Renaissance

RENEWABLE INTEGRATION & SUSTAINABILITY
IN ENERGY COMMUNITIES

RENAISSANCE GLOSSY REPORT FINAL VERSION

Energy communities survey: fostering social-acceptance beyond project stakeholders

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source: Anders J - @oj5tot

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PROJECT OVERVIEW

The RENAISSANCE project is an Innovation Action (IA) funded by the European Commission under the Horizon 2020 programme. The RENAISSANCE aim is to deliver a community-driven, scalable and replicable approach, to implementing new business models and technologies which support the clean production and shared distribution of energy within local communities.
In the first phase, the Consortium collected data to identify stable and equitable business cases in four Local Energy Communities (LEC) across Europe. The resulting scenarios supported the co-design of the Renergise tool, which helped identify the optimal configuration for integrated and decarbonised Local Energy Systems (LES) and in this survey their acceptance has been explored. In the last phase of the research, the overall RENAISSANCE approach has been simulated under market conditions in more than 10 sites across the globe, to demonstrate its scalability and replicability potential.

"Renaissance project supports the shift from technology-driven approaches to consumer-driven approaches, fostering the activation of communities"

EXECUTIVE SUMMARY

Within the RENAISSANCE project, in addition to technical and economic aspects, it is deemed essential to include an analysis of the social aspects that influence the acceptance of clean technologies and measures, including renewable energy generation technologies. Technologies that are technically and economically feasible in a given context may not be successfully implemented due to social resistance, lack of awareness of the technology, low engagement and so forth. Therefore the survey on social acceptance of potential end-users (pilot sites inhabitants, stakeholders, further energy market actors involved) had several objectives:

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- it allowed the identification of end-users' needs, which led to the development of energy scenarios and engagement strategies more adherent to the different contexts;
- it provided respondents with an initial set of information concerning the deployment of local energy communities, guiding them through the transition process;
- it tracked the acceptance of RENAISSANCE solutions and, more in general, of the deployment of renewable energy communities across countries and in the different project phases;

WHAT IS SOCIAL ACCEPTANCE?

Social or public acceptance is generally defined, as a positive attitude towards a technology or measure, which leads to supporting behaviour if needed or requested, and the counteracting of resistance by others.

Why a survey on the RENAISSANCE approach acceptance?

Renewable energy communities are going to be a reality in Europe soon, pushed by the recent Clean Energy Directive approved in late 2019. The EU Commission is showing an increasing commitment towards sustainability and several European projects are purposely focusing on direct consumer engagement in the energy transition.
Connected energy communities are key players in the RENAISSANCE project which explores and tests in real-life conditions, the innovative business models and technologies supporting a prosumer-consumer future energy market. The RENAISSANCE survey on renewable energies and community-based solutions assesses European citizens awareness and expectations concerning emerging business models in the energy market: Local Energy Communities (LECs) and Renewable Energy Communities (RECs).

WHAT ARE THE MOST RECENT UPDATES CONCERNING ENERGY COMMUNITIES IN EUROPE?

The directive "Clean energy for all Europeans" obliges Member States to ensure a more competitive, customer-centred, flexible and non-discriminatory EU electricity market with market-based supply prices. It strengthens existing customer rights, introduces new ones and provides a framework for energy communities of prosumers. Currently Member States are working on the transposition of the Directive into national regulations.

WHAT DOES "PROSUMER" MEAN?

In the context of renewable energies, a prosumer is someone that both consumes and produces energy, mainly based on distributed systems installed in households or within minigrid community networks.

3.1. SURVEY DISTRIBUTION

The "Survey on social acceptance of RENAISSANCE solutions" assessed the social aspects influencing the acceptance of renewables, including local energy generation technologies. Moreover, the survey promoted awareness of renewable energy generation systems and of regulatory measures activated in the European Union to facilitate the energy transition. Its main objective was to compare awareness and acceptance levels and track how they change over time, across different segments of respondents, distributed primarily in 5 European countries. To this aim the survey has been translated into 6 different European languages and its distribution was planned in three different phases of the project:

- FIRST RUN (May-June 2020): a first version of the survey was distributed in early 2020 and it offered insights from the early stages of implementation of RENAISSANCE solutions. The results are presented in the RENAISSANCE First Glossy Report[1] and represent a baseline both for general awareness and acceptance of recent European energy directives and of the specific solutions proposed by RENAISSANCE.

- SECOND RUN (November-January 2021): the survey was distributed a second time through the online tool Survey Monkey. This time the survey focused on the perception and opinion of a broader range of the general public, in order to assess if and how their attitude showed substantial differences from the full set of 'first run' respondents, who were more familiar with the concepts in the survey since they were already involved to some extent in the RENAISSANCE project. From this second set of answers the project gained a consolidated overview of the most relevant awareness and acceptance indicators, resulting not only in a validation of the engagement strategies put in place by the project, but more importantly how awareness and acceptance levels changed over time.

- THIRD RUN (December 2021): towards the end of the project the survey was distributed once again to a wider public but also to pilot sites stakeholders, in order to gather final insights about changes in awareness and acceptance levels. The responses were collected through the online tool Survey Monkey. More specifically, the pool of paid responses came from the five countries in which we deployed the project's approach: Greece, Spain, Belgium, Poland and the Netherlands. Whilst on one hand respondents not directly involved in the project were expected to show unvaried trends, on the other those participating in pilot sites activities and all other involved actors (ESG members, project's followers, researchers) were predicted to disclose higher levels of awareness and interest.

3.2. SURVEY DESIGN

We referred to Wüstenhagen et al.[2], and the 3 main sub-components of social acceptance, **forming the so-called "*triangle of social acceptance*"**:

- Community acceptance
- Market acceptance
- Socio-political acceptance

From the recent literature[3][4][5] we derived the most relevant aspects influencing social acceptance in all the 3 above-mentioned components.

In addition, a fourth, psychological dimension has been added: Individual acceptance. The sub-components of this dimension have been derived from grounded theories such as Theory of Planned Behaviour[6], Technology Acceptance Model[7], Norm Activation Model[8], Locus of Control Theory[9] and Self-efficacy[10] to finally obtain:

Awareness

1. Energy production and distribution issues perception
2. Knowledge of the technology/innovative business models and regulations (European directive)

Attitude

3. Concern of environmental and energy problems (climate change, pollution, energy consumption, etc.)

Environmental risk perception and decision making (risks and benefits)

4. Perceived costs in implementing the technology
5. Perceived benefits and usefulness in implementing the technology

1 RENAISSANCE First Glossy Report - https://www.renaissance-h2020.eu/resource/renaissance-survey-on-renewable-energies-and-community-based-solutions-glossy-report/

2 Wüstenhagen, Rolf, Maarten Wolsink, and Mary Jean Bürer. "Social acceptance of renewable energy innovation: An introduction to the concept." Energy policy 35.5 (2007): 2683-2691.

3 Polimp.eu - 1ST POLICY BRIEF June 2014 Acceleration of clean technology deployment within https://climatepolicyinfohub.eu/

4 The social acceptance of wind energy, Ellis Geraint, Ferraro Gianluca, JRC, 2016

5 Huijts, Nicole MA, Eric JE Molin, and Linda Steg. "Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework." Renewable and sustainable energy reviews 16.1 (2012): 525-531.

6 Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50, 179-211.

7 Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13 (3), 319-340. doi:10.2307/249008, JSTOR 249008

8 Schwartz, S. H., & Howard, J. A. (1981). A normative decision-making model of altruism. In J. P. Rushton & R. M. Sorrentino (Eds.), Altruism and helping behavior (pp. 89–211). Hillsdale: Erlbaum.

9 Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological monographs: General and applied, 80(1), 1.

10 Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. Psychological Review, 84(2), 191.

Social Norms (local factors influencing dm)

6. Social norms and community influence (herding behaviour, are your neighbour/friends/colleagues/relatives in favour and/or adopting the technology?))

Acceptance and adoption

7. Citizen acceptance: in favour of public innovations, collective implementation of technologies
8. Consumer acceptance: Intention to use and adopt the technology.

Starting from questionnaires developed by Moula, Munjur et al.[10], complemented also with additional questions[11] [12] to cover all the dimensions above, we developed the following questionnaire to assess social acceptance of renewable energies and of innovative community-based production and consumption models.

Moreover, we refer directly to proceedings of the Intergrid project, more specifically to their D1.4 Design of Consumer's Engagement Strategies , where the project identifies the main barrier to citizens' engagement and acceptance as being the fact that users are not aware of how energy systems work. Specifically, if this information was provided in advance, it may assist the consumer in finding solutions when there are problems with the device (Natural Resources, 2014).

10 Moula, Md Munjur E., et al. "Researching social acceptability of renewable energy technologies in Finland." International Journal of Sustainable Built Environment 2.1 (2013): 89-98.

11 http://unfccc.org.mk/content/FBUR/Climate%20change%20survey%20FBUR.pdf

12 https://www.questionpro.com/survey-templates/climate-change-awareness-survey-template/

