

D3.5

Case study 5 report: Earnest App - A virtual community for sustainable mobility in Darmstadt, Germany

Prepared by: Fraunhofer ISI

Deliverable nature	Report
Dissemination level (Confidentiality)	Public (PU)
Delivery date	2022-12-23
Version	1.0
Total number of pages	49
Keywords	Case study, mobility, spillover effects, young people, virtual community, digital app
Cite as	Kantel, A., Preuß, S., Stadler, M., Rummel, A. (2022). Case study 5 report: Earnest App - A virtual community for sustainable mobility in Darmstadt, Germany. D3.5 of the Horizon 2020 Project GRETA, EC grant agreement no. 101022317, Karlsruhe, Germany.
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022317.

Disclaimer and acknowledgement

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022317.

Executive summary

The overall objective of WP3 is to gather data from case studies and the multinational citizen consultation to respond to GRETA's goal to include communities in order to deepen and advance state-of-the-art knowledge of determinants that influence the emergence of energy citizenship. WP3 deliverables are presented on a case-study basis focusing on (mostly) qualitative data collected by the case studies within the tasks of WP1 and WP3. Moreover, the case study reports provide input for the synthesis of project results and the development of policy recommendations in WP6.

This case study report #5 outlines the findings of the Earnest App case study in Darmstadt, Germany, in regard to GRETA's objectives to understand better how energy citizens act and interact (Objective 2) and to observe and potentially develop behavioural approaches and policies for facilitating energy citizenship (Objective 3). The case study took place in the summer of 2022 at the University of Applied Science in Darmstadt and was led by the Fraunhofer Institute for Systems and Innovation Research. The case study's geographical scope focuses on Darmstadt and surrounding areas and explores how the use of a digital app by members of a virtual energy community affects citizens' awareness and behaviour in regard to their mobility and energy consumption choices in everyday life, potentially fostering energy citizenship.

Within the scope of WP3, the Earnest App case study applied a mixed-method approach collecting both quantitative survey data as well as qualitative data to not only assess *if* the use of a digital app by members of a virtual community can facilitate energy citizenship but also *how* and *why*. The findings derived from the collected data offer valuable insights for GRETA. This report illustrates how qualitative and descriptive quantitative data results indicate that the use of the app contributed to an increase in both energy awareness and sustainable mobility behaviour of research participants. Moreover, the case study's findings also point to an increase in sustainable behaviour in other sectors than mobility, such as electricity and heating consumption. This can be interpreted as spillover effects through which users start to adopt a broader sustainability view leading to further conscious actions in other related areas. Finally, the case study findings highlight the role virtual communities can play for a crucial demographic for a successful transition to a sustainable and just energy system now and in the future: young citizens.

The deliverable is structured as follows. Section 1 offers a detailed description of the case study as well as the actor and policy landscape it is embedded in, and provides an overview of the case study-specific research design and methods. Section 2 provides a summary of the case study-specific research results and Section 3 analyses these results in light of the energy citizenship emergence framework developed and documented in D1.1 using data from qualitative interviews conducted within the scope of T1.3. Section 4 offers a discussion and reflection of the main analysis points before Section 5 summarizes and concludes the case study's findings.

Project information

Grant agreement No.	101022317
Acronym	GRETA
Full title	GReen Energy Transition Actions
H2020 Topic	H2020-LC-SC3-2020-NZE-RES-CC
Project URL	www.projectgreta.eu

Document information

	Number	Title
Deliverable	D3.5	Case study 5 report: Earnest App - A virtual community for sustainable mobility in Darmstadt, Germany
Work package	WP3	Data gathering from case studies and multinational citizen consultation
Task	T3.4	Synthesis and validation of case study results

Delivery date	Contractual: M20, Actual: M20
Nature	<input checked="" type="checkbox"/> Report <input type="checkbox"/> Other <input type="checkbox"/> ORDP
Dissemination level	<input checked="" type="checkbox"/> Public <input type="checkbox"/> Confidential
Authors (partners)	Anne Kantel, Sabine Preuß, Maria Stadler, Alexandra Rummel (Fraunhofer ISI)
Reviewers (partners)	Lurian Klein (Cleanwatts)
Summary (for dissemination)	This report outlines, analyses and discusses the findings from the Earnest App case study in light of GRETA's objectives.
Keywords	Case study, mobility, spillover, youths, virtual community, digital app

Version	Date	Description
0.1	2022-12-07	Version prepared for internal review
0.2	2022-12-16	Revised version
1.0	2022-12-23	Final version

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1 Introduction

The Earnest App case study seeks to provide several valuable insights for GRETA. First, it hopes to speak to the role a digital app can play in supporting energy awareness and behavioural changes in regard to sustainable mobility practices in citizens' everyday life. Second, it seeks to offer insights on the role of virtual communities for the development of energy citizenship. Third, it wants to highlight the role of a crucial demographic for a successful transition to a sustainable and just energy system now and in the future: young citizens.

This report is structured as follows. Section 1 offers a detailed description of the case study as well as the actor and policy landscape it is embedded in, and provides an overview of the case study's mixed-methods research design. Moreover, Section 1 introduces the qualitative and quantitative methods of data collection that were conducted by the case study within the scope of WP3. Section 2 provides a summary of both the WP3-specific case study research results as well as case study-specific data that was collected within the scope of T1.3 (i.e., data from qualitative interviews). Section 3 focuses specifically on insights from the data of these qualitative interviews that were conducted with policymakers, citizens, businesses and citizen initiatives in and around the city of Darmstadt and analyses these results within the framework of energy citizenship emergence developed and documented in D1.1 of the GRETA project. Section 4 zooms out again to take a broader perspective of all of the case study-specific data and offers a discussion and reflection of the main analysis points in light of the case study's overall research questions. Section 5 summarizes and concludes the case study's findings.

1.1 Case study description

The German case study is called "The Earnest App – a virtual community for sustainable mobility in Darmstadt". It took place in the summer of 2022 at the University of Applied Science (short: *h_da*) in Darmstadt and was led by the Fraunhofer Institute for Systems and Innovation Research. The case study's geographical scope focuses on Darmstadt – a city with 160.000 inhabitants located in the state of Hesse in Germany. The case study explores how a virtual energy community – connected by the shared experience of using a mobile sustainability app regularly – affects citizens' awareness and behaviour in regard to their *mobility* and *energy consumption choices* in everyday life, potentially fostering energy citizenship. The energy citizens in focus of this case study are young citizens, especially students.

At the core of the case study is the Earnest App, a freely available digital app providing the user with information and advice on (1) how behaviours in their everyday life contribute to energy consumption and CO₂ emissions and (2) how they can reduce their individual CO₂ impact within the mobility and energy sector. The Earnest App is

an informative, interactive, and game-like online tool that provides information in the form of short articles as well as quizzes and so-called challenges. Through regular push-up messages sent to the users' mobile devices the app's objective is for the users to begin (or continue) to question their current energy and mobility behaviour. It aims to encourage reflections on energy and mobility behaviour and – based on a growing understanding of the systemic consequences of mobility and consumption choices – seeks to incite gradual behavioural change toward a more climate-friendly lifestyle. The app is designed with a system-wide approach for citizens to gain insights and actively engage in reduced energy consumption behaviour in their everyday life, which means that it provides information on various - often intersecting - categories. One key category of the app includes information and behavioural nudges for everyday mobility and travel, which is the focus of the case study. The research hypothesis of the case study is that by engaging with the app, users will increase both (1) their awareness of their mobility and energy consumption and how their choices contribute to CO₂ emissions, and (2) change their behaviour toward a more sustainable lifestyle in their everyday practices. Moreover, we assume that by learning more about the mobility and travel sector, users start to adopt a broader sustainability view leading to further conscious actions in other, related areas, such as energy efficiency (spillover effects). In addition, community members might influence others and act as role models – leading not only to a more active type of energy citizen but also to the dissemination of knowledge and starting to create a socially normative pro-environmental behaviour.

Within the scope of WP3, the case study design applied a mixed-method approach allowing us to analyse not only *if* and when people change their behaviour but also *why* and *how*. We used a range of data collection methods to assess the effect of using a mobile app on people's everyday mobility practices. First, case study participants responded to a quantitative pre- and post-survey (before and after an agreed upon phase of using the app) to monitor their behaviour and potential behavioural changes in regard to mobility and energy consumption activities. Second, case study members documented and exchanged their experiences with using the app by regularly contributing to an online discussion board – as part of a virtual community. Third, two in-person workshops (within the scope of WP2) and a qualitative online discussion group assessed transition pathways studying more closely how and why participants did or did not change levels of energy citizenship engagement. Finally, within the scope of T1.3 we also conducted case study-specific qualitative interviews with citizens, policymakers, businesses and citizen initiatives/NGO involved in sustainable mobility activities in Darmstadt and surroundings.

1.2 Relevant actor and policy landscape

A more detailed description and analysis of the case study's actor and policy landscape can be found in D6.1 of the GRETA project. The following is a brief summary of the findings to provide some context for the case study data analysis, reflection, and

discussion. The information outlined in this section was collected through desk research and qualitative interviews with policymakers, business actors and citizens in and around the city of Darmstadt (as part of the research activities in T1.3).

Actor landscape

Next to the energy citizens (participants of this case study are mainly but not exclusively students at the University of Applied Science in Darmstadt), actor groups relevant for this study are policymakers on different policy levels, businesses and further societal actors such as local groups and initiatives or NGOs. A rich network of these actor groups shapes the conditions for energy citizenship emergence in our specific case of a virtual community that engages in sustainable mobility in and around the city of Darmstadt. Since Germany has a federal system - with the national, regional, and local level as the most important political divisions - it is also important to consider the specific levels actors are active in and/or have influence on.

Energy citizens (case study participants)

Participants for the case study were recruited through a cooperation with the University of Applied Science in Darmstadt (short: *h_da*). A first group of research participants consisted of university students representing young and educated people interested in the topic of energy consumption. A second group of case study participants consisted of people from the students' environment (e.g., roommates, parents, siblings, friends, family members etc.). This resulted in some diversity in socio-demographic features in case study participants in regard to age, socio-economic background, education, living situation, gender etc.

The starting point of energy citizenship among case study participants was assumed to be "aware". Case study participants self-selected into participating in the study with the motivation to use the Earnest App. The app aims to increase the use of sustainable mobility options (e.g., public transport) and reduce long-term travel. Through the systemic perspective and showing behavioural consequences, users' awareness and knowledge of sustainable mobility may increase and lead to spillover effects into adjacent areas of a sustainable lifestyle. We hypothesized that this could result in a development of energy citizenship from "aware" to "involved" or "active."

