	18.3	17.2	29.0	31.0	15.1	31.3
Alone with child(ren)	4.5	4.7	3.2	5.8	3.5	3.5	3.8	3.4	2.8	3.0	0	6.3
Together with partner	40.3	38.7	47.5	47.8	42.3	41.4	46.2	48.3	45.5	43.5	56.6	50.0
Together with partner and child(ren)	28.2	28.1	27.2	33.3	25.0	23.8	30.8	31.0	21.8	21.1	28.3	12.5
Other	1.9	2.1	.9	0	1.2	1.3	1.0	0	1.0	1.2	0	0
Employment												
Paid employment	57.7	58.4	47.9	75.4	48.9	49.4	46.0	48.3	43.5	43.7	42.3	43.8

Temporarily unemployed	1.2	1.2	1.8	0	1.1	1.3	0	0	0.8	.6	1.9	0
Unemployed	1.4	1.4	1.4	0	1.4	1.3	1.0	3.4	1.8	1.5	3.8	
Retired	22.9	21.7	32.3	15.9	31.4	29.8	40.0	34.5	34.1	32.9	38.5	43.8
Student	1.9	2.1	.5	2.9	1.1	1.2	1.0	0	0.8	.9	0	0
Taking care of the housekeeping/ caring for children	4.6	4.8	3.2	4.3	4.5	4.8	3.0	3.4	5.3	6.2	1.9	0
Work disability	8.8	9.0	9.7	1.4	9.7	10.3	7.0	6.9	10.4	11.7	1.9	12.5
Volunteer	0.6	.6	.9	0	1.0	1.2	0	0	1.3	1.2	1.9	0
Self-employed	0.4	.3	.9	0	0.4	.3	1.0	0	1.5	.6	7.7	0
Seasonal employee	0.1	.2	0	0	0.1	0	1.0	0	0.3	.3	0	0
Other	0.5	.3	1.4	0	0.4	.3	0	3.4	0.3	.3	0	0
Housing situation												
Rent	35.5	37.2	28.1	26.1	35.2	37.6	20.2	34.5	33.0	35.5	21.6	18.8
Own	63.6	62.0	70.5	72.5	64.2	61.5	79.8	65.5	66.2	63.6	78.4	81.3
Other	0.9	.8	1.4	1.4	0.7	.8	0	0	0.8	.9	0	0
Age (mean/SD)	51.76	51.60	54.73	45.80	57.26	56.97	58.65	55.18	59.24	58.82	61.24	61.56
Range 19-93	(17.04)	(16.81)	(17.37)	(18.26)	(15.29)	(15.16)	(15.81)	(16.43)	(13.64)	(13.67)	(12.19)	(17.13)

Note. Non-M = Non-member of an energy community, M= Member of an energy community.

3.2.3 General Population Spain

Participants were recruited using the Prolific panel (https://www.prolific.com/), a pre-recruited panel, ensuring a representative sample for gender of the adult Spanish population. Following completion of the questionnaire, participants were rewarded at the rate of £8.00/hr. Data was collected at three distinct time points, each approximately 6 months apart. Data collection for the measurement (T1) occurred between October 20th and November 11th, 2022. The total number of respondents who participated in the study was 1043 (participations already screened based on attention checks). Follow-up data collection for the second measurement (T2) took place between April 26th and May 17th, 2023. A total of 712 participants took part at this time (participations already screened based on attention checks). Data for the third measurement (T3) was collected between November 6th and 7th, 2023. A total of 402 participants participated in this final measurement (participants were already screened based on attention checks).

Table 3. Descriptive statistics of the background variables (in %) of the sample from the General Spanish population

Variable Name	T1				T2				T3			
	Total	Unaware	Aware		Total	Unaware	Aware		Total	Unaware	Aware	
			Non-M	M			Non-M	M			Non-M	M
Gender												
Male	48.0	47.3	58.1	37.9	50.1	48.9	54.5	65.0	50.7	50.4	46.8	80.0
Female	50.0	50.8	39.8	58.6	48.5	49.8	44.3	30.0	47.8	47.8	53.2	20.0
Other	1.9	1.8	2.2	3.4	1.4	1.3	1.1	5.0	1.5	1.7	0	0
Ethnic minority												
No	88.4	88.6	87.1	86.2	90.4	91.6	81.8	95.0	90.7	90.0	93.6	100.0
Yes	11.6	11.4	12.9	13.8	9.6	8.4	18.2	5.0	9.3	10.0	6.4	0
Household income*												
Less than 1000€ per month	13.2	13.1	15.1	10.3	10.4	10.4	10.2	15.0	10.2	11.1	6.4	0
€1000 - €1999	30.2	30.5	30.1	20.7	29.0	29.6	27.3	20.0	28.3	27.8	29.8	40.0
€2000 - €2999	27.8	27.7	29.0	27.6	27.4	27.3	29.5	25.0	28.6	26.6	40.4	40.0
€3000 - €3999	13.2	12.6	19.4	13.8	14.1	13.5	18.2	15.0	13.3	14.0	8.5	10.0
4000€ or more	8.7	8.8	6.5	13.8	11.5	11.7	9.1	10.0	11.5	12.0	8.5	10.0
Prefer not to say	6.7	7.2	0	13.8	7.5	7.5	5.7	15.0	8.2	8.7	6.4	0
Education												
Low	2.3	2.3	3.2	2.3	2.5	1.7	8.0	5.0	3.3	3.3	4.3	0
Medium	19.4	19.5	19.4	19.5	17.1	17.4	14.8	20.0	16.8	17.0	17.0	10.0
High	78.3	78.3	77.4	78.3	80.3	80.9	77.3	75.0	79.9	79.8	78.7	90.0
Living situation												
Alone	16.0	16.5	10.8	17.2	10.5	9.7	14.9	15.0	10.5	9.9	14.9	10.0
Alone with child(ren)	1.8	1.7	3.2	0	2.1	2.0	3.4	0	2.7	2.3	4.3	10.0
Together with partner	21.8	21.2	25.8	27.6	17.8	16.9	24.1	20.0	15.7	15.7	12.8	30.0
Together with partner and child(ren)	16.2	16.3	18.3	6.9	17.7	18.4	12.6	20.0	23.2	24.1	14.9	30.0
Other	44.1	44.3	41.9	48.2	51.8	53.1	44.8	45.0	47.9	48	53.2	20.0
Employment												
Paid employment	51.9	51.0	59.1	55.2	52.7	50.9	64.8	50.0	54.7	53.7	54.3	90.0
Temporarily unemployed	4.4	4.4	3.2	6.9	3.6	3.0	4.5	15.0	3.6	3.9	2.2	0

Unemployed	7.4	7.6	6.5	3.4	7.4	8.1	3.4	5.0	9.5	9.3	13.0	0
Retired	.6	.7	0	0	.6	.7	0	0	.5	.6	0	0
Student	27.1	27.5	24.7	20.7	24.1	25.9	15.9	10.0	19.7	20.6	15.2	10.0
Taking care of the housekeeping/caring for children	1.0	1.0	1.1	0	1.3	1.5	0	0	1.0	1.2	0	0
Work disability	.7	.8	0	0	.7	.8	0	0	0	0	0	0
Volunteer	.3	0.3	0	0	.3	.3	0	0	.3	.3	0	0
Self-employed	3.4	3.7	2.2	0	5.1	5.2	4.5	5.0	7.4	7.5	8.7	0
Seasonal employee	.4	.4	0	0	1.7	1.5	2.3	5.0	1.3	1.2	2.2	0
Other	3.0	2.6	3.2	13.8	2.6	2.0	4.5	10.0	2.0	1.8	4.3	0
Housing situation												
Rent	40.0	40.6	36.6	34.5	35.0	33.7	46.6	25.0	31.7	33.2	23.4	20.0
Own	45.2	44.4	51.6	51.7	49.4	50.2	39.8	65.0	53.7	52.1	59.6	80.0
Other	14.8	15.1	11.8	13.8	15.7	16.2	13.6	10.0	14.6	14.7	17.0	0
Age (mean/SD)	34.37	34.61	32.17	33.62	36.51	37.06	32.93	34.45	35.37	35.03	36.79	40.78
Range 19-93	(62.27)	(66.07)	(9.81)	(11.45)	(74.90)	(81.20)	(9.52)	(8.87)	(11.53)	(11.50)	(11.93)	(9.58)

Note. Non-M = Non-member of an energy community, M= Member of an energy community. * The category €1000 per month income combines categories “less than €500 per month” and “500-999€” and 4000€ or more combined the categories 4000-4999 to 5000€ or more per month. These are absolute income levels, relative income may differ between countries.

3.2.4 Buurkracht (Netherlands)

Data was collected among members and non-members of Buurkracht initiatives in the Netherlands via a personal e-mail invitation to 35.000 Buurkracht newsletter subscribers and Buurkracht App users. Additionally Buurkracht published a news item on the survey on their LinkedIn and Facebook. Buurkracht (translating to 'neighbour power'; https://www.buurkracht.nl/) is an organisation operating in 500 neighbourhoods in the Netherlands with the aim of contributing to energy saving awareness and renewable energy production by connecting people in neighbourhoods and supporting them in improving the neighbourhood. These initiatives are based in, and limited to, a local community, and run by local volunteers. All initiatives have the declared goal of encouraging sustainable energy behaviour in their community, employing varying approaches toward this goal. Non-members were additionally approached through the newsletter of the network of sustainable villages (https://www.netwerkduurzamedorpen.nl/). To incentivize participation, a community prize was awarded to one of the participating initiatives through a lottery among all participants. Data collection occurred at two different time points, approximately 9 months apart.

Participants at T1 were recruited between May 17th and September 2022. A total of 827 respondents participated in this study (of which 443 participants finished the survey). The same participants were recruited (T2) between June 13th and September 10th 2023. A total of 141 respondents participated in the survey of which 138 finished the survey (see Table 4 for an overview of descriptive statistics per sample).

Table 4. Descriptive statistics of the background variables (in %) of the Buurkracht sample

Variable	T1				T2			
	Total	Unaware	Aware		Total	Unaware	Aware	
			Non-M	M			Non-M	M
Gender								
Male	71.9	68.2	73.0	84.4	76.8	80.5	66.7	82.9
Female	27.2	31.0	26.1	15.6	23.2	19.5	33.3	17.1
Other	0.9	0.8	0.9	0	0	0	0	0
Ethnic minority								
No	97.9	97.7	98.2	98.4	97.3	100.0	97.3	94.1
Yes	2.1	2.3	1.8	1.6	2.7	0	2.7	5.9
Household income*								
€1000 - €1999	9.4	10.0	9.8	6.3	9.4	11.6	7.9	8.3
€2000 - €2999	20.1	18.5	23.2	21.9	17.9	18.6	15.8	19.4
€3000 - €3999	21.9	22.8	22.3	17.2	29.1	32.6	31.6	22.2
4000€ or more	33.8	37.1	25.0	35.9	35.9	27.9	42.1	38.9
Prefer not to say	14.8	11.6	19.6	18.8	7.7	9.3	2.6	11.1
Education								
Low	9.7	8.6	12.8	9.7	9.5	11.6	10.8	5.6
Medium	16.2	15.6	15.6	21.0	12.1	11.6	18.9	5.6
High	74.1	75.9	71.6	69.4	78.4	76.7	70.3	88.9

Living situation								
Alone	15.2	15.8	15.7	12.5	16.0	16.7	19.0	12.2
Alone with child(ren)	1.6	1.9	1.7	0	0.8	2.1	0	0
Together with partner	59.5	57.7	60.0	67.2	62.6	64.6	57.1	65.9
Together with partner and child(ren)	22.4	22.3	22.6	20.3	18.3	16.7	19.0	19.5
Other	1.4	2.3	0	0	2.3	0	4.8	2.4
Employment								
Paid employment	39.0	39.8	38.9	34.4	34.7	34.1	39.5	30.6
Temporarily unemployed	0.9	1.5	0	1.6	0.8	0	2.6	0
Unemployed	0.9	1.2	0	0	0.8	0	0	2.8
Retired	49.2	47.9	52.2	51.6	54.2	56.8	44.7	61.1
Student	0.5	0.8	0	0	0	0	0	0
Taking care of the housekeeping /caring for children	1.1	1.2	0	3.1	1.7	4.5	0	0
Work disability	3.2	3.1	2.7	3.1	2.5	4.5	2.6	0
Volunteer	1.4	1.2	0.9	3.1	3.4	0	5.3	5.6
Self-employed	2.3	2.7	2.7	0	1.7	0	5.3	0
Seasonal employee	0.9	0.4	0.9	3.1	0	0	0	0
Other	0.7	0.4	1.8	0	0	0	0	0
Housing Situation								
Rent	11.1	13.8	7.0	7.8	12.3	19.5	10.8	5.6
Own	88.0	85.0	92.2	92.2	87.7	80.5	89.2	94.4
Other	0.9	1.2	0.9	0	0	0	0	0
Age (mean/SD) Range 24-91	63.94 (11.93)	63.06 (12.16)	65.64 (12.01)	65.08 (10.15)	64.62 (11.20)	64.10 (11.01)	61.89 (13.13)	68.21 (8.05)

Note. Non-M = Non-member of an energy community, M= Member of an energy community.
*These are absolute income levels, relative income may differ between countries.

3.2.5 Global Ecovillage Network (Europe)

Data was collected among members of the Global Ecovillage Network (GEN) Europe. GEN Europe is the European network for ecovillages and sustainable communities, and one of EC^2 project partners. Their vision is of a conscious, resilient and sustainable Europe where ecovillage and community values and lifestyles are widely adopted. An ecovillage is defined by GEN as "an intentional, traditional or urban community that is consciously designed through locally owned, participatory processes and aims to address the Ecovillage Principles in all four areas of regeneration (social, culture, ecology and economy)" (https://ecovillage.org/about/about-gen/). GEN Europe counted over 100 ecovillages at the time of data collection. GEN Europe first advertised the survey questionnaire amongst its members

at the annual conference held in July 2022; furthermore, the survey was advertised to all members associated with an ecovillage from the GEN network via the network's media channels (email, newsletter, social media, website). Respondents could fill out the questionnaire in German, Italian, Polish, Spanish, and Dutch next to English. Compensation for participation was allocated to the eco-villages in terms of a budget for energy-efficient measures in the eco-village. As a compensation, five prizes of 600 Euros each in the form of a voucher with the specific purpose of contributing to enhancing the sustainable energy infrastructure within the ecovillage, were awarded to participating ecovillages in Europe, via a prize raffle. Data was collected at two different timepoints with approximately one year in between. Three of the prizes could be won in the first round of data collection and an additional two in the final round. The first data (T1) was collected between 18 july and 19 december 2022. A total of 222 participants gave informed consent of which 180 started with the survey and 150 finished the survey. The second round of data collection (T2) took place between 28 June and 30 August among the same participants. In total 37 started with the survey of which 35 finished the survey.

Table 5. Descriptive statistics of the background variables (in %) of the GEN ecovillages sample

Variable name	T1	T2
Gender		
Male	50.3	66.7
Female	49.0	33.3
Other	0.7	0
Ethnic minority		
No	89.3	95.8
Yes	10.7	4.2
Household income*		
Less than 500€ per month	18.0	15.4
€500 - €999	24.0	11.5
€1000 - €1999	24.0	26.9
€2000 - €2999	12.7	30.8
€3000 - €3999	8.0	7.7
€4000 - €4999	2.0	0
5000€ or more	4.0	0
Prefer not to say	7.3	7.7
Education		
Low	0.7	0
Medium	10.3	4.0
High	89.0	96.0
Living situation		
Alone	31.8	22.9
Alone with child(ren)	4.6	2.9
Together with partner	19.2	14.3
Together with partner and child(ren)	17.2	5.7
Together with other family members	1.3	0
Communal living/ together with housemates	22.5	42.9
Other	3.3	11.4
Employment		

Paid employment	32.0	19.2
Temporarily unemployed	6.0	0
Unemployed	2.0	3.8
Retired	11.3	15.4
Student	0	0
Taking care of the housekeeping/ caring for children	3.3 0.7	7.7 0
Work disability	18.7	15.4
Volunteer	19.3	38.5
Self-employed/freelancer	1.3	0
Seasonal employee	5.3	0
Other	0	0
Housing situation***		
Rent	30.9	25.0
Own	30.2	20.8
Other	38.9	54.2
Age (mean/SD)	49.58	53.65
Range 27-76	(14.36)	(15.48)

Note. *Income categories were adjusted for people living in Poland and the UK to correspond to similar levels in Euro. These are absolute income levels, relative income may differ between countries. **Level of education is adjusted for different countries based on ISCED 2011 levels. *** For GEN ecovillages the amount of respondents indicating the "other" category is much higher compared to other samples as the rent/own division does not always seem to correspond to their living arrangements.

3.2.6 Energy Communities Europe

We contacted 130 energy cooperatives associated with REScoop, the European federation of citizen energy cooperatives. REScoop's network comprises approximately 1,900 European energy cooperatives and 1,250,000 active citizens engaged in the energy transition (https://www.rescoop.eu/). We reached out to these cooperatives via their provided email addresses on the website, requesting their assistance in sharing a questionnaire survey link with their members through various channels such as email, newsletters, social media, and websites. Respondents could fill out the questionnaire in German, Italian, Polish, and Spanish next to English. Data collection occurred from July 18th, 2022, to December 19th, 2022. Out of 118 respondents who provided informed consent, 66 completed the questionnaire.

We additionally approached participants via ICLEI Europe - Local Governments for Sustainability (ICLEI hereafter). ICLEI is an extended network of local and regional governments in more than 35 European countries, and a partner in the EC^2 project. With support from ICLEI, we distributed the survey across their network of municipalities. Each municipality was requested to share the questionnaire link with its citizens using available communication channels. Additionally, we directly contacted select municipalities through our EC^2 network contacts, including the Municipality of Urroz Villa in Northern Spain and the Municipality of Scalenghe in Northern Italy, targeting both members and non-members of energy communities. Data collection occurred from July 29th, 2022, to November 14th, 2022. Out of 84 participants providing informed consent, 31 participants completed the questionnaire. We combined these datasets resulting in a total of 132 members of energy communities (leaving out the non-members as this was a very

small group).

Table 6. Descriptive statistics of the background variables (in %) EU Ecom

Variable name	T1
Gender	
Male	81.6
Female	17.1
Other	1.3
Ethnic minority	
No	96.1
Yes	3.9
Household income*	
Less than 500€ per month	0
€500 - €999	0
€1000 - €1999	14.3
€2000 - €2999	33.8
€3000 - €3999	18.2
€4000 - €4999	10.4
5000€ or more	14.3
Prefer not to say	9.1
Education	
Low	2.7
Medium	14.6
High	82.7
Living situation	
Alone	19.2
Alone with child(ren)	1.3
Together with partner	48.7
Together with partner and child(ren)	23.1
Together with housemates	2.6
Other	5.1
Employment	
Paid employment	50.6
Temporarily unemployed	2.6
Unemployed	1.3
Retired	32.5
Student	0
Taking care of the housekeeping/ caring for children	0
Work disability	9.1
Self-employed/freelancer	3.9
Seasonal employee	0
Other	0
Housing situation	
Rent	26.0
Own	72.7
Other	1.3
Age (mean/SD)	59.99
Range 30-82	(11.90)

Note. *Income categories were adjusted for people living in Poland and the UK to correspond to similar levels in euro. **Level of education was adjusted for different countries based on ISCED 2011 levels.

3.2.7 Housing Cooperative Wroclaw South (Poland)

Finally, we collected data from a different socio-political context, Poland. Data was collected within a housing cooperative in Poland named Spółdzielnia Mieszkaniowa Wrocław-Południe (Housing Cooperative Wroclaw South; HCWS). Energy communities are still a niche development in Poland (Bertel et al., 2022; Schwanitz, et al., 2023) and they mainly exist as a part of housing cooperatives (see D3.3; p. 64). In addition, a focus on tenants instead of home owners is often lacking in research on energy communities. HCWS is one of the largest housing cooperatives in Wroclaw, with approximately 30.000 residents living in nearly 11,000 apartments and 102 buildings. Within HCWS there exist multiple community energy initiatives, such as residents collectively deciding to install PV systems on a particular building.

We contacted participants through a contact person at HCWS, being one of our project partners in the EC^2 project. The survey was specifically tailored for this housing cooperation in collaboration with project partners from WUEB and a HCWS representative. It was made available on HCWS's online platform, accessible to all residents. As an incentive, participants were offered entry into a prize draw for ten 200 Zloty vouchers. Data was collected between January 19th to June 18th, 2023. Out of 214 participants providing informed consent, 154 started the survey, and 114 successfully completed it.

Table 7. Descriptive statistics of the background variables (in %) HCWS

Variable Name	T1			
	Total	Unaware	Aware	
			Non-M	M
Gender				
Male	43.6	42.7	56.5	25
Female	56.4	57.3	43.5	75
Other	0	0	0	0
Ethnic minority				
No	97.4	97.4	100	91.7
Yes	2.6	2.6	0	8.3
Household income				
Less than 2000 Zloty per month	0.9	1.3	0	0
2000- 2999 Zloty	7.1	5.2	16.7	0
3000 - 3999 Zloty	8.0	7.8	8.3	8.3
4000 - 4999 Zloty	10.6	13.0	4.2	8.3
5000 - 5999 Zloty	4.4	3.9	4.2	8.3
6000 - 6999 Zloty	10.6	13.0	0	16.7
7000 or more Zloty per month	33.6	32.5	41.7	25
Prefer not to say	24.8	23.4	25	33.3
Education**				
Low	0.9	0	4.2	0
Medium	8.1	6.7	12.5	8.3
High	91.0	93.3	83.3	91.7
Living situation				
Alone	21.1	15.4	33.3	33.3

Alone with child(ren)	5.3	6.4	4.2	0
Together with partner	37.7	39.7	29.2	41.7
Together with partner and child(ren)	32.5	37.2	25.0	16.7
Together with other family members	3.5	1.3	8.3	8.3
Employment				
Paid employment	72.8	78.2	54.2	75
Temporarily unemployed	1.8	1.3	4.2	0
Unemployed	0	0	0	0
Retired	14.9	9.0	29.2	25
Student	0.9	1.3	0	0
Taking care of the housekeeping/caring for children	0	0	0	0
Work disability	0	0	0	0
Volunteer	0	0	0	0
Self-employed	9.6	10.3	12.5	0
Seasonal employee	0	0	0	0
Other	0	0	0	0
Age (mean/SD)	48.01	46.97	52.08	46.17
Range 24-75	(12.78)	(11.73)	(13.97)	(15.70)

Note. Non-M = Non-member of an energy community, M= Member of an energy community. *The answer options for disposable income per month were measured in Zloty, corresponding to the following amount of euro (as of the time of the data collection); Less than 2000 Zloty (~ €440), 2000-2999 Zloty (~ €440-€661), 3000-3999 Zloty (~ €661-€882), 4000-4999 Zloty (~ €882-€1101), 5000-5999 Zloty (~ €1102-€1323), 6000-6999 Zloty (~€1323-€1543), and >7000 Zloty (~ €1543). **The level of education was based on ISCED 2011 levels.