METHODOLOGY

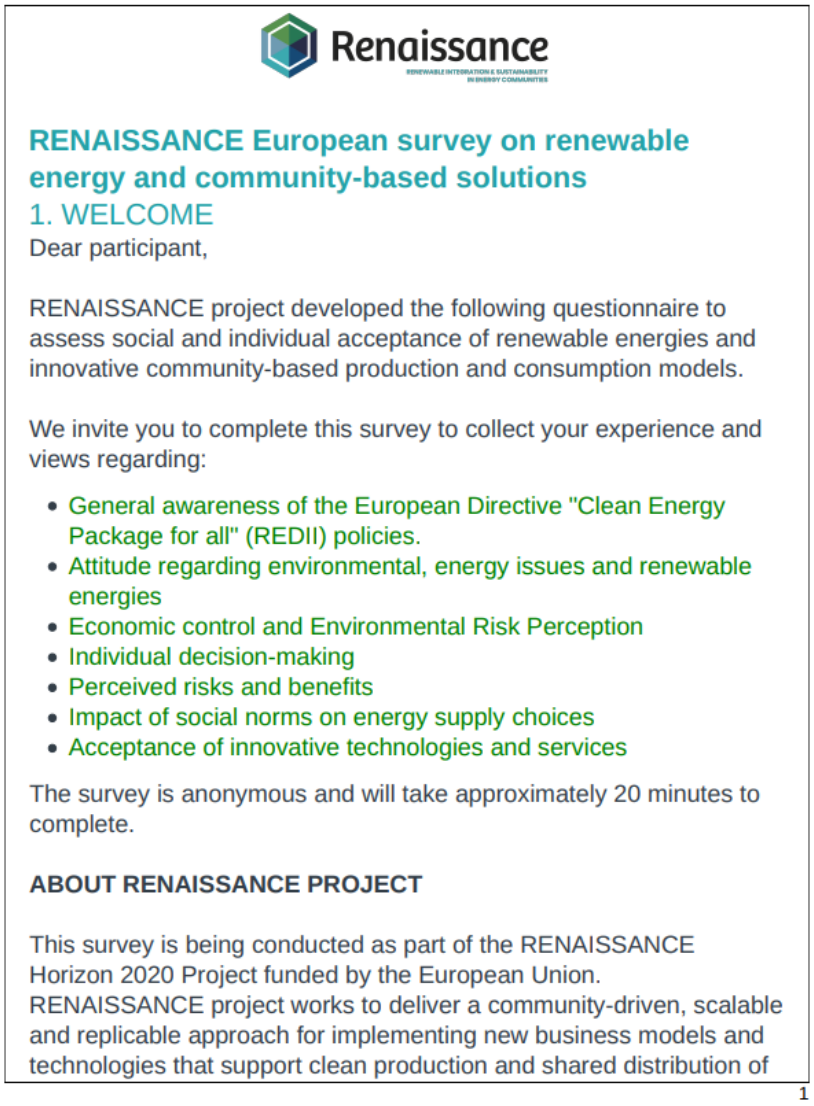
4.1. DISTRIBUTION

The online survey was distributed via the Survey Monkey platform. See section 5 for details on the recruitment strategies used to build the sample. The survey was composed of 37 questions, organised around the factor described in the section 1.3. The survey presented 10 closed ended questions, 4 multiple-choice questions, 15 items requiring the respondent to declare the level of agreement on a 5-point Likert scale, 7 items that required the respondent to rank the order of perceived importance of elements and 1 open-ended question. Examples of the various survey components can be seen in the table below (TABLE 1).

Item Category	Example of item	Example of response
Multiple Choice	Among the following energy sources, please select the ones you think are renewable:	□ Geothermal □ Natural Gas □ Biofuels □ Biomass □ Hydroelectric □ Coal □ Oil □ Wind □ Nuclear □ Solar
Likert-Scale	"I would switch to renewable-only energy providers, if it would result in a slightly higher bill"	1-Very unlikely 2-Unlikely 3-Neither likely nor unlikely 4-Likely 5-Very likely
Ranking	Among the following risks, please rank the ones which would prevent you from switching to a renewable energy-only provider. from the most impactful (1st) to the least (5th):	[#] Hidden or unknown costs. [#] Too much hassle to switch. [#] Low maturity of service [#] Market resulting in lower quality of service. [#] Transparency issues and distributive justice.

Table 01. Example of Items

The first part of the survey introduced the project and the aims of the survey as well as all references to privacy policy, consent forms and GDPR compliance information. (Figure 1).


Renaissance

RENAISSANCE European survey on renewable energy and community-based solutions

1. WELCOME

Dear participant,

RENAISSANCE project developed the following questionnaire to assess social and individual acceptance of renewable energies and innovative community-based production and consumption models.

We invite you to complete this survey to collect your experience and views regarding:

- General awareness of the European Directive "Clean Energy Package for all" (REDII) policies.
- Attitude regarding environmental, energy issues and renewable energies
- Economic control and Environmental Risk Perception
- Individual decision-making
- Perceived risks and benefits
- Impact of social norms on energy supply choices
- Acceptance of innovative technologies and services

The survey is anonymous and will take approximately 20 minutes to complete.

ABOUT RENAISSANCE PROJECT

This survey is being conducted as part of the RENAISSANCE Horizon 2020 Project funded by the European Union. RENAISSANCE project works to deliver a community-driven, scalable and replicable approach for implementing new business models and technologies that support clean production and shared distribution of

1

Figure 01. Preview of the online survey form

The second section collected 8 socio-demographic variables (such as: gender, age, country, level of education and other background information, like context density). This information was analysed in an aggregated and anonymised way, in order to cluster the response of the factors in the analysis part. The third part of the survey has collected data from 4 questions about the awareness factor; 8 questions about the attitude factor, 4 questions about business models; 3 questions on social norms factor, 1 on individual decision making; 7 on perceived risks and benefits and 2 on acceptance. All of the questions in the second and third part of the survey were mandatory, so the respondent could not proceed with the survey if an item was not responded to. The option "other" was often available to enable respondents express additional information or comments and integrate their own response. The survey was distributed in English across the 25th and 26th of January 2022.. The sample size of the second run (See section 1.2) was N=531 respondents. Additional information on the sample size will be detailed in the section 5.1. Background Information. The plan for the statistical analysis is presented in section 5. Survey Analysis.

4.2. EXPECTED OUTCOMES

The comparison between initial and final answers, collected among the different segments of respondents, can inform the project Consortium about the project success in terms of:

- Awareness level concerning renewables and energy communities
- Acceptance level concerning renewables and energy communities
- Customer engagement level linked to specific business models
- Overall assessment of the project dissemination strategy

4.3. TARGET

This questionnaire was distributed across a gender and age balanced sample of respondents through the online tool, Survey Monkey. Respondents were chosen in relation to European countries where project pilot sites are located: Belgium, Netherlands, Poland, Spain and Greece.

SURVEY ANALYSIS

This section introduces the statistical analysis plan, together with the results of the statistical analysis itself. Depending on the nature of the variable considered, the data analysis process can be described as follows:

- **Calculate descriptive statistics for both independent (IV) and all dependent variables (DV).**
- **For Independent variables:** split group on median split / quartile split will be performed, in order to reduce the levels for independent variables for inferential analysis. The main independent variables are described in the section 5.1. Background Information
- **For the variable to be ranked:** the Mode of the most frequent ranked position will be calculated
- **For the Multiple-choices answers:** frequencies will be calculated, along with Chi-Squared, analysis to assess the statistical significance of the difference in the observed cases, for different IV (median-splitted).
- **For the Likert scales: perform descriptive and inferential analysis:** General Linear Model (GLM), repeated measures on multiple dependent variables.
- The open-ended questions will be used to gain insight for the colcusions.

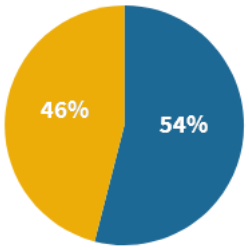
Details on the statistical analysis performed for each variables, together with the results, presented from section 1.5.1.1 to section 1.5.1.8 while the Discussions are presented from section 5 to section 7 while the key findings and recommendations are presented in section 8.

5.1. BACKGROUND INFORMATION

The background information section of the survey collected information such as age, country of residence, level of education and socio-economic context. The questions focused on aspects which could influence individual behaviour related to energy procurement. Namely age, income, level of education, country of residence, population density of the surrounding area, and type of energy consumer, all factors identified as being key.

Age and Gender

1st RUN



2nd RUN

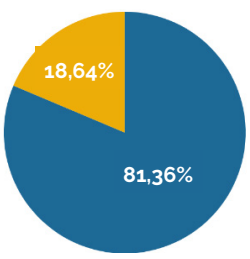
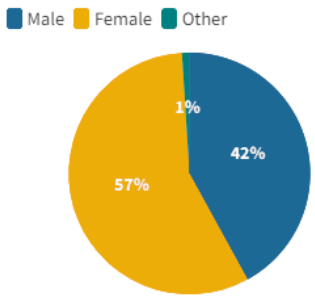


Figure 02. Age

1st RUN



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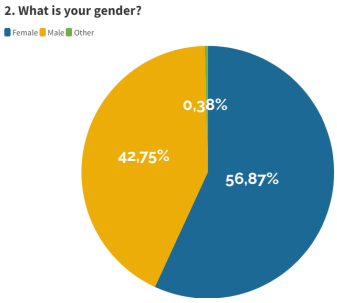


Figure 02B. Gender

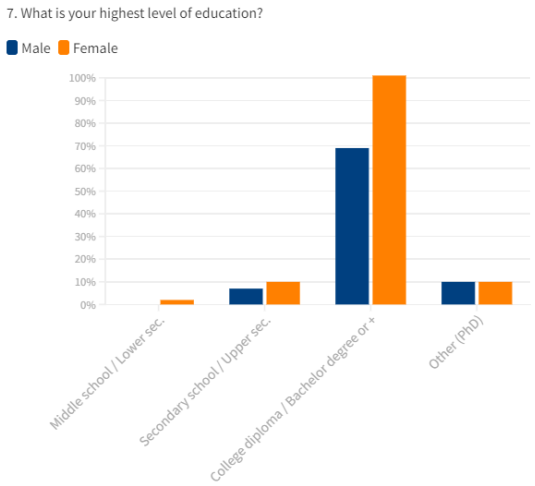
Age and Gender distribution of respondents can be seen in Table 02 . Similarly to the first run survey, the gender distribution was almost balanced: females 56.87%, males 42.75% and others 0.38%. Differently from age, where younger respondents (cumulative percent: 81.36%) are far more frequent than older respondents (cumulative percent: 18.64%). Nonetheless, at least 10 respondents are present for each age range. Age and Gender will be used as independent variables.

Age	Female	Male	Other Gender	Total Frequency	Percentage	Cumulative Percentage
18-24	64	54	1	119	22.41%	22.41%
25-34	126	61	0	187	35.22%	57.63%
35-44	67	59	0	126	23.73%	81.36%
45-54	29	36	1	66	12.43%	93.79%
55-64	10	9	0	19	3.58%	97.37%
65+	6	8	0	14	2.63%	100%
Total	302	227	2	531	100%	100%

Table 02. Age and Gender distribution

Education

1st RUN



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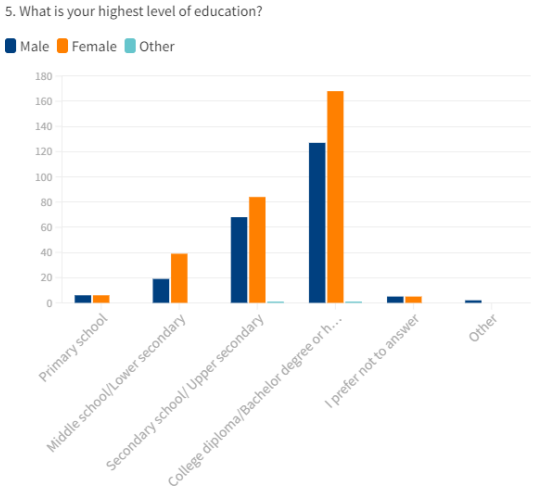


Figure 03. Gender and Education

Respondents' education level varied between Middle school (N = 58), Secondary school (N = 153) and bachelor's degree (N = 296) (cumulative percent: 95.48%). Bachelor's degree is by far the most frequent category, followed by secondary school. No statistical differences were noted in the Gender x Education distribution $X^2(10,531) = 6.417$, $\rho = .779$

Type of consumers

Figure 04. Energy consumer types

The full sample was more than half composed of household consumers (N = 206) and public service consumers (N = 95). Differing from the first survey, there was more variety in consumer types. This survey especially considers industrial or commercial consumers (N = 35), absent in the first run.