Policy actors

Policymakers on the local, regional, and national level shape the conditions under which energy citizenship might emerge. For our case of a virtual community engaging in sustainable mobility, several national level policy actors are important. These are federal ministries such as the Federal Ministry for Digital and Transport (BMDV). Furthermore, responsible agencies for the charging infrastructure are for example the *Bundesnetzagentur* (Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway) and the *Nationale Leitstelle Ladeinfrastruktur* (National Centre for

Charging Infrastructure). These agencies are commissioned with the implementation of certain policy measures and the infrastructural provision, e.g., of charging infrastructure. On the regional and local level, the Hessian ministries for transportation or the Mobility Office of the city of Darmstadt are important policy actors to develop local strategies, and to coordinate and implement measures.

Businesses

Businesses can play quite different roles for the emergence of energy citizenship. Especially national-level businesses are important for developing apps and digital communication tools that set the basis for the formation of a digital community. Also, for the development of further technical solutions in relation to sustainable mobility, national level businesses and associations can play a pioneering role. On the regional and local level, mobility and energy providers set the basis for providing citizens with access to different solutions for sustainable energy consumption and mobility choices. The city and the district of Darmstadt are the responsible institutions in regard to mobility provision. For local energy provision, which focuses on renewable gas and electricity, the city of Darmstadt is a major shareholder. Due to these ownership structures, a close cooperation between businesses and policymakers exists on the local level.

Societal actors (citizen initiatives)

Energy citizenship is mainly driven by communal societal actors that take joint action towards more sustainable energy and mobility behaviours. For the specific context of our case study, local citizen initiatives are crucial. However, national level associations often work as role models or allow for the sharing of knowledge. On the national level, different associations are specialized on different options for sustainable mobility – a pedestrian association, an association for car-free lifestyles or the general German bicycling club are just a few examples here.

In the city of Darmstadt, a rich network of societal actors engages in different topics related to sustainable energy, sustainable mobility, and more broadly climate protection measures. These can take the shape of an informal network or an organized citizen initiative that organizes political referenda. In some cases, for example in the case of a local bicycle referendum (that took place in 2018) and a climate protection referendum (that took place in 2019), the initiatives emerged around university groups or student associations. Other initiatives, such as the "transition town" initiative in Darmstadt, are part of a national or global network that encourages sustainable behaviour. Furthermore, in and around Darmstadt different energy cooperatives engage in local (renewable) energy production. Interestingly, the regional level has often been described as less important for the specific case of energy citizenship emergence by interview partners in this case study. However, regional associations might encourage knowledge sharing and transfer among initiatives, for example among energy cooperatives that are connected in a regional network.

Policy landscape

The policy landscape governing the person-transport mobility sector in the city of Darmstadt consists of a mix of EU, national, regional, and local policies (see Figure 1).

European Level		National Level	
Strategies	Paris Agreement European Green Deal White paper Transport climate & energy framework 2030 ...	Strategies	Climate Protection Plan 2050 Climate Protection Plan 2030 Master plan Charging infrastructure Government program for electromobility ...
Policy instruments	2014/94/EU : alternative fuels infrastructure 2019/631/EU : CO2 emission performance standards 2018/858/EU : approval of motor vehicles 2008/50/EG : ambient air quality & cleaner air for Europe 2009/28/EG : Renewable Energies Directive 2019/1161/EU : clean road transport vehicles 2018/844/EU : energy performance of buildings ...	Policy instruments	EEG : Renewable Energy Source Act BImSchG : Federal Pollution Control Act LSV : Charging station regulation StromStG : Electricity Tax Act BGB : Tenancy Law SchnellLIG : Fast Charging Act EmoG : Electromobility Act ...
Regional Level		Local Level	
Policies of the federal state of Hesse		Policies of the city of Darmstadt	
IKSP : Integrated Climate Protection Plan Hesse HEG : Hessian Energy Act HGO : Hessian Municipal Code		Climate protection concept Concept for a demand-oriented charging infrastructure Bike strategy Darmstadt ...	

source: https://www.bmvi.de/SharedDocs/DE/Anlage/G/buendnis-fuer-moderne-mobilitaet-gesetzeskarte-elektromobilitaet.pdf?__blob=publicationFile

Figure 1: Policy Landscape Overview

Based on data collected during qualitative interviews with policymakers at the local, regional, and national level in Germany, it is striking that most policymakers regard policy instruments that have immediate implications for the citizens as the most relevant for everyday governance of the mobility sector. Generalized, overarching strategies such as the government program for e-mobility were mentioned less often and are regarded as less relevant – even if these strategies might set the basis for developing further policy instruments, such as funding programs or regulations. However, these strategies are not perceived as directly influential for energy citizenship. An exception are two overarching strategies on the local level: the climate protection concept of the city of Darmstadt and the concept for the development of a demand-oriented charging infrastructure of the city. Local policymakers emphasize that these concepts have a coordinating function and allow to plan activities in cooperation between different actors (e.g., between different municipalities). Furthermore, strategies like these often set the basis for dedicating personnel and financial resources to planning further activities.

For the European, national, and regional policy level, overarching policy strategies were mentioned less often as relevant for energy citizenship (compared to the local policy level). Actors rather referred to regulations that allow to directly plan and derive activities from - for example to phase-out regulations of combustion engines. Also, economic incentives and funding programs play a crucial role for all actor groups. Policies that refer to nudging approaches, such as eco-design standards were only mentioned by national level policymakers but not described as directly influential for activities on the local level.

There are also differences in the types of policies related to different policy levels. For example, EU level policy is often designed for setting clear policy targets. In the context of mobility transitions, the most important policy mentioned by different actors is the EU regulation 2019/631 that defines targets for CO₂ emission reductions in the transport sector. This regulation is seen as an important transition step by different actor groups, such as businesses and local policymakers. On the national level, especially funding programs and economic incentives were described as enabling policies by some of the interview participants in this case study. However, the complexity of certain policy frameworks, especially laws and regulations, is understood as a barrier for energy citizenship engagement. While policies on the local level are especially important to coordinate and implement activities locally, policies on the regional level were mentioned less.

Differences exist also in terms of actor groups that describe different types of policies as relevant for the emergence of energy citizenship. *Policymakers* often refer to policy frameworks that allow for coordination between different policy levels or different bodies of policy making. Interestingly, while for example the Tenant Electricity Act 2017 is described by national level policy makers as an important framework to coordinate activities on the local level, local level policy makers did not perceive this to be an important policy. Local policy interviewees instead described national policies, such as the Electricity Act, as not applicable to the specific local conditions in the city of Darmstadt. *Civil society actors* highlighted the complexity of certain policy frameworks, for example the Renewable Energy Source Act, as a barrier for energy citizenship. *Citizens* often lack expertise in dealing with these very complex frameworks, which hinders them in becoming more engaged. Another difference exists in terms of the speed in which actors react to different policies. One example is provided by *businesses* operating on the national level. While they describe that e-mobility solutions are already well established among national level businesses, especially policymakers on the local level still face difficulties in terms of how to implement measures related to e-mobility locally.

1.3 Case study research design

The aim of the Earnest App case study was to assess not only if and when people might change their behaviour in regard to energy consumption and mobility behaviour, but

also how and why. The following research questions guided the research design and selection of research methods:

1. What are barriers and drivers for becoming an energy citizen in everyday life?
2. What role can and does an app play in the emergence and development of energy citizenship?
3. What role does a virtual community play in the emergence and development of energy citizenship?
4. Where and how do aspects of social justice play a role in energy citizenship development?
5. What is the role of policy, or where would policy have to start in order to support energy citizenship?

Data collection methods

To address these case study-specific research questions, the Fraunhofer team applied a mixed-method research approach that focused on a six- to eight-week-long phase, during which a total of 50 case study participants volunteered to use the Earnest App on a regular basis (at least twice a week) in their everyday lives. In order to assess the role of the app, within the scope of WP3, the case study design included different types of data collection, namely a two-part quantitative survey within the case study, a focus group discussion, and participants' written contributions in an online forum. Additionally, qualitative interviews were conducted within T1.3. Finally, two community-level indicator workshops (CLI-workshops) were conducted with the participants of the Earnest App case study as part of WP2. The goal of these workshops was to use a co-design methodology to develop shared (i.e. community-based) understandings of the concept of a community as well as define shared goals in regard to energy and mobility consumption as well as pathways and measurements (i.e. indicators) to reach these goals. The second CLI-workshop conducted in the Earnest App case study was also used to develop the case study's Community Transition Pathways (CTP). More details on the method and the results of these workshops are reported as part of D2.3 (A set of community level indicators) and D5.3 (Roadmap for Community Transition Pathways).

Below, you find a timetable indicating the different steps of the mixed-method research design applied specifically in the Earnest App case study.

Table 1: Timeline of the case study's mixed-methods design

May 2022	June 2022	July 2022	August 2022	Sept./Oct. 2022
CLI-Workshop 1		CLI-Workshop 2		
	Active App-Using & Online Forum Phase		Discussion Group	
Pre-Survey				Post-Survey
Qualitative Interviews				

The different types of data collection applied specifically for the Earnest App case study within the scope of WP3 and WP1.3 are listed and described in more detail below:

(1) Qualitative interviews

As part of T1.3, a total of 16 of semi-structured interviews were conducted with case study participants, policymakers from different policy levels, (local) businesses and local civil society initiatives. The aim of the interviews was to gain insights into the conditions under which energy citizenship emerges, the different behaviours, activities and motivations of different actor groups and their relationships. The interviews were conducted online and structured by an interview guide (which can be found in Annex 1 of this deliverable). The interview guide was jointly developed by the GRETA consortium and adapted to the actor groups and the specific interview situations in Germany by the Fraunhofer team. Building on the analytical framework developed in T1.1, the aim of the interview guide was to gain insights into individual citizen and relational behaviour. Therefore, interview questions were chosen to provide insights into the following aspects:

- Past behaviour and planned actions of different actors
- Potential outcomes of activities
- Norms that guide behaviours of different actors
- Factors influencing the agency to perform the behaviour of interest
- Relational models (characteristic of relationships between different actors)

The selection of interviewees was based on their role for energy citizenship emergence in Darmstadt and informed by desktop research. At the end of each interview, we asked interviewees about potential further interview contacts that also informed the selection of interviewees. While the contact to local initiatives and business worked well, contacts to policymakers especially on the regional level, proved difficult due to time constraints of interviewees. The average duration of the interviews was one hour. Except of one interview, all interviews were recorded and partly transcribed using the data analysis software MAXQDA. Next to background information for the policy and actors landscape introduced above, the main result of the interviews was the creation of a matrix of behavioural patterns and asymmetries across different actor types (see D1.1 for the framework that guided the analysis and Section 3 of this deliverable for a more detailed outline of the main interview results). Interviews were conducted online (except for one in-person interview) between May and July 2022.

(2) Quantitative pre- and post-survey within the case study

The main empirical data collection phase of the case study took place between April and October 2022. During this time period, case study participants agreed to use the Earnest App on their private mobile devices for at least two times per week for the duration of six to eight weeks, document their experiences with the app by answering

questions in an online forum (a Padlet board created for this case study), and participated in two quantitative online surveys, one prior to the app-using-phase and one after. Participation in the online forum was implemented as a means to guarantee and foster the establishment of a virtual community among the case study participants. The pre- and post-surveys took about 20-25 minutes to be completed online. For their participation in the pre- and post-survey as well as the app-using phase, case study members received a participation incentive of 15€.