3.3 Measures

The survey was presented to participants as divided into five main sections, comprising a variety of measures, as depicted in Figure 3. The main measures included in the survey as relevant for this deliverable, alongside with an example item and references, are shown in Table 8 (see Appendix 1 for an overview of all scale items)[2]. All items were measured on a 7-point-likert scale (strongly disagree/not at all to strongly agree/very much) except for biospheric values which were measured on a 9-point-likert scale ranging from -1 “opposed to my principles” to 7 “of supreme importance”.

[2] Next to the variables described, other variables were included in the survey which were not relevant for this deliverable (e.g., altruistic, egoistic and hedonic values, individual and collective self-determined motivation, general well-being, personal and collective vision, agency, trust in the government and trust in the energy community, interpersonal contact, relational models, intergroup differences, volunteer hours, burn out, leaving the energy community, household related energy behaviours and non-energy-related private and public pro-environmental behaviours).

Figure 3. Overview of the survey

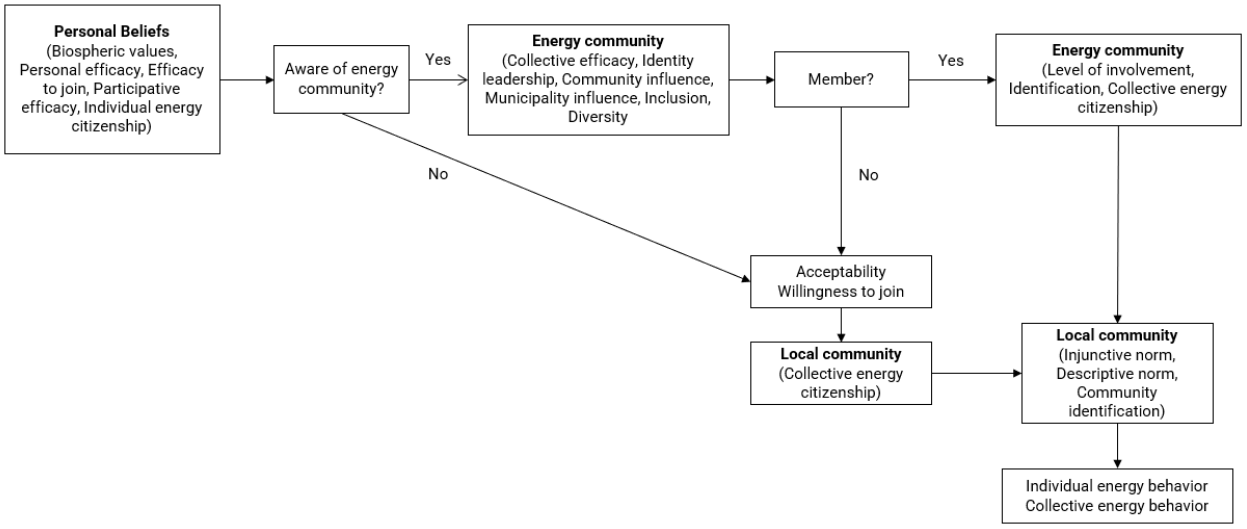


Table 8. Measures and items central to analyses for this deliverable

Measure	Example item	Nr. of items	Reference
Outcomes			
Acceptability	I approve of an/the community energy initiative.	1	Self-created
Willingness to join	I want to become involved in an/the community energy initiative (investing time, money etc.)	2	Sloot et al., 2018
Membership	Do you participate in this community energy initiative? [no/yes]	1	
Level of involvement	How actively involved are you in your community energy initiative?	1	
Identification with the energy community	I identify with members of my community energy initiative.	1	Postmes et al., 2013
Individual Energy citizenship	I consider affordable sustainable energy to be an important right.	9	Held et al, 2022
Collective Energy citizenship (energy community)	We, members of the community energy initiative, consider affordable sustainable energy to be an important right.	9	Held et al, 2022.
Collective energy citizenship (local region)	We, inhabitants of the local region, consider affordable sustainable energy to be an important right.	9	Held et al, 2022

Personal factors			
Biospheric values	RESPECTING THE EARTH: harmony with other species	4	De Groot & Steg, 2007
Personal self-efficacy	I believe that I, as an individual, can promote a just and sustainable transition.	1	Adapted from Hamann & Reese, 2020, van Zomeren et al., 2013
Efficacy to join	I think that I can become involved in an/the community energy initiative (investing time, money etc.) if I want to.	1	Adjusted from Ajzen, 1991.
Participative efficacy	I can make a significant contribution, so that the community energy initiative can promote a just and sustainable energy transition	2	Adapted from Hamann & Reese, 2020; van Zomeren et al., 2013; Hamann et al. (2023)
Energy community:			
Collective efficacy (aim-related)	Members of my energy community initiative can advance an energy transition that is just and sustainable.	2	Adapted from Hamann & Reese, 2020; van Zomeren et al., 2013; Hamann et al. (2023)
Identity leadership	The community energy initiative is representative of inhabitants of my local region.	4	Adapted from Steffens et al., 2014
Community influence	Inhabitants of my local region have influence on what the community energy initiative stands for and the decisions made.	1	Jans et al., 2021
Municipality influence	Local authorities and/or small-medium enterprises have influence on what the community energy initiative stands for and the decisions made.	1	Jans et al., 2021
Interests of marginalised groups	Members of the energy community take the interests of marginalised groups into account.		
Diversity of members	Members of the community energy initiative represent the diversity of people within society.	1	Based on Leach et al. 2008; self-definition items
Local community			
Injunctive norm	I think the majority of inhabitants of my local region approves of a/the community energy initiative.	1	Adapted from Hamann & Reese, 2020
Descriptive norm	I think the majority of inhabitants of my local region are involved in a/the community energy initiative (investing time, money etc.).	1	Adapted from Hamann & Reese, 2020
Identification with community	I identify with inhabitants of my local region.	1	Postmes et al., 2013

Behaviours supporting broader sustainability goals			
Private energy-related behaviours	In the past 6 months, to what extent have you… … reduced your energy consumption?	3	Adapted from Sloot et al., 2018; adapted from Hamann & Reese, 2020
Civic energy-related behaviours	In the past 6 months, to what extent have you… … discussed a just and sustainable energy transition with people in your local region?	6	Adapted from Hamann & Reese, 2020; Alisat & Riemer, 2015)

In the first section, *"Your personal beliefs"*, participants were presented with questions regarding their personal values, their individual energy citizenship (e.g. *"I consider affordable sustainable energy to be an important right"*), and their self-efficacy beliefs (e.g., I believe that I, as an individual, can promote a just and sustainable transition"). The scale used to measure energy citizenship was derived from WP2 in which a psychological scale to measure energy citizenship was developed to measure this both at the individual and the collective level (see Held et al., 2022). This scale encompassed various aspects relevant to energy citizenship such as people's perceived rights to and their felt responsibility for an energy transition that is both socially just and ecologically sustainable, and their willingness to contribute to an such transition.

In the second section, *"Involvement in your (a) community energy initiative"*, respondents were asked about their awareness and involvement in a community energy initiative, after being provided with a general description of what an energy community entails[3]. Depending on whether they were unaware of an energy community in their local region, aware or also actively involved (membership), they were presented with a different set of questions[4]. All respondents who indicated to be aware of an energy community, including members, received questions about the perceived collective efficacy of the energy community, identity leadership (whether the initiative is perceived as representing "us" as inhabitants of the local community), their perceived involvement of local inhabitants in the energy community and the perceived involvement of external stakeholders including the municipality, and their perceived diversity of the energy community and the inclusion of the interested of marginalised groups (see

[3] The description of energy communities as provided in the survey: "A community energy initiative generally aims to generate or facilitate sustainable energy and/or sustainable practices within a community. This entails, for example, energy saving programs, self-consumption and providing energy surplus to the grid, collective purchase of solar cells, and energy production. A community energy initiative sometimes takes the form of a legal entity, such as a co-operation, providing energy services to its members or shareholders (which can be citizens, local authorities such as municipalities, or small-medium enterprises). Energy communities are typically based upon open and voluntary participation, and are controlled by their members."

[4] In the samples consisting of members only participants skipped this part and were directly directed to the aware member questions (see Figure 3). The energy community was always the reference point, but it was worded as "your" community for involved members, "the" community for those aware of a specific initiative but not a member, or just "a" community energy initiative in general for those unaware of an energy community in their local area.

Introduction and Table 8). Both aware and unaware non-members additionally received questions on their acceptability of the/an energy community and their interest to join. Members received additional questions on their level of involvement, their identification with their energy community and their collective energy citizenship on the level of the energy community (e.g., "We, members of the community energy initiative**,** consider affordable sustainable energy to be an important right").

In the third section, *"You and the inhabitants of your local region"*, all participants were asked questions about how they perceived themselves as inhabitants of their local community (either neighbourhood or municipality)[5] such as their identification with their wider local community, whether they believed other community members were approving of an energy community (injunctive norm) or are already involved in an energy community (descriptive norm). Respondents who previously indicated to be non-aware of an energy community in their local region were additionally presented with the energy citizenship scale at the collective level, with reference to the inhabitants of the local region (e.g.; "*We, inhabitants of the local region, consider affordable sustainable energy to be an important right*").

In the fourth section, *"Your personal energy behaviour"*, participants were asked a series of questions about both private (e.g., reducing one's energy consumption) and civic energy-related behaviours (e.g., engaging in community activities focused on a just and sustainable energy transition).

The fifth and final section consisted of socio-demographic variables such as gender, age, income, ethnicity, education, employment and living situation[6].

4 Results

We tested our model in all samples separately. To analyse our data we used R version 4.2.0 (R Core Team, 2017). ANOVA and t-tests were performed with post hoc tests to indicate potential differences between unaware non-members, aware non-members and members for all concepts included where applicable. In addition, we explored whether differences in (individual) energy citizenship between those aware vs. unaware of an energy community in their locality and members vs. non-members remained similar or changed over time using mixed regression models (time nested within individuals and, where possible, individuals nested in energy communities).

Next, we estimated bivariate correlations between all concepts in our model per subsample separately; among those unaware of the energy community in their local region, among those aware, and among members. To interpret the magnitude of the bivariate correlations we used the guideline as provided by Cohen (1988) with r = >.50 as strong effect size, r = >.30 as medium effect size and r = >.10 as small effect size. We interpret strong (r = >.50) to medium (r = >.30)

[5] In the Dutch Panel and Buurkracht samples "my local region" was specified as "my neighbourhood" and in the Polish HCWS sample with "the residents of HCWS".

[6] In the representative samples questions about participant's socio-demographics were included at the beginning of the questionnaire in order to reach the quota needed whereas in all other samples the socio-demographic background questions were asked at the end of the questionnaire.

effect sizes as meaningful relations between factors.

In a final step, we added Gaussian Graphs per subsample were possible[7], which further specifies the partial correlations between the concepts (i.e., while controlling for the relationships between the other concepts). Such graphs can help to explore which are the best predictors for particular outcomes, taking into account all other predictors in the model. These models are especially useful for large datasets for which analysis with the use of correlation tables only is harder to interpret (see for more information on Gaussian models and an application in environmental psychology; Bushan, 2019)[8]. In addition, these models can help to avoid spurious correlations between two variables (caused by a third variable in the dataset). They comprise a set of items or variables, depicted by circles, and a set of lines that visualise relationships between the items or variables (Lauritzen, 1996; Epskamp et al., 2018). In this deliverable, we included 23 variables reflecting the concepts introduced above (the exact number depends on the subsample used). Importantly, all partial correlation coefficients and interpretations of the Gaussian plots are conditional on the variables included in the model. As different variables were included in the different subsamples and sample sizes differed between samples (and were sometimes limited, especially among members), we did not engage in any formal comparisons between plots and results need to be interpreted with caution.

4.1 General Population the Netherlands

First, from the descriptives in Table 9, we observe that those unaware of an energy community in their local region generally score lower on all measures, compared to those aware of an energy community. Specifically, those aware of an energy community score higher on individual energy citizenship and perceived collective energy citizenship of their local region. Although those aware and those unaware of an energy community do not differ in their biospheric values, those aware of an energy community do feel more efficacious to join and to foster a just and sustainable energy transition, and identify more with their local region, than those unaware of an energy community. Furthermore, those aware engage more in both private and civic energy-related behaviours. Yet, while those aware of an energy community, compared to those unaware, perceive stronger approval from their local community of the energy community (injunctive norm), they perceive less participation of the local community in the energy community (descriptive norm).

Among those aware of an energy community, members and non-members generally do not differ much on all measures. Specifically, we did not find significant differences between

[7] Due to limited sample sizes in some subsamples and/or multicollinearity issues (two variables being perfectly correlated, or one variable being perfectly predictable based on a number of others), there are no Gaussian graphs included in some of the (sub)samples.

[8] Using the estimated correlation matrices as input, the Gaussian graphical model was estimated using the *glasso* algorithm (Friedman et al., 2014). This algorithm forces small partial correlation coefficients to zero to reduce sparsity making sure that the strongest relationships are retained (Bushan et al, 2019). The graphs were then visualised using the R package qgraph (Epskamp et al., 2012). In qgraph, variables which are strongly correlated are placed spatially close to each other based on the Fruchterman Reingold algorithm (Epskamp et al., 2012). It is important to note that this does not imply that they are in any way semantically or conceptually similar (for more details about this visualisation algorithm, see Jones et al., 2018; Bushan et al., 2019).

members and non-members in individual energy citizenship, biospheric values, and personal self-efficacy to foster a just and sustainable energy transition. We do find that members of energy communities, compared to non-members, feel that they can make a more significant contribution so that the energy community can promote a just and sustainable energy transition (participate efficacy), feel more that the initiative represents their local community and perceive the members of the energy community as more diverse. Members also assume more participation of the local community in the energy community (descriptive norm), and engage significantly more in both private and civic energy-related behaviours. Overall, all participants scored lower on civic sustainability behaviours compared to private sustainability behaviours, among all subsamples. Interestingly, participants across subgroups perceived the influence of the community on what the community energy initiative stands for and the decisions made as much lower than the influence of the municipality.

Table 9. Means and standard deviations per subsample general population the Netherlands at T1

Variable	Total	Unaware *N* = 1265-1273		Aware			
				Non-member *N* = 217-219		Member *N* = 69	
	α/ r_{sb}	*M*	*SD*	*M*	*SD*	*M*	*SD*
Acceptability	-	4.99[a]	1.24	5.22[b]	1.27	-	-
Willingness to join	.88	4.19[a]	1.40	4.38[a]	1.45	-	-
Level of involvement	-	-	-	-	-	4.42	1.66
Identification energy community		-	-	-	-	4.65	1.47
Individual Energy Citizenship	.90	4.59[a]	1.06	5.03[b]	0.99	5.10[b]	0.90
Collective Energy Citizenship (Ecom)	.88					5.22	0.92
Collective Energy Citizenship (C)	.93	4.23[a]	1.11	4.80[b]	0.96	-	-
Biospheric Values	.88	4.49[a]	1.51	4.73[a]	1.47	4.57[a]	1.51
Personal efficacy	-	4.16[a]	1.49	4.75[b]	1.56	5.09[b]	1.40
Efficacy to join	-	4.37[a]	1.41	4.97[b]	1.47	-	-
Participative efficacy	.88	-	-	4.42[a]	1.37	4.80[b]	1.28
Collective efficacy	.85	-	-	4.76[a]	1.21	4.92[a]	1.24
Identity leadership	.85	-	-	4.35[a]	1.15	4.84[b]	1.16
Community influence	-	-	-	3.97[a]	1.52	4.35[a]	1.45
Municipality influence	-	-	-	4.87[a]	1.19	4.97[a]	1.42
Inclusion marginalised groups	-	-	-	4.39[a]	1.25	4.42[a]	1.59
Diversity members	-	-	-	4.18[a]	1.25	4.59[b]	1.47
Injunctive norm	-	4.44[a]	1.23	4.82[b]	1.29	4.96[b]	1.17
Descriptive norm	-	4.23[a]	1.29	3.86[b]	1.49	4.41[ac]	1.58
Community identification	-	4.40[a]	1.49	4.95[b]	1.32	5.00[b]	1.24
Private energy behaviour	.64	4.34[a]	1.26	4.83[b]	1.17	5.30[c]	0.81
Civic energy behaviour	.95	2.11[a]	1.46	2.56[b]	1.15	3.71[c]	1.46

Note. Ecom = energy community; C = local region. Involvement and energy citizenship (main outcomes) in blue, individual factors in purple, collective factors at the level of the energy community in yellow, collective factors at the level of the local region in orange, and energy behaviours in green. Superscripts indicate significant mean differences based on (Welch) T-test or (Welch) ANOVA with either Tukey or Games Howell post-hoc test.

Effects of T1 energy community awareness and involvement on individual energy citizenship over time

As displayed in Table 10, individual energy citizenship at T1 and T2 correlates, and both correlate also with energy community awareness and membership at T1. Regression analyses show that energy citizenship does not change over time. Awareness at T1 is related to energy citizenship, and these effects are not moderated by time, implying that the effects of awareness remains equally strong over time (see Tables 11)[9].

Table 10. Correlations EC² outcome measures at T1 and individual EC at T2

		1	2	3
1	Individual EC T1			
2	Individual EC T2	.743**		
3	Awareness T1	.169**	.162**	
4	Membership T1	.087**	.091**	.452**

Note: ** $p < .01$, * $p < .05$

Table 11. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure)

	Individual energy citizenship		
	b (SE)	**95%CI**	***p***
Intercept	4.60 (.03)	4.54; 4.65	.000
Time (T2-T1)	.02 (.03)	-.04; .08	.458
Awareness_T1	.39 (.07)	.25; .53	<.001
Membership_T1	.12 (.13)	-.13; .37	.357
Awareness_T1*time	-.13 (.09)	-.30; .04	.140
Membership_T1*time	.13 (.19)	-.24; .50	.494

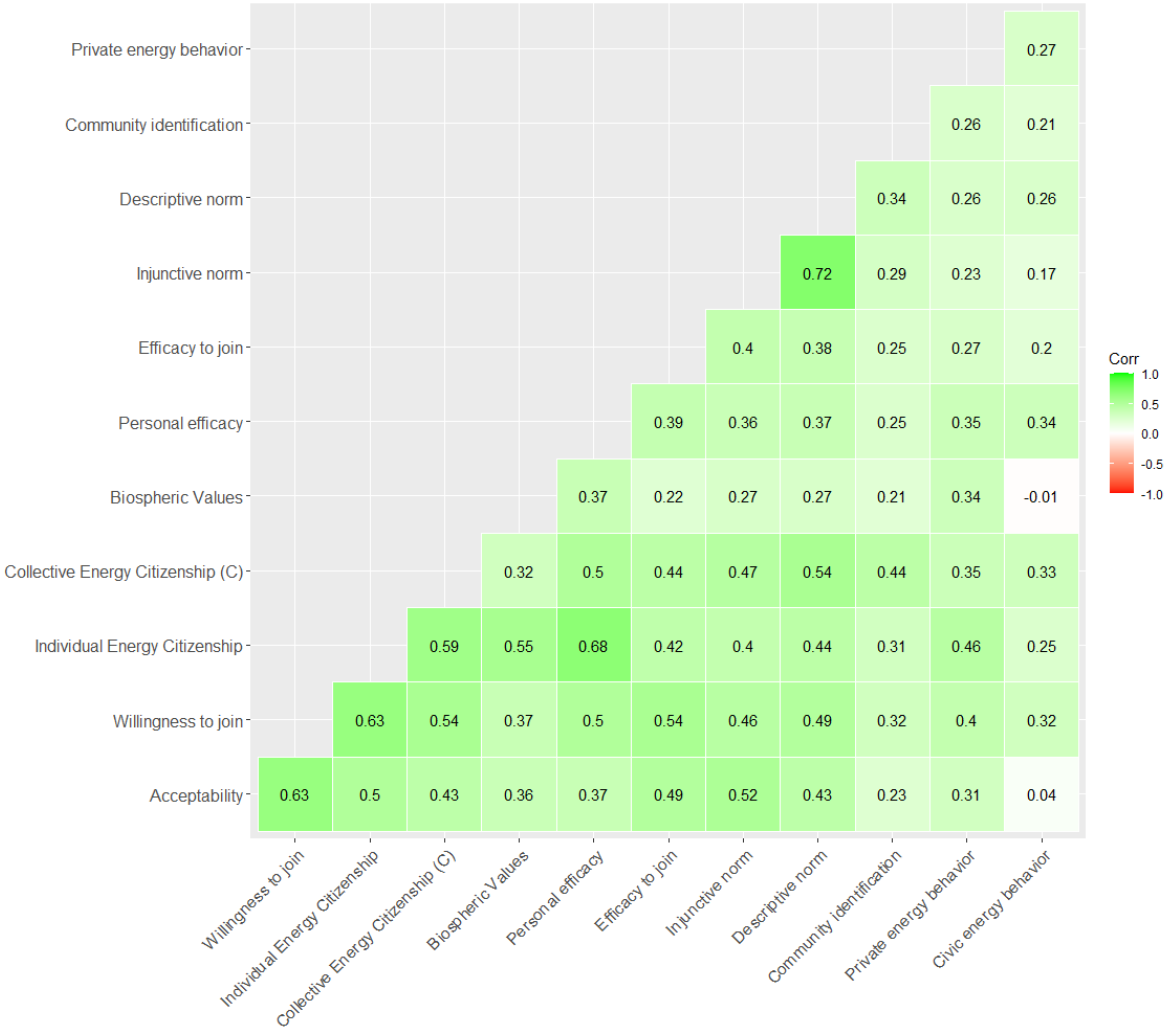
People unaware of an energy community at T1

Bivariate correlations in Table 12 show that, as expected, among those unaware of an energy community, both individual energy citizenship and collective energy citizenship at the level of the local community correlate strongly with acceptability of and willingness to join an energy community ($r >= .50$).