Geographical Area

In terms of country of residence, the geographical distribution of respondents is shown in figure. Differently from the first run, having the possibility to target respondents through the Survey Monkey platform, Northern and Southern European countries have been selected, in accordance with the project pilot sites and the division identified in the first run (Table 03)

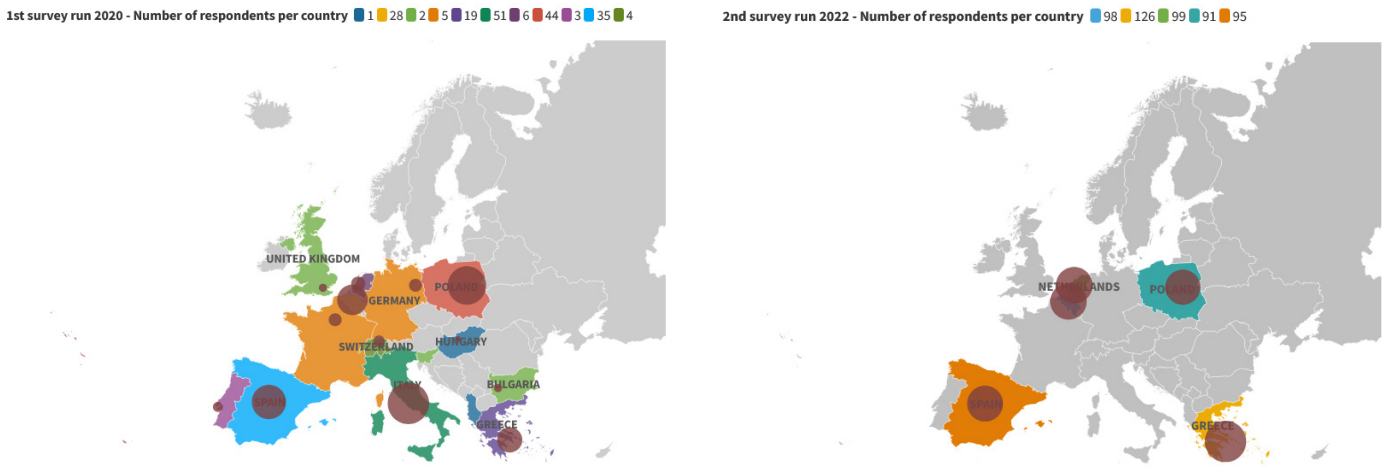


Figure 05. Geographical distribution of respondents - 1st run and 2nd run

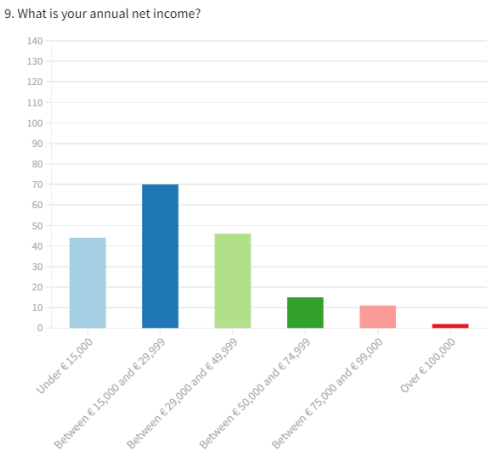
Region	Country	Frequency	Region	Country	Frequency	Reg.	Country	Freq.
	Belgium	98		Grece	126			
Northern	Netherlands	99	Southern	Spain	95	Other		
	Poland	91						
	Total	288		Total	221		Total	20

Table 03. Geographical distributions by region

The "northern group" (N = 288) included respondents from Belgium, Netherland and Poland, while the "southern group" (N = 221) included respondents from Greece and Spain. These nations were selected according to the pilot sites the RENAISSANCE project is involved with.
In addition to the northern vs southern group, population density of the respondents' living context was asked. The majority of respondents (41.81%) live in an intermediate density area (N = 222), while the other respondents live evenly between thinly populated areas (N = 151; 28.44%) and densely populated areas (N = 158; 29.75%). Since thinly and intermediate together would account for more than 70% of the respondents, this time population density has not been grouped keeping it as a three-level independent variable.

Income

1st RUN



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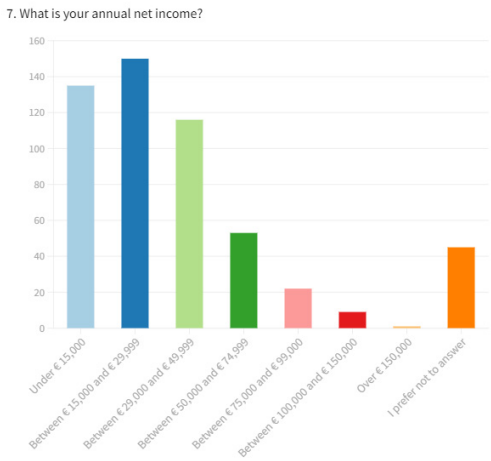
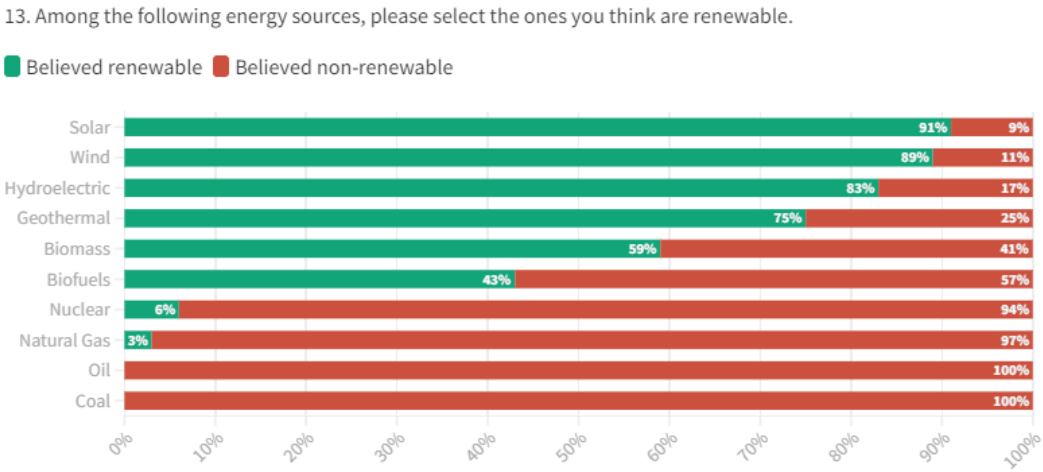


Figure 06. Annual net income

The distribution of the annual net income is represented in figure 8 where the most frequent category is represented by respondents with a net annual income between 15.000€ and 29.999€ (N = 150), akin to the first survey, followed by those with a net annual income under 15.000€ (N = 135) and those with a net annual income between 30.000€ and 49.999€ (N = 116). These three groups together account for more than ¾ of the respondents (cumulative percent: 75.52%) declaring an income lower than 50.000€, while 8.47% of subjects (N = 43) preferred not to answer this question.

Current Knowledge of Renewable Energy

1st RUN



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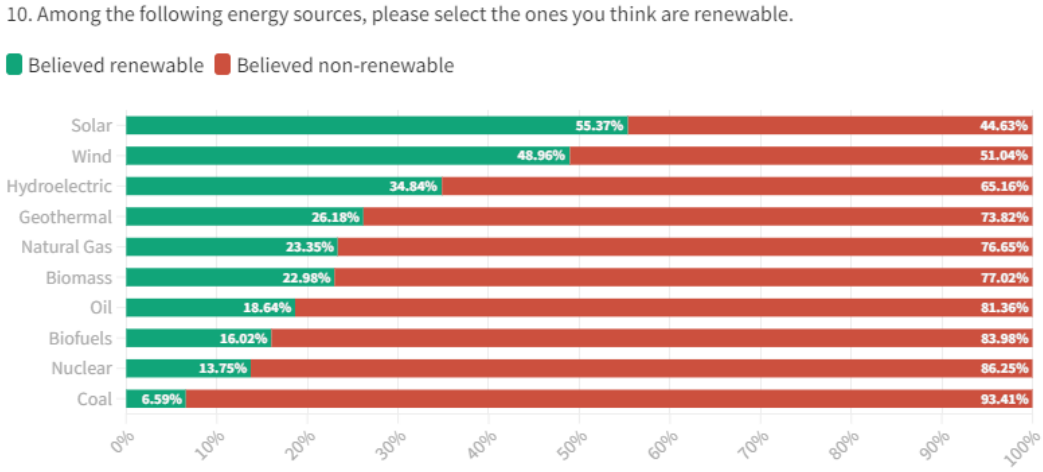
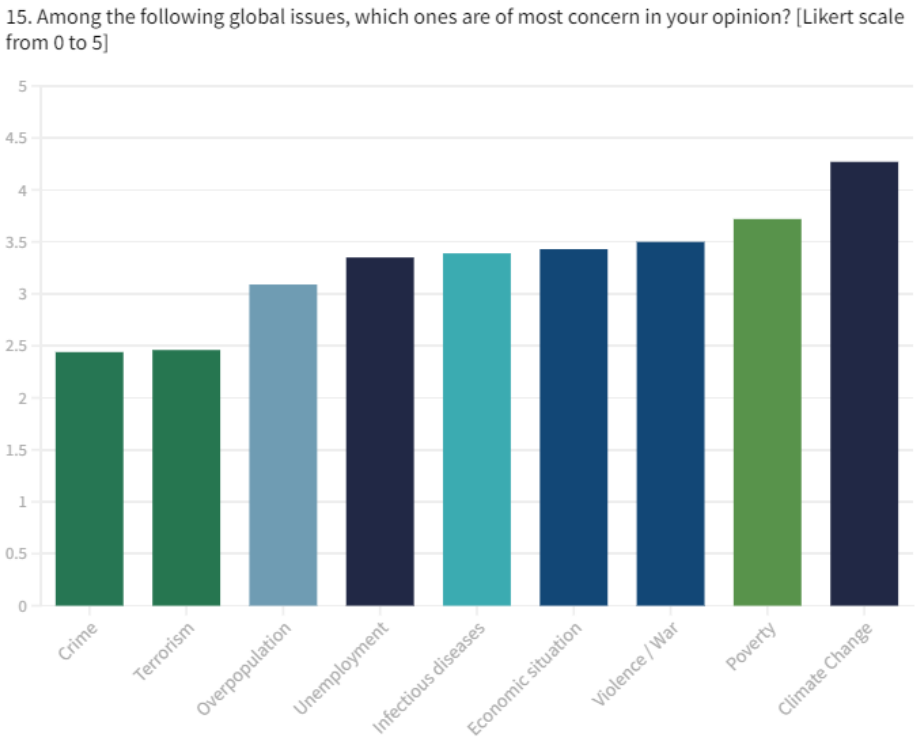