A total of 50 persons participated in the two online surveys, which was designed to assess changes over time and caused by using the Earnest App. Thus, in the online surveys, we implemented items measuring participants' socio-demographic variables (mostly pre-questionnaire), their behavioural intentions regarding energy and mobility as well as potential spillover effects.

After matching the responses in the pre- and post-questionnaire (with an individual pseudomized code), a total of 24 participants remained, presenting our final sample. In addition, we included two control items to ensure high data quality; no participant answered both control items incorrectly, thus, the data quality was good and there was no need to exclude participants due to the control items. The final case study sample ($n = 24$) consisted of mostly female participants ($n = 17$, 71%) compared to men ($n = 7$, 29%); no one identified as "divers" (= the third official gender category in Germany). The participants' age ranged between 18 and 57 years with the vast majority being younger than 30 years old ($n = 19$, 79%). Regarding education, except for one person, everyone was holding a university entrance level degree ($n = 18$, 75%) or university degree ($n = 5$, 21%). Moreover, the majority of participants were students ($n = 17$, 71%), while six respondents (26%) worked full- or part-time and one person chose "other" as current activity status. To summarize, we reached the expected target group of mostly young citizens, while still including socio-demographic variety in our sample.

Regarding their living situation, due to their student life, it is not surprising that most participants lived in a rented apartment with roommates ($n = 13$, 54%) or with their parents ($n = 7$, 29%). A few respondents lived alone ($n = 1$, 4%), as a couple with a child ($n = 2$, 8%) or chose other ($n = 1$, 4%). Regarding their heating system five participants did not know it (21%), nine had a gas boiler (38%), six an oil boiler (25%) and four an electric boiler (17%).

(3) The online forum and online discussion group

Throughout the six to eight weeks-long app-using-phase from June to July 2022 case study participants participated in an online forum in form of a Padlet board. The forum was designed to (a) document and share the case study participants' experiences with the app on a regular basis and (b) foster the establishment of a virtual community.

After the conclusion of the app-using-phase, 9 study participants participated in an online discussion group that was conducted on August 24, 2022, moderated by the

researchers at Fraunhofer, and lasted about 1.5 hours. Using a preliminary coding scheme derived from two main research questions, the written contributions on the Padlet board served as input to derive questions for the discussion group, which was designed to assess how and why the usage of the Earnest app did or did not influence the case study participant's awareness of sustainable mobility and their everyday behaviour in regard to energy citizenship. For their participation in the online discussion group, research participants received a participation incentive of 10€. The question guideline for the discussion group is included in Annex 3.

Data analysis methods

To analyse the quantitative data from the pre-and post-surveys, we used the statistic software SPSS and assessed the descriptive statistics of the relevant variables. Moreover, to find potential effects caused by the use of the app over time, we conducted paired samples t-tests as inference statistical analyses. It is important to note that the using-phase of the app ended in July 2022. Until then, every participant had used the app for six to eight weeks. The pre-survey was completed directly before the using phase; however, the post-survey was conducted in October 2022; thus, we assess rather long-term effects of the app using-phase (rather than short-term effects).

To analyse the qualitative data from the Padlet board and the online discussion group, a qualitative content analysis was conducted using an iterative approach of deductive and inductive coding of the written data (the audio-data of the online discussion group was transcribed) following a structured qualitative content analysis approach as described by Kuckartz 2018.¹ In a first step, a literature-based coding scheme was derived corresponding to the guiding research questions already outlined above. MAXQDA served as a software to code and analyse the collected data. In a second step, the data was analysed once again, using an inductive coding approach. The final list of codes is depicted below.

¹ Kuckartz, Udo (2018). *Qualitative Inhaltsanalyse, Methoden, Praxis, Computerunterstützung*. Weinheim, Basel: Beltz Juventa.

Table 2: Coding system for the qualitative document analysis

List of Codes	Frequency
Codes Total	345
System vs. Individual	7
Practices / Lifestyle prior to the Study (Baseline Information)	12
Social Justice	13
Communities	23
Communication about app topics	18
Role of the app for energy citizenship	3
Expectations	5
Form of app use	28
Behavioural change based on app use	6
Indirect behavioural change	7
Direct behavioural change	14
Learning potential based on app use	37
Reasons against app use	22
Reasons for app use	21
Frequency of app use	48
Barriers and drivers for energy citizenship	11
Infrastructure / mobility	24
Awareness / Knowledge / Interests	8
Resources	0
Community	10
Time	9
Education	4
Financial resources	15

2 Research results

This section outlines the research results gained from the qualitative interviews (T1.3) and the pre- and post-survey, the online forum and discussion group (WP3).

2.1 Qualitative interviews

While the main results of the interviews can be found in Section 3 of this deliverable, the summary below presents the main topics of the analysis guided by the analytical framework provided in WP1.

Past behaviour and planned actions of different actors: The starting point for analysing individual citizen relational behaviours were the behavioural goals as well as past behaviours of the interviewees. In our case, the main behaviour refers to changes in mobility choices by citizens that lead to an overall more sustainable mobility behaviour (for more details, see Section 3.1).

Potential outcomes of activities: After identifying behavioural goals, interviewees were asked about the (positive or negative) outcomes that they anticipate with their behaviour. Our results show that all of the citizens expect environmental benefits from their behavioural changes. However, this goes along with financial and personal disadvantages such as a high investment of time and/or money (for more details, see Section 3.2).

Norms that guide behaviours of different actors: To better understand the drivers of energy related behaviours, interviewees were asked about the norms that guide behaviours. This follows the hypothesis that actors with higher social pressure towards a certain energy related behaviour are more likely to change behaviours in this direction. Indeed, according to our interview results, social norms and peer pressures are a key source of motivation for citizens towards more sustainable mobility behaviours (for more details, see Section 3.3).

Factors influencing the agency to perform the behaviour of interest: Behaviours are not only motivated by certain norms but also influenced by other factors that affect the ability to act. Agency, for example, is linked to institutional support, resources, skills, and knowledge. In our interviews we found that while there is a good amount of information and knowledge about different sustainable mobility options, resources such as money, time, and especially good infrastructural conditions might be missing (for more details, see Section 3.4).

Relational models (characteristic of relationships between different actors): Interviewees were asked about their relationships with other actors to identify drivers and barriers based on these relationships. Our results show that good contacts between

different actor groups play an important role for achieving more sustainable mobility behaviours. However, especially citizens often have no interactions with policymakers, businesses, or even local NGOs (for more details, see Section 3.5).

Asymmetries: After analysing behavioural factors for each actor type, we compared differences in behavioural goals, outcomes, norms, and agency across actors to identify similarities as well as asymmetries. This revealed that all actors share the goal to engage in more sustainable mobility behaviours. Also, financial disadvantages are regarded a barrier for all actors. Moreover, from the perspective of citizens and local initiatives, a lack of political support is described as an important barrier.

2.2 Pre- and post-survey data

Mobility-related behaviour

We expected the regular use of the app to have positive effects on participants' mobility and energy-related behaviour. Thus, we examined whether there is a change in the choice of mobility options in everyday life. From an inference statistical viewpoint, we did not detect significant effects in participants' mobility choices. However, descriptively, we observed that more respondents used their own bike or a sharing bike as well as an electric bike and public transport for long-distance travel. In return, the use of cars with combustion engine and the use of public transport within the city was a little bit reduced (descriptively). Besides the use of the app, a major influence for this trend could be the 9€-ticket which was available in Germany for three months during the summer 2022 and allowed to take the train for free (except rapid trains). For details of these non-significant trends, see Figure 2.

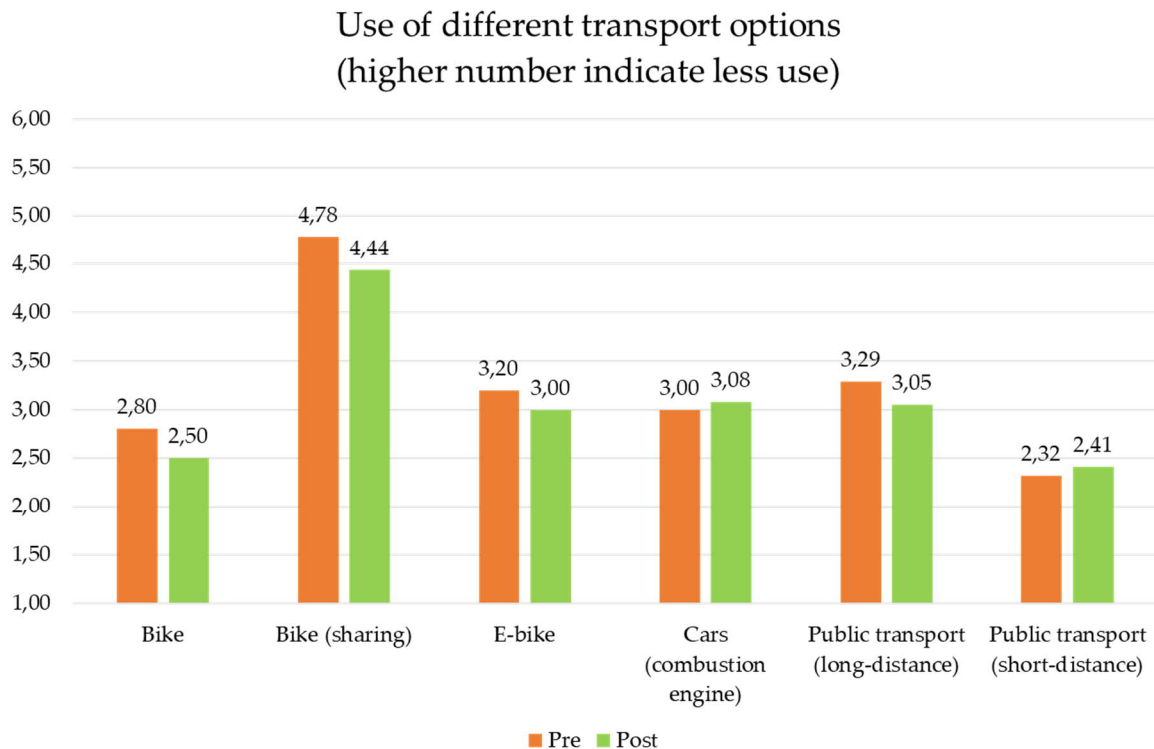


Figure 2: Use of different transport options

Note: Frequency of using different transport options in everyday life on a scale ranging from 1 = Yes, I use it (almost) daily (5-7 days per week) to 6 = Yes, I have the choice, but I never use it.