Furthermore, all individual factors (i.e. biospheric values) and collective factors (i.e. injunctive norms) correlated positively with acceptability of and willingness to join an energy community ($r >= .30$) except for identification with the local community ($r >= .10$). Willingness to join showed particularly strong correlations with personal efficacy to contribute to a just and sustainable energy transition and acceptability with injunctive norms ($r >= .50$), the latter indicating that participants find an energy community more acceptable when others in the community approve of an energy community as well. Willingness to join, acceptability, and energy citizenship, also correlated positively with sustainable energy behaviours ($r >= .30$), except for civic energy behaviour ($r <= .10$) which did not correlate with acceptability.

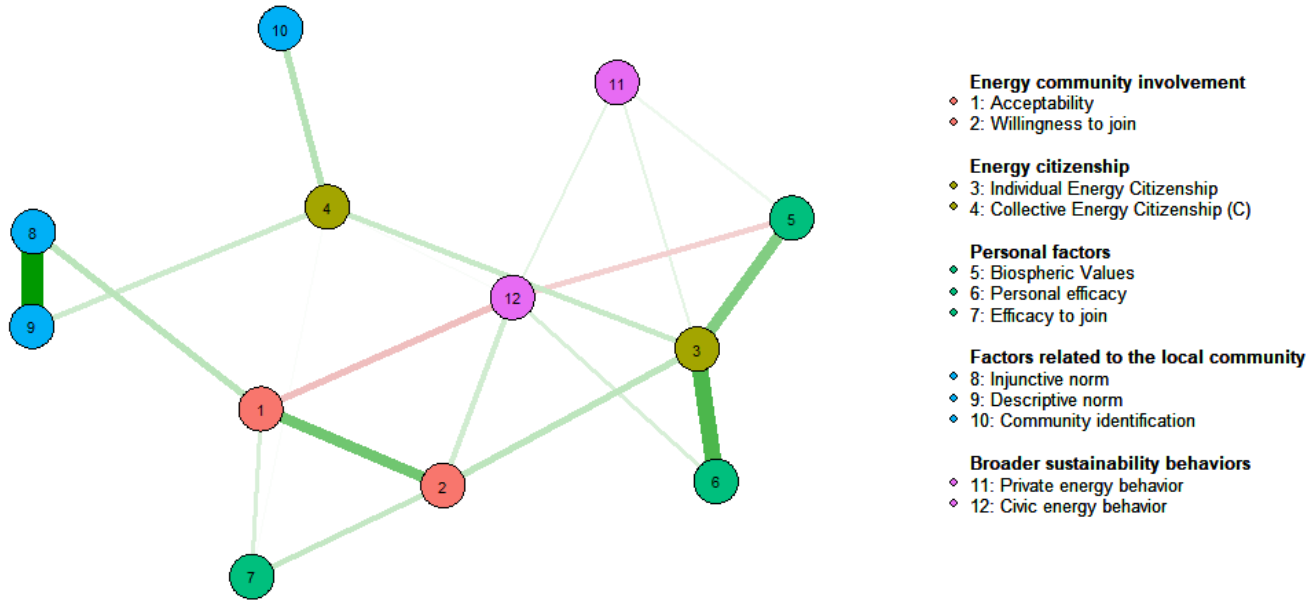
[9] Due to the limited number of members at T3 we only tested for effects between T1 and T2.

Table 12. Correlations unaware non-members NL at T1



When looking at the partial correlations as shown in Figure 4, we see that, after controlling for all other factors in the model, acceptability and willingness to join are positively correlated with energy citizenship on the individual rather than collective level. Both willingness to join and acceptability are quite strongly correlated with efficacy to join the energy community but not with any of the other personal factors anymore. Furthermore, of the collective factors only the perceived injunctive norm within the community is related to acceptability, when controlling for all other factors. Interestingly, individual energy citizenship is in turn strongly related to biospheric values and personal efficacy to foster a just and sustainable energy transition whereas collective citizenship is mostly related to factors related to the local community (i.e. injunctive norms). Of the sustainable energy behaviours, only civic behaviours are related to willingness to join. In fact, the latter even seems negatively related to acceptability.

Figure 4. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the unaware non-member sample from Panel NL at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

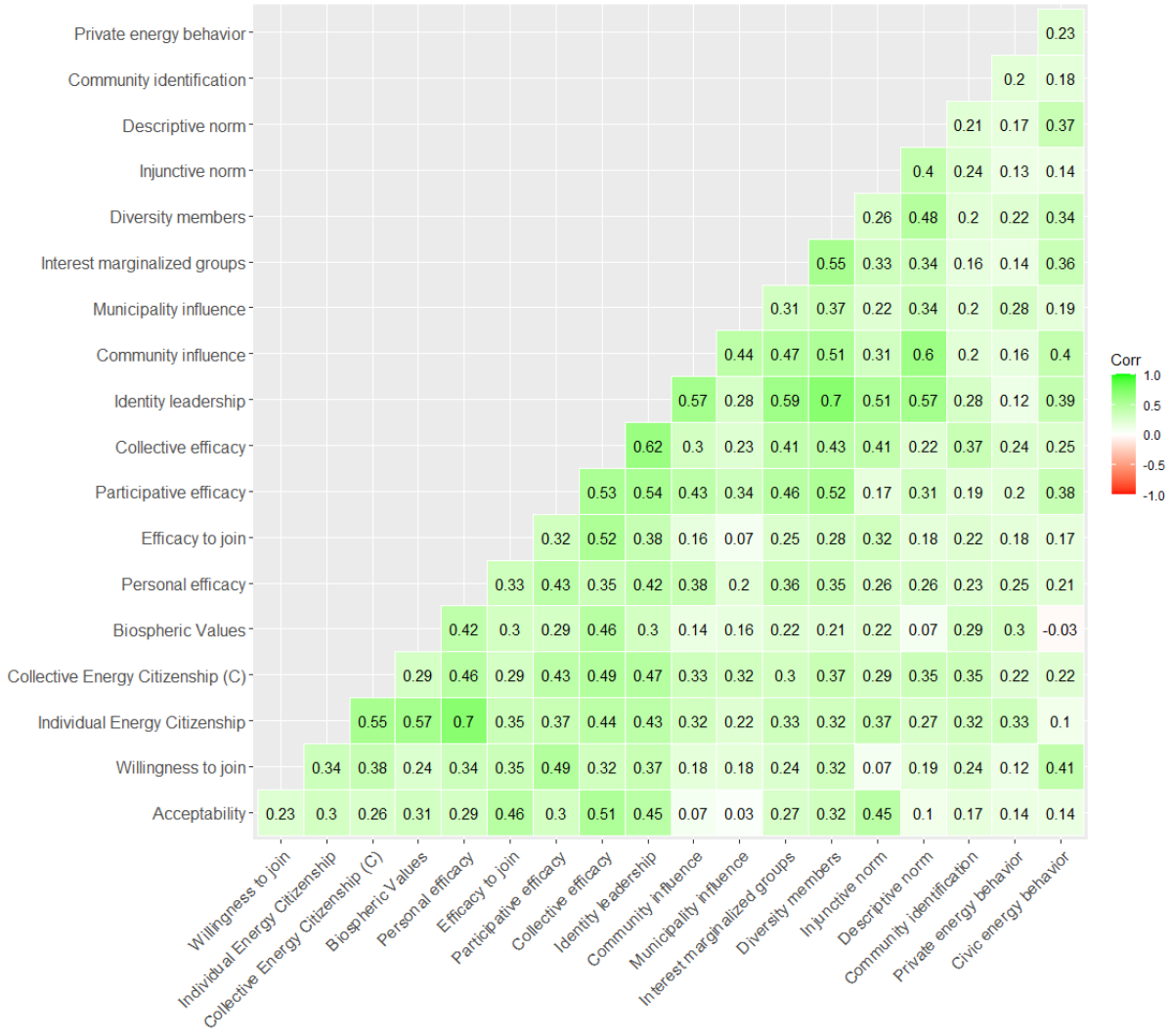
Aware non-members of an energy community at T1

Among the aware non-members, bivariate correlations in Table 13 show that, as expected, again both individual and collective energy citizenship are correlated with willingness to join an energy community ($r >= .30$) but only weakly correlated with acceptability of the energy community ($r >= .10$).

As for unaware non-members, we observed individual and collective factors (i.e. collective efficacy, identity leadership) to correlate positively with willingness to join and acceptability ($r >= .30$), yet we only find a weak correlation between willingness to join and biospheric values and between acceptability and personal efficacy ($r >= .10$). Interestingly, we do not find perceived community or municipality influence on the decision making of the energy community to matter while we do find the perceived diversity and inclusion of interests of marginalised groups to relate to both willingness and acceptability ($r >= .30$). Of the factors related to the local community we find that although all correlations are in the expected positive direction, the perceived injunctive norm and acceptability are most strongly correlated ($r >= .30$).

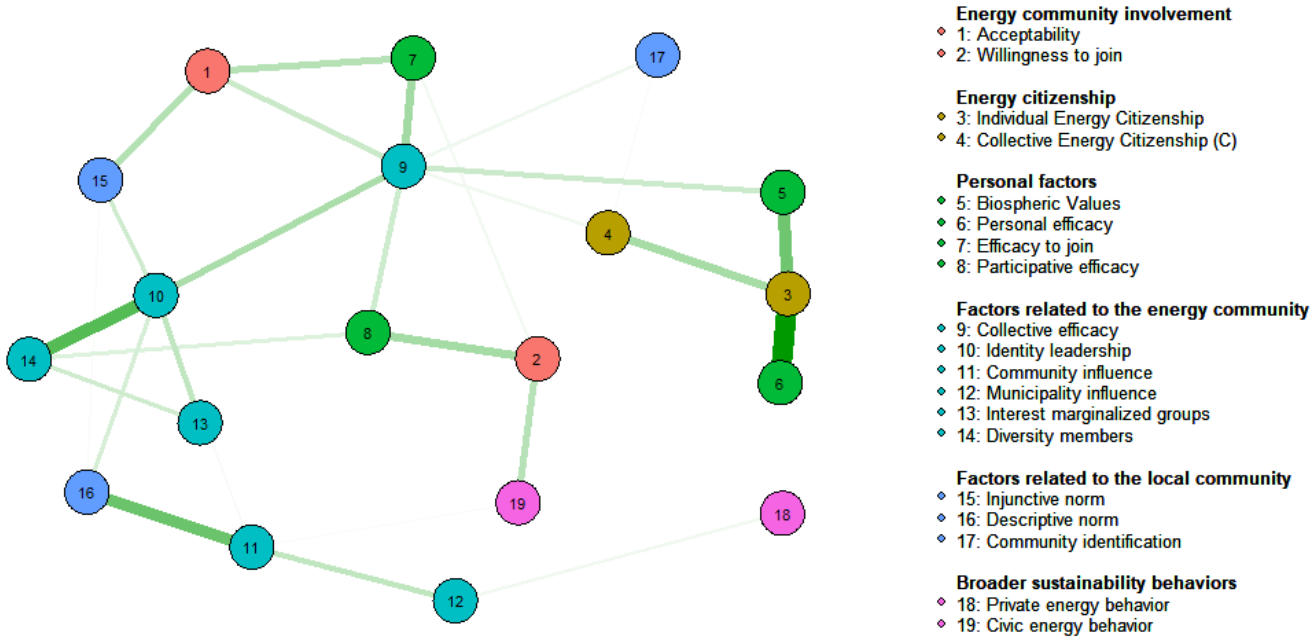
Both individual and collective energy citizenship are only somewhat correlated with both private and civic sustainability behaviours, in particular individual energy citizenship with private energy behaviour ($r >= .30$). Interestingly, willingness to join correlates relatively strongly with civic behaviour($r >= .30$), yet hardly with private energy behaviours, as does acceptability ($r >= .10$).

Table 13. Correlations aware non-members Panel NL at T1



The partial correlations as shown in Figure 5, show that both acceptability and willingness to join are not related to energy citizenship at the individual and collective level. Again, we find that efficacy to join and participative efficacy correlated with acceptability and willingness to join, respectively. We also find acceptability to be related to collective efficacy and the perceived injunctive norm within the local community. Interestingly, again we find that individual energy citizenship is strongly related to biospheric values and personal efficacy, yet here we do not find collective energy citizenship to be strongly related to community factors. In fact, we do not find any of the set-up features of the energy community to matter for our outcomes. Furthermore, we only find private behaviours to be related to willingness to join but not acceptability and civic behaviour to any of our outcomes.

Figure 5. Visualisation of partial bivariate scale relationships (r > 0.05) with Gaussian, based on the aware non-member sample from Panel NL at T1

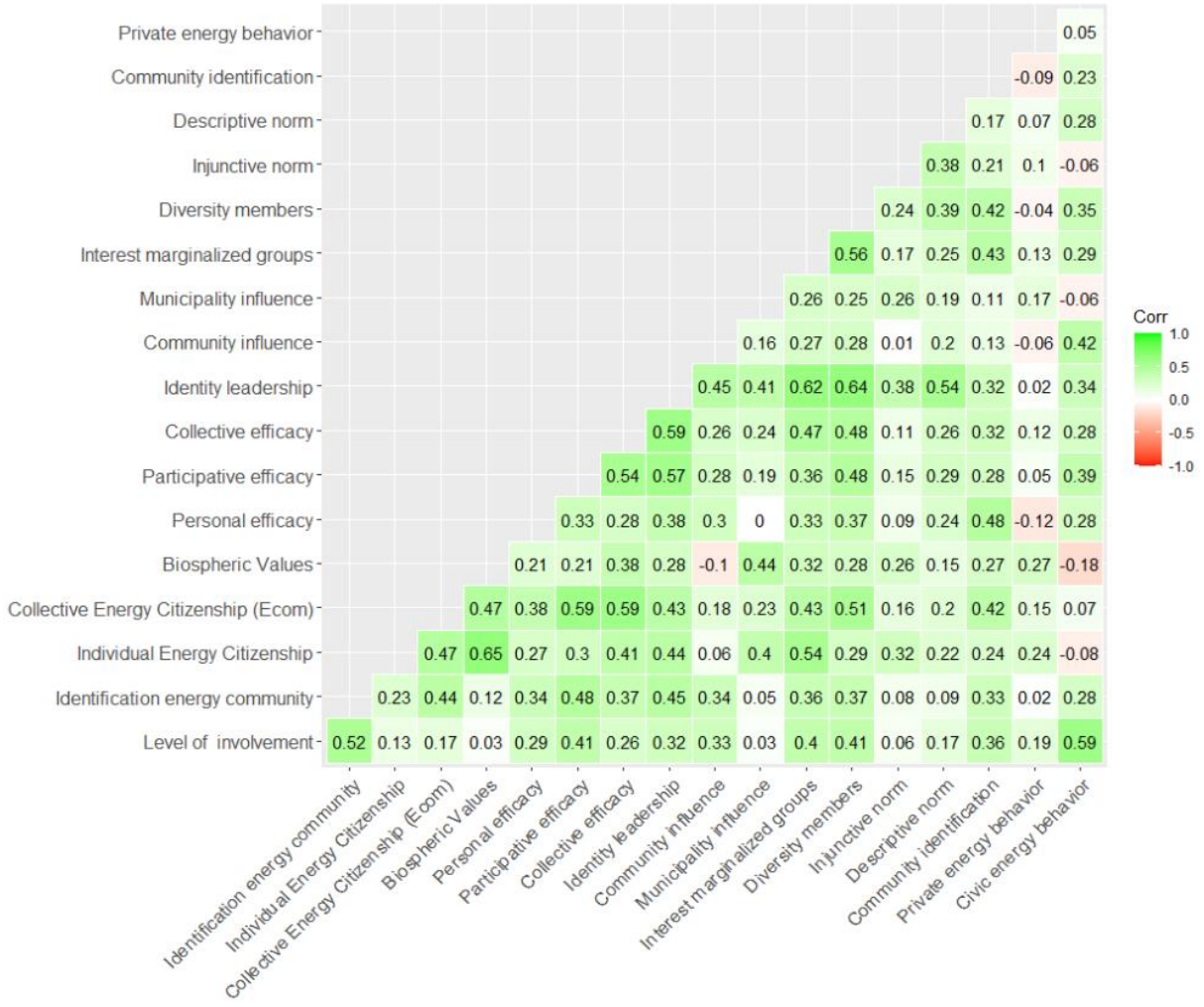


Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

Aware members of an energy community at T1

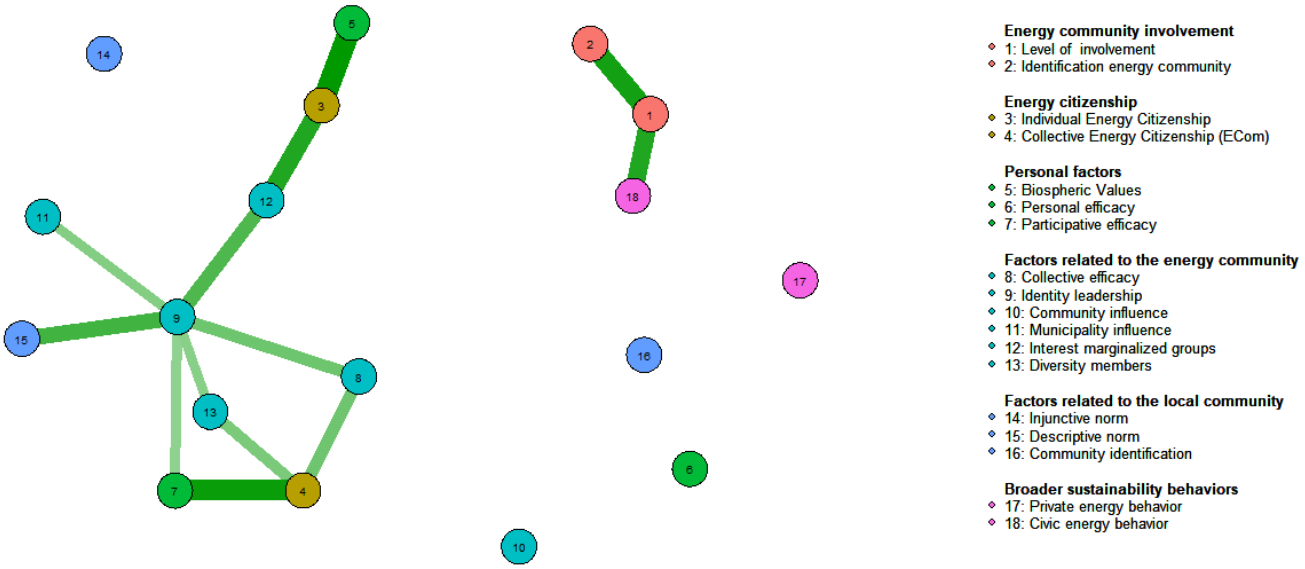
Among members, we find energy citizenship at both levels to be only weakly correlated with level of involvement, except for collective energy citizenship (on the level of the energy community) and identification with the energy community (r >= 0.30; see Tabel 14). Individual factors correlate with both indicators of involvement except for biospheric values. Furthermore, both levels of involvement and identification with the energy community are related to identity leadership, community influence, the perceived diversity and inclusion of interests of marginalised groups and community identification (r >= 0.30) but less with the other (energy) community factors. Finally, civic behaviours are mostly related to level of involvement and to a lesser extent to identification with the energy community, whereas we do not find private behaviours to matter for involvement.

Table 14. Correlations member Panel NL at T1



Looking at the partial correlations plot (Figure 6) we observe a less clear picture. We do not find energy citizenship at the individual and collective level to be related to both indicators of involvement. In fact, the level of involvement and identification with the energy community does not seem to be related to any of the other factors in our model. Both levels of energy citizenship seem related to both personal factors and factors related to the energy community with individual energy citizenship strongly associated with biospheric values and taking the interest of marginalised groups into account and collectively energy citizenship with participative efficacy, collective efficacy and the perceived diversity of members. Finally, the level of involvement in the energy community is strongly correlated with civic energy behaviour, but private behaviours do not seem to be related to any other factors among members.

Figure 6. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from Panel NL at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

4.2 General Population Spain

As shown in Table 15, we find a similar trend for all measures between subsamples as in the Netherlands general population sample with those aware of an energy community scoring higher on all measures and among those, members scoring higher compared to non-members. Yet, contrary to our findings from the Netherlands we did not find significant differences in individual energy citizenship between the different subsamples, while we did find collective energy citizenship to be significantly higher among those aware of an energy community compared to those unaware. We did not find any of the personal factors or collective factors related to the energy community to differ significantly between subsamples yet both the injunctive norm and the descriptive norm were significantly higher among those aware of an energy community compared to those unaware. Yet among those aware, we did not find any significant differences between members and non-members. Interestingly, the perceived descriptive norm is much lower than in the Netherlands general population sample.
As expected, those aware of an energy community scored significantly higher on civic sustainability behaviours compared to those unaware, yet we did not find any significant differences between members and non-members. Aware members scored significantly higher on private energy behaviours compared to unaware non-members but not to aware non-members. Again, we find that participants in all subsamples score lower on civic engagement compared to private energy behaviours and scored lower on perceived community influence compared to the influence of municipality on what the community energy initiative stands for and the decisions made.