Figure 07. Knowledge of renewable energy sources

5.2. IDENTIFICATION OF RENEWABLE ENERGY SOURCES

Participants were asked to identify and select renewable energy sources from a list of possible options. Their responses are visible in figure 07. The most frequently identified renewable energy source was "Solar" (N =), followed by Wind (N =) and Hydroelectric (N =) that, differently from the first survey run where no ambiguous judgments were found, were recognized and chosen less frequently. Respondents' opinions about Biomass (22.98%) and Biofuel (16.02%) this time were not controversial since they were not chosen as Renewable energy sources even if they are, highlighting a lack of awareness amongst the general population about the difference between a renewable and a sustainable source. Differently from the first run, nuclear energy had been classified as a renewable energy source by almost 14% of respondents. Such outcome could be somehow related to the ongoing discussion around the EU Taxonomy or more in general with the larger sample characterisation. Furthermore, among the non-renewable energy sources Natural Gas and Oil were not correctly identified as non-renewable respectively by 23.35% and 18.64% of respondents. Instead, coal had been correctly identified as non-renewable with only a few percent of participants suggesting that it was renewable.

1st RUN



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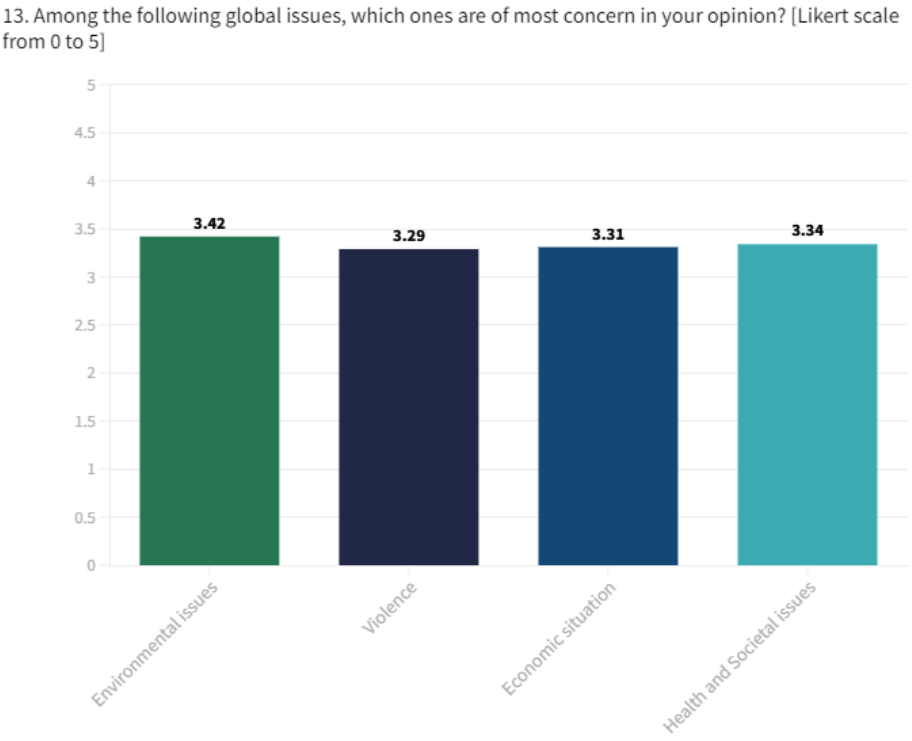


Figure 08. Average ranking of global issues of most concern

5.3. MATTERS OF CONCERN

In the second run the most concerning issues mentioned by question 15 have been condensed, since there was a direct correspondence in respondents answers among some of them. More specifically they were transformed into:

- Environmental issues, Climate Change, Loss of biodiversity and Pollution;
- Violence of Crime, Terrorism and War;
- Economic Situation of Poverty, Unemployment, and Inflation;
- Health and Societal Issues of Infectious diseases, Overpopulation and Social disruption.

Participants were asked to express, on a 5-point Likert scale, their concern about the above groups of global issues. The average concern for each group is shown in figure 09. Environmental issues were considered the most concerning to the respondents (M = 3.42; SD = 1.12), followed by Health and Societal Issues (M = 3.34; SD = 1.05), Economic situation (M = 3.31; SD = 1.09), and Violence (M = 3.29; SD = 1.08). It should be noted that this survey was launched in 2022, after the first two years of the COVID-19 pandemic.

Checking for Gender, Age and Geographical area there are some significant differences. Whilst there is no significant difference in the concern demonstrated between males and females, younger respondents are significantly more concerned about global issues than older respondents. Furthermore, southerners are more concerned about global issues than northerners.

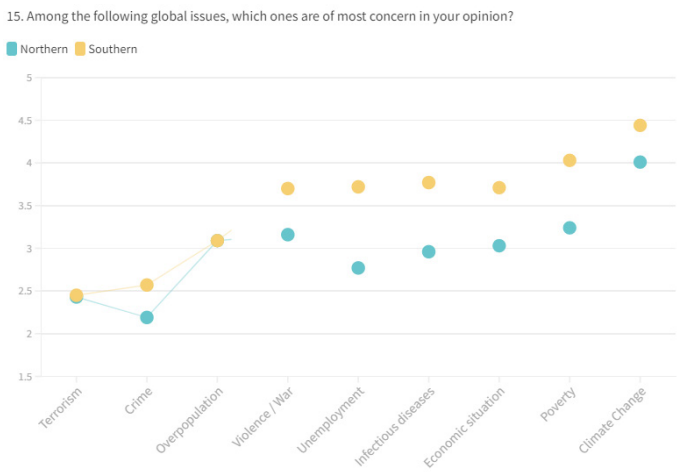
STATISTICAL ANALYSIS

A repeated multivariate analysis of variance (MANOVA) for Gender, Age and Geographical area was performed on the rating of Global Issues (4-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($\rho < .05$). As it can be seen in Table 4 there were no significant differences between male and females $F(8,518)=.850$, $\rho=.559$, $\eta\rho^2=.007$, while there were for younger and older respondents $F(4,518)=3.660$, $\rho=.006$, $\eta\rho^2=.028$ and geographical area $F(8,518)=3.206$, $\rho=.001$, $\eta\rho^2=.024$.
Partial Eta squared indicated a small significance, but looking at contrast analysis, it appears that older respondents were more concerned compared to younger ones for the Global issue: Economic situation $F(1,518)=4.39$, $\rho=.037$, $\eta\rho^2=.008$; while it appears that southerners were more concerned compared to northerners for the Global issue: Violence $F(2,518)=4.95$, $\rho=.007$, $\eta\rho^2=.019$ and Economic situation $F(2,518)=3.31$, $\rho=.037$, $\eta\rho2=.013$.

Variables		df	F	Sig.	Partial Eta Squared	Observed Power
Gender	Assuming Sphericity	8	.850	.559	.007	.402
Age	Assuming Sphericity	4	3.660	.006	.028	.879
Geographical Area	Huynh-Feldt	8	3.206	.001	.024	.971

Table 04. Multivariate Analysis for Global Issues Variance

1st RUN



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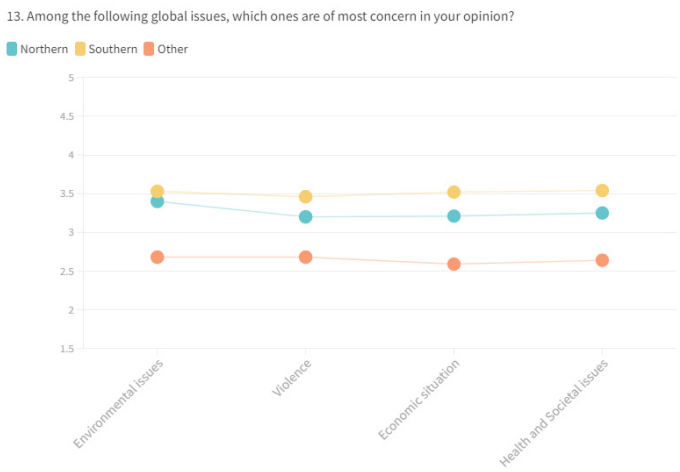


Figure 09. Global Issue concerns for Geographical Areas

				Cumulate Percentage		
	M	SD	Sum	25%	50%	75%
Environmental Issues	3.42	1.12	1818	3.0	3.0	4.0
Violence	3.29	1.08	1746	3.0	3.0	4.0
Economic Situation	3.31	1.09	1759	3.0	3.0	4.0
Health and Societal issues	3.34	1.05	1775	3.0	3.0	4.0

Table 05. Statistical analysis of global issues of most concern: M= Mean | SD = Standard deviation | Sum = sum of total votes received on a 5-point Likert scale | Cumulate percentage = Bayesian distribution

The second attitude item goes into more detail, examining the environmental issues of most concern, requiring the respondents to express their concerns on a series of specific environmental issues.

				Cumulate Percentage		
	M	SD	Sum	25%	50%	75%
Pollution	3.54	1.097	1881	3.0	4.0	4.0
Extreme weather conditions	3.40	1.128	1808	3.0	3.0	4.0
Loss of biodiversity	3.36	1.026	1784	3.0	3.0	4.0
Traffic congestion	3.21	.979	1704	3.0	3.0	4.0
Waste disposal	3.39	1.059	1801	3.0	3.0	4.0

Table 06. Statistical analysis of environmental issues of most concern: M= Mean | SD = Standard deviation | Sum = sum of total votes received on a 5-point Likert scale | Cumulate percentage = Bayesian distribution

Checking for Gender, Age and Geographical area there are some significant differences. There is a significant difference in the concern for environmental issues demonstrated between males and females: males are slightly more concerned than women on environmental issues. Secondly, older respondents are significantly more concerned about environmental issues than younger respondents. Furthermore, southerners are more concerned about environmental issues than northerners.