In addition, we asked respondents about the number and type of cars they have access to (i.e., have in their household). Compared to the beginning of the case study, the average number of cars with combustion engine decreased slightly from $M = 1.33$ ($SD = 1.40$; pre-survey) to $M = 1.13$ ($SD = 1.04$; post-survey). Moreover, one additional person bought a fully electric vehicle (EV) during the time of the case study, increasing the number of participants who have access to an EV from one to two. What is more, we asked participants “in everyday life, replacing my car with other transport options is... not possible (1), difficult (2), neither nor (3), mostly possible (4), possible (5)”. Again, the paired samples t-test comparing the pre- and post-answers did not reach the statistically significance level of .05; however, the descriptive statistics showed an increase of the mean from 3.79 (pre-survey) to 3.92 (post-survey; see Figure 3 for descriptives), indicating that on average it was mostly possible for the respondents to replace their cars after using the app at the end of the case study.

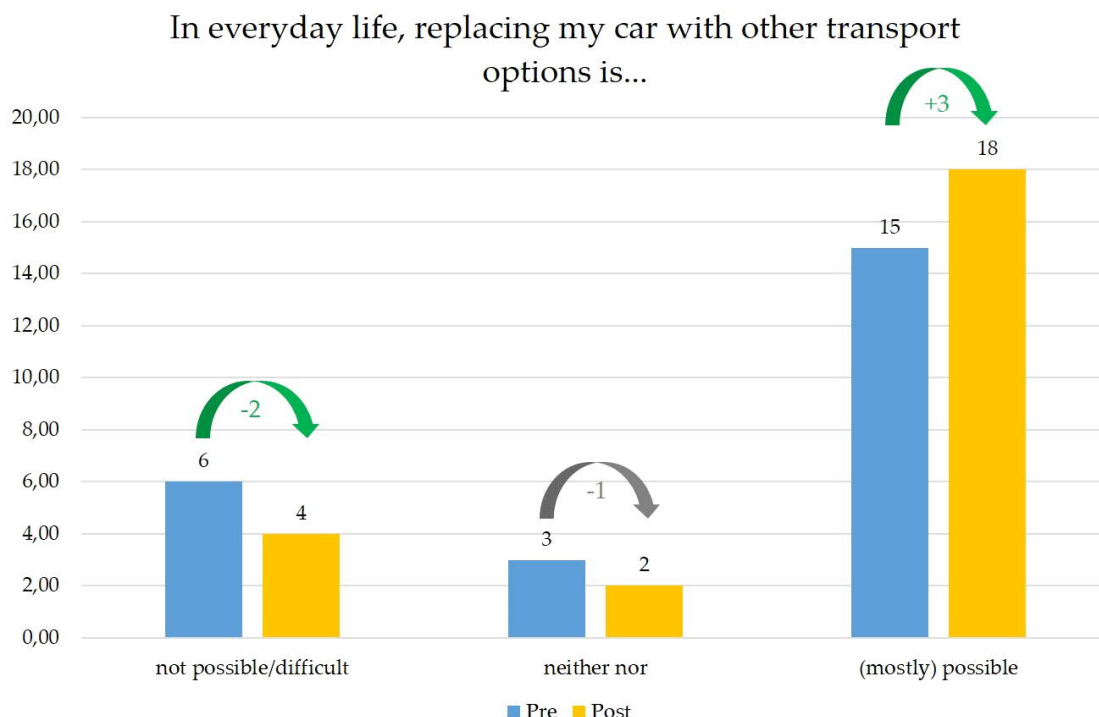


Figure 3: Average rating (mean) and frequency of answers by respondents in the pre- and post-survey regarding the replacement of a car in everyday life

We also asked participants for their behaviour and behavioural intentions. Specifically, we used four items (e.g., "in everyday life, I try to use sustainable transport options"; two items reversed-scored on a 5-point Likert-scale ranging from 1 = almost never to 5 = almost always) in the survey before and after the app-using phase. We combined these four items into one mobility-behaviour score (Cronbach's alpha = .79 and .64, respectively) and compared the pre- and post-scores with a paired-samples t-test. Again, we found the same pattern: Results did not reveal a significant effect, however, descriptively, we found an increase in sustainable mobility behaviour (mean pre-survey 3.93, mean post-survey 3.98).

The described changes – although they are non-significant – provide a first hint that the use of the Earnest App improved participants' awareness regarding sustainable mobility. Reasons for the lack of significant results could be the small sample size and the fact that respondents in the pre-survey reported already quite sustainable mobility behaviour (with average ratings above the scale's midpoint) leaving little space for improvement. Regarding the role of the 9€-ticket, we found that the majority of participants (n = 18, 75%) reported to have used the 9€-ticket in all three months. This can be interpreted as another hint that the app led to the more sustainable mobility behaviour. However, it is also possible that this result is caused by our most student sample.

Spillover effects

Since the Earnest App does not only target mobility-related behaviour but a more systemic view on the energy system and more sustainable options, we expected changes in mobility and other energy-related behaviours. Besides the described mobility-related behavioural changes, we asked respondents about eight other behaviours (on the 5-point Likert-scale ranging from 1 = almost never to 5 = almost always). The items cover different areas of sustainable behaviour; thus, it is not surprising that Cronbach's alpha as indicator for the internal consistency did not reach the threshold of .70. Consequently, we did not compute a score across the eight items but analysed them separately. Again, we performed paired-samples t-tests (for each item) to examine whether the answers differed between the pre- and the post-survey, but we did not find significant effects – except in one item. Descriptively, we found that in six of the eight items, respondents reported a higher frequency of more sustainable behaviour after the app-using phase than before. Thus, the app may have caused a spillover effect. Results revealed a significant increase in frequency for the behaviour of sustainable heating. This may be triggered by the on-going debate regarding the energy crisis that is prevalent in German media during the time of the case study. For details of the items and the means see Table 3.

Table 3: Average frequency of spillover behaviour as reported by respondents in the pre- and post-survey

	PRE Mean (SD)	POST Mean (SD)	paired t-test (no. of answers)
I make sure to save electricity in the household (e.g. switch off lights, switch off electrical appliances, do not leave computer/laptop in standby mode).	3.96 (0.95)	4.21 (0.83)	n.s. N = 24
When buying household appliances, I pay attention to the energy efficiency of the appliances (A/A+/A++ energy efficiency label).	3.41 (1.50)	3.41 (1.47)	n.s. N = 22
I heat in an energy-saving way (e.g. put on a jumper instead of turning up the heating, turn off the heating when airing, turn down the heating when I am away).	3.67 (1.27)	4.04 (1.00)	* p = .036 N = 24
I make sure to save water in the household (e.g. only wash when the laundry drum is full; turn off the water in the shower when soaping up; turn off the water when brushing my teeth).	4.25 (0.90)	4.41 (0.78)	n.s. N = 24
<i>I mainly buy regional and/or seasonal food and/or organic products.</i>	3.35 (1.07)	3.26 (1.05)	n.s. N = 23
I eat meat.	2.63 (1.06)	2.46 (1.14)	n.s. N = 24
I make sure to avoid packaging/plastic waste directly when shopping (e.g. buying vegetables unpackaged, not using plastic bags when buying food and clothes).	3.83 (0.92)	4.04 (0.86)	n.s. N = 24
<i>I make sure that I separate my waste correctly in everyday life.</i>	4.79 (0.41)	4.71 (0.55)	n.s. N = 24

Note: For statements in italics, respondents did not report a higher frequency in the post-survey than in the pre-survey, indicating more sustainable behaviour. The frequency of the item "I eat meat" also does not increase; however, this indicates more sustainable behaviour.

In addition, we asked case study participants whether they have an electricity tariff that uses exclusively renewable energy and whether they own photovoltaic panels. Based on their answers in the pre- and post-survey, one additional person switched from a non-renewable electricity tariff to a renewable one (pre n = 10, post n = 11). In addition, four additional persons installed a photovoltaic plant (pre n = 4, post n = 8). From the results, it is open whether this is caused by the use of the app and the case study or whether it has been planned before and, for instance, the photovoltaic plant has – by chance – been delivered during the case study period.

Overall energy citizenship activity level

We were also interested in participants' activity level regarding energy citizenship and whether it changes over time due to the use of the app. Thus, we use one item to measure each of the identified GRETA activity levels (see Figure 4). Since participants

answered “true” or “false” a paired-samples t-test could not be analysed. Comparing pre- and post-results descriptively, we found the results displayed in Figure 4. After using the app, everyone identified with the statement of being an aware energy citizen. Specifically, using the app during our case study increased the intention to save energy in everyday life (from almost all to all respondents). We observed no other changes. Interestingly, one person shifted from advocate to active. However, this could be caused by the exact wording of the item (the statement for active is more concrete than the statement for advocate “I try to”). All other ratings remained the same between pre- and post-survey and the six-months period. Thus, the app led to an increase of awareness regarding energy citizenship.

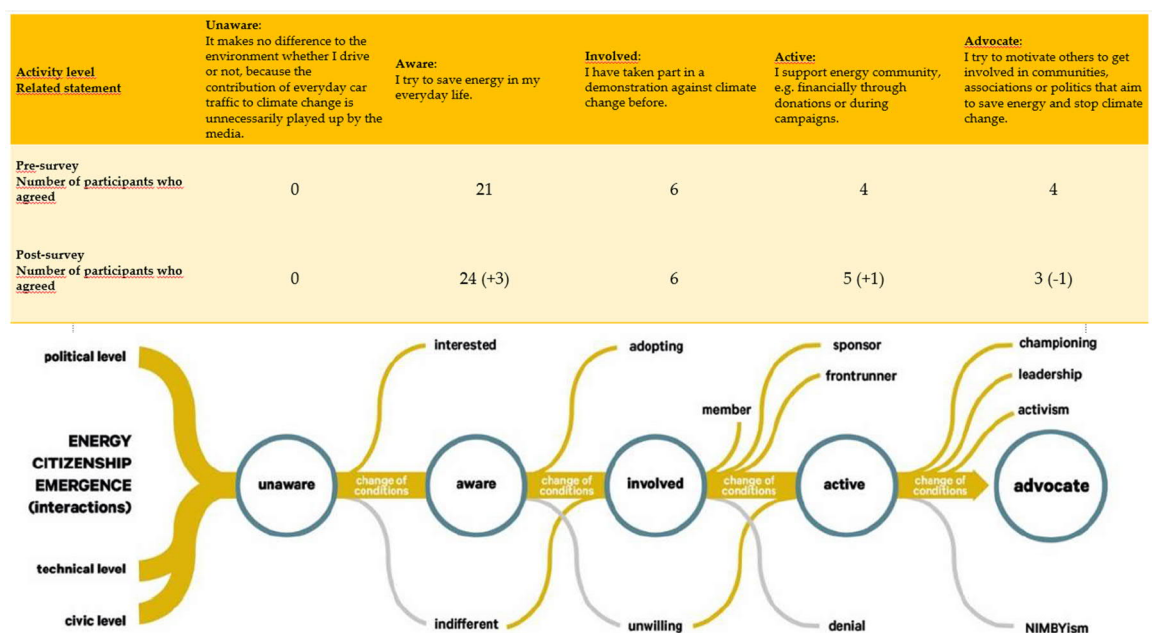


Figure 4: GRETA activity levels, related statements in the surveys and number of participants that agreed with the statement in the pre- and post-survey.