Table 15. Means and standard deviations per subsample Spanish general population at T1

Variable	Total	Unaware		Aware			
				Non-Member		Member	
		N = 921		*N* = 93		*N* = 29	
	α/ r_{sb}	*M*	*SD*	*M*	*SD*	*M*	*SD*
Acceptability	-	5.64[a]	1.10	5.62[a]	1.26	-	-
Willingness to join	.92	4.61[a]	1.32	4.41[a]	1.42	-	-
Level of involvement	-	-	-	-	-	3.10	1.80
Identification energy community		-	-	-	-	4.62	1.29
Individual Energy Citizenship	.84	4.97[a]	0.88	5.10[a]	0.93	5.13[a]	0.93
Collective Energy Citizenship (Ecom)	.93	-	-	-	-	5.44	0.99
Collective Energy Citizenship (C)	.91	4.62[a]	1.02	5.06[b]	0.96	-	-
Biospheric Values	.86	5.22[a]	1.30	5.33[a]	1.36	5.42[a]	1.16
Personal efficacy	-	4.48[a]	1.49	4.76[a]	1.41	4.76[a]	1.33
Efficacy to join	-	4.58[a]	1.44	4.66[a]	1.68	-	-
Participative efficacy	.91	-	-	4.18[a]	1.47	4.28[a]	1.37
Collective efficacy	.94	-	-	4.73[a]	1.63	5.02[a]	1.12
Identity leadership	.88	-	-	4.21[a]	1.27	4.43[a]	1.15
Community influence	-	-	-	3.67[a]	1.48	4.07[a]	1.13
Municipality influence	-	-	-	4.59[a]	1.45	4.97[a]	1.09
Inclusion marginalised groups	-	-	-	3.87[a]	1.63	3.97[a]	1.74
Diversity members	-	-	-	4.09[a]	1.49	4.14[a]	1.33
Injunctive norm	-	4.44[a]	1.28	4.87[b]	1.23	5.24[b]	1.21
Descriptive norm	-	2.81[a]	1.34	3.17[b]	1.52	3.66[b]	1.32
Community identification	-	4.34[a]	1.56	4.75[b]	1.66	4.38[ab]	1.63
Private energy behaviour	.55	4.04[a]	1.16	4.33[ab]	1.26	4.59[b]	1.21
Civic energy behaviour	.87	2.08[a]	1.21	2.59[b]	1.37	2.80[b]	1.28

Note. Ecom = energy community; C = local region. Involvement and energy citizenship (main outcomes) in blue, individual factors in purple, collective factors at the level of the energy community in yellow, collective factors at the level of the local region in orange, and energy behaviours in green. Superscripts indicate significant mean differences based on (Welch) T-test or (Welch) ANOVA with either Tukey or Games Howell post-hoc test.

Effects of T1 energy community awareness and involvement on individual energy citizenship over time

As displayed in Table 16, individual energy citizenship at T1 and T2 correlate, while both only correlate with membership in an energy community but not awareness at T1. Regression analyses show that energy citizenship does not change over time, nor do awareness or membership at T1 is related to energy citizenship (see Table 17).

Table 16. Correlations EC^2 outcome measures at different timepoints

		1	2	3
1	Individual EC T1			
2	Individual EC T2	.637**		
3	Awareness T1	.051	.035	
4	Membership T1	.069*	.083*	.420**

Note: ** $p < .01$, * $p < .05$

Table 17. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure)

	Individual energy citizenship		
	b (SE)	**95%CI**	***p***
Intercept	4.97 (.03)	4.91; 5.03	.000
Time (T2-T1)	-.03 (.03)	-.09; .03	.346
Awareness_T1	.11 (.09)	-.07; .28	.232
Membership_T1	.06 (.16)	-.25; .37	.685
Awareness_T1*time	.12 (.11)	-.09; .33	.258
Membership_T1*time	.09 (.22)	-.34; .51	.685

People unaware of an energy community at T1

Bivariate correlations in Table 18 show, among unaware non-members in Spain, we find a medium to strong correlation between individual and collective energy citizenship and acceptability and willingness to join ($r >= .30$), yet acceptability is only weakly correlated with collective energy citizenship ($r >= .10$). Furthermore, all personal factors correlated positively with willingness to join and, to a lesser extent, acceptability, except for biospheric values. We did not find any of the factors related to the local community to relate to willingness to join or acceptability. Both private and civic sustainability behaviours correlated positively with individual and collective energy citizenship yet we only find civic energy behaviours to be related to willingness to join ($r >= .30$).

Table 18. Correlations unaware non-members Panel ES at T1

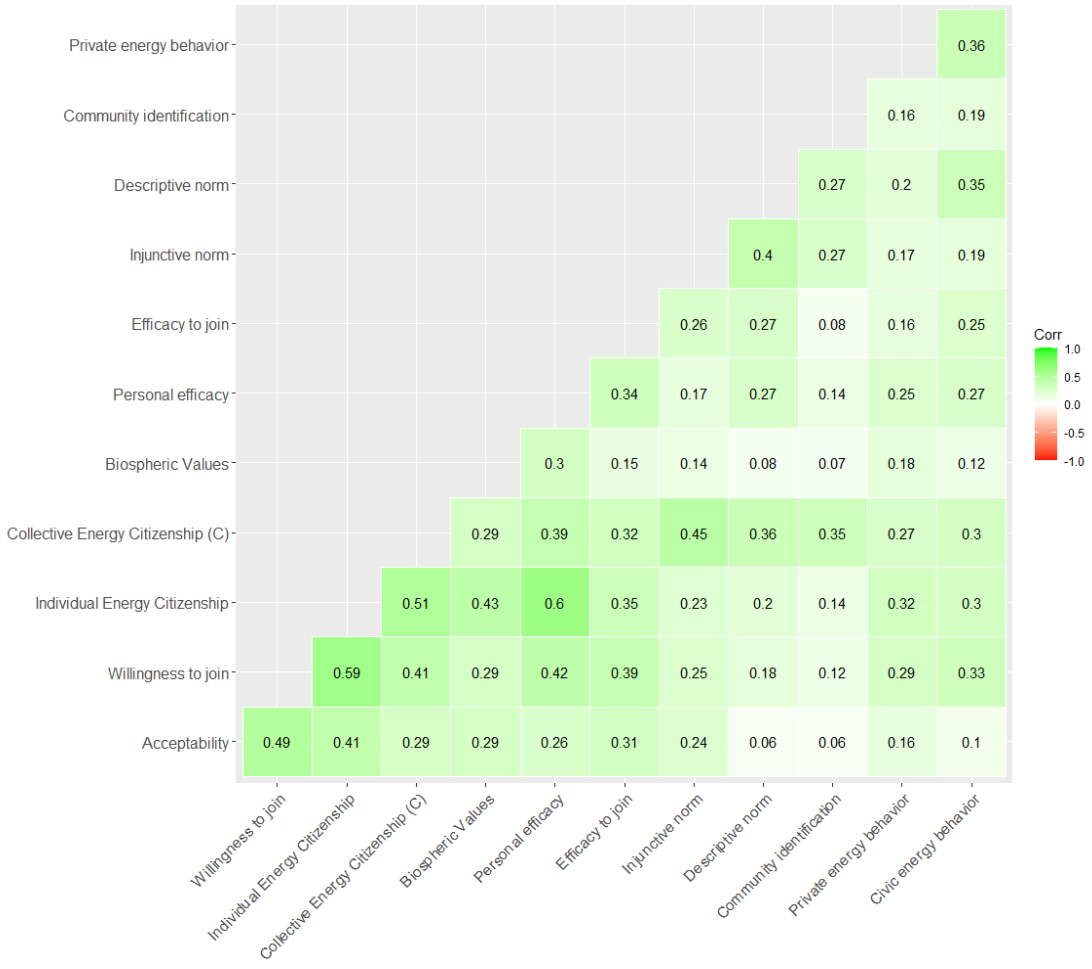
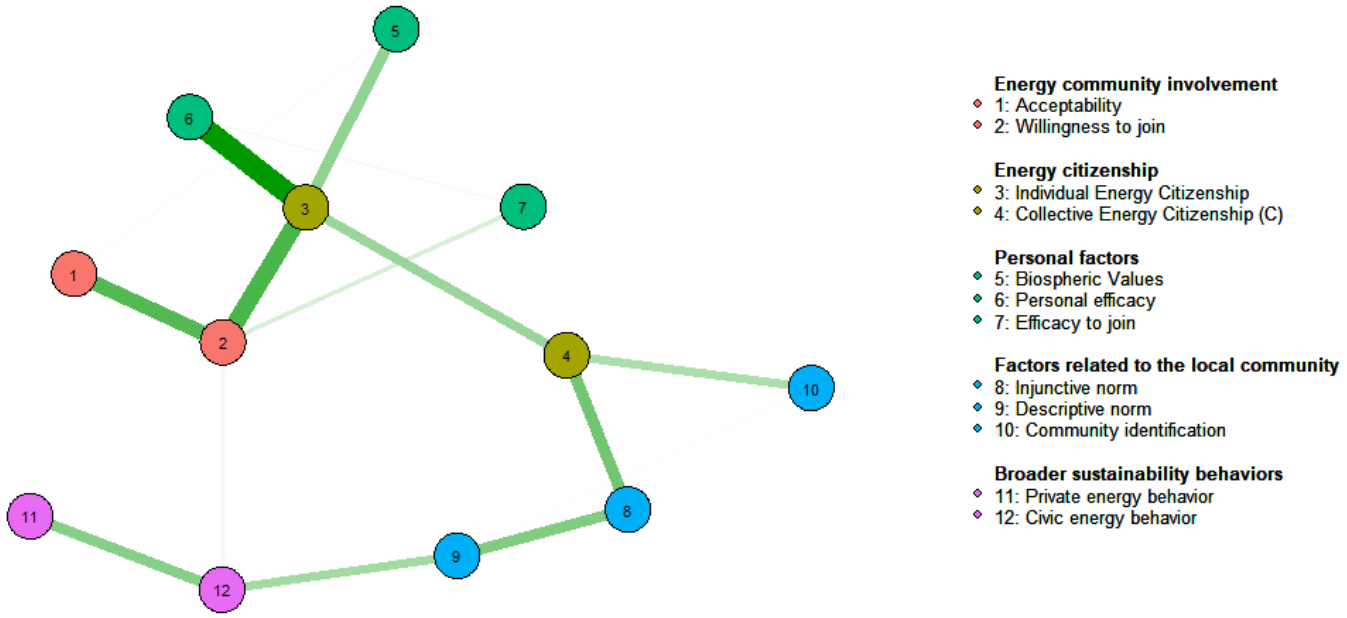


Figure 7 shows a somewhat similar pattern to the Dutch panel data, with acceptability and willingness to join being positively correlated with energy citizenship on the individual rather than the collective level. Also here we find willingness to join but not acceptability to be correlated with efficacy to join the energy community and no association with any of the other measures. Individual energy citizenship with all personal factors and collective energy citizenship on the local community levels relates most strongly with the local community factors. Of the sustainable energy behaviours, only civic behaviours are (weakly) related to willingness to join.

Figure 7. Visualisation of partial bivariate scale relationships (r > 0.05) with Gaussian Graphs, based on the unaware non-member sample from Panel ES at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

Aware non-members of an energy community at T1

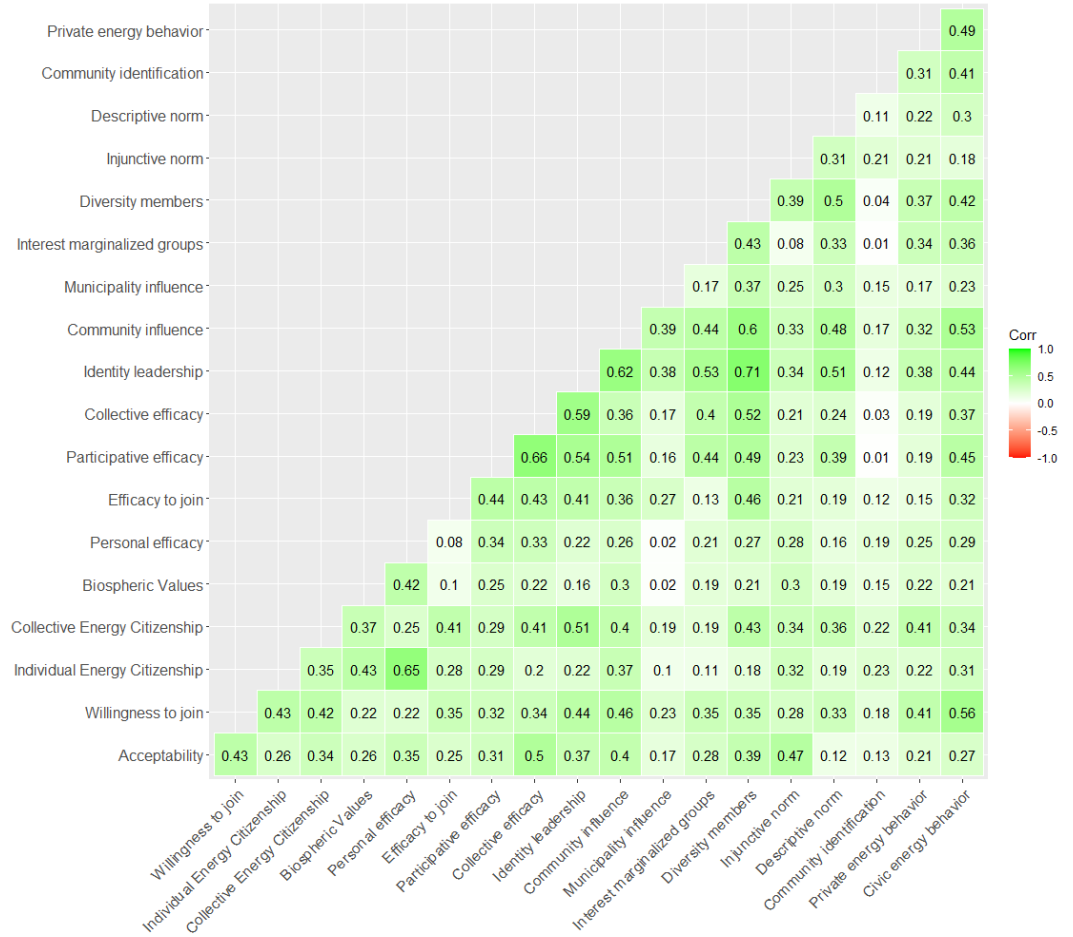
Among aware non-members, as expected, again both individual and collective energy citizenship are correlated with willingness to join an energy community and acceptability (r >= .30), except for individual energy citizenship and acceptability (Table 19).

Furthermore, we find all personal factors to be positively related to acceptability and willingness to join (r >= .30), except for biospheric values. Of the factors related to the energy community, collective efficacy, identity leadership, perceived community influence, and the perceived diversity of members are positively correlated with both acceptability and willingness to join (r >= .30). Yet we generally do not find factors related to the local community to be related to both indicators of involvement except for injunctive norms and acceptability and descriptive norms and willingness to join.

Finally, acceptability is only weakly associated with broader sustainability behaviours whereas willingness to join is strongly correlated with civic energy behaviour (r >= .50) and private energy behaviour (r >= .30)[10].

[10] Due to multicollinearity we could not assess the relative associations between factors with Gaussian models.

Table 19. Correlations aware non-members Panel ES at T1

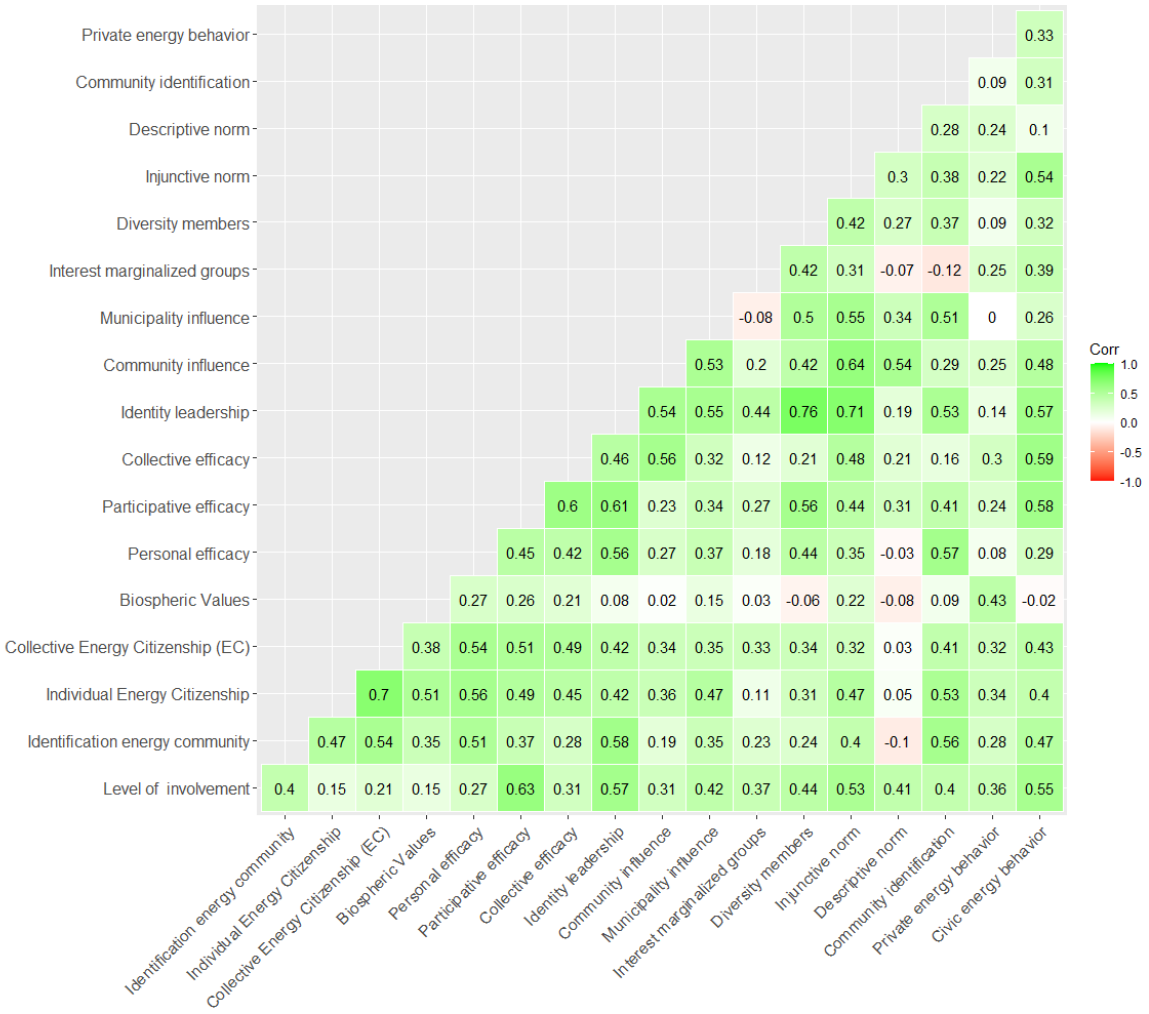


Aware members of an energy community at T1

Among members, level of involvement is weakly correlated with both individual and collective energy citizenship, whereas identification with the energy community is strongly correlated with collective energy citizenship (r >= .50) and to a medium degree with individual energy citizenship (r >= .30) (see Table 20[11]). Furthermore, while level of involvement is only weakly associated with the personal factors except for participative efficacy, identification with the energy community is medium to strongly correlated with all personal factors. Both indicators of level of involvement are strongly correlated with identity leadership (r >= .50), yet while level of involvement in the energy community is correlated to a medium degree to all other factors related to the energy community and the local community (r >= .30), identification with the energy community is only strongly correlated with the factors related to the local community except for the descriptive norm, yet it shows weak correlations with collective efficacy, community influence, the perceived inclusion of the interests of marginalised groups and perceived diversity of members (r >= .10). Both private and civic behaviours are to a medium or strong degree related to the level of involvement, identification with the energy community and energy citizenship at both levels (r >= .30).

[11] N = 29 and as such results need to be interpreted with caution.

Table 20. Correlations members Panel ES at T1



4.3 Buurkracht (Netherlands)

From the descriptives in Table 21, we observe a more mixed pattern between subsamples compared to the panel studies. Contrary to our findings from the Dutch panel data we did not find any differences between unaware and aware non-members of a Buurkracht (BK) initiative on individual energy citizenship, yet among those aware of a BK initiative in their neighbourhood, we do find individual energy citizenship was significantly higher among members than non-members. As expected, we do again find collective energy citizenship to be significantly higher among aware non-members compared to unaware non-members. As expected we find personal efficacy to be significantly higher among members compared to non-members. In addition, we find that those aware of a BK initiative feel more efficacious to join, and identify more with the neighbourhood compared to those unaware. Yet, similar to the Dutch panel data, but contrary to our expectations, we find that those aware of a BK initiative assume less participation of the local community in the energy community (descriptive norm).

Among those aware we again find participative efficacy to be higher among members compared to non-members, members more strongly feel that the energy community can contribute to a sustainable and just energy transition (collective efficacy), that the initiative is represents the community (identity leadership), feel that the inhabitants of the local community

have influence on the BK initiative, perceive the initiative as including the interests of marginalised groups more strongly, and perceive stronger approval from their local community of the energy community (injunctive norm). Members do not score significantly higher on municipality influence, perceived diversity of members, the descriptive community norms or community identification, compared to non-members.

Contrary to the panels, we did not find a difference in private or civic energy behaviours between those aware or unaware of a BK initiative. Yet, again we did find that among those aware of a BK initiative, members scored higher on civic energy behaviours compared to non-members.