STATISTICAL ANALYSIS

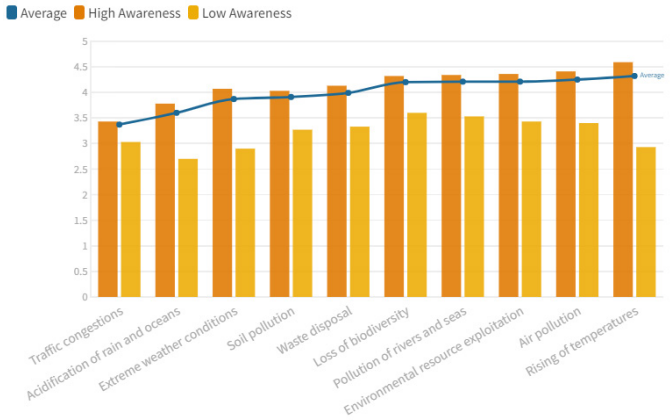
A repeated multivariate analysis of variance (MANOVA) for Gender, Age and Geographical area was performed on the rating of Environmental Issues (5-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($p < .05$). As it can be seen in Table 7 there were significant differences among male and females $F(14,518)=1.77$, $p=.039$, $\eta p^2=.024$, while for youngers and older respondents $F(7,518)=2.66$, $p=.011$, $\eta p^2=.035$ and geographical area $F(14,518)=2.05$, $p=.012$, $\eta p^2=.012$.
Partial Eta squared indicate a small significance, but looking at contrast analysis, it appears that Elders are more concerned compared to Youngers for the Environmental issue: Pollution $F(1,518)=10.96$, $p=.001$, $\eta p^2=.021$; while it appears that Southerners are more concerned compared to Northern for the Environmental issue: Extreme weather $F(2,518)=3.41$, $p=.034$, $\eta p^2=.013$. Tuckey HSD post-hoc test does not show differences for the variable gender.

Variables		df	F	Sig.	Partial Eta Squared	Observed Power
Environmental Issues						
Gender	Assuming Sphericity	14	1.768	.039	.024	.921
Age	Assuming Sphericity	7	2.655	.011	.035	.901
Geographical Area	Huynh-Feldt	14	2.050	.012	.027	.959

Table 07. Comparative analysis of environmental issues: df= degrees of freedom | F = FTest | Sig = significance

Considering the answer to the previous question on global issues of most concern (See "Concern of global issues") it was possible to divide the sample into respondents that showed high vs low scores when evaluating Environmental issues such as climate change. The objective of this analysis was to assess if a different level of concern had any relevant influence on the perceived impact of the current energy system on the environment and on the individual opinion about who should take the first steps towards the energy transition to renewables. The "higher concern" group (HC) includes all the respondents who ranked as high importance the issue of climate change (N=171 respondents), while the "lower concern" group (LC) gave a low importance ranking to climate change (N=212 respondents). The numerosity of the two groups is almost balanced, but no inferential analysis was performed, yet this distinction was taken into consideration when presenting the results of the specific environmental issue concerning Descriptive Statistics (fig.10).

1st RUN



2nd RUN

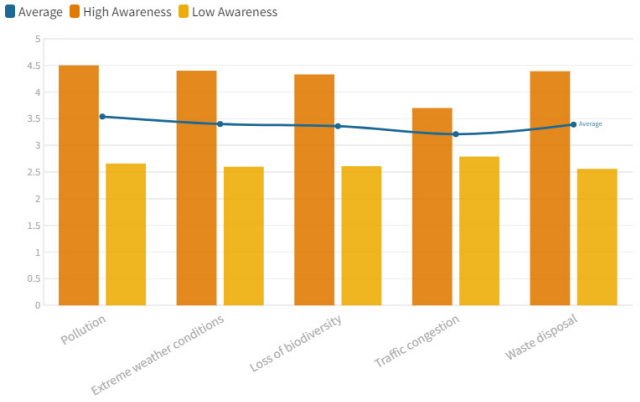
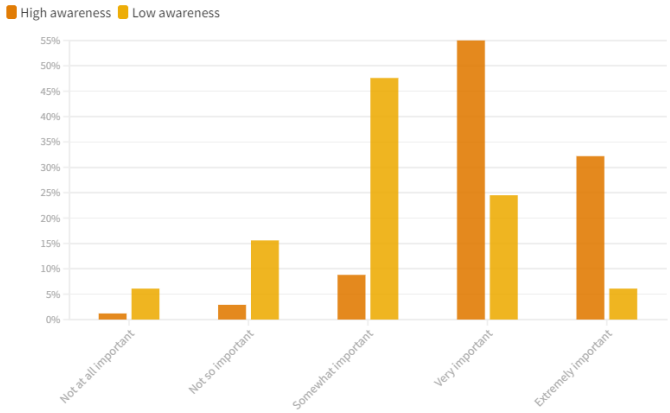


Figure 10. Average ranking of environmental issues of most concern

The most interesting differences between the two groups are apparent in the level of concern related to Pollution, extreme weather conditions, loss of biodiversity and waste disposal. Findings very close and similar to the first run.
Such issues are considered by LC group less concerning than traffic congestion. The HC group, instead, selected Pollution as the most concerning environmental issue. Numbers suggest that projects, such as RENAISSANCE and scientific dissemination at large, do not only have to inform their target audience about specific topics or detailed research objectives: bridging knowledge and attempting correlations between different phaenomena (e.g. between acidification of rain and oceans, soil pollution and the extensive extraction and use of fossil fuels) is an important responsibility to support a more holistic comprehension of our planet's complex ecosystems.

1st RUN



2nd RUN

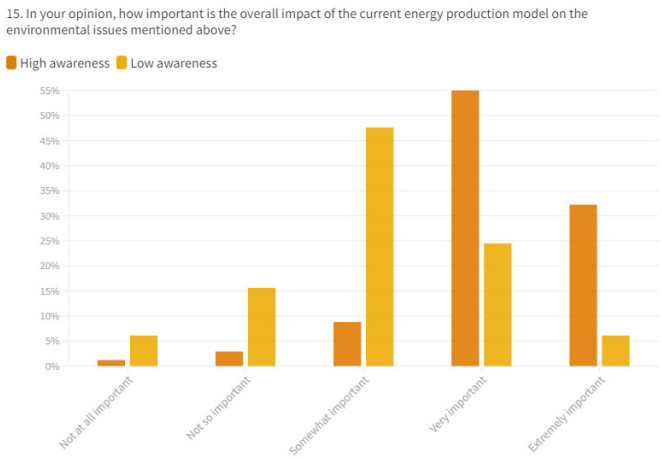
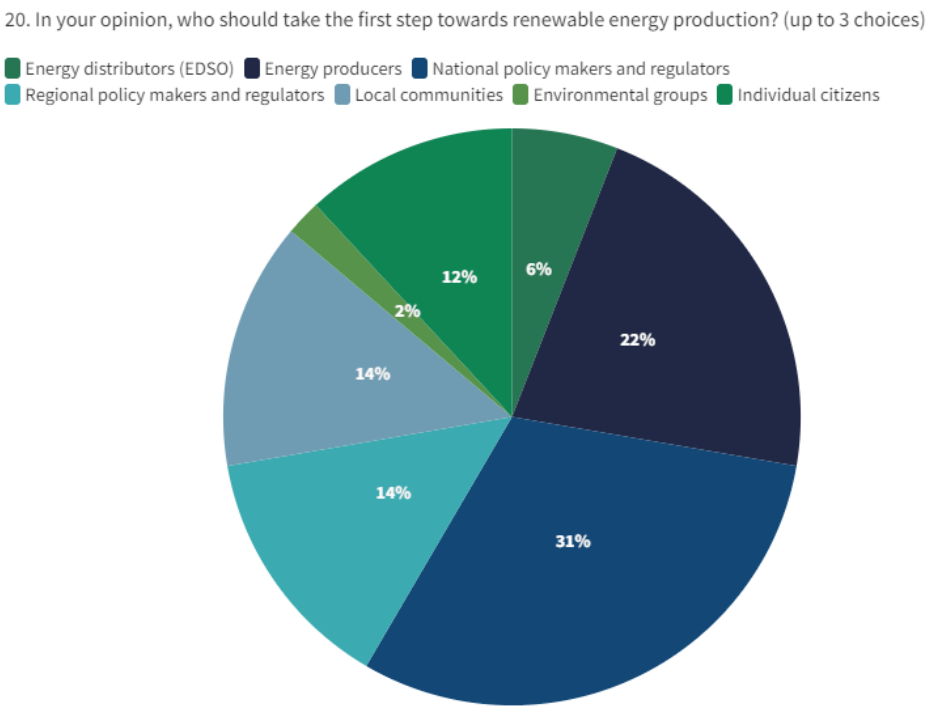


Figure 11. Perceived importance of the current energy production model on environmental issues

Regarding the perceived impact of the current energy production model on environmental issues a polarization between the HC and LC responders emerged in both survey runs. Fig. 11 shows how in the second run the level of concern influences perception: 32.2% of HC answered extremely important; while only 6.1% of LC participants perceived extremely important the impact of the current production model on Environmental Issues.
Nevertheless, the majority of respondents are aware that the production of energy has a strong impact on the environment, no matter how concerned they are.