2.3 Online Forum (Padlet Board) and Online Discussion Group

As described in Section 1, the online forum data as well as the data collected during the online discussion group with research participants was assessed by conducting a structured content analysis and delivered some interesting findings in regard to the overarching research question of how energy citizenship behaviour emerges and develops.

Drivers and barriers for mobility-related behaviour

The data offers up several barriers and drivers for energy citizenship. While most research participants expressed interest in energy citizenship behaviour and/or were already actively trying to reduce energy consumption in everyday life, several challenges but also some drivers were identified. First, in regard to everyday mobility

behaviour, research participants named financial and infrastructural constraints as the most important reasons for not using public transportation options (instead of private cars). The cost of public transport was perceived as too high and access to and frequency of public transport too low to make it a feasible alternative in certain rural regions around the city of Darmstadt. Second, research participants highlighted delays and reliability of and overcrowded public transport as a barrier. However, particularly students also highlighted their subsidized student semester ticket, which allowed them to use public transportation for free as an enabler of energy-saving and CO₂-reducing mobility behaviour.

The data also shows that lack or availability of certain resources influences energy citizenship behaviour. First and foremost, the lack of financial resources was perceived as one of the most important barriers to participate in the energy transition and to be an active energy citizen in everyday life. This was particularly the case for specific members of the society, such as students, citizens with low or no income, and families. Additionally, (lack of) time was mentioned as another relevant resource. Educating oneself or getting involved in energy-saving activities beyond behaviour that are perceived as low-threshold (such as turning off the lights when leaving the room) are regarded as time-intensive and much less likely to be engaged in.

The data indicates that the interaction with other people and being part of a social group that shares values and a lifestyle can on the one hand contribute to energy citizenship behaviour by adhering to peer pressure in a group that values energy-saving behaviour, by supporting each other, and by providing a group infrastructure that enables everyday activities that contribute to a more sustainable footprint. While individual norms and values matter for motivation, socio-economic variables influence the adaptation of corresponding behaviour. For example, research participants emphasized that their energy consumption behaviour is impacted by who they live with (roommates, family, partners etc.), as well as where they live in regard to availability and accessibility of public transport infrastructure (rural vs. urban). On the other hand, group settings can also be detrimental to people's motivation to engage in energy citizenship behaviour when others act differently by, for example, not recycling their trash or using public transport as this can reduce the perceived impact an individual can have.

Energy Citizenship: The role of individual action

The data allows for some preliminary conclusion on the role individuals see for themselves when it comes to having an impact on the energy transition in Germany. While the perceptions were mixed, most research participants regard their own behaviour as having a limited effect on overall transition efforts. The most relevant impact was perceived to take place within their own social groups by educating others and by wanting to be a role model to peers and others. As one research participant put it: "I value my contribution in the sense that it can be a role model for others, or at least a reason to see some things differently. But I see my individual contribution as a

lifestyle and not an effective way to contribute to the energy transition."² Moreover, some research participants highlighted the role consumers can play by making conscious purchase decisions. However, while the external impact of individual behaviour in everyday life was perceived to be low, the data illustrates that research participants thought to personally benefit from acting energy-conscious in everyday life by feeling good about their behaviour and doing their (limited) part.

The role of the app and the virtual community

In regard to the role of the app in the emergence and development of GRETA behaviour, the qualitative data offers the following findings. On the one hand, research participants perceived information provided by the app as helpful to act energy-conscious in low-threshold aspects of their lives (for example, turning off the lights and electric devices). Some app users indicated that they learned something new and adapted some new behaviour through the use of the app, while others found the information provided repetitive of what they already knew and regarded the app (and the regular push messages received by it) more as a regular reminder to continue behaving in an energy-conscious way. The Earnest App offers information as well as advice and challenges to integrate into the users' everyday lives. The data shows that the more time-intensive a challenge was perceived to be, the less likely it was that the users would integrate it into their own lives. The most direct impact of the app to energy citizenship behaviour identified by the research participants was that its use provided regular input for everyday conversations with friends and family, thus raising awareness around energy consumption issues within users' own social groups.

Finally, a specific characteristic of the Earnest App case study was that it was designed around a virtual community. The virtual character of the app and the community was perceived as a positive aspect by most research participants as it allows for participation and engagement even if members do not live in the same place or live a lifestyle that has them change locations often (such as students). However, research participants also highlighted that the anonymity of the members taking part in the community (due to research data protection considerations) as well as the set-up of the online-forum (which did not really allow for a direct exchange between participants) limited the experience of a community.

² GRETA_Padlet_Final text: 3: 3842 - 3: 4073 (translated from German)

3 Analysis

While the sections above focused on energy citizens and summarized results of all of the case study-specific activities conducted by the Fraunhofer team, the data in the following section focuses exclusively on the qualitative interviews conducted as part of T1.3. The section interprets the roles different actors, such as policymakers, business and civil society actors, play for energy citizenship emergence in the specific context of our case study. The analysis is integrated into the energy citizenship engagement model introduced in GRETA's report D1.1., which identifies goals, outcomes, norms and agency as factors that shape energy behaviour of different actor groups. Comparing differences and similarities among actor groups finally allows to draw conclusions on how behaviours influence each other.

The analysis presented in this section is based on the results of a total of 16 qualitative interviews that we conducted with different actor groups (energy citizens, local initiatives, policymakers, businesses). An anonymized list of interviewees can be found in Annex 2 of this deliverable.

3.1 Behaviour and goals per actor

The overarching societal goal of the case study in Germany is to contribute to an increased sustainable mobility behaviour among the case study participants, located in and around the city of Darmstadt. The hypothesis of the case study is that by using an app that provides knowledge and tips for more sustainable mobility behaviour, citizens' awareness of their mobility increases and energy consumption decreases (both in the mobility sector as well as in adjoining sectors (= spillover effect). Different actor groups, especially citizens (app users), NGOs & local initiatives, policymakers (regional & local level), and businesses engage in these goals by, first, practicing energy citizen behaviour (energy citizens and local initiatives) and second, by shaping the conditions for energy citizenship emergence and development (policy makers and businesses).

- Citizens: From the perspective of citizens (app users) the main goal is to reduce energy consumption by changing behaviours in everyday life. This especially refers to mobility behaviours such as using public transport, walking, bicycling or driving electric vehicles, which are charged with renewable energies. The citizens interviewed for this analysis had a high level of awareness for sustainable energy consumption and sustainable mobility. All of them relied on cars in different situations (for holiday travels, shopping, etc.) but in daily life often used public transport options or a bicycle.
- Local initiatives: On the local level, initiatives often emerge out of very concrete problems or possibilities. In Darmstadt, citizen initiatives exist with different goals in relation to (sustainable) energy production and mobility options. A main objective of these initiatives is to change existing policy conditions that currently hinder more

sustainable energy and transport options or to improve the availability and use of infrastructures, e.g., by running campaigns and lobbying for political support.

- **Policymakers:** Goals of policymakers, especially on the local level, include implementing local strategies on the reduction of CO₂ emissions. Therefore, behaviours and activities involve the implementation of laws, setting up local planning processes and providing infrastructural conditions for sustainable transport options, e.g., by providing charging points for electric vehicles. However, these goals are often in contradiction with other policy goals and face the challenge of scarce (human and financial) resources across all three levels of government (local, regional and national).
- **Businesses:** From the perspective of businesses, most relevant behaviours or activities is the provision of a range of sustainable energy and transport options, including electric vehicles and their charging infrastructure, on-demand mobility services or renewable energies for electrified public transport options. This is pushed both by consumer demands and by regulatory policy frameworks requiring the reduction of CO₂ emissions in the use of certain transport options.

3.2 Positive and negative outcomes associated with engaging in GRETA

The outcomes that citizens expect from engaging in activities related to GRETA refer to environmental benefits insofar as the use of more sustainable transport options (bike, public transport etc.) is considered to reduce the individual CO₂ footprint. In the context of everyday experiences, mostly personal benefits are mentioned. Using sustainable transport options are perceived to have a higher esteem, especially among students and other young people living in the city. Sustainable mobility behaviour conforms to social norms dominant in those groups. From a practical perspective, personal benefits arise from sustainable transport options in form of saving time when riding the bike to the city centre or being independent from schedules of public transport. Using public transport in contrast allows more social contacts by meeting other students on the tram or by the possibility to use the time spent on public transport to study. For students, the use of public transport furthermore has financial benefits as the student semester ticket available in Darmstadt makes public transport cheaper than driving a car. Financial disadvantages mainly refer to electric vehicles, which are often too expensive for students, or to people who do not benefit from subsidized public transport tickets. Personal disadvantages refer to train delays and crowded trams as well as the lack of infrastructure for people living outside the city limits in more rural areas.

In interviews with local initiatives and NGOs, no personal benefits were mentioned from engaging in activities related to GRETA goals. The most prevailing outcomes mentioned were environmental benefits and the reduction of CO₂ emissions through the use of more sustainable transport options or renewable energy production. Financial benefits were mentioned, e.g., local and renewable energy supply in many cases is cheaper than other forms of energy provision. A financial disadvantage

emerges, however, when policy frameworks hinder the investment of local initiatives in certain technologies and investments get risky due to changing policy frameworks. A personal disadvantage that reaches beyond direct membership of local initiatives emerges when the number of people using public transport options increases faster than infrastructural capacities allow it – this can both be dangerous (bicycling) or stressful (public transport). The main personal disadvantage from the perspective of local initiatives and NGOs is the high investment of time and the sometimes frustrating (policy) conditions that might hinder activities from local initiatives.

Policymakers highlight environmental benefits through the increase of charging infrastructure for e-mobility on the local level. Personal benefits arise in form of policy instruments that encourage certain mobility and energy behaviours through financial or tax incentives. One example are free parking options for electric vehicles, which in contrast to cars with combustion engines are not charged in the city centre. Next to these incentives, further policy instruments bring financial benefits for more energy friendly behaviours such as subsidies for e-mobility or, on the other side, taxes on fossil fuels. These subsidies, however, bring also financial disadvantages on the municipal level due to the high financial investments needed. According to our interview partners, examples from other countries (e.g., the Netherlands) show more favourable business models that allow municipalities to earn money by awarding concessions for charging points. Personal disadvantages are not mentioned by policymakers.

Like all other interviewed actor groups, businesses mentioned the reduction of CO₂ emissions as most important environmental benefit of their activities related to sustainable energy and transport. The fact that policymakers support sustainable energy and mobility options allows for better targeted business solutions. Businesses mention an improvement of financial support and subsidies since 2021, when a new national government was elected in Germany. However, financial disadvantages still remain in form of high investment costs for sustainable technologies that come with uncertain payoffs or very long time-horizons in terms of financial returns. Personal disadvantages are also not mentioned among actors from businesses.