Table 21. Means and standard deviations per subsample BK at T1

Variable	Total	Unaware		Aware			
				Non-Member		Member	
		N = 257-418		*N* = 109-215		*N* = 62-115	
	α/ r_{sb}	*M*	*SD*	*M*	*SD*	*M*	*SD*
Acceptability	-	4.91[a]	1.42	5.38[b]	1.40	-	-
Willingness to join	.87	4.35[a]	1.18	4.13[a]	1.45	-	-
Level of involvement	-	-	-	-	-	3.83	2.11
Identification energy community		-	-	-	-	4.58	1.29
Individual Energy Citizenship	.85	5.19[a]	0.86	5.11[a]	0.91	5.48[b]	0.89
Collective Energy Citizenship (Ecom)	.92	-	-	-	-	5.20	1.08
Collective Energy Citizenship (C)	.93	4.37[a]	1.08	4.59[b]	0.98	-	-
Biospheric Values	.85	5.41[a]	1.25	5.29[a]	1.17	5.27[a]	1.47
Personal efficacy	-	4.56[a]	1.52	4.55[a]	1.52	5.05[b]	1.52
Efficacy to join	-	4.92[a]	1.29	5.08[a]	1.58	-	-
Participative efficacy	.92	-	-	4.13[a]	1.38	4.70[b]	1.28
Collective efficacy	.90	-	-	4.56[a]	1.35	5.02[b]	1.24
Identity leadership	.86	-	-	4.32[a]	1.06	4.86[b]	1.07
Community influence	-	-	-	3.99[a]	1.32	4.50[b]	1.40
Municipality influence	-	-	-	4.54[a]	1.35	4.58[a]	1.39
Inclusion marginalised groups	-	-	-	4.20[a]	1.06	4.51[b]	1.15
Diversity members	-	-	-	3.78[a]	1.24	4.01[a]	1.49
Injunctive norm	-	4.68[a]	1.24	4.74[a]	1.23	5.14[b]	1.25
Descriptive norm	-	4.14[a]	1.29	3.14[b]	1.31	3.42[b]	1.43
Community identification	-	4.52[a]	1.39	4.87[b]	1.44	5.00[b]	1.28
Private energy behaviour	.54	4.85[a]	1.30	5.10[a]	1.16	5.26[b]	1.18
Civic energy behaviour	.81	2.19[a]	1.28	2.30[a]	1.18	3.00[b]	1.57

Note. Ecom = energy community; C = local region. Involvement and energy citizenship (main outcomes) in blue, individual factors in purple, collective factors at the level of the energy community in yellow, collective factors at the level of the local region in orange, and energy behaviours in green. Superscripts indicate significant mean differences based on (Welch) T-test or (Welch) ANOVA with either Tukey or Games Howell post-hoc test.

Effects of T1 energy community awareness and involvement on individual energy citizenship over time

As displayed in Table 22, individual energy citizenship at T1 and T2 correlate, and both also correlate with energy community membership at T1 but not awareness. Regression analyses show that energy citizenship does not change over time. Only membership T1 is related to energy citizenship, and this effect is not moderated by time, implying that the effect of membership remains equally strong over time (Table 23)[12].

Table 22. Correlations EC² outcome measures at T1 and individual EC at T2

		1	2	3
1	Individual EC T1			
2	Individual EC T2	.661**		
3	Awareness T1	.030	.015	
4	Membership T1	.136**	.130	.475**

Note: ** $p < .01$, * $p < .05$

Table 23. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure)

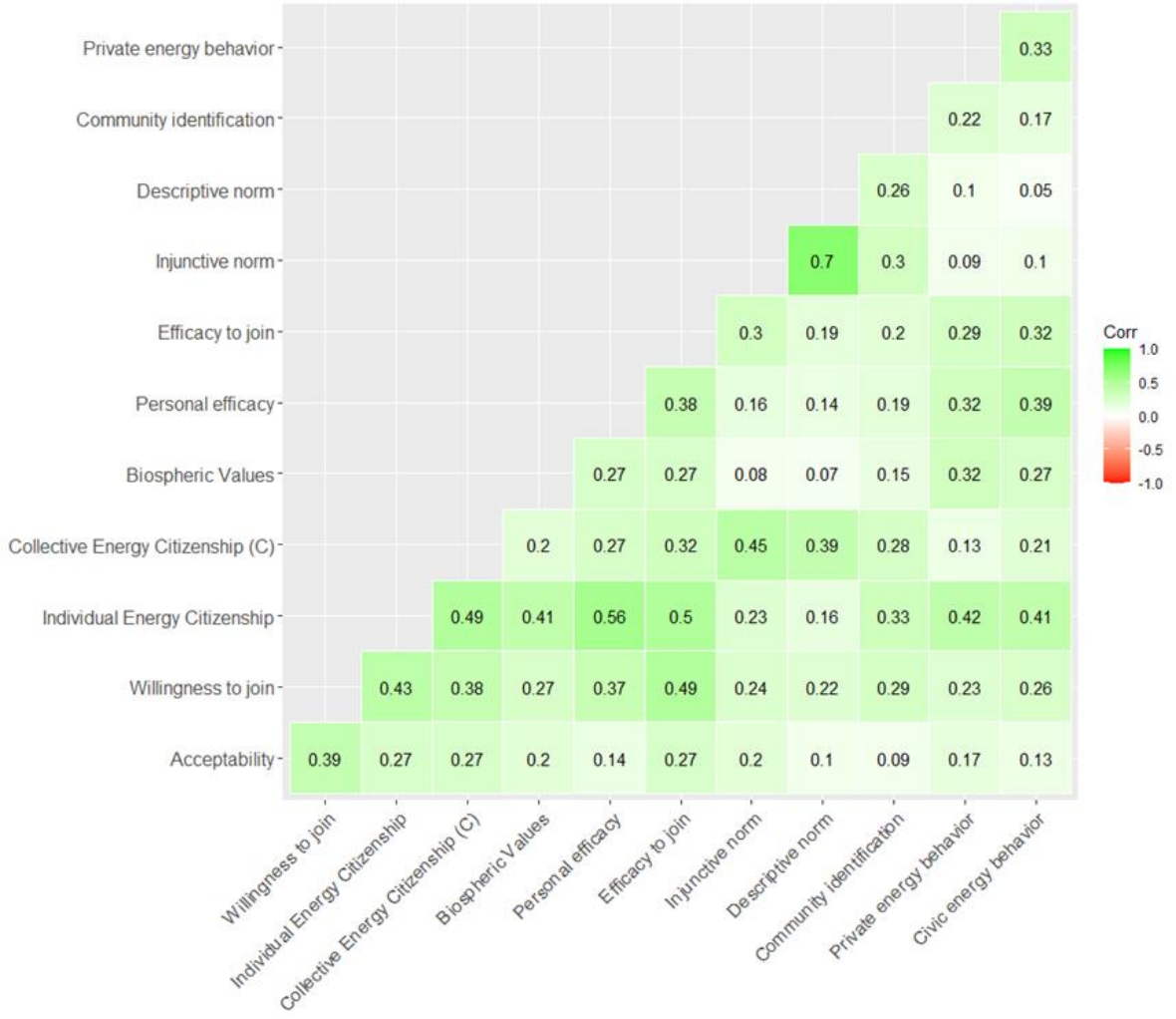
	Individual energy citizenship		
	b (SE)	**95%CI**	***p***
Intercept	5.19 (.04)	5.10; 5.26	.000
Time (T2-T1)	-.09 (.09)	-.27; .09	.327
Awareness_T1	-.08 (.07)	-.22; .06	.284
Membership_T1	.37 (.10)	.18; .57	<.001
Awareness_T1*time	.13 (.15)	-.17; .42	.398
Membership_T1*time	-.19 (.18)	-.55; .16	.286

People unaware of a BK initiative at T1

Bivariate correlations in Table 24 show that, among the people unaware of a BK initiative, similar to the panels, collective and individual energy citizenship related strongly to willingness to join a BK initiative ($r >= .30$), yet, contrary to our findings from the panels, only weakly to acceptability ($r >= .10$). In addition, both indicators of involvement merely correlated weakly with all other personal and community factors in our model except for efficacy to join, personal efficacy, community identification and willingness to join ($r >= .30$). Willingness to join, acceptability and collective energy citizenship at the level of local community also only weakly correlated with both private and civic energy behaviours while we did find individual energy citizenship to be correlated to a medium degree with both behaviours.

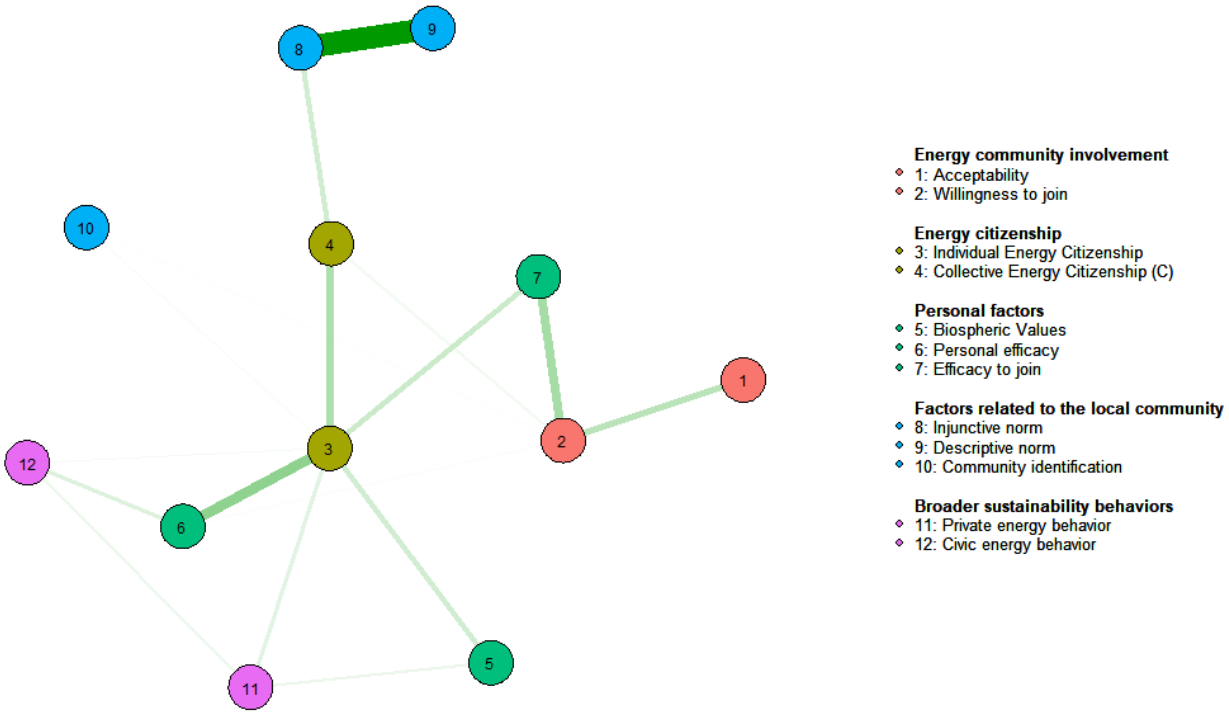
[12] Due to the limited number of members at T3 we only tested for effects between T1 and T2

Table 24. Correlations unaware non-members BK at T1



When looking at the partial correlation shown in Figure 8, contrary to our expectations, there is no direct partial correlation between acceptability of and willingness to join a BK initiative and individual energy citizenship and only a weak partial correlation to collective energy citizenship. Again, as in the panels, willingness to join is quite strongly correlated with efficacy to join the energy community whereas acceptability only seems indirectly related to other factors via willingness to join. Individual energy citizenship in turn is again correlated with all personal factors (i.e., biospheric values) and collective energy citizenship with the local community factors except for community identification. Both private energy behaviour and civic energy behaviour are only weakly correlated with individual energy citizenship but not to any of the other outcomes.

Figure 8. Visualisation of partial bivariate scale relationships (r > 0.05) with Gaussian Graphs, based on the unaware non-member sample from BK at T1

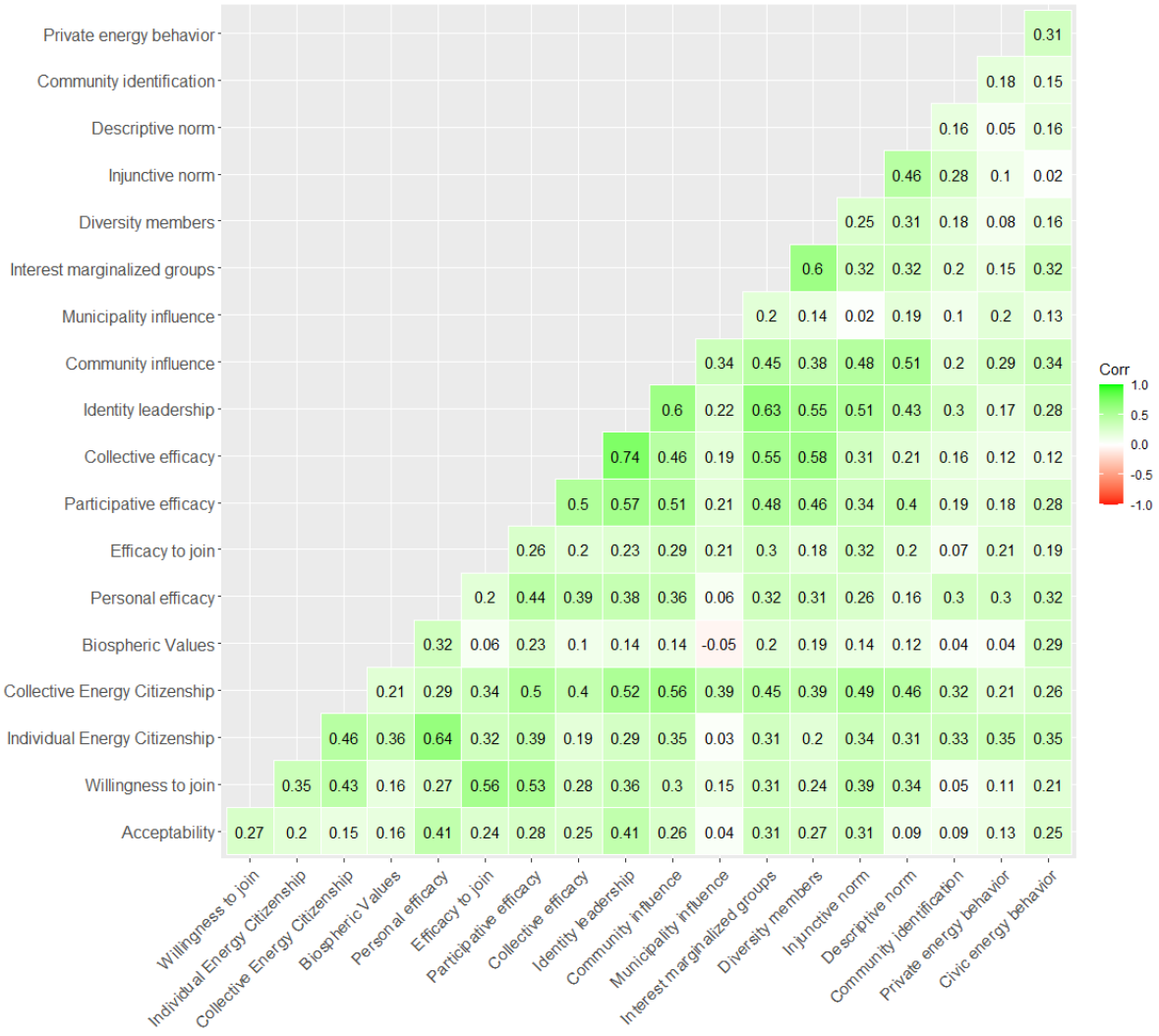


Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

Aware non-members of a BK initiative at T1

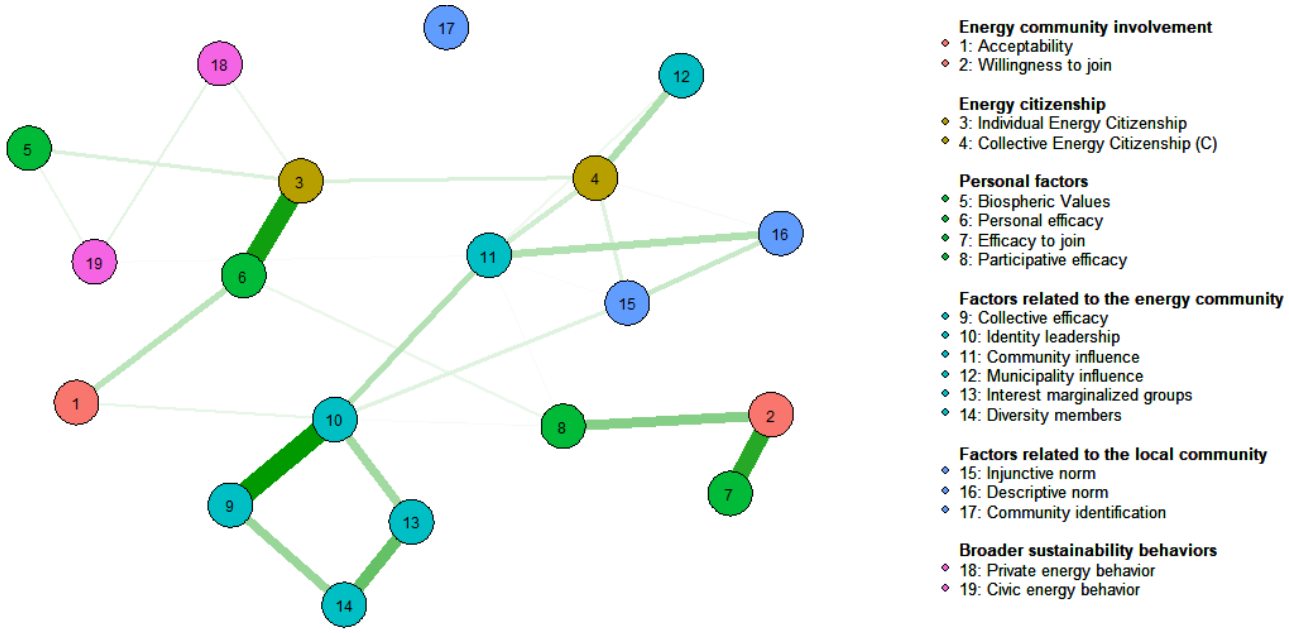
Among aware non-members of a BK initiative, individual and collective energy citizenship were both correlated with willingness to join (r >= .30), yet less with acceptability (r >= .10; see Table 25). Of the personal factors, again efficacy to join and participative efficacy were strongly correlated with willingness to join (r >= .50), while only personal efficacy was associated with acceptability (r >= .30). Furthermore, the energy community characteristics, similar to the Spanish panel, mainly identity leadership, community influence, and taking the interest of marginalised groups into account were associated with both acceptability and willingness to join (r >= .30). Again, we did not find factors related to the local community to be correlated with both indicators of involvement except for injunctive norms with acceptability and descriptive norms with willingness to join. Finally, both private and civic behaviours are only weakly related to acceptability, willingness to join and collective energy citizenship while individual energy citizenship is positively associated with both (r >= .30).

Table 25. Correlations aware non-members BK at T1



When looking at the partial correlations as shown in Figure 9, again, we find no direct correlation between both levels of energy citizenship, acceptability and willingness to join. Also here, willingness to join is directly related to the personal factors efficacy to join and participative efficacy while acceptability shows a partial correlation with personal efficacy and identity leadership. Again, we find individual energy citizenship to be correlated with personal factors (i.e., biospheric values and personal efficacy) while collective energy citizenship is again related to both community and municipality influence and local community norms. Interestingly, all factors related to the energy community are strongly clustered while we observe a less clear pattern among the personal factors. Again, private energy behaviour is correlated to individual energy citizenship but not directly to any of the other outcomes.

Figure 9. Visualisation of partial bivariate scale relationships (r > 0.05) with Gaussian, based on the aware non-member sample from BK at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

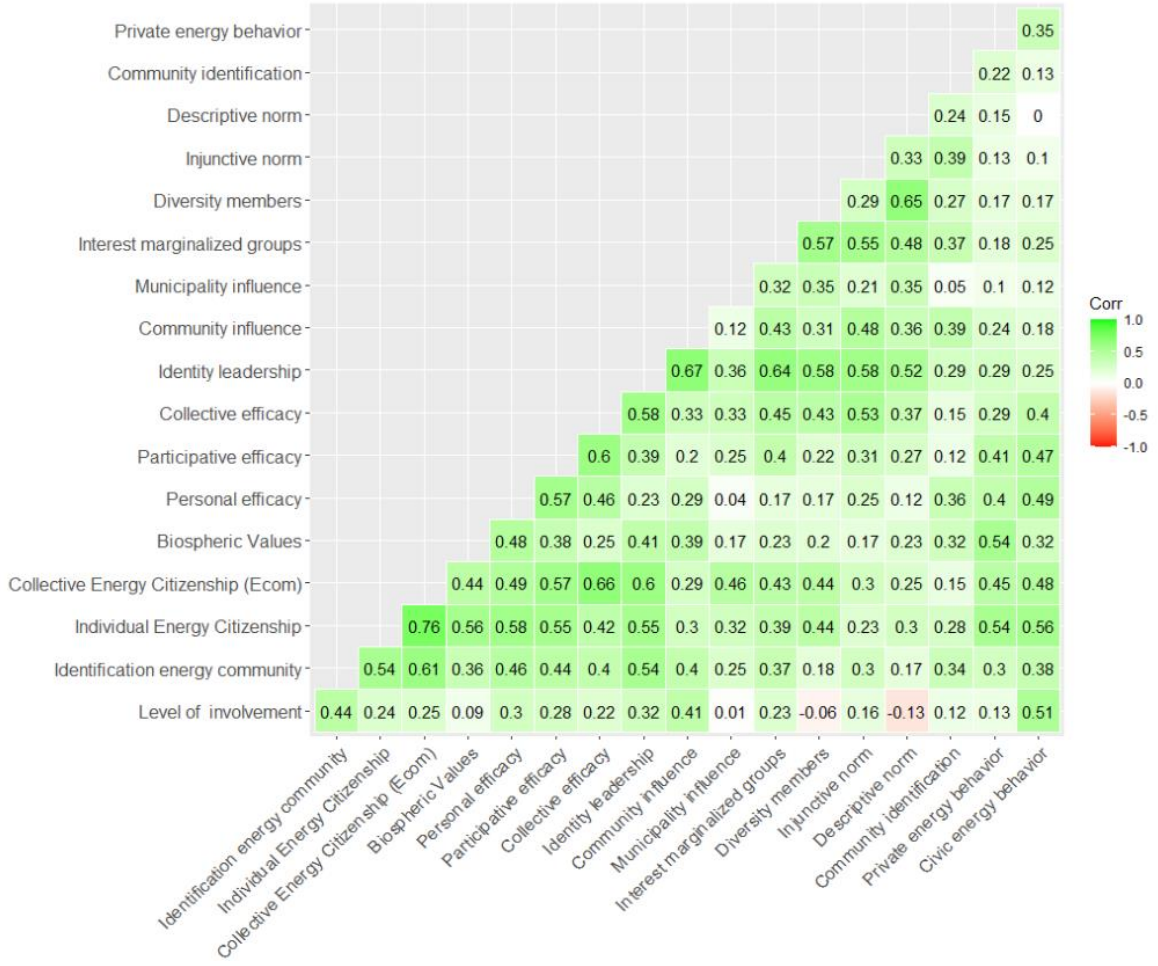
Aware members of a BK initiative at T1

Among members (see Table 26), similar to the Spanish panel, level of involvement is only weakly correlated with both indicators of energy citizenship (r >= .10) whereas identification with the energy community correlated strongly with energy citizenship (r >= .50).