5.4. WHO SHOULD TAKE THE FIRST STEP TOWARDS RENEWABLE ENERGY PRODUCTION MODELS

1st RUN



2nd RUN

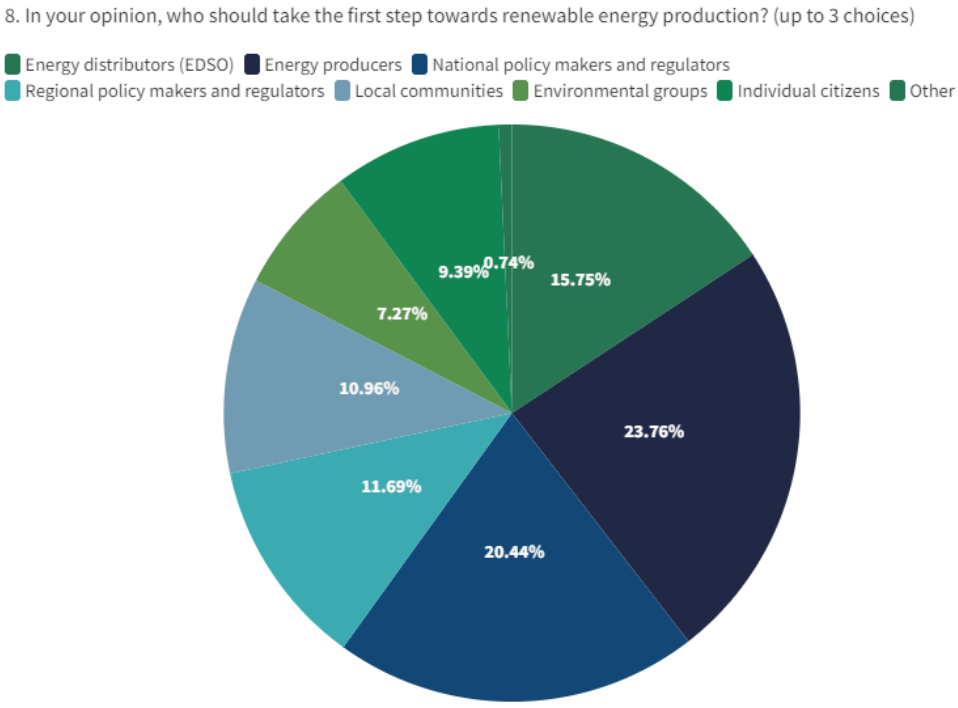


Figure 12. Who should take the first steps towards renewable energy production models

Participants were asked "Who should take the first step towards renewable energy production models" (Up to 3 choices). The majority of respondents answered Energy producers (23.76%), National Policy Makers and Regulators (20.44%) and Energy Distributors (15.75%). The least chosen option in taking steps toward renewable energies are Environmental Groups (7.27%) (fig. 12).

Analysing the answers of respondents belonging to differently populated areas (High density N = 158 vs. Low density N = 151) it is noticeable that people living in high density areas, consider National policy makers and individual citizens to have a large responsibility compared to those living in low density are, which conversely, consider Environmental groups and Regional policymakers and regulators to have an higher responsibility (fig. 13).

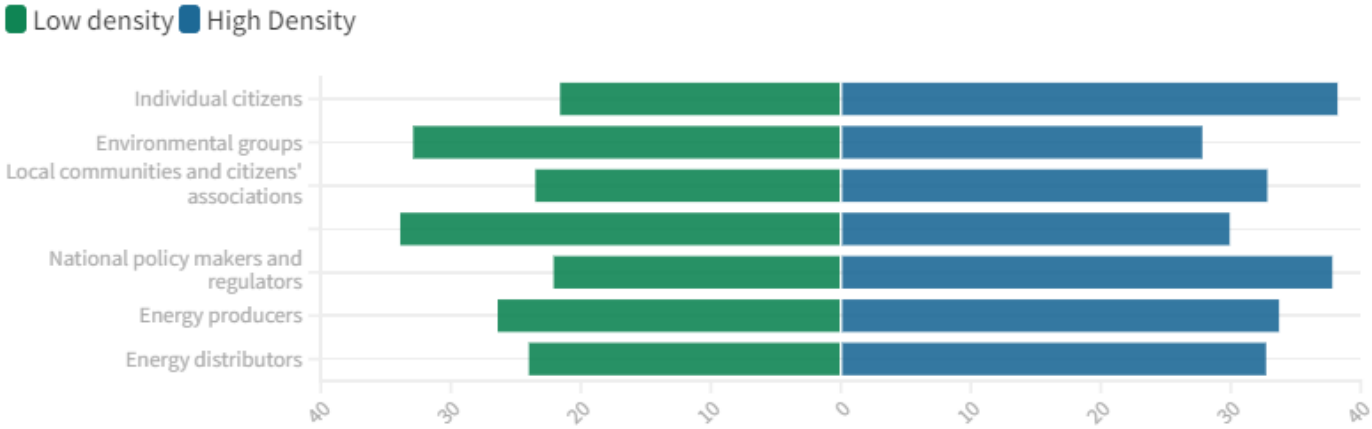


Figure 13. Who should take the first step towards energy transition by density area

5.5. AWARENESS OF THE CLEAN ENERGY FOR ALL EUROPEANS DIRECTIVE

Figure 14. Awareness of the "Clean Energy for All Europeans" directive

when asked about knowledge on the existence of the directive "CLEAN ENERGY FOR ALL EUROPEANS" approved in 2019, 63.84% of respondents confirmed to be aware about it, while 36.16% declared not to be aware of it (fig. 14).

The significantly higher level of awareness of respondents to the 2nd run is likely due both to the amount of time passed since the emanation of the directive and to the larger segment of European Citizens represented. In both cases. Respondents from low density and intermediate density are more likely to be aware of the directive than those coming from desely populated areas. Furthermore, younger respondents are more likely to be aware of the directive than older respondents (fig. 15).

STATISTICAL ANALYSIS

There is a significant association between Population density and Awareness of the "Clean Energy for All Europeans" directive. $X^2=(2,N=531)=11.668$, ρ = .003. Respondents from low density (72.2%) and intermediate density (65.3%) population area are more likely to be aware than those living in a densely populated area (53.8%). Cramer's V = .148 (small effect size).

Chi-Squared analysis	Population Density		Income Range		Geography		Age	
	X^2	p	X^2	p	X^2	p	X^2	p
Awareness of the "Clean Energy for All Europeans" Directive	11.668	.003	8.588	.284	4.310	.116	17.82	.000

Table 08. Chi squared analysis of awareness rates by population density, income, geographical area and age

STATISTICAL ANALYSIS

There is a significant association between Age and Awareness of the "Clean Energy for All Europeans" Directive. $X^2=(1,N=531)=17.822$, ρ = .000. Respondents from the young group (68.1%) are more likely to be aware of the directive than the older group (45.5%). Cramer's V = .183 (small effect size). This association is in line with findings related to the level of concern about environmental issues (See fig. 09) No other independent variables were able to explain the variance of frequency in a significant way.

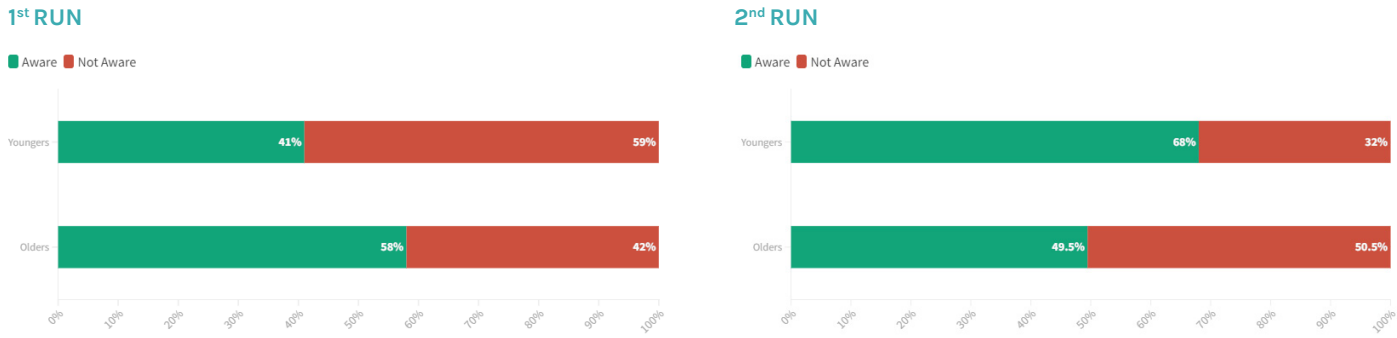
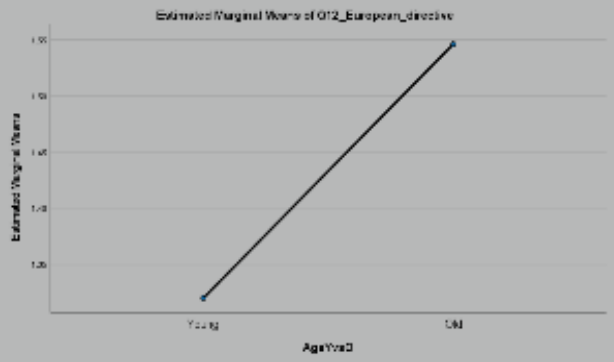


Figure 15. Significant difference in "Clean Energy for All Europeans" awareness by Age groups

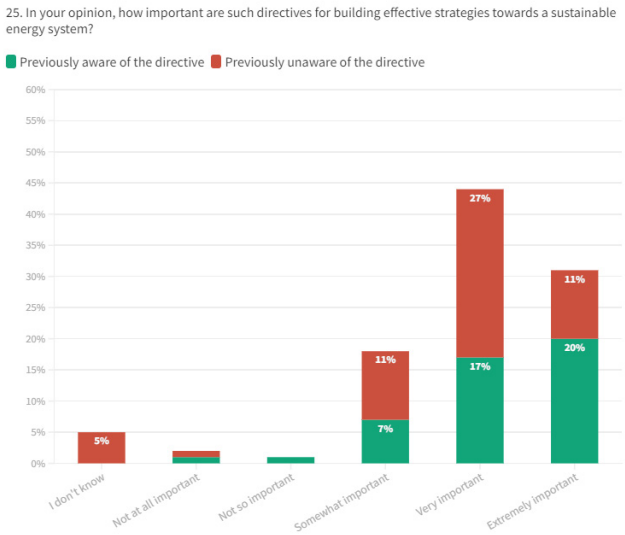
ANOVA: The level Age had a significant impact on awareness "Clean Energy for All Europeans" F(1,529) = 18.37, ρ = .000



A significant difference has been found for the Age ANOVA. The awareness of the directive resulted unevenly distributed in the Age groups. Differently from the first survey run where younger respondents were not aware of the directive compared to the older respondents, the results of the second run show younger respondents as significantly more aware of the directive than older respondents.

Regarding the perceived importance of this directive, it must be noted that the larger proportion of the sample perceived it as somewhat important (25.4%), very important (44.1%) or extremely important (15.8%), with only 3.4% of the respondents that considered the directive not important at all (fig. 15).