3.3 Norms associated with engaging in GRETA

Citizens - in our case this mainly refers to students – do mention normative pressures from peers as influential to their energy and mobility behaviour. For some students, using sustainable mobility options such as public transport and bikes even feels 'normal' and students described that they are generally used to certain types of sustainable mobility behaviour. However, some contradictory norms also arose as a point of interest in the data. Especially travelling, being mobile and staying abroad is perceived as an influential activity and social norm that contradict normative assumptions about sustainable behaviours. Some interviewees also mentioned how the social context they grew up in can be in contradiction to norms of their peer group, e.g., when family members do not question the use of car-based traffic but student peers

do. Similarly, a family context, in which sustainability is already an important practice helps with energy citizenship behaviour later in life since it increases levels of awareness and familiarity. Finally, financial costs play an important role in determining what is perceived as possible energy citizenship behaviour and what is not.

All interviewed NGOs and local initiatives mentioned pressure from citizens and peers towards an increased engagement for sustainable energy and mobility solutions as influential for their activities. Generally, they described a high normative support from different stakeholder groups for their engagement that encourages their activities. However, contradictory views on the political level, e.g., from conservative or national oriented politicians lobbying for fuel-based individual traffic, can be a barrier as they challenge or reframe activities of local initiatives. For example, according to conservative and national oriented politicians, reducing car-based traffic would take away personal rights for free mobility. Also, past disagreements with local policymakers were described as a barrier for the engagement in renewable energy provision as it limits network access and hinders productive exchanges.

Norms, that policymakers mentioned, refer to pressure from citizens towards better infrastructure conditions. This is especially the case in regard to an increase of charging infrastructure for electric vehicles since the general public opinion seems to support e-mobility and renewable energies. From business actors, policymakers registered an increasing competition between the automotive industries, electricity providers and batteries producers. According to policymakers, there seems to be a lack of cooperation between these technology providers that hinders engagement in more sustainable energy and mobility infrastructures. On the other side, policymakers also mentioned certain hindering norms and organisational barriers, for example due to the complexity of planning regulations on the local level or when national regulations don't apply to local context conditions. According to the interviewees, stricter norms and regulations are necessary to reduce individual traffic demand - including traffic caused by electric vehicles and charged with renewable energy.

Businesses mentioned pressure from local and European policymakers as normative impulses to fulfil CO₂ emission targets. For example, EU regulations set limits for CO₂ emissions in the transport sector that influence strategies of businesses. Also, pressure from citizens to support local and renewable energy production is described as having an impact on business strategies. However, particularly in niche-technology development phases, the demand and consumer choices might be low or non-existent (e.g., low demand for electrified on-demand-shuttles), which indicates a context-based role for consumer demand in regard to business strategies. Smaller businesses might not be able to pay increased prices for e-mobility and other technologies (e.g., to change their vehicle fleet). In contrast to other actor groups interviewed, business actors described the most barriers related to norms outlining that it is often difficult to navigate contradictory narratives and norms. For example, on the one hand, sustainably-oriented businesses are impacted by more politically conservative and national oriented norms refusing any development of renewable energy plants or more

sustainable transport solutions. This often co-exists with norms seeking to protect animal welfare and nature conservation even though the context of these norms misaligns. On the other hand are norms pushed by actors that seek both higher standards for as well as a faster development of renewable energies. Finally, business actors mention a lack of political support especially for unpopular decisions. One example is the installation of a pay system for parking in the city centre, which would reduce traffic in the city centre.

3.4 Agency associated with engaging in GRETA

Resources that citizens mentioned as supportive to engage in GRETA related topics mainly involve better local infrastructural conditions and financially more attractive options for public transport options. So far, the personal resources citizens invest encompass time and patience when using public transport. Therefore, political support should mainly target the improvement of these mobility options to make public transport more attractive to a wider range of people.

NGOs and local initiatives (like all other actors except citizens) mentioned the lack of staff to further engage in sustainable mobility planning and activities. The lack of personnel resources or expertise in certain topics (e.g., financial or bureaucratic requirements) relates to other activities such as bureaucratic barriers that hinder engagement. While initiatives would benefit from learning from each other, the scarce time resources reduce the capacities to connect with others and exchange experiences. Also, some policies, especially on the local level, are mentioned as hindering activities, such as the lack of clear climate protection or mobility targets.

While policymakers also mentioned the lack of staff and personnel resources and expertise as a barrier to engage in and develop sustainable mobility activities, interviewees focused on another relevant aspect: the resources to provide knowledge and inform citizens, e.g., through campaigns. Innovative technological solutions together with financial support are furthermore mentioned as important but scarce resources at the policy level. Despite these different types of resources, clear responsibilities would be needed together with closer cooperation among different stakeholders. Cooperation among policy, business and technology actors, or the lack thereof, is also mentioned as a barrier to act on the national level.

Just as policymakers and local initiatives, businesses mentioned a lack of staff and personnel resources as a reason for some slow-moving developments in the sustainable mobility sector which hinders their activities. Moreover, with regard to novel technologies, financial support, investment security and expert knowledge is a scarce resource. Finally, businesses mention a lack of knowledge among policymakers about the needs of businesses and the importance of improving communication between

businesses and policymakers. The reduction of bureaucratic barriers would reduce the need of staff for businesses.

3.5 Relational model associated with engaging in GRETA

For citizens, the relationship with other actors is mostly dominated by a lack of personal contact or even knowledge about possible contact persons when it comes to policy makers or NGOs and local initiatives. The (lack of a) close relationship and interaction is exacerbated by the fact that policy is made and administered at different levels of governance and the relationships between policymakers on different policy levels are complex and require knowledge of the system and close coordination. NGOs and local initiatives are actors that are very engaged in connecting with other actors such as policymakers, citizens and other initiatives. However, they often have limited resources to institutionalize these relationships to make them permanent and regular. For policymakers, all actor groups are relevant. However, the type of relationships might differ quite a lot depending on the type of actors. While citizens and local initiatives often seek contact policymakers to articulate demands, the relationship is not well developed and rather uni-directional. More established relationships and contacts exist between policy and businesses. Businesses often describe their activities in a way that they seem to proactively engage in relationships to all types of actors.

However, relationships to all actor groups from the perspective of businesses can be both supportive or critical. A more detailed overview of the relation model for the Earnest App case study is depicted in Table 4 below.

Table 4: Relational model for the Earnest App case study

	Energy citizens (app user)	NGOs & local initiatives	Policymakers	Businesses
Energy citizens (app users)	Lack of personal, face-to-face exchange (would increase community feeling)	Important to reach out to citizens (good contact with media and press)	Citizens articulate demand for improved charging infrastructure; citizens should understand that political processes are slow	Information events for citizens; citizens articulate demand for charging infrastructure, citizens represented as part of an advisory board of regional mobility provider

NGOs & local initiatives	Lack of knowledge about contact person	Peer-to-peer learning between different local initiatives	Frequent exchange with different local initiatives and interest groups	Citizens and local groups can buy shares of renewable energy plants; critical perspective from NGOs (e.g. standards not strict enough)
Policy-makers	Lack of knowledge about contact person; rather not seen or heard; different participation formats needed (e.g. only 'loud' people are heard)	Regular meetings with municipal institutions, political parties but rather top-down; more informal contacts important; difficult for small initiatives to engage in bureaucratic structures	Difficulties due to complex structures of responsibilities (coordination between policy levels very complex); district ('Landkreis') as coordinator between municipalities; better coordination needed	Energy supplier, mobility provider as subsidiary of municipality; need to meet requirements; financial support; active contact with policy makers from different levels
Businesses	Local mobility providers as first contact for questions related to sustainable mobility, big business perceived as 'bad guys'	Businesses often not interested in direct contact with small scale initiatives	Wish for more engagement of businesses, municipality not as provider for energy infrastructure (but lack of financial benefits for businesses); lack of staff to maintain contacts	Cooperation between energy supplier and mobility provider; good contact between different mobility companies in the district, relationship between mobility provider and the city of Darmstadt sometimes difficult

3.6 Asymmetries analysis across actors

Referring back to our research hypothesis, we assumed that by engaging with the app, citizens will increase both their awareness for their mobility and energy consumption, change their behaviour toward a more sustainable lifestyle and encourage others to do so. The results of the study show that different actor groups (local initiatives, policymakers and businesses) are involved in these behavioural changes insofar as they provide infrastructure, offer mobility solutions or lobby for certain sustainable energy and transport solutions.

Table 5 below presents an overview of the behavioural patterns and asymmetries across actors.

Table 5: Asymmetry analysis for the Earnest App case study

	Energy citizens (app user)	NGOs & local initiatives	Policymakers	Businesses
Goal / behaviour	energy reduction by changing behaviours in everyday life	encourage and promote sustainable energy and transport options	implementing local strategies on the reduction of CO2 emissions	provision of a wide range of sustainable energy and transport options
Attitude	environmental benefits (CO2 reduction); personal benefits (saving time and money), financial benefits (semester ticket for public transport for students), Financial disadvantages (high costs of electric vehicles)	environmental benefits (CO2 reduction), financial benefits (local, renewable energy supply cheaper); financial disadvantages (risky financial investments due to changing policies), personal disadvantages (time investment, danger when infrastructure is bad)	environmental benefits (electric vehicles charged with green electricity), personal benefits (when policy instruments create personal benefits), financial benefits (when policy instruments create financial benefits), financial disadvantages (high investment costs)	environmental benefits (CO2 reduction); personal benefits (increased political support), financial benefits (better financial support), financial disadvantages (high investments often don't pay off)
Social Norm	Peer-pressure among students; but sometimes contradicting norms (e.g.,	Pressure from citizens, peer- pressure; general support, some disagreements with	Pressure from citizens and local initiatives; general support for e-mobility	Pressure from local policymakers, citizens, EU policies;

	sustainable mobility vs. travelling)	local policymakers; hindering: conservative or national political parties	and renewable energies; price differences and bureaucratic barriers as hindering	general support but low demand for certain mobility solutions; lack of political support for some (unpopular) decisions; NGOs lobby for stricter standards
Agency	Better local infrastructures, financially more attractive public transport options, time and patience when using public transport	Staff and personnel resources, reduction of bureaucratic barriers and hindering policies	Staff and personnel resources, closer cooperation between different stakeholders, clear responsibilities, financial support for municipalities, innovative technical solutions, etc.	Staff and personnel resources; knowledge about political and technical solutions, financial support, reduction of bureaucratic barriers and hindering policies, closer cooperation with policymakers and other businesses

Most striking are the similarities that all actors listed here share. All actors seem to share a general goal and interest in reducing CO₂ emissions. A key motivation across actors is the peer-pressure from other actors or pressure from citizens. Only businesses report also the important role that pressures from EU policies have for their activities. However, all actor groups report financial disadvantages and concerns about financial investments or a lack of time resources and staff. Because mobility behaviour is very much related to infrastructural conditions with high investment costs, the questions who takes the costs of changing infrastructural systems seems to be most contested.