Furthermore, both indicators of level of involvement correlated to a medium degree with all personal factors except for biospheric values, and to collective efficacy and identity leadership. Of the set-up features, both community influence and the perceived inclusion of the interest of marginalised groups (r >= .30) are related to the level of involvement and identification with the energy community, while we do not find municipality involvement and perceived diversity of members to be related. Of the factors related to the local community, we only find both the perceived injunctive norm and identification with the energy community to be related to identification with the energy community but none of these factors seem to be associated with level of involvement. In fact, we find a small negative correlation between the perceived descriptive community norm and level of involvement.

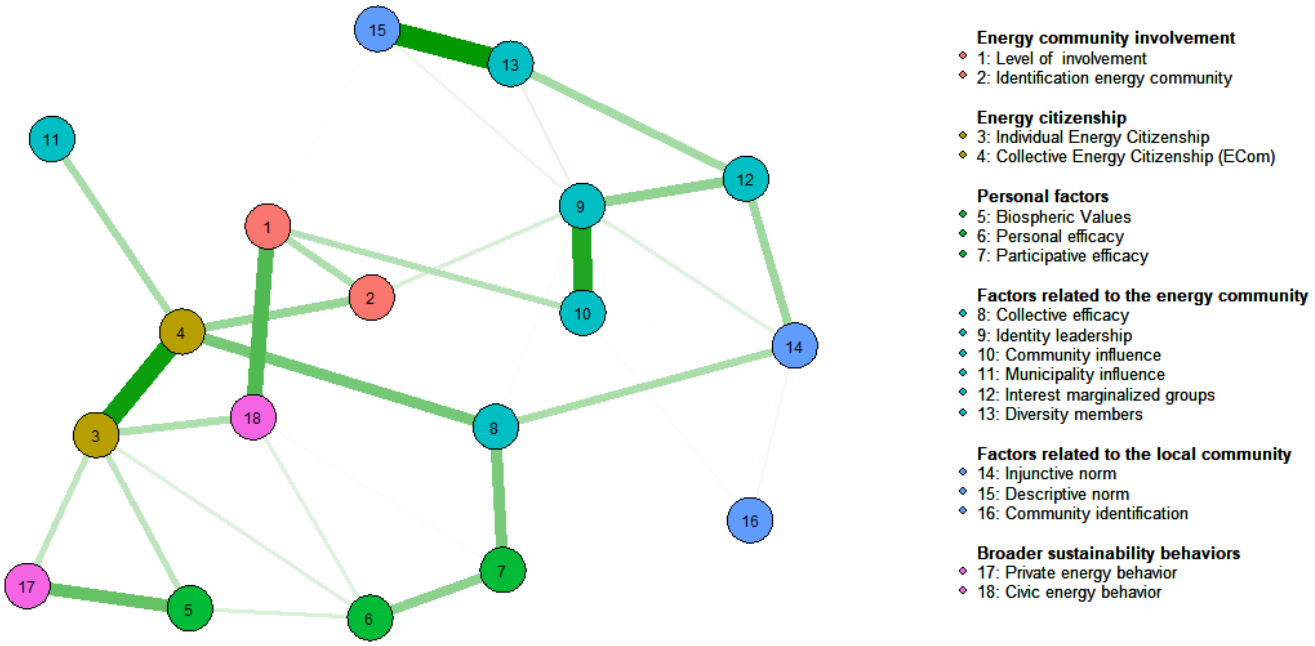
Finally, both private energy behaviour and civic behaviour are positively related to involvement (r >= .30) except for private energy behaviour and level of involvement.

Table 26. Correlations members BK at T1



Looking at the partial correlations plot (Figure 10) we observe a much more connected picture compared to the members among the Dutch panel data. Here, as expected, we do find collective energy citizenship to be related to identification with the energy community, while we only find the other outcomes to be indirectly related to each other. We do not find any of the personal factors to be directly correlated to involvement. Identification with the energy community is most strongly connected to identity leadership whereas level of involvement is most strongly connected to perceived community influence. Again, individual energy citizenship is related mostly to personal factors (although more indirectly here) whereas collective energy citizenship is mostly related to some of the factors related to the energy community. Finally, level of involvement is strongly related to civic energy behaviour whereas private energy behaviour is only (directly) related to individual energy citizenship but not to any of the other outcomes.

Figure 10. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from BK at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

4.4 Global Ecovillage Network (GEN) (Europe)

Table 27. Means and standard deviations per subsample GEN at T1

Variable	Total	Member *N* = 151-180	
	α/ r_{sb}	*M*	*SD*
Level of involvement	-	5.47	1.58
Identification energy community	-	5.37	1.40
Individual Energy Citizenship	.79	5.70	0.73
Collective Energy Citizenship (Ecom)	.89	5.61	0.83
Biospheric Values	.83	5.91	1.09
Personal efficacy	-	5.24	1.22
Participative efficacy	.93	5.42	1.14
Collective efficacy	.88	5.45	1.11
Identity leadership	.80	4.03	1.18
Community influence	-	2.74	1.63
Municipality influence	-	3.11	1.62
Inclusion marginalised groups	-	5.04	1.21
Diversity members	-	4.13	1.83
Injunctive norm	-	4.54	1.35
Descriptive norm	-	2.53	1.49
Private energy behaviour	.50	5.00	1.29
Civic energy behaviour	.78	3.26	1.41

Note. Ecom = energy community; C = local region. Involvement and energy citizenship (main

outcomes) in blue, individual factors in purple, collective factors at the level of the energy community in yellow, collective factors at the level of the local region in orange, and energy behaviours in green. Superscripts indicate significant mean differences based on (Welch) T-test or (Welch) ANOVA with either Tukey or Games Howell post-hoc test.

Effects of individual energy citizenship over time

As displayed in Table 28, regression analyses show that individual energy citizenship does not change over time among members of GEN[13].

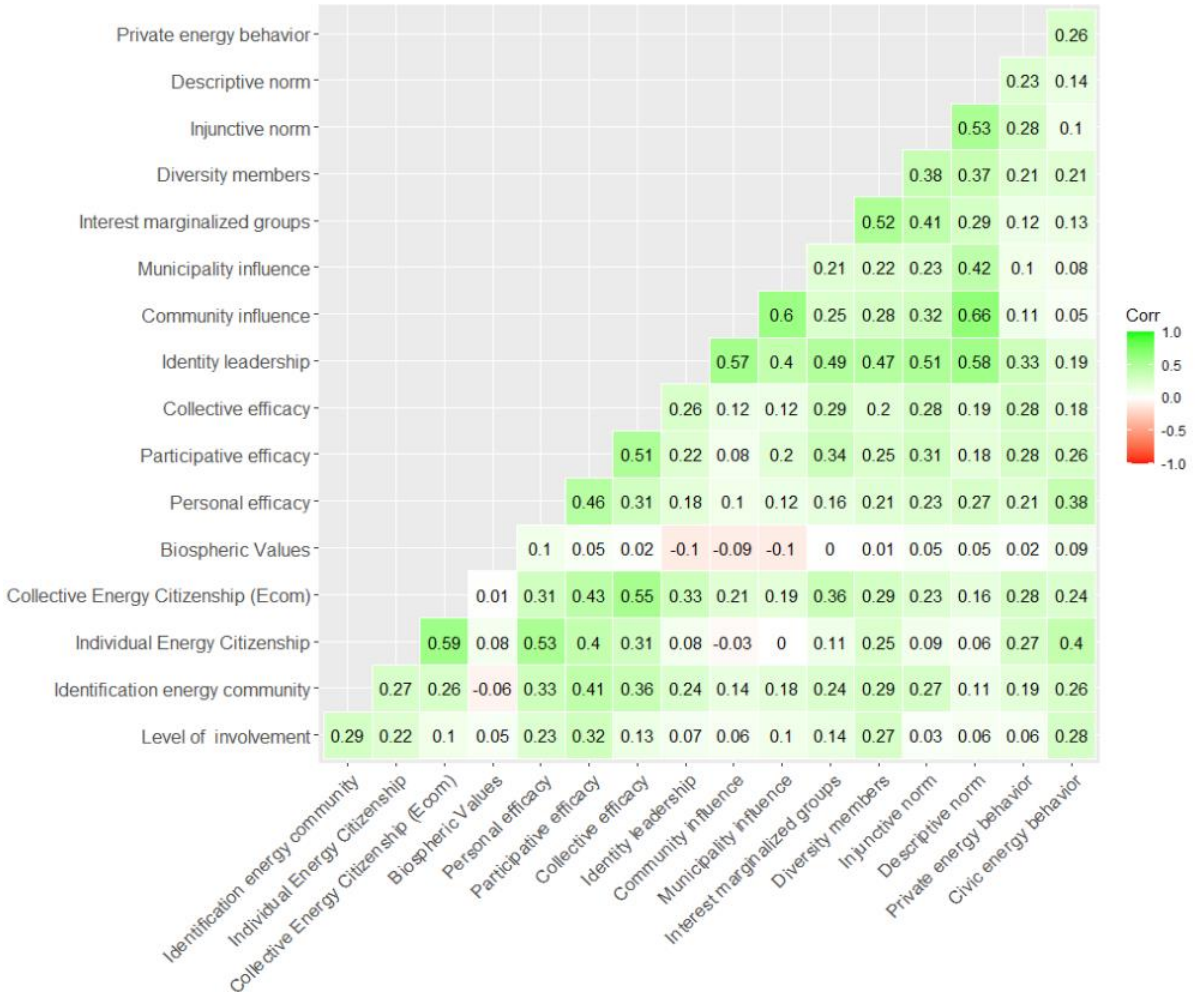
Table 28. Mixed-model regression of awareness and membership on individual energy citizenship and the interaction with time (time as repeated measure)

	Individual energy citizenship		
	b (SE)	**95%CI**	***p***
Intercept	5.70 (.05)	5.60; 5.81	<.001
Time (T2-T1)	-.12 (.10)	-.32; .08	.217

Both levels of involvement and identification with the ecovillage show medium correlations with individual and collective energy citizenship (see Table 29). Furthermore, both indicators of involvement are associated with participative efficacy, while identification with the ecovillage is also associated with personal efficacy (r >= .30). Yet, contrary to our expectations, all other personal factors and all collective and community factors are only weakly correlated with level of involvement or identification with the ecovillage. In addition, both indicators of involvement are only weakly associated with broader sustainability behaviours.

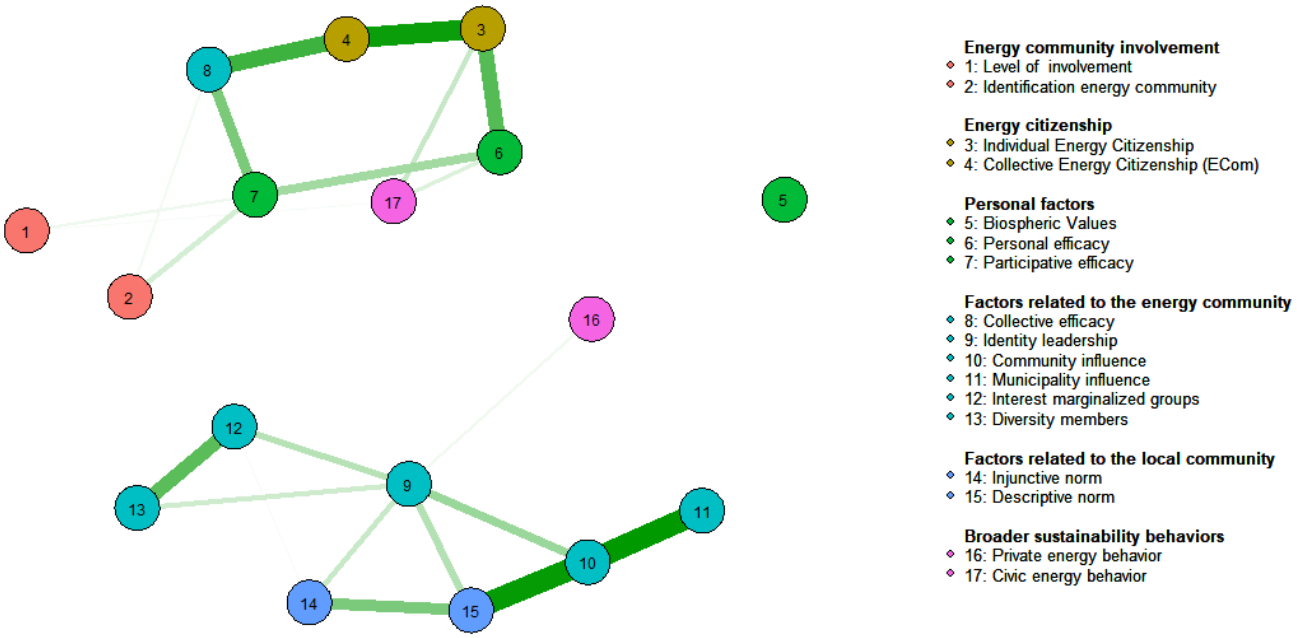
[13] We additionally ran a random intercept model with members being nested in ecovillages, yet this did not alter our estimates substantially, as intra-class correlations (ICC) were low (below .05).

Table 29. Correlations members GEN at T1



When looking at the partial correlations as shown in Figure 11, we do not find the level of involvement and identification with the ecovillage to correlate directly with individual and collective energy citizenship. We do again find that the level of involvement and identification with the ecovillage are correlated with participative efficacy but not with any of the other factors. Individual and collective energy citizenship have a strong partial correlation with personal efficacy, collective efficacy of the ecovillage, and civic energy behaviours but not to private behaviours. Interestingly, there seems to be a complete disconnect between the set-ups features of ecovillages and our outcomes.

Figure 11. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from GEN at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

4.5 Energy Communities Europe

Table 30. Means and standard deviations per subsample EU Ecom at T1

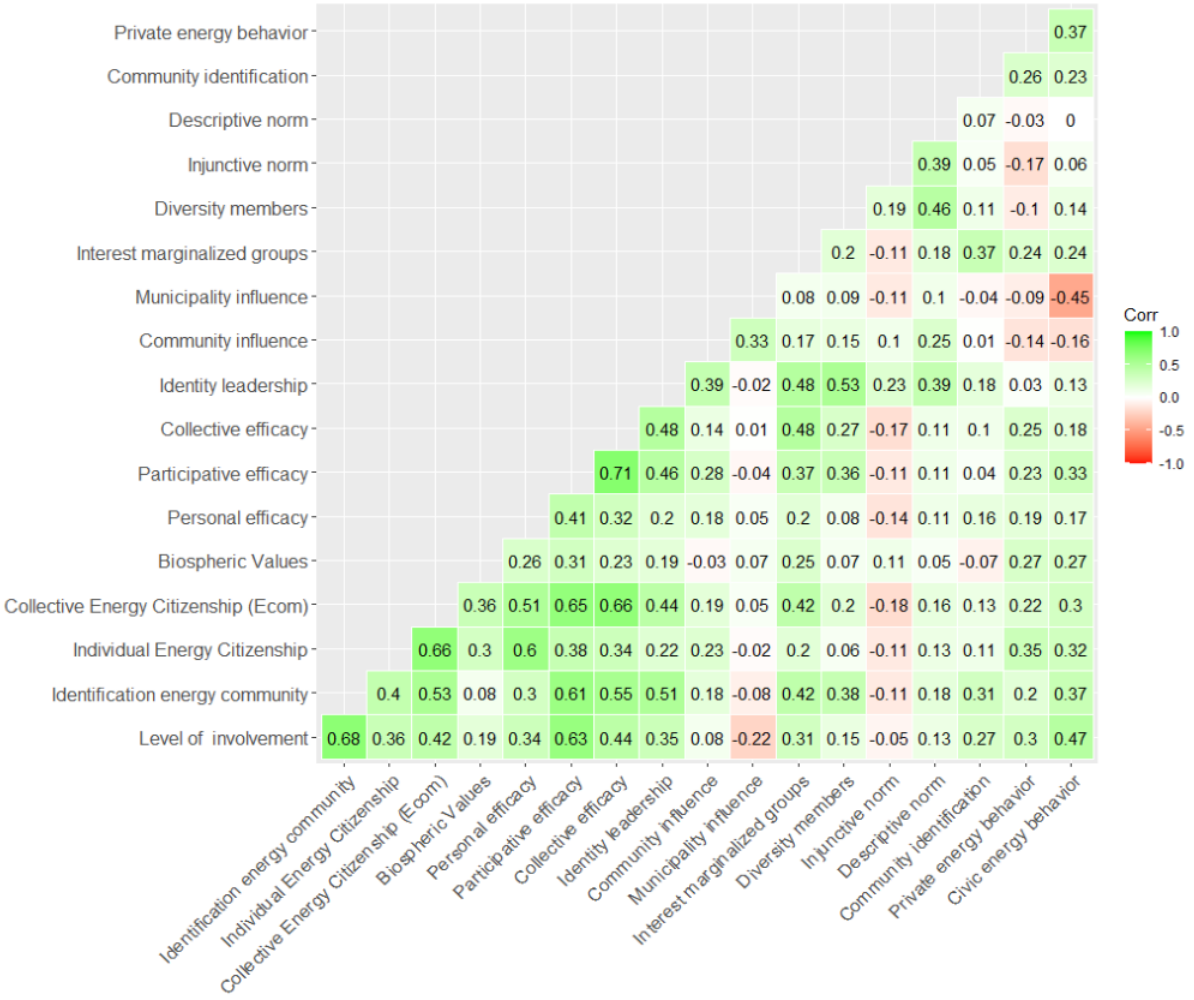
Variable	Total	Member *N* = 78-132	
	α/ r$_{sb}$	*M*	*SD*
Level of involvement	-	3.65	2.10
Identification energy community	-	5.00	1.43
Individual Energy Citizenship	.81	5.85	0.70
Collective Energy Citizenship (Ecom)	.93	5.84	0.84
Biospheric Values	.94	5.72	1.01
Personal efficacy	-	5.28	1.32
Participative efficacy	.79	5.33	1.15
Collective efficacy	.91	5.44	1.13
Identity leadership	.89	4.56	1.08
Community influence	-	3.84	1.51
Municipality influence	-	4.50	1.43
Inclusion marginalised groups	-	4.74	1.37
Diversity members	-	4.07	1.57
Injunctive norm	-	4.57	1.25
Descriptive norm	-	2.63	1.20
Community identification	-	4.94	1.16
Private energy behaviour	.57	5.04	1.22
Civic energy behaviour	.72	4.22	1.28

Note. Ecom = energy community; C = local region. Involvement and energy citizenship (main outcomes) in blue, individual factors in purple, collective factors at the level of the energy community in yellow, collective factors at the level of the local region in orange, and energy behaviours in green. Superscripts indicate significant mean differences based on (Welch) T-test or (Welch) ANOVA with either Tukey or Games Howell post-hoc test.

Bivariate correlations in Table 31 show again medium to strong correlations between level of involvement and identification with the energy community and individual and collective energy citizenship. Furthermore, both personal and, particularly strongly, participative efficacy are associated with level of involvement and identification with the energy community, but not biospheric values. Both levels of involvement and identification with the energy community are also medium to strongly correlated with collective efficacy, identity leadership, the perceived inclusion of marginalised groups and perceived diversity of members while we do not find perceived community or municipality involvement to matter much. In fact, interestingly, municipal influence correlates negatively with level of involvement and, to a lesser extent, identification with the energy community.

Finally, level of involvement and identification with the ecovillage are correlated with both indicators of broader sustainability behaviours (r >= .30), yet the latter is only weakly correlated with private energy behaviours.