1st RUN



2nd RUN

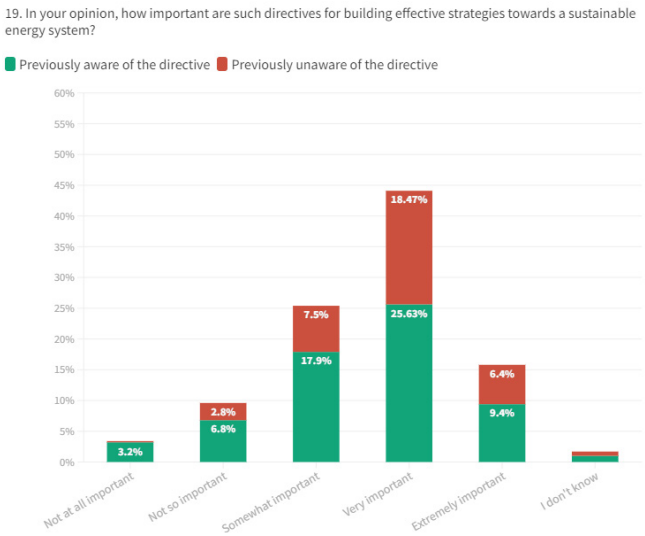
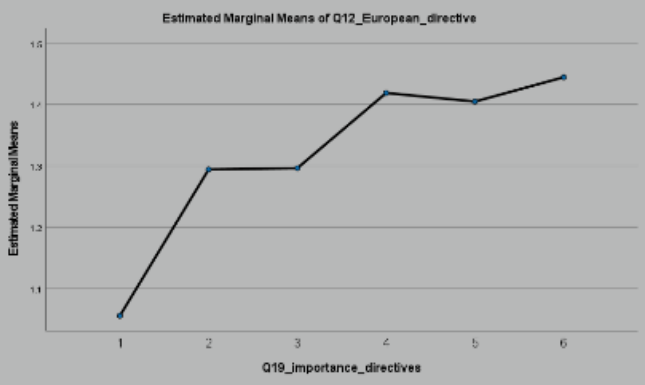


Figure 16. Significant difference in "Clean Energy for All Europeans" awareness by importance directives



ANOVA: The level Importance directives had a significant impact on awareness "Clean Energy for All Europeans" $F(1,525) = 1315.57$, $p = .000$. Significant difference between 1 (not at all important) and 4 (very important) ($p = .023$)

As a conclusion, from the results of the first run and second run, an evenly distributed weak knowledge of measures supporting the transition to a sustainable energy system, doesn't derive from a low consideration of the importance of such initiative but more likely from a lack of knowledge of existing ones or, more significantly, from the lack of appropriate information about them (fig. 16).

NOTE

The Clean Energy for All Europeans[12] obliges Member States to ensure a more competitive, consumer-centered, flexible and non-discriminatory EU electricity market with market-based supply prices. The package consists of eight legislative acts and they must be transposed into national laws of EU countries within 2 years from its approval by the EU parliament.

5.6. SWITCHING TO RENEWABLE-ONLY ENERGY SOURCES

Figure 17. I would switch to renewable-only energy provider if

As expected, and as a confirmation of the first survey run, participants would be more prone to switch to a renewable energy provider, if it would involve lower bill costs. While there is no significant difference on the acceptance of higher bills when accounting for age, population density and geographical area, the level of income significantly impacted the intention to accept higher bills (fig. 17).

STATISTICAL ANALYSIS

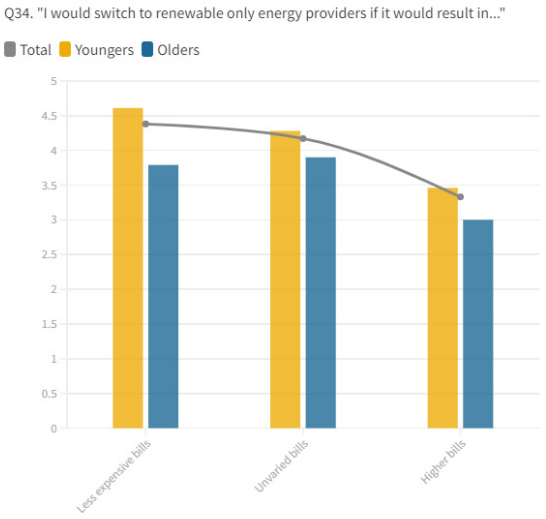
A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on Cost of bills (3-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($\rho < .05$). As it can be seen in Table 09 there were significant differences among income levels $F(21,518)=2.31$, $\rho=.000$, $\eta\rho^2=.035$, while there were no significant differences for all the other variables.

Less expensive income $F(7,518)=3.56$, $\rho=.000$, $\eta\rho^2=.053$
More expensive income $F(7,518)=2.617$, $\rho=.012$, $\eta\rho^2=.040$

Variables		df	F	Sig.	Partial Eta Squared	Observed Power
Cost of bills						
Population density	Assuming Sphericity	6	1.755	.105	.012	.667
Income	Assuming Sphericity	21	2.314	.000	.035	.997
Geography	Huynh-Feldt	6	1.064	.383	.007	.425
Age	Assuming Sphericity	3	.697	.544	.005	.198

Table 09. Comparative analysis of environmental issues: df= degrees of freedom | F = FTest | Sig = significance

1st RUN



2nd RUN

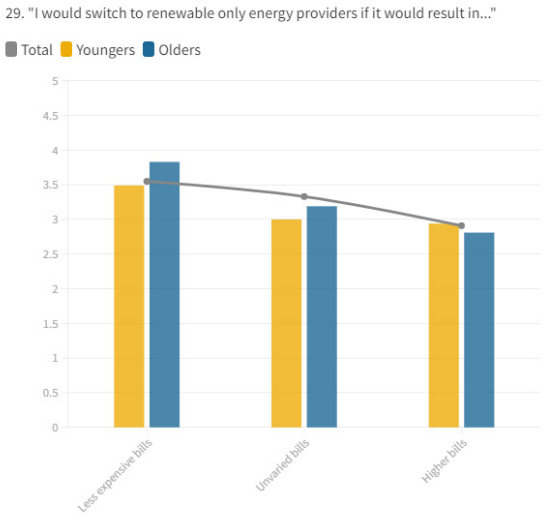
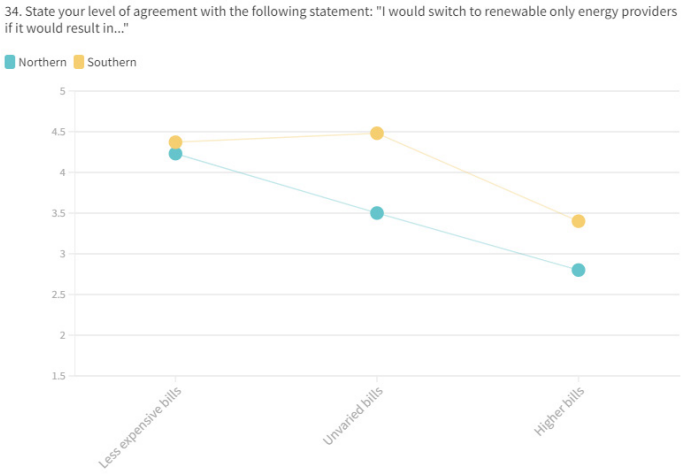


Figure 18. Driver of cost of the bills before switching to a renewable only energy provider by Age

Looking at the age ranges into detail, people belonging to the >45Y (older) group tend to be more likely to pay a lower or unvaried bill compared to respondents <45Y (younger), who are more prone to facing higher bill costs when switching to renewable-only energy providers compared to older participants. This result is in contradiction with the results obtained from the first survey run (fig. 18).

1st RUN



2nd RUN

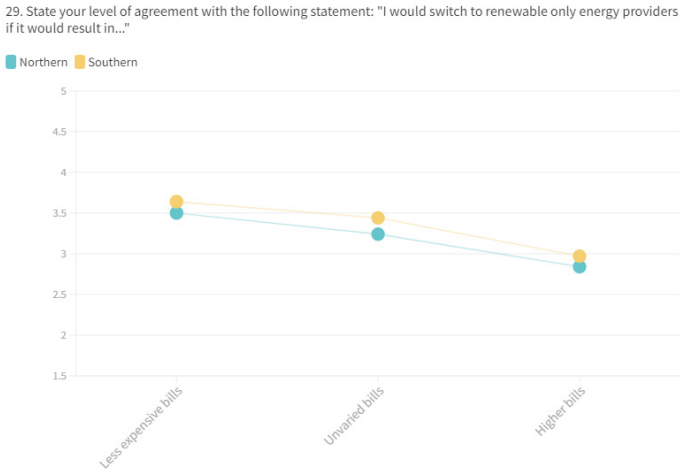


Figure 19. Driver of cost of the bills before switching to a renewable only energy provider by Geographical Area

Again, differently from the first run, the results when considering the Geographical Area of the respondents: Northern and Southern Europe agree on all three conditions. Although a less expensive bill is agreed as the first driver, unvaried and higher bills are not, and no significant differences have been observed between the two groups (fig. 19).

5.7. BARRIERS TO SWITCHING TO RENEWABLE-ONLY ENERGY SOURCES

Figure 20. Ranking of the top risks before switching to a renewable-only energy provider by Geographical Area

In terms of ranking of "Risks preventing acceptance to switch to a renewable energy only provider", on average, respondents ranked the first blocker to switching as the hidden or unknown costs (Mode = 1st); followed by fear of lower maturity of services (Mode = 2nd) and transparency issues (Mode = 3rd). The cost of bills did not significantly impact the decision, even when accounting for age, population density, geographical area and income (fig. 20).

STATISTICAL ANALYSIS

Considering the ranking as a continuous scale (four-point Likert scale on agreement of the main risk) a repeated multivariate analysis of variance (MANOVA) for income, age population density and geographical area was performed on the switch-risks identified (4-level variable: low maturity of service; hidden or unknown costs; too much hassle to switch; transparency issues). The level "cost of bills" is not significantly impacting the decisions.

STATISTICAL ANALYSIS

A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on Cost of bills (3-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($p < .05$). There were no significant differences for all the variables.

5.8. BARRIERS TO INSTALLING A SMALL RENEWABLE ENERGY PRODUCTION SYSTEM IN ONE'S OWN PROPERTY

Figure 21. Ranking of the top risks preventing installation of a small renewable energy production system in own property (Mode)

The metrics show a detailed description of the most impactful risks associated with the possibility of installing a small to medium sized renewable energy production system in one's own property (e.g., photovoltaic panel). Fig. 21 shows the ranking of the main perceived impact, with health issues as first, high maintenance costs at second, safety and environmental issues concerns both as third. In particular, people living in densely populated areas are more sensitive to aesthetic issues. People with a lower income are less prone to switch due to the fear of complex bureaucracy and paperwork.