An interesting difference exist between business actors, who report a rather low demand of certain mobility solutions and citizens, who argue that a greater variety of choices would encourage more sustainable mobility behaviours. Disagreements with local policymakers (mentioned by local initiatives) and lack of political support for

rather unpopular decisions (mentioned by businesses) is considered a barrier for greater engagement. Even policymakers articulate a wish for a clearer division of responsibilities.

4 Discussion and reflection

While the previous section focused on factors of the energy citizenship emergence model introduced in D1.1 by the GRETA project and was based on data collected through qualitative interviews as part of WP1.3, this section seeks to zoom out to include all other case study-specific data collected as part of WP3 and outlined in section 2 of this report. The objective of this section is to discuss and reflect the data in light of the case study-specific research questions already introduced in section 1.3 above:

1. What are barriers and drivers for becoming an energy citizen in everyday life?
2. What role can and does an app play in the emergence and development of energy citizenship?
3. What role does a virtual community play in the emergence and development of energy citizenship?
4. Where and how do aspects of social justice play a role in energy citizenship development?
5. What is the role of policy, or where would policy have to start in order to support energy citizenship?

4.1 Drivers and barriers and the role of agency in energy citizenship

Asking people to engage in active energy citizenship activity is asking them to take responsibility for their lifestyles' impacts on local, national and global CO₂ emissions. Energy citizenship is placing the individual in a position of actively contributing to the energy transition. The data from our case study shows that many young people are motivated to become active energy citizens, and most of our research participants (who self-selected into the study) were highly aware of and actively engaged in sustainable mobility behaviours in their everyday lives. Most research participants across all actor types outlined either environmental and ecological norms or regulatory policy frameworks (incentives) as reasons for engaging in the energy transition. Using sustainable transport options are perceived to have a higher esteem, especially among students and other young people living in the city. The normative objective to reduce CO₂ emissions either through policy changes or individual behaviour can be seen as an important driver of energy citizenship but exists in tension with other dominant norms, such as being mobile (for employment opportunities), travel the world, and living abroad.

Social interaction with other people and being part of a social group that shares environmental and ecological values and a lifestyle can contribute to energy citizenship behaviour due to perceived peer-pressure as well as through the provision of a group infrastructure that enables everyday activities that contribute to a more sustainable energy footprint. Research participants reported that the regular interaction through

the online forum made them feel accountable for their activities and contributed to committing to behavioural changes. On the other hand, group settings can also be detrimental to people's motivation to engage in energy citizenship behaviour. When peers or other groups are observed to behave in a way that is perceived as having a negative impact on sustainability, the motivation of energy citizens to act differently, i.e., more sustainably, can also decrease since the behaviour of others affects individuals' calculations of how much of an impact on over CO₂ emissions their actions can have.

Energy citizenship behaviour is deeply embedded into a system of overlapping and sometimes contradictory social norms, policies and infrastructures that can enable or hinder its emergence and development. Group dynamics are therefore an important factor when considering the role of agency in energy citizenship. While the perceptions were mixed, most research participants regarded their own behaviour as having a limited effect on overall transition efforts. The most relevant impact was perceived to take place within their own social groups by educating others and by wanting to be a role model to peers and others. Moreover, the data illustrates that many research participants thought to personally benefit from acting energy-conscious in everyday life by feeling good about their behaviour.

However, research participants also reported several barriers to energy citizenship, which can be categorized into policy-level and individual-level barriers to energy citizenship and again categorized into types of actors. On the policy level, lack of regulatory frameworks and policy commitment in regard to long-term investment strategies (and therewith investment security) are seen as an important barrier for local (citizen) initiatives and businesses to engage in energy citizenship behaviour. Moreover, complex governance structures with weakly defined or overlapping responsibilities often due to intersecting policy sectors are perceived as an important barrier for energy citizenship both by involved policymakers as well as by citizens and local (citizen) initiatives, who have difficulties identifying their institutional access points to submit requests or find relevant (policy) information to engage in energy citizenship behaviour, such as the creation of a renewable energy community (REC). The lack of policy knowledge (on the side of citizens and citizen initiatives) and community knowledge (on the side of policymakers and businesses) combined with the lack of human resources and time-constraints is highlighted as a relevant barrier for policies that would enable energy citizenship behaviour rather than restrict it. Finally, the lack of or the existence of insufficient or eroding infrastructure - particularly in the sector of sustainable mobility - is perceived as a major barrier to engage in more sustainable mobility behaviour in everyday life.

In regard to individual-level barriers for everyday mobility behaviour, research participants named financial constraints as the most important reason for not using public transportation options (instead of private cars). Subsidized public transport tickets, such as student semester tickets or the temporary measure of the 9€-ticket, however, were highlighted as a positive driver for energy citizenship in the mobility sector. Additionally, research participants highlighted delays and reliability of and

overcrowded public transport as a barrier since these factors are negatively affecting the comfort of everyday commutes and other travel. Similar to barriers for sustainable mobility behaviour, the findings of this case study highlight lack of financial resources as well as time as one of the most relevant barriers to individual citizenship engagement in the energy transition. The more time-consuming an activity was perceived to be, the less like it was that research participants engaged in them. To summarize, while there seems to be high awareness of energy-related topics, strong pro-environmental social norms, and peer-pressure to motivate citizens to engage in energy citizenship behaviour, practical barriers (such as finances and times) appear to hinder the active, higher-threshold engagement in people's everyday lives.

4.2 The role of a digital app and a virtual energy community

The findings in this study do now allow for a conclusive statement on the role of a digital app to influence people's everyday behaviours in favour of more sustainable mobility practices. From an inference statistical viewpoint, we did not detect significant effects in participants' mobility choices. However, descriptively, we observed a change in behaviour toward more sustainable mobility practices, such as using bikes and trains. In turn, the use of cars with combustion engine and the use of public transport within the city was slightly reduced (descriptively). As a caveat, the study did not control for unforeseen external circumstances that might have had an impact on case participants' behaviour in addition or in place of the app. The Russian War in the Ukraine put energy saving on the agenda of mainstream media and discourses. Moreover, Germany introduced the 9€-ticket from June to August 2022, which allowed ticket-owners to use local and regional public transport. Nevertheless, the observed changes in the pre- and post-survey – although they are non-significant – together with qualitative data from the Padlet board and the online discussion group, provide a hint that the use of a digital app, such as the Earnest App, can improve participants' awareness regarding sustainable mobility and contribute to a change in behaviour.

A specific characteristic of the Earnest App case study was that it was designed around a virtual community. On the one hand, the virtual character of the app and the community was perceived as a positive aspect by most research participants as it allows for participation and engagement even if members do not live in the same place or live a lifestyle that has them change locations often (such as students). This hints at an important aspect: Virtual energy communities might allow for a more inclusive approach than more place-based energy communities as they provide opportunities for engagement over a long period of time even if members live very mobile lifestyles. Moreover, the threshold to become actively involved in a virtual energy community might be lower compared to more traditional energy communities. Participation is possible at any time and from anywhere, which is particularly attractive for younger people with a mobile lifestyle (such as students and young professionals).

On the other hand, the case study also revealed some challenges concerning virtual energy communities, particularly in regard to social justice considerations. First, access to and participation in a virtual energy community requires digital literacy as well as material resources (such as access to a phone, laptop and internet), which might be limited in certain societal groups (such as low-income populations). Second, commitment and loyalty to a virtual community might be lower than place-based energy communities and the effect on its members less pronounced. While limited commitment was observed in the virtual community in this case study, this might have been due to the case study design as the community was created for the study and allowed the participants to stay anonymous in the online forum to adhere to EU data protection policies. This option was used by most case study participants and might have negatively affected the development of a shared community and long-term commitment to it. However, we did observe a what we could call "place-based"-effect even among member of the virtual community: Research participants shared place specific conditions that enabled or hindered lifestyle changes and also expressed the desire to include place-based recommendations in regard to sustainable lifestyles within the app. Concluding, while we did observe some long-term effects in behavioural changes of community members, the virtual community in itself did not continue after the study ended. However, differently set up virtual communities might make different experiences in regard to commitment and loyalty.

4.3 The role of policy

The findings of this case study show that the policy landscape energy citizens find themselves in plays an important role in either enabling or hindering active engagement in the energy transition. As highlighted above, complex policies and the involvement of various policy actors across different levels of governance can make it difficult for citizens, local (citizen initiatives) and business actors to understand their own role, rights and responsibilities. A coordinated policy response is necessary that involves direct institutional access points for citizens at the local level to share their concerns and gain information about regulations, incentives, technologies and funding programs. While most of the people who participated in this case study see how they - as individuals - can contribute to energy transition, they also emphasize the limitation of such an approach. Most research participants perceive their individual impact as almost negligible in terms of CO₂-emission reduction if not combined with greater (policy) efforts to reduce energy consumption in other areas than individual lifestyles and provide the appropriate policy and infrastructure landscape for citizens to become active *energy* citizens. This attitude directed towards policy is something that the policymakers we interviewed are already aware of and interpret as a mandate to act on. While this awareness is not yet facilitating energy citizenship per se, it is a sign that close dialogue between citizens and policy is needed and wanted on both sides.

5 Conclusion

The Earnest App case study provides valuable insights for GRETA. One of the research hypotheses was that by engaging with the app, users will increase both their awareness of their mobility and energy consumption and how their choices contribute to CO₂ emissions and change their behaviour toward a more sustainable lifestyle in their everyday practices. The observed changes in the pre- and post-survey data – although they are non-significant – together with qualitative data from the Padlet board and the online discussion group, provide a hint that the use of a digital app, such as the Earnest App, can improve participants' awareness regarding sustainable mobility and contribute to a change in behaviour. Overall, the use of the app led to an increase of awareness regarding energy citizenship allowing this case study to speak to the role of an app and nudging approaches in supporting energy awareness enhancement.

Moreover, we assumed that by learning more about the mobility and travel sector, users start to adopt a broader sustainability view leading to further conscious actions in other, related areas, such as energy efficiency (spillover effects). We found that respondent did report a higher frequency of sustainable behaviour in some other sectors, such as electricity and heating consumption in the household. While this may also be triggered by the on-going discourse regarding the energy crisis prevalent in Germany since the outbreak of the Russian war in the Ukraine, qualitative data results do indicate that research participants appreciated the system-wide approach to sustainability offered by the Earnest App by expressing that the use of the app did incite them to learn more about sustainability in sectors they hadn't previously be aware of.

In addition, we posited that community members might influence others and act as role models – leading not only to a more active type of energy citizen but also to spreading the knowledge and starting to create a socially normative pro-environmental behaviour. The findings of this case study support this assumption. Group dynamics play an important factor when considering the role of agency in energy citizenship. Virtual communities can offer a venue for people to participate in the energy transition who would otherwise not find themselves able to become part of an energy community, such as young people who are highly mobile. Nevertheless, the benefits of virtual energy communities need to be weighed against potential negative aspects (such as access, affordability and commitment). Further research could support questions on appropriate designs of virtual tools and communities in the energy transition.