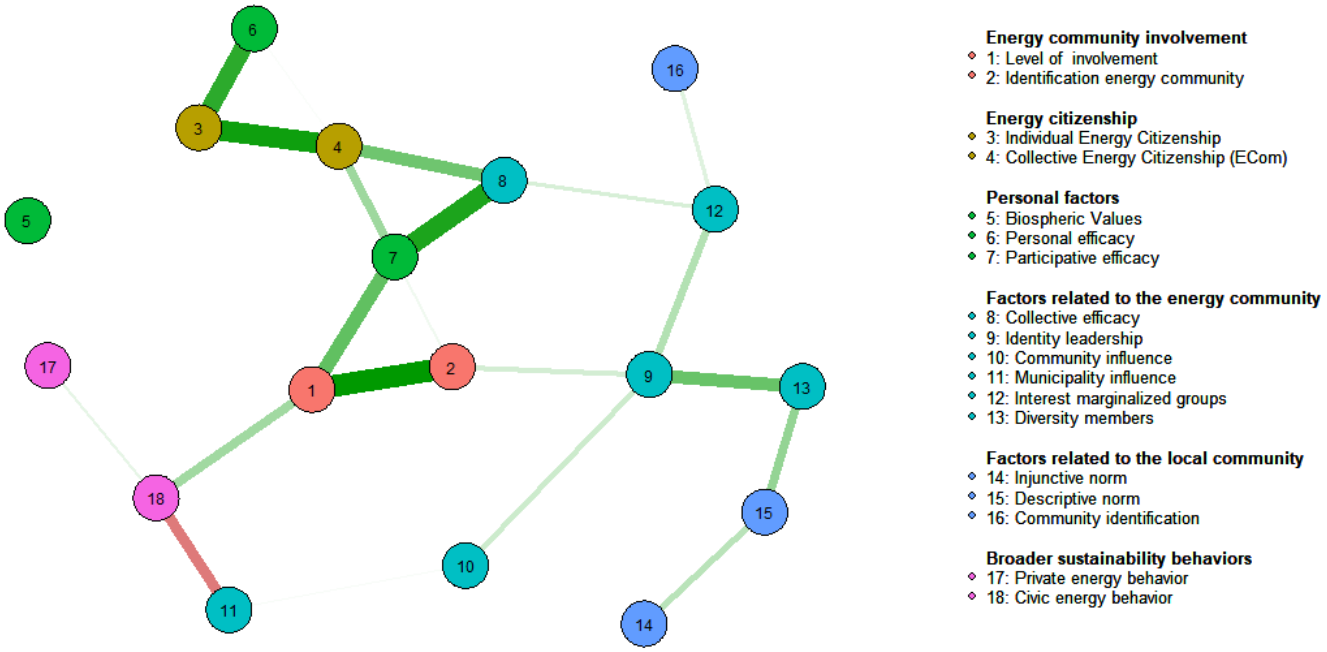
Table 31. Correlations members EU Ecom at T1



Again, when looking at the partial correlations as shown in Figure 12, we do not find the level of involvement and identification with the ecovillage to correlate directly with individual and collective energy citizenship. Again, level of involvement is strongly correlated with participative efficacy whereas identification with the energy community is mainly related to identity leadership. Here, we only find a strong partial correlation between individual energy citizenship and personal efficacy and, while all factors related to the energy community are associated with each other, we only find collective efficacy to be associated with collective energy citizenship.

Furthermore, level of involvement related quite strongly to civic energy behaviour but not to private energy behaviours. Interestingly, we find a negative partial association between municipality influence and civic energy behaviour. This may be due to the fact that the civic behaviour measure also contains items about protest behaviour, yet we do not find this in any of the other samples.

Figure 12. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the member sample from EU Ecom at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

4.6 Housing Cooperative Wroclaw South (Poland)

Contrary to the findings from the panels and the BK sample, we did not find any significant differences in both individual and collective energy citizenship between the different subsamples (see Table 32) within HCWS. In addition, we do not find any of the personal factors to significantly differ between those aware and those unaware of an energy community. Notably, sample sizes were much smaller here and in fact, we could not conduct further analyses among the members of an initiative within HCWS due to the limited sample size.

We did find that among those aware of an energy community within HCWS, members scored significantly higher on participative efficacy, collective efficacy, identity leadership, and both descriptive and injunctive norms compared to aware non-members. Members and non-members do not seem to differ in their perceived influence of other inhabitants or the municipality, nor do they differ in their perceived diversity of the members of the energy community or the interests of marginalised groups being taken into account. In addition, we do not find any of the factors related to the local community to significantly differ between those aware and those unaware of an energy community. We do find that members within HCWS identify more with other inhabitants of HCWS compared to unaware non-members.

Contrary to our findings in the panels, we did not find a difference between private or civic energy behaviours between subsamples. Notably, civic sustainability behaviour seems particularly low here among all subsamples.

Table 32. Means and standard deviations per subsample HCWS at T1

Variable	Total	Unaware		Aware			
				Non-Member		Member[14]	
		N = 78-89		*N* = 24-37		*N* = 12-19	
	α/ r$_{sb}$	*M*	*SD*	*M*	*SD*	*M*	*SD*
Acceptability	-	5.10[a]	1.14	5.52[a]	1.38	-	-
Willingness to join	.89	4.25[a]	1.19	4.07[a]	1.52	-	-
Level of involvement	-	-	-	-	-	2.50	1.55
Identification energy community		-	-	-	-	4.93	1.33
Individual Energy Citizenship	.91	5.04[a]	1.02	5.18[a]	1.04	5.59[a]	0.78
Collective Energy Citizenship (Ecom)	.97	-	-	-	-	5.82	0.82
Collective Energy Citizenship (C)	.94	4.52[a]	1.16	4.95[a]	1.28	-	-
Biospheric Values	.93	5.13[a]	1.68	5.32[a]	1.44	5.55[a]	1.38
Personal efficacy	-	4.56[a]	1.50	4.58[a]	1.46	5.21[a]	1.23
Efficacy to join	-	4.16[a]	1.47	4.24[a]	1.64	-	-
Participative efficacy	.92	-	-	4.36[a]	1.07	5.14[b]	1.08
Collective efficacy	.82	-	-	4.80[a]	1.14	5.53[b]	0.74
Identity leadership	.89	-	-	4.56[a]	1.09	5.31[b]	0.92
Community influence*	-	-	-	4.03[a]	1.19	4.78[a]	1.63
Municipality influence**	-	-	-	5.00[a]	1.22	5.33[a]	1.14
Inclusion marginalised groups	-	-	-	4.35[a]	1.08	4.78[a]	0.94
Diversity members	-	-	-	4.55[a]	1.39	4.94[a]	0.94
Injunctive norm	-	4.14[a]	1.21	4.61[a]	1.48	5.61[b]	0.70
Descriptive norm	-	2.95[a]	1.34	3.12[a]	1.32	4.11[b]	1.53
Community identification	-	4.27[a]	1.39	4.96[ab]	1.26	5.57[b]	1.60
Private energy behaviour	.45	4.15[a]	1.33	4.21[a]	0.94	4.59[a]	1.01
Civic energy behaviour	.89	1.46[a]	1.01	1.52[a]	0.84	2.06[a]	1.41

Note. Ecom = energy community; C = local region. Involvement and energy citizenship (main outcomes) in blue, individual factors in purple, collective factors at the level of the energy community in yellow, collective factors at the level of the local region in orange, and energy behaviours in green. Superscripts indicate significant mean differences based on (Welch) T-test or (Welch) ANOVA with either Tukey or Games Howell post-hoc test.
*This item was phrased as: "Residents of HCWS have influence on what the community energy initiative stands for and the decisions made" instead of "inhabitants of my local region"
**This item was phrased as: "HCWS has influence on what the community energy initiative stands for and the decisions made" instead of "the municipality/local authorities"

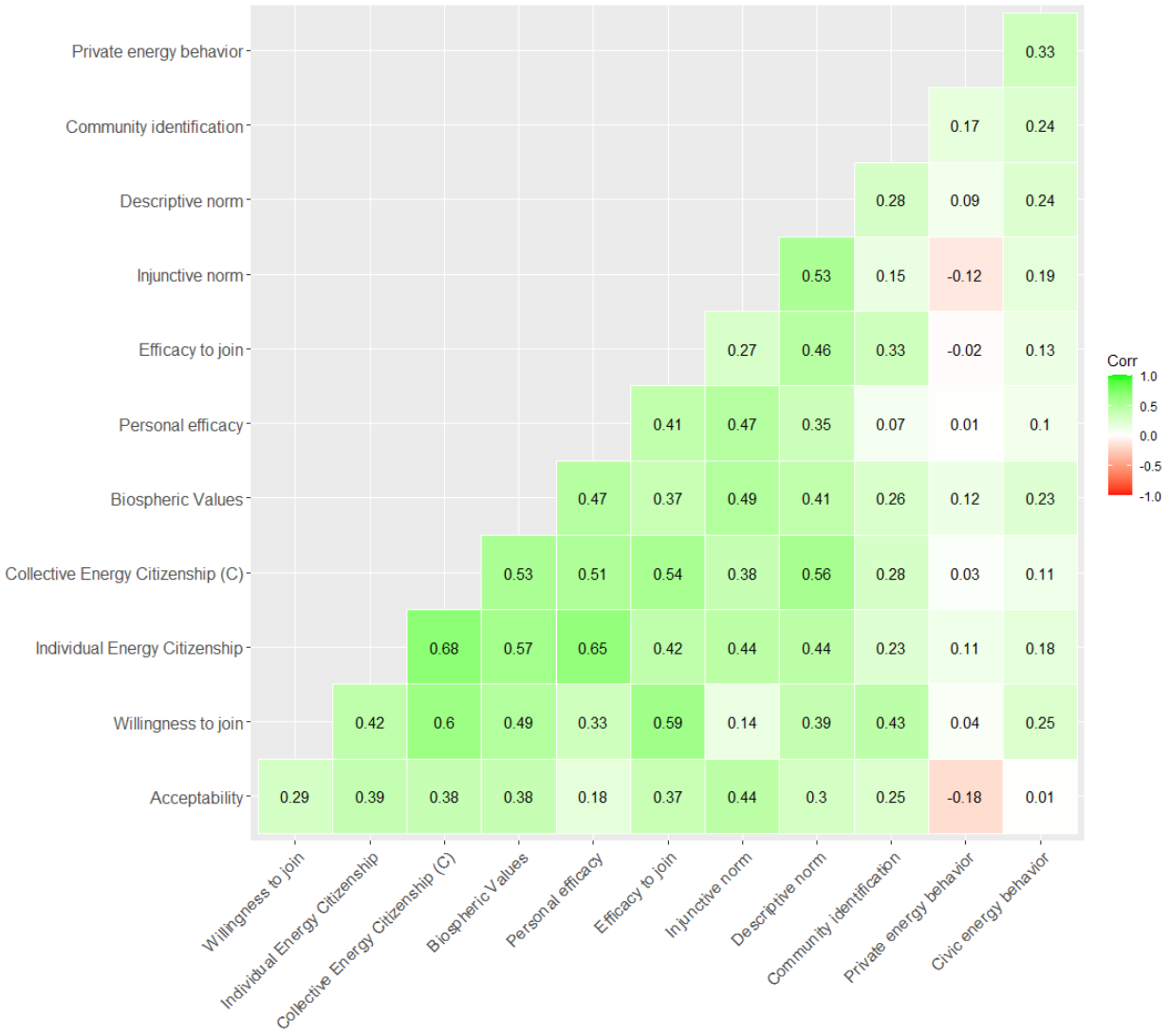
People unaware of an energy community within HCWS at T1

Bivariate correlations (Table 33) show again a medium to strong correlation between individual and collective energy citizenship at the level of the local community and willingness to join and acceptability (*r* >= .30). Furthermore, all individual factors (i.e. biospheric values) and collective factors (i.e. descriptive norms) correlated positively with acceptability of and willingness to join an energy community (*r* >= .30) except for personal efficacy and community identification with acceptability and injunctive norms and willingness to join. Contrary to our expectations, we did

[14] The word "member" was replaced with "participant" in this sample

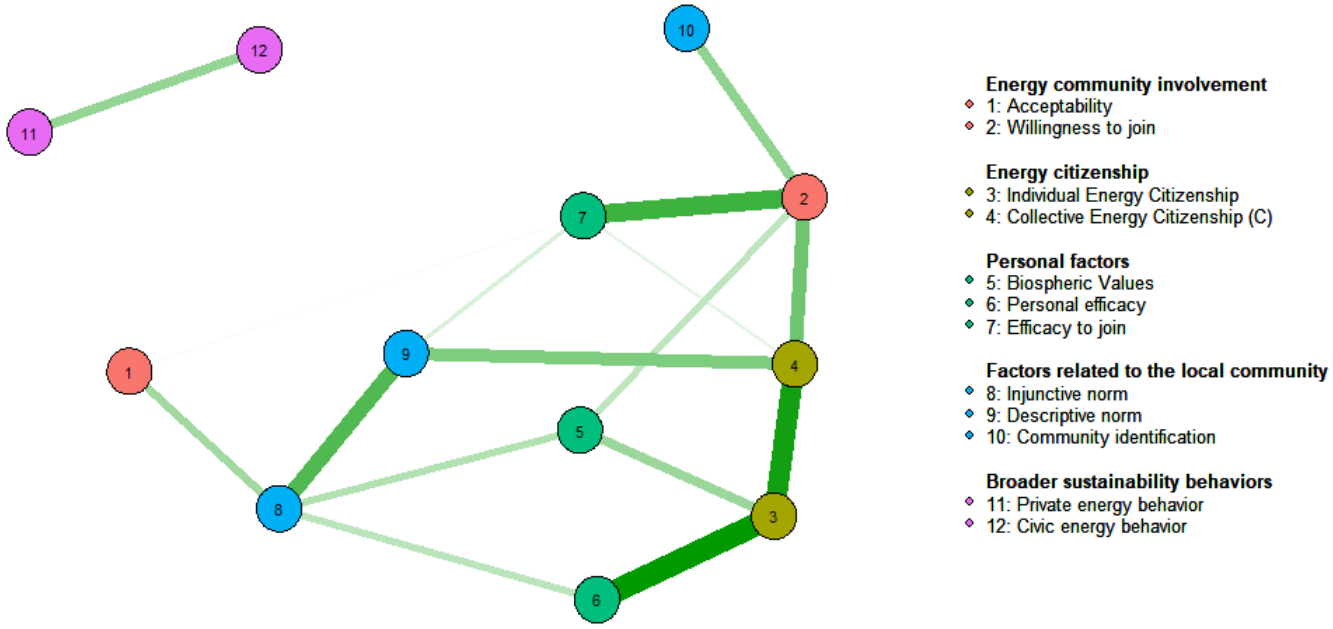
not find any of our outcomes to be associated with either private or civic behaviours and in fact, we find a small to medium negative correlation between private behaviours and acceptability.

Table 33. Correlations unaware non-members HCWS at T1



Partial correlations as shown in Figure 13 indicated that willingness to join is directly related to collective energy citizenship and indirectly to individual energy citizenship via collective energy citizenship. Individual energy citizenship is again associated with mainly personal factors; biospheric values and personal efficacy whereas willingness to join is mainly related to efficacy to join and community identification. Acceptability seems mainly correlated with injunctive community norms. Private and civic energy behaviours only seem to relate to one another but not to any of the outcomes.

Figure 13. Visualisation of partial bivariate scale relationships (r > 0.05) with Gaussian Graphs, based on the unaware non-member sample from HCWS at T1



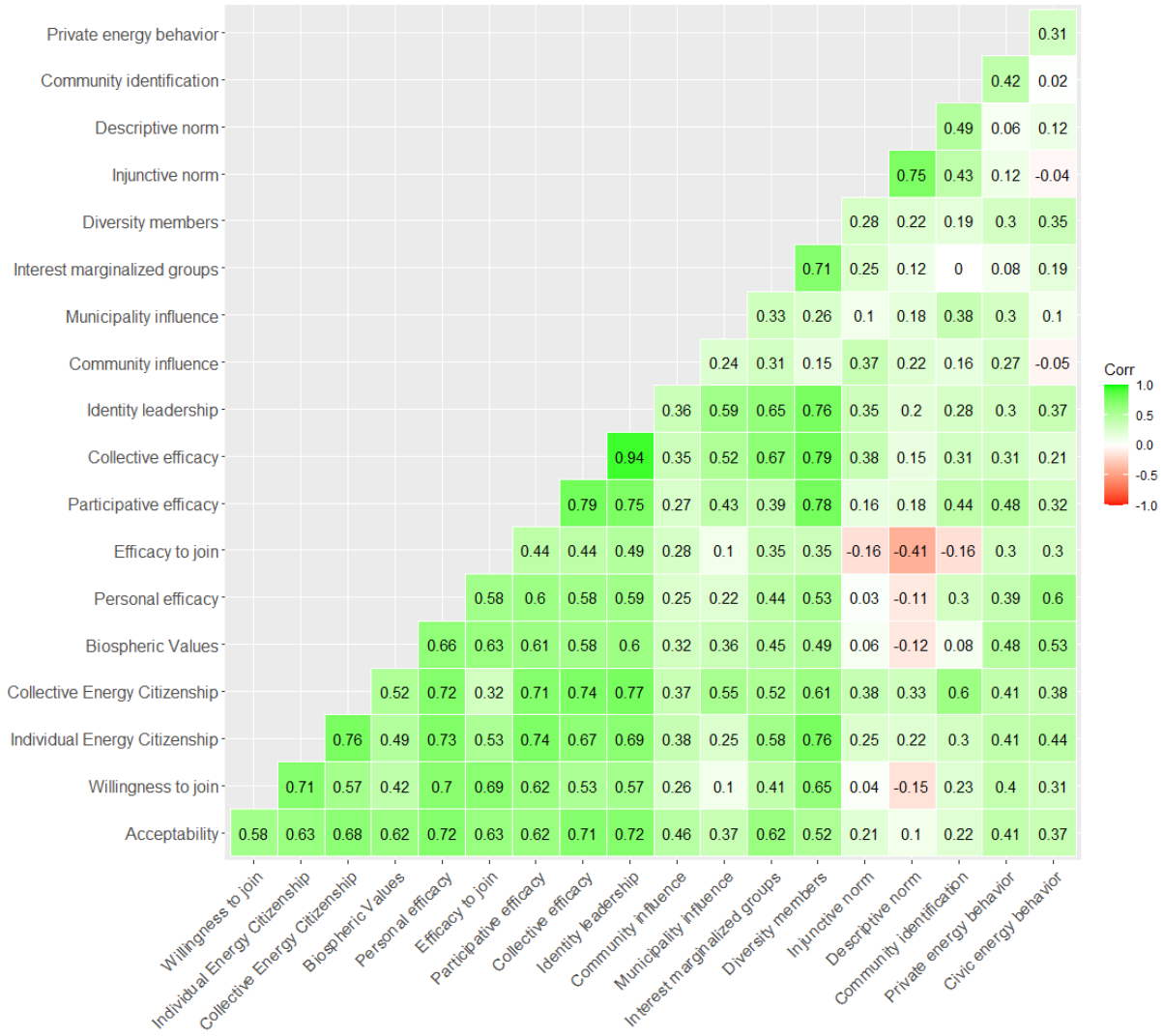
Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

Aware non-participants of an energy community within HCWS at T1

Bivariate correlations in Table 34[15] show particularly strong correlations between individual and collective energy citizenship acceptability and willingness to join (r >= .50). We also observe particularly strong correlations between the personal and collective factors and acceptability and willingness to join. Furthermore, we find medium to strong correlations between all energy community set-up features and both indicators of involvement, yet, as expected we observe only a weak(er) association with municipality involvement. We do not find local community factors to be related to acceptability and willingness to join, in fact, interestingly, as in the BK member data, we find a negative correlation between willingness to join and the perceived descriptive local community norm. Finally, both acceptability and willingness to join are correlated to a medium degree with both indicators of broader sustainability behaviours.

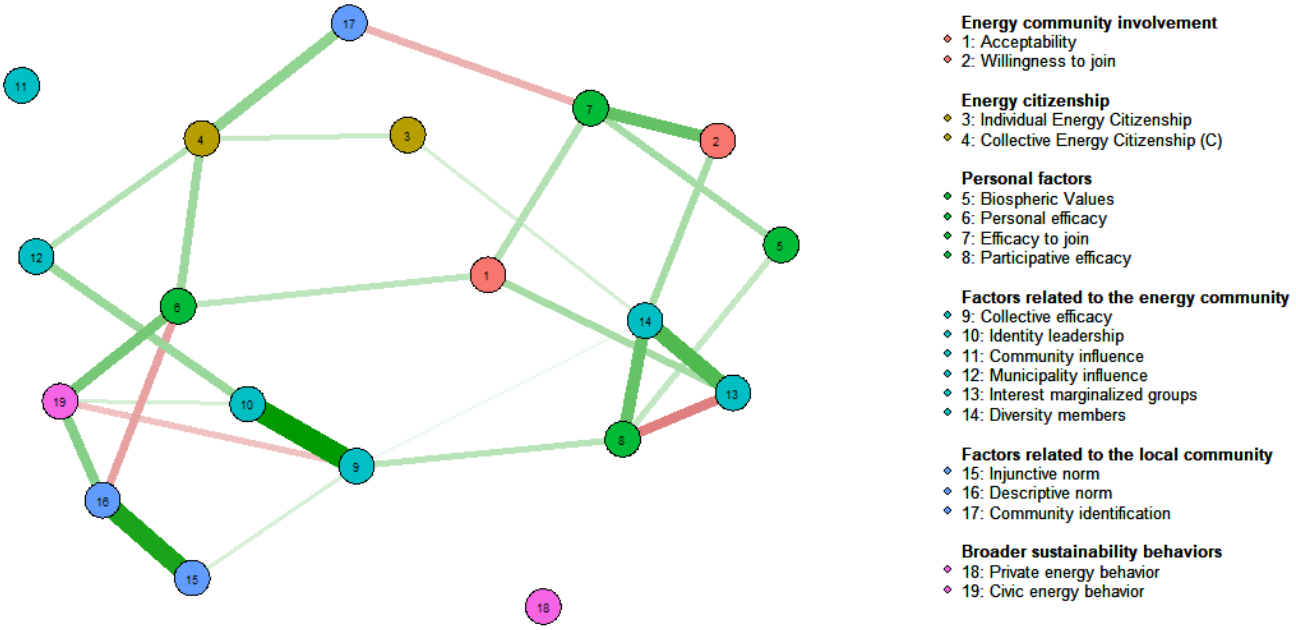
[15] N = 24-37 and as such results need to be interpreted with caution.