STATISTICAL ANALYSIS

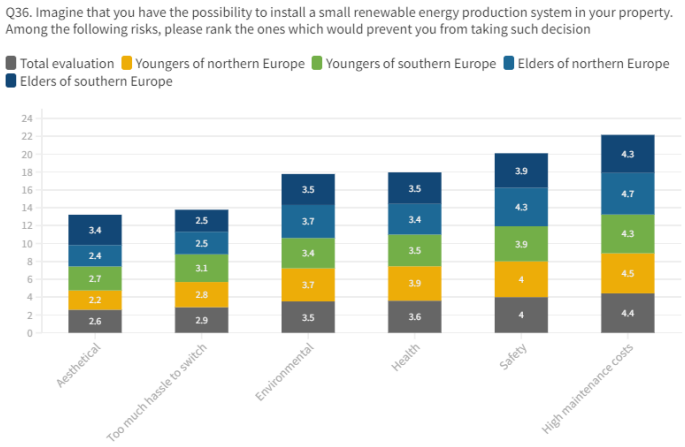
A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on Impact (6-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($p < .05$). As it can be seen in Table 10 there were significant differences among income levels $F(35,518)=1.47$, $p=.036$, $\eta p2=.022$ and among population densities $F(10,518)=2.08$, $p=.024$, $\eta p2=.023$, while there were no significant differences for all the other variables.

Context: aesthetical + dense vs thinly populated areas
$F(2,518)=3.096$, $p=.046$, $\eta p2=.014$
Income: hassle to switch + income groups
$F(7,518)=2.065$, $p=.046$, $\eta p2=.031$

Variables		df	F	Sig.	Partial Eta Squared	Observed Power
Impact						
Population density	Assuming Sphericity	10	2.081	.024	.023	.901
Income	Assuming Sphericity	35	1.474	.036	.022	.993
Geography	Huynh-Feldt	10	1.691	.078	.019	.815
Age	Assuming Sphericity	5	1.209	.304	.013	.431

Table 10. Comparative analysis of environmental issues: df= degrees of freedom | F = FTest | Sig = significance

1st RUN



2nd RUN

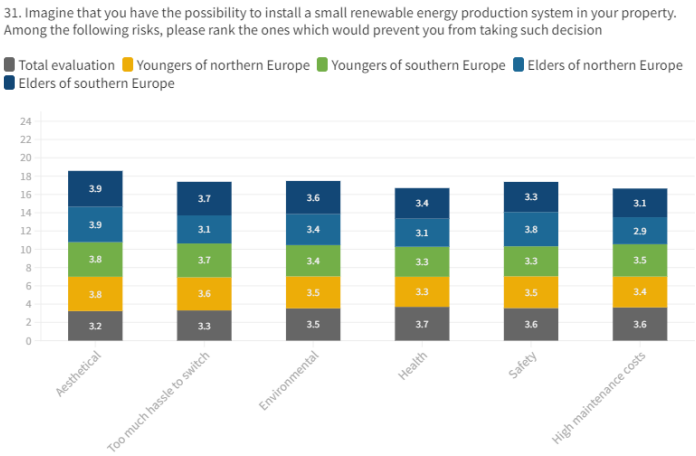
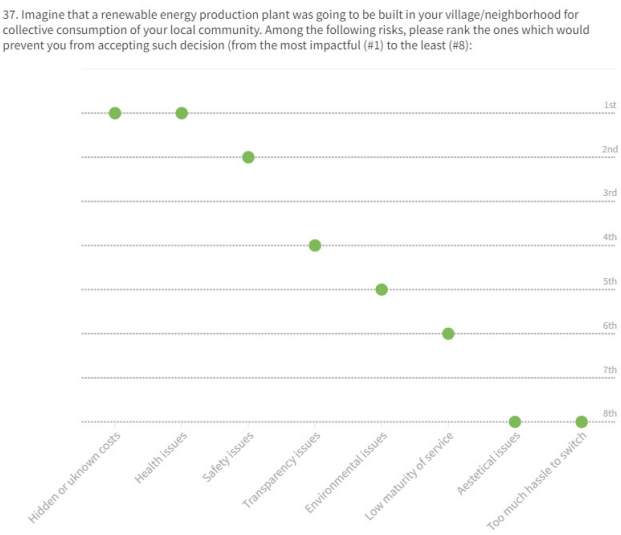


Figure 22. Ranking of the top risks preventing installation of a small renewable energy production system in own property by Age and Geographical Area

Generally, looking at the non-statistically significant tendencies, safety can be considered the risk of most concern, followed by the fear of high maintenance costs and health issues. Older respondents, both in southern and northern Europe, rank higher scores for the aesthetical risks (fig. 22).

1st RUN



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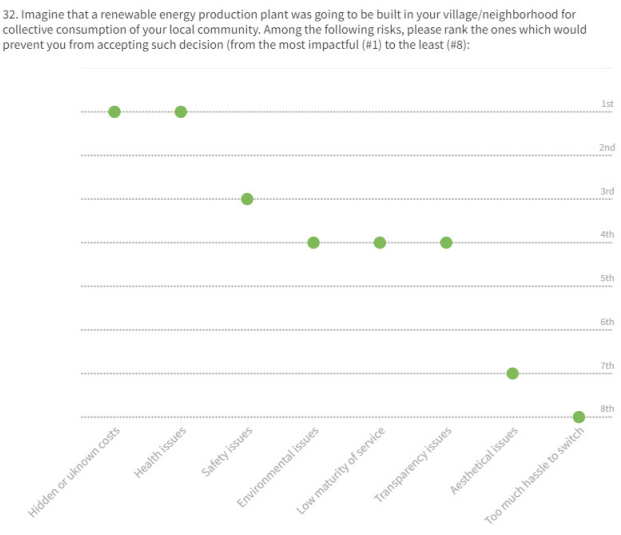


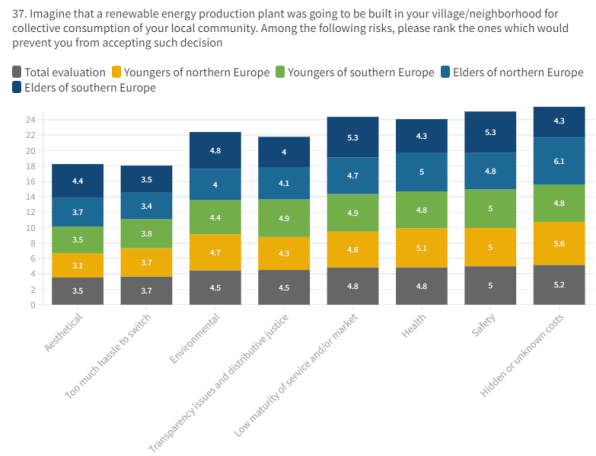
Figure 23. Risks preventing the acceptance of a small to medium renewable energy production plant in own village_neighbourhood for collective consumption (Mode)

When asked to imagine installing a renewable energy production plant in the **local village/ neighbourhood** for the collective consumption of the community, participants identified and ranked risks preventing them from accepting such a decision, such as hidden or unknown costs, health concerns and thirdly safety concerns (fig. 23).

STATISTICAL ANALYSIS

A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on Impact (8-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($\rho < .05$). There were no significant differences for all the variables.

1st RUN



2nd RUN

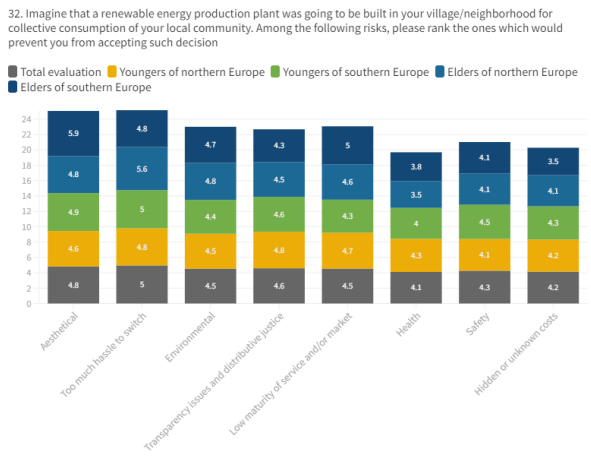


Figure 24. Ranking of the top risks preventing installation of a small renewable energy production system in own property by Age and Geographical Area

Looking at the perceived risks deriving from the construction of a local renewable energy production plant,the overall results show a significant difference between the first and second run. The second run detects a higher sensitivity to aesthetical issues and the fear of complex procedures to switch. Environmental concerns keep the third position, while hidden costs, health and safety issues are considered of lower importance (fig. 24).

5.9. DRIVERS OF SWITCHING TO RENEWABLE-ONLY ENERGY SOURCES

Figure 25. Ranking of benefits of switching to a renewable energy only provider for own energy supply (Mode)

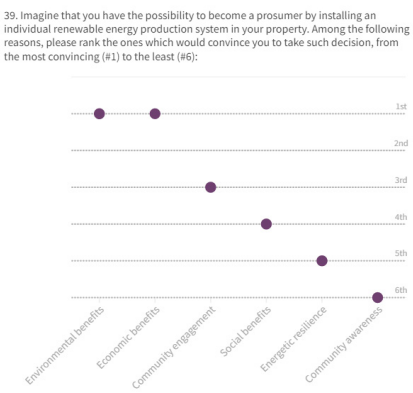
Concerning the benefits that would come from adopting renewable technologies (fig. 25) that identified as most relevant was the economic benefit, followed by the environmental benefit. Conversely, community engagement and community awareness are the latest important benefits, as perceived by the respondents.

STATISTICAL ANALYSIS

A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on Benefits of technology (7-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($\rho < .05$). There were no significant differences for all the variables.

5.10. DRIVERS OF INSTALLING INDIVIDUAL RES SYSTEMS IN YOUR OWN PROPERTY FOR OWN ENERGY SUPPLY

1st RUN



2nd RUN

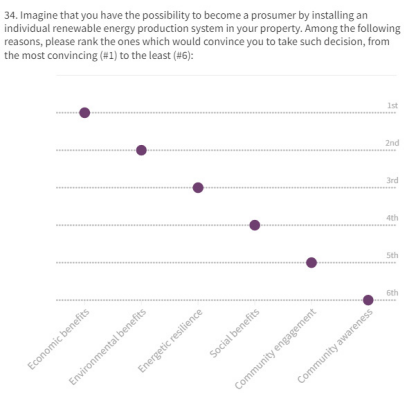