Finally, the case study findings highlight the role of a crucial demographic for a successful transition to a sustainable and just energy system now and in the future: young citizens. The case study sample consisted of a total of 50 research participants who signed up to use the app for six to eight weeks and participated in at least one of the pre- and post-questionnaires. After matching the responses in the pre- and post-

questionnaire, a total of 24 participants remained. Our final sample consisted of mostly female students under 30 years old. Thus, we reached our target sample of younger citizens.

Based on the analysis of the factors contributing to energy citizenship emergence in section 3 and the discussion and reflection of drivers and barriers for energy citizenship in section 4, the following policy recommendations are derived from the case study's findings. First, the case study identified the lack of integration of local and community knowledge in policymaking as a barrier for energy citizenship. Insights from our case study on the use of an app suggest that digital platforms – which are attractive especially for young citizens – could help to collect community knowledge from young citizens to integrate this knowledge into policymaking. A possible way to address this is to provide funding for third actors to develop and set up digital platforms for interactive knowledge exchanges between citizens and policymakers – attractive to and known among young people. Second, the specific focus of our case study on sustainable transport options highlights the important role of providing good infrastructural conditions as the basis for more sustainable mobility behaviours. This requires policymakers to prioritize a timely, comprehensive (accessibility) and affordable public transport infrastructure in both urban and particularly rural areas. Third, the complexity of the current policy landscape both for policy administrators (at different levels) as well as citizens too understand and act on and benefit from was also identified as a barrier. One way to address the complexity and unclear division of responsibilities between policymakers is to require the establishment of regular communication between policymakers from different policy domains and policy levels in national and regional transport policies. This would allow to improve the sense for responsibilities as well as coordination and knowledge exchange between policymakers. For citizens, the establishment of regional institutional access points would allow for the provision of information about the transport policy landscape and responsible policy actors (to better get engaged in energy citizen activities). Fourth, even if there is a high motivation for citizen engagement towards more sustainable lifestyles, high time investment is regarded as a huge challenge for communal activities. With an increased focus on a more active role for citizens in energy transitions, it is important to establish incentives and compensation tools for formal engagement as energy citizens to (monetarily) value the time of citizen activities.

Annex 1: Guide for interviews

GENERAL INFORMATION

- 1) Could you briefly introduce yourself?
 - Name of the interviewee
 - Professional activity
 - Organisation / political actor
 - etc.

Part 1:

POLICIES

- 1) In your opinion, what are the 2-3 most important political measures (in transport policy, which e.g. influence the use of green electricity in electro mobility)?
- 2) Are there any laws, regulations or programmes that you regularly deal with in your daily work?

RELATIONSHIPS

- 1) Who do you think are the main contacts, i.e. who is responsible when it comes to societal needs in transport behaviour? / Who do you think is your first contact in politics when it comes to your organisation's needs in transport behaviour?
- 2) In your opinion, how should the relationship between politics, companies and citizens be structured so that the various needs in transport behaviour can be adequately taken into account? (targeted status)
- 3) How are relations between politics, companies and citizens (in the field of transport behaviour) currently structured? (as-is status)
- 4) In your opinion, what are the three most important tasks for policy-makers with regard to sustainable transport behaviour in the next 2 / in the next 10 years?
- 5) What do you expect from politics in the next 2 / in the next 10 years?

DIVERSITY

- 1) Which social actors does your organisation aim to represent in relation to sustainable transport behaviour? / Which social or political actors do you feel best represent you in relation to your transport behaviour?
- 2) Are there any actors you would like to involve more actively in transport policy in order to better represent or reflect needs in society?
- 3) Do you feel understood and seen by policy makers and companies in relation to the transport needs you represent?
 - If no: Which of your needs are not addressed so far? Where is need for improvement?
 - If yes: Can you give an example situation where you felt well understood?
- 4) Where do you encounter diversity-aspects in your daily work?
- 5) In your opinion, which actors are currently best positioned to assert diverse social needs in transport policy?
- 6) In your opinion, is there a need for action to make transport behaviour not only more sustainable but also more diverse?
 - If no: Can you give reasons for your answer?
 - If yes: Where do you see a need for action?

Part 2:

BEHAVIOUR (PAST AND FUTURE)

Citizen

- 1) Have you purchased green electricity at home in the recent past (i.e. in the last 5 years)?
 - Do you plan to purchase green electricity at home in the near future (i.e. in the next 5 years)? (Reasons?)
 - If applicable, have you already researched suppliers? (Which ones?)
 - Do you (also) plan to purchase green electricity at home in the distant future (i.e. in the next 6-12 years)? (Reasons?)
- 2) Which two means of transport have you used most in the recent past?
 - What reasons do you have for using the above means of transport?
 - Do you plan to (continue to) use the above means of transport in the near future (i.e. in the next 5 years)? (Reasons?)
 - What would have to change for you to switch (even more often) to public transport?
 - What do you think about the use of electric vehicles in public transport (useful / less useful)? Can you explain your answer?
 - Would you be willing to pay higher fares for public transport if vehicle fleets were powered exclusively by green electricity?

If car in (2): You just explained that you often use a car. Have you used an electric vehicle in the recent past? (Reasons?)

- Have you bought an electric vehicle in the recent past?
 - Have you charged your car at home with green electricity in the recent past?
- 3) Do you plan to buy an electric vehicle in the near future (i.e. in the next 5 years)? (Reasons?)
 - Filter, if yes: Do you plan to charge your car at home with green electricity in the near future (i.e. in the next 5 years)?

4) Do you plan to buy an electric vehicle in the distant future (i.e. in the next 6-12 years)? (Reasons?)

- Filter, if yes: Do you plan to charge your car at home with green electricity in the distant future (i.e. in the next 6-12 years)?

Businesses

- 1) Do you provide your employees with charging stations for e-cars at your location?
 - If so, are they powered by green electricity?
- 2) Do you plan to provide your employees with eco-powered charging stations for electric vehicles at your site in the near / distant future?
 - What would have to change in law for you to provide eco-powered charging stations for electric vehicles at your company location?
 - What would have to change socially for you to provide green electricity charging stations for electric vehicles at your company location?

NGOs

- 1) Does your organisation support the private and/or public use of green electricity for charging electric vehicles? In what form does your organisation provide support, if any?
- 2) Do you plan to support the private and/or public use of green electricity for charging electric vehicles in the near / distant future? (if applicable, in what form?)
 - Filter, if no: a) What would have to change in law for you to support the use of green electricity for charging electric vehicles?
 - What would have to change socially

Policymaker

- 1) Is there a law or are you actively involved in a legislative process that obliges operators of public charging stations for electric vehicles to operate them with green electricity?
- 2) Do you plan to actively participate in a legislative procedure in the future that obliges operators of public charging stations for electric vehicles to operate them with green electricity? (In the near future / in the distant future?)

POTENTIAL EFFECT OF THE BEHAVIOUR

- 1) Where do you see potential impacts through your work in relation to the use of green electricity for electric vehicle charging in the next one to two years? / by the use of the mentioned means of transport in the next two years?
 - Positive effects or advantages
 - Negative effects or disadvantages

NORMS

- 1) Are there any persons, organisations, institutions or companies that you think urge you to advocate the use of green electricity for charging electric vehicles?
- 2) Are there any persons, organisations, institutions or companies that in your opinion prevent you from advocating the use of green electricity for charging electric vehicles?

PERSONAL RESOURCES

- 1) What / what resources do you need to use public transport more often? / to buy green electricity / to buy an electric vehicle?
- 2) What do you need to advocate for electric vehicles to be charged with green electricity?
 - Information,
 - staff
 - financial resources
 - infrastructure
 - contacts
 - time
- 3) Does your commitment to charging electric vehicles with green electricity depend on certain circumstances or experience? You are welcome to name circumstances that promote your commitment or hinder/reduce it.

CONCLUDING QUESTIONS

- 1) Is there anything else you would like to share with us regarding sustainable transport behaviour? Have we not discussed an important aspect of your work so far?
- 2) Who else do you think we should ask for an interview on this topic?
- 3) May we contact you again if we have any queries?

Annex 2: Anonymized list of interviewees

Interview No.	Type of actor	Date of interview	Duration of interview	Interviewer
1	Citizen (local initiative)	09.05.2022	64 min	Maria Stadler
2	Citizen (local initiative)	09.05.2022	61 min	Maria Stadler
3	Policy maker (local level)	19.05.2022	99 min	Maria Stadler
4	Business	31.05.2022	97 min	Maria Stadler
5	Business	02.06.2022	58 min	Maria Stadler
6	Citizen (local initiative)	08.06.2022	70 min	Maria Stadler
7	Researcher	08.06.2022	67 min	Sabine Preuß
8	Researcher	07.06.2022	Not recorded	Anne Kantel
9	Policy maker (district level)	10.05.2022	37 min	Anne Kantel
10	Business	09.06.2022	60 min	Anne Kantel
11	Business	10.06.2022	38 min	Anne Kantel
12	Multiplier	14.06.2022	33 min	Anne Kantel
13	Citizen (app user)	14.07.2022	33 min	Maria Stadler
14	Citizen (app user)	21.07.2022	38 min	Maria Stadler
15	policy maker (national level)	26.07.2022	91 min	Maria Stadler
16	Researcher / citizen	28.07.2022	51 min	Maria Stadler

Annex 3: Online discussion group guidelines

PART A: Role of App for Emergence and Development of Energy Citizenship

1. Certain features of the app seemed to be better received by you as users than others. The challenges and quizzes, for example, seemed to be popular. The DIY offers, on the other hand, were often seen in the online discussion forum as not feasible or not applicable in everyday life. What did you like using most in the app and why?
2. What role have regular push notifications played for you in your day-to-day use of the app?
3. Some of you have repeatedly remarked in the online forum that there was no really new content information for you in the app. What content was ultimately interesting for you in your everyday life? What could you have done without?
4. How did you personally perceive the benefits of the online forum during the app usage phase? What role did the regular virtual exchange play?

PART B: Behavioural Change (app-based)

5. Please think about your everyday life while you were using the app. During this time, did you integrate things that you experienced in the app into your everyday life? If so, why did you decide to change your behaviour in this respect? Did you behave differently in your everyday life? And if so, why?
6. Are there things you learned in the app that you haven't integrated into your daily life? If yes, why not?
7. Have you possibly changed a behaviour in the last few weeks that didn't come directly through the app, but may have been prompted by your experience with it?
8. Have your behaviour changes had an impact on other household members?
Follow-up question: Did anyone in your household join in or oppose the change?

PART C: Barriers and Drivers for Energy Citizenship

9. One of the questions in the online forum that you discussed was how sustainably you drive or can drive to university or work, or how sustainable travel works. What do you think would have to change for you to be able to travel sustainably in your everyday life and also on vacation?
10. Approaches and tools like the Earnest App put your focus on changing individual behaviour (riding a bike more, separating more waste in your own home, eating less meat, etc.). Where do you see the responsibility and role of yourself and your environment in combating the energy and climate crisis? In other words, what can you do and change as an energy citizen?
11. What role can this app or apps in general play in the future for sustainable energy behaviour?