Table 34. Correlations aware non-members HCWS at T1



When looking at the partial correlations as shown in Figure 14, similar to the other samples, we find no direct correlation between both levels of energy citizenship and acceptability and willingness to join. Again, willingness to join and, to a lesser extent, acceptability, are both strongly correlated with efficacy to join the energy community. Contrary to our findings from previous samples but in line with our expectations, willingness to join is related to the perceived diversity of members and acceptability to the perceived inclusion of the interests of marginalised groups. Furthermore, individual energy citizenship does not seem to be related to personal factors, as we observed in the previous samples, and collective energy citizenship seems to be related to both personal factors (personal efficacy), and factors related to the energy community (municipality influence) and the local community (community identification). Finally, both private energy behaviour and civic energy behaviours are not correlated to any of the outcomes.

Figure 14. Visualisation of partial bivariate scale relationships ($r > 0.05$) with Gaussian Graphs, based on the aware non-member sample from HCWS at T1



Note. The thickness of these lines represents the strength of the relationships between variables; and consequently, the absence of a line implies no or very weak relationships between the relevant variables. The green lines indicate positive partial correlation coefficients and red lines indicate negative partial correlations.

5 Discussion

5.1 Main conclusions

5.1.1 Diversity and inclusion in energy communities

Overall, we find that relatively few participants were aware of an energy community in their locality or involved in an energy community, independent of whether energy communities are still a niche (e.g., Poland and Spain), or are more common such as in the Netherlands where energy communities exist in 85% of the municipalities (Lokale energie-monitor, 2022). Furthermore, in line with previous findings among initiative takers in energy communities (Aiken, 2012; Łapniewska, 2019; Fraune, 2015; Warbroek et al., 2019; Yildizet al., 2015), we observe an imbalance with regard to socio-demographics in the involvement in energy communities across most samples. Among our participants, men, people with a high SES (income and education), home-owners, and people who are retired are more likely to be aware and/or members of energy communities. Yet, men and women seem to be more equally represented in GEN ecovillages and women even more represented than men among members in the HCWS sample. In addition, in the GEN sample, highly educated people with a low income are relatively strongly represented. Yet these differences may (partly) be due to self-selection bias among respondents (some groups answering the questionnaire more often than others; especially considering the limited sample size in the HCWS sample). More research is needed to better understand why certain groups are less (willing to be) involved in energy communities, including potential intersectionalities, within different socio-political contexts.

5.1.2 EC^2 outcomes: Energy citizenship and involvement in energy communities

We examined to what extent awareness of and membership in an energy community was related to individual energy citizenship, over time. We find that individual energy citizenship remained stable over time across all samples. In the Dutch panel sample, those aware of an energy community score significantly higher on individual energy citizenship, compared to those unaware and awareness of an energy community is associated with individual energy citizenship at that time and half a year later. Within the Buurkracht sample, we find that members of an energy community score higher on individual energy citizenship than aware non-members, with membership being associated with individual energy citizenship at that time and half a year later. However, we do not find any relations between awareness nor membership and individual energy citizenship in the other samples. It might be that the effects of awareness of and involvement in an energy community on individual energy citizenship are only found in those countries in which energy communities are more common (the Netherlands) compared to countries in which energy communities are a relatively new phenomenon. For example, when energy communities are more common, it might be that people have recognised them more as a way to enact their energy citizenship and/or that energy communities had more chances to shape people's energy citizenship. We consistently find that collective energy citizenship at the local region level is higher for those aware of an energy community compared to those unaware. Mere awareness of energy communities in one's local region may thus already enhance peoples collective energy citizenship, even without being a member, or vice versa. Importantly, as we find collective and individual energy citizenship to be related in most samples, stronger collective energy citizenship may be a route through which individual energy citizenship may be enhanced.

Next, we examined whether energy citizenship was related to acceptance of and willingness to join an energy community. We find both levels of energy citizenship to be strongly (Dutch and Spanish panel) or to a medium degree (Buurkracht and HCWS) related to willingness to join an energy community. Acceptability of an energy community and individual and collective energy citizenship are strongly related in the Dutch sample, to a medium degree in the Polish housing sample, but only weakly correlated in the Spanish and Buurkracht samples. We observe a similar pattern among those aware of an energy community in their local region, except for the Dutch representative panel, where we find a weak instead of strong relation between energy citizenship and acceptability of an energy community[16]. Yet, when taking all other factors into account, these patterns become less clear; we only observe positive correlations between individual (but not collective) energy citizenship and willingness to join an energy community in the Dutch and Spanish panels, and between collective energy citizenship and willingness to join in the Buurkracht and HCWS samples, but no relations between energy citizenship and acceptability of an energy community. Thus, overall energy citizenship seems to be more (often) related to willingness to join than acceptability of an energy community which may indicate that energy citizenship is more related to action intentions than to attitudes/cognitions. Yet, considering that relations between energy citizenship and acceptability and willingness to join are weaker when other factors are taken into account, these other factors may influence energy

[16] Importantly, differences between samples in the strength of the relations may be in part due to differences in sample size between the different (sub)samples and subsequent power and so comparisons between the different samples should be interpreted with caution.

citizenship and acceptability of and involvement in an energy community, as well as their mutual relation (e.g., energy citizenship only being linked to willingness to join when people think they can actually participate).

Among members, we examined whether energy citizenship was related to identification with, and level of involvement in the energy community. We find that collective, and to a lesser extent individual, energy citizenship are correlated positively with identification with the energy community (except in the GEN sample), but not with level of involvement. Again, when controlling for all other factors in the model, we do not observe correlations between energy citizenship on the one hand and level of involvement and identification with the energy community on the other hand, except for Buurkracht, where the positive relation between collective energy citizenship and identification with the energy community remained. Thus, collective energy citizenship seems most relevant for people's identification with the energy community but not their level of involvement.

5.1.3 Other factors related to involvement in energy communities

Personal factors

In line with our expectations, all personal factors (biospheric values, personal self-efficacy, efficacy to join, and participative efficacy) are related to acceptability of and willingness to join an energy community, although it differed between samples which factors matter most. Efficacy to join an energy community seems to play a particularly important role for willingness to join in all samples, even when taking all other factors into account. Additionally, among aware non-members, we find participative efficacy (ability to help the energy community to contribute to a sustainable and just energy transition by participating), and to a lesser extent personal efficacy beliefs (ability to personally contribute to this transition), to be related to acceptability and willingness to join. Overall, we generally did not find strong associations between biospheric values and acceptability and willingness to join an energy community. Thus, it seems that although biospheric values and motivation to join might be important, it is essential that people feel able to join and contribute to an energy community and to a just and sustainable energy transition as this ability seems to define whether people accept and are willing to join an energy community.

Among members, data revealed a particularly strong association between participative efficacy and both the level of involvement and identification with the energy community across samples. Among members of GEN and EU Ecom this remained the case even after controlling for all other factors in the model. In line with previous research, this seems to indicate that especially whether people think their participation will help the energy community reach its sustainability goals (see van Zomeren et al., 2013; Bamberg et al., 2015) is important for involvement in energy communities; in turn, being more involved in an energy community might make people feel more capable of effectively contributing (participative efficacy) - future research is needed to specify the direction of relationships between participatory efficacy and the level of involvement in energy communities.

Local community factors

Data revealed a less clear picture when it comes to factors related to the local community (injunctive and descriptive norms, and community identification). Overall, we find that community norms seem to play a positive role for acceptability and willingness to join in some of the samples, with injunctive norms being more consistently related to acceptability and descriptive norms to willingness to join. In the Dutch panel and HCWS samples, among those unaware of an energy community in their locality, as expected, we find the perceived injunctive and descriptive norm and identification with the local region to be positively correlated with acceptability of an energy community and willingness to join. Yet, contrary to our expectations, we only find identification with the local community to be related to willingness to join in a Buurkracht initiative among those unaware of an energy community in their locality but not in the other samples.

Among those aware of an energy community, we observe a quite similar pattern. Here, acceptability seems mainly related to the perceived injunctive community norm, and willingness to join to the perceived descriptive norm in the community, except for the HCWS sample, where we only find a negative correlation between willingness to join and the perceived descriptive norm, instead. This may suggest that in some cases people are particularly likely to join when they think others won't. Yet, when controlling for all other factors, we only find the perceived injunctive community norm to be related to acceptability in the Dutch panel and HCWS samples, and community identification to willingness to join for those unaware of an energy community in the HCWS sample.

Among members, generally local community factors seem more strongly related to identification with the energy community compared to level of involvement. More specifically, within the representative Dutch panel and in the EU Ecom samples, community identification is associated with both the level of involvement and identification with the energy community but not any of the perceived community norms. In the Spanish panel and Buurkracht samples we do find the injunctive community norm to be related to both indicators of involvement, in addition to community identification. In Buurkracht, we again find a negative correlation between the perceived descriptive community norm and level of involvement. Interestingly, in the GEN sample, both identification with, and level of involvement in, the ecovillage are not related to community factors. This may indicate that the GEN ecovillages represent a different type of energy community, less embedded in their local region. Yet, when taking all other factors into account, all relations between community factors and identification or level of involvement disappeared in all samples.

It might therefore depend on the specific local context in which people and the energy community are embedded how much wider community norms and identification are related to people's acceptance of and involvement in energy communities. Future research could be directed at testing this.

Energy community characteristics

Next we examined whether perceived collective efficacy (this energy community initiative can advance an energy transition that is just and sustainable) and identity leadership (this energy

community represents the inhabitants of the local community) of an energy community relate to its acceptance and willingness to join among aware non-members. In line with our expectations, we consistently find that perceived collective efficacy and identity leadership of an energy community are positively associated with its acceptability and willingness to join. In addition, we examined several energy community set-up characteristics (perceived community and municipality influence, perceived inclusion of the interests of marginalised groups and the diversity of members). As expected, and in line with our findings from D4.1 and D4.2, we find the perceived influence of the community, and not of the municipality, on the energy community, is positively correlated with acceptability of and willingness to join an energy community. Furthermore, the perceived inclusion of interests of marginalised groups and the diversity of members positively correlate with acceptability and willingness to join across samples. Yet, when taking all other factors into account, results are less clear. In the Dutch and Buurkracht samples acceptability was only related to collective efficacy and identity leadership, while in the HCWS sample the perceived inclusion of the interests of marginalised groups correlated positively with willingness to join and the diversity of members with acceptability.

Among members of an energy community, identity leadership is consistently strongly related to both level of involvement and identification with the energy community, except for the GEN sample. Collective efficacy only correlates to level of involvement and identification with the energy community in the Buurkracht, EU Ecom, and GEN samples, but not in the other samples. Again, the energy community characteristics (the perceived community, and not the municipality, influence, the perceived inclusion of the interests of marginalised groups, and, to a lesser extent, the perceived diversity of members) are generally consistently related to the level of involvement and identification with the energy community, and with each other in most samples. Yet, we do not find either community or municipality influence to be related to our indicators of level of involvement among members of EU Ecom. In addition, in GEN, we do not find any of the energy community characteristics to be related to involvement. When taking all other factors into account, only the relation between identification with the energy community and identity leadership remained in the Buurkracht and EU Ecom samples. This seems to imply that mainly the extent to which the energy community represents the local community relates to whether members identify with the energy community, but this effect seems to be dependent on the specific type of energy community or sample.

Interestingly, participants consistently rated the perceived influence of the community on the energy community as lower than the influence of the municipality. Yet, we find that the perception that the local community is represented by the energy community (identity leadership), and that community influences the energy community are both positively related to acceptability of and involvement in an energy community. This suggests that citizens' influence on organising and managing their own energy communities is essential.

5.1.4 Other factors related to energy citizenship

We also examined whether these personal and collective factors and characteristics of energy communities were associated with energy citizenship. Individual energy citizenship is strongly associated with personal factors, biospheric values and personal efficacy, across samples, whereas collective factors are mostly related to collective energy citizenship, especially to collective efficacy, while it varies between samples which (energy) community factors matter

most. As such, they seem to qualify the relation between acceptability of and willingness to join an energy community and energy citizenship at least to some extent.

5.1.5 Behaviours supporting broader sustainability goals

Finally, we examined whether involvement in energy communities and/or energy citizenship was related to behaviours which support broader sustainability goals. We find those aware of an energy community compared to those unaware in the Dutch and Spanish panel samples, and members compared to non-members in the Dutch Panel and Buurkracht samples, engage in more private an civic behaviours supporting broader sustainability goals. We did not find any differences between groups in the HCWS sample. Again, this could be the result of country differences in the existence of energy communities. Importantly, we find that civic engagement in HCWS was particularly low. Furthermore, people living in a housing cooperation such as HCWS may generally have less opportunities to engage in sustainable behaviours as this is one of the reasons various sustainable initiatives have been instigated there.

We also generally find strong correlations between civic behaviour and willingness to join but no or only weak correlations between civic behaviours and acceptability of an energy community. This may indicate that willingness to join is perceived as a collective action and a form of active engagement compared to mere acceptability and as such more related to other forms of collective energy behaviours. Notably, this relationship may also be rather indicating that civic sustainability behaviours, as measured in our survey, and involvement (intention) in an energy community is partly measuring a similar concept (e.g., engaging in community activities focused on a just and sustainable energy transition). While, in line with previous findings (Sloot et al., 2018), private energy behaviours are also generally correlated with both acceptability and willingness to join, when taking all other factors into account, they seem to mainly play an indirect role via individual energy citizenship. Yet, future research is needed to specify the direction of the relationship between involvement (intention) in energy communities and energy citizenship on the one hand and support for broader sustainability goals on the other hand.

5.2 Limitations

This is a first exploration of our model using the different samples collected within the EC^2 project, in which we combined concepts from different theories to gain insights into energy citizenship and involvement in energy communities, over time. Importantly, Gaussian graphical models capture partial correlation coefficients and all interpretations are conditional on the variables included in the model. To make the model and consequently any interpretation meaningful, researchers must ensure that all variables relevant for the study are included. While we selected the variables to include based on their relevance for this deliverable, by no means is this an exhaustive list of concepts which may matter for involvement in energy communities and energy citizenship. Future research is needed to test and explore additional relations and examine which mechanisms play a role (e.g., mediation and moderation analyses) using more sophisticated (multilevel) regression models.

Importantly, different variables were included in the different subsamples (unaware non-members, aware non-members, and members), and samples differed in their size, making any

formal comparisons between the Gaussian plots challenging (see Bushan et al. 2019 for more details on comparisons between graphs). Due to this and the limited sample size in some of the (member) samples, both bivariate results and the results from the Gaussian plots need to be interpreted with caution.

Finally, we examined the relationship between involvement in energy communities and energy citizenship over time, yet due to limited changes in membership over time, we could not additionally take change in membership over time into account. Future research is needed to specify the direction of relationships between involvement (intention) in energy communities and energy citizenship.

5.3 Practical implications

Fostering inclusivity of energy communities by increasing awareness of how socioeconomic, gender, sociocultural, and socio-political factors impact involvement in energy communities is a key aspect of the EC^2 project. Yet, we observe an imbalance with regard to socio-demographics in the involvement in energy communities across samples. It is important that policy makers and energy communities are aware of and understand potential (existing) inequalities among members and aware and unaware non-members, in order to enable people with less privilege and resource-bound commitments to become involved in energy communities and engage in energy citizenship (see for more tools on how to improve awareness of diversity and inclusion of energy communities also D6.2 Energy Citizenship Empowerment Kit). Furthermore, initiators could actively look for representatives and new members with diverse social connections in the community and with different socio-demographic backgrounds and policies could be directed at supporting this.

We consistently find that collective energy citizenship is higher among those aware compared to those unaware of an energy community. Importantly, as we find collective and individual energy citizenship to be related in most samples, stronger collective energy citizenship may be a route through which individual energy citizenship may be enhanced. Furthermore, we find both private and civic energy behaviours supporting broader sustainability goals to be higher for those aware compared to those unaware of an energy community. Yet, considering the low proportion of people aware of an energy community in their locality, it is highly recommended to direct policies to raise awareness.

In addition, efficacy beliefs (especially efficacy to join) are related to both acceptability of and willingness to join an energy community (over and above biospheric values). Importantly, we also find individual energy citizenship to be strongly associated with efficacy beliefs. As such, they seem to qualify the relation between acceptability of and willingness to join an energy community and energy citizenship at least to some extent. Thus, policies could be directed at enabling people to get involved in energy communities and engage in energy citizenship.

In addition, as we find that people's perceived influence of the community is positively related to both acceptability of and willingness to join an energy community, as well as for levels of involvement among members, it seems citizens' influence on organising and managing their own energy communities is essential. Yet, participants consistently rated the perceived

influence of the community as being lower than the perceived influence of the municipality. Furthermore, we find that the perceived inclusion of interests of marginalised groups and the diversity of members are positively related to acceptability of and involvement in an energy community, while we also observed an imbalance in involvement between socio-demographic groups. Thus, policies could be directed at strengthening citizens' involvement and representation in setting up and organising energy communities and communicating this to the wider local region.

Finally, especially civic behaviours supporting broader sustainability goals seem to relate to willingness to join whereas private behaviours seem mostly related to individual energy citizenship. Yet, future research is needed to specify the direction of relationships between involvement (intention) in energy communities and energy citizenship on the one hand and support for broader sustainability goals on the other hand before we can give clear recommendations.

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7 Appendix Item overview

These items represent exemplary items for all the studies while some have been adjusted for specific samples. They were initially in Dutch, German and/or English and were translated with the help of deepl.com and all involved project partners.

Table A1. Scale items

Measure	Items
Outcomes:	
Willingness to join	1. I want to become involved in an/the community energy initiative (investing time, money etc.) 2. I am interested in joining an/the community energy initiative.
Individual Energy citizenship	1. Affordable sustainable energy is an important right for me. 2. Being informed about the energy efficiency of different products is an important right for me. 3. I consider the possibility to actively participate in the energy market (e.g. produce/ sell/ exchange/ store energy) as an important right. 4. I feel responsible for supporting others to participate in the sustainable energy transition (e.g. by sharing my knowledge). 5. I feel responsible for contributing to a sustainable energy transition myself. 6. I feel responsible for actively participating in the energy market (e.g. producing/ selling/ exchanging/ storing energy). 7. I am willing to actively work to ensure that no one is disadvantaged in the sustainable energy transition. 8. Investing time, effort and money to be able to use more renewable energy fills me with pride. 9. I am open to helping shape energy policy and legislation.
Collective Energy citizenship (energy community)	1. We, members of the community energy initiative, consider affordable sustainable energy to be an important right. 2. We, members of the community energy initiative, consider it an important right to be informed about the energy efficiency of various products. 3. We, members of the community energy initiative, consider being able to actively participate in the energy market (e.g., being able to produce /sell /exchange /store energy) to be an important right. 4. We, members of the community energy initiative, see it as our responsibility to help others to participate in the sustainable energy transition (e.g., by sharing my knowledge). 5. We, members of the community energy initiative, see it as our responsibility to contribute towards a sustainable energy transition. 6. We, members of the community energy initiative, see it as our responsibility to actively participate in the energy market (e.g., produce/sell/exchange/store energy). 7. We, members of the community energy initiative, are willing to

	play an active role in ensuring that no one is at a disadvantage during the sustainable energy transition. 8. Investing time, effort, and money to be able to use more renewable energy is a source of pride for us, members of the community energy initiative. 9. We, members of the community energy initiative, are open to helping to influence energy policy and legislation.
Collective energy citizenship (local region)	1. We, inhabitants of the [local region], consider affordable sustainable energy to be an important right. 2. We, inhabitants of the [local region], consider it an important right to be informed about the energy efficiency of various products. 3. We, inhabitants of the [local region], consider being able to actively participate in the energy market (e.g., being able to produce /sell /exchange /store energy) to be an important right. 4. We, inhabitants of the [local region], see it as our responsibility to help others to participate in the sustainable energy transition (e.g., by sharing my knowledge). 5. We, inhabitants of the [local region], see it as our responsibility to contribute towards a sustainable energy transition. 6. We, inhabitants of the [local region], see it as our responsibility to actively participate in the energy market (e.g., produce/sell/exchange/store energy). 7. We, inhabitants of the [local region], are willing to play an active role in ensuring that no one is at a disadvantage during the sustainable energy transition. 8. Investing time, effort, and money to be able to use more renewable energy is a source of pride for us, inhabitants of the [local region]. 9. We, inhabitants of the [local region], are open to helping to influence energy policy and legislation.
Personal factors:	
Biospheric values	Please rate how important each value is for you as A GUIDING PRINCIPLE IN YOUR LIFE: 1. RESPECTING THE EARTH: harmony with other species 2. UNITY WITH NATURE: fitting into nature 3. PROTECTING THE ENVIRONMENT: preserving nature 4. PREVENTING POLLUTION: protecting natural resources
Participative efficacy	1. I can make a significant contribution, so that the community energy initiative can promote a just and sustainable energy transition 2. I can make a significant contribution, so that the community energy initiative can advance a just and sustainable energy transition

Energy community:	
Collective efficacy (aim-related)	1. Members of my energy community initiative can promote an energy transition that is just and sustainable 2. Members of my energy community initiative can advance an energy transition that is just and sustainable
Identity leadership	1. The community energy initiative is representative of inhabitants of my local region. 2. The community energy initiative creates a sense of cohesion within inhabitants of my local region. 3. The community energy initiative promotes the interests of inhabitants of my local region. 4. The community energy initiative engages in activities which are useful for inhabitants of my local region.
Broader sustainability behaviours	
Private behaviour	In the past 6 months, to what extent have you… 1. … reduced your energy consumption? 2. … used energy efficient household devices? 3. … used household energy from renewable sources?
Civic behaviour	In the past 6 months, to what extent have you… 1. … discussed a just and sustainable energy transition with people in your [local region]? 2. … signed a petition for a just and sustainable energy transition? 3. … contributed financially to an organisation promoting a just and sustainable energy transition? 4. … participated in a protest for a just and sustainable energy transition? 5. … organised an event on the topic of a just and sustainable energy transition? 6. … engaged in community activities focused on a just and sustainable energy transition?

8 CRediT author contribution statement

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9 Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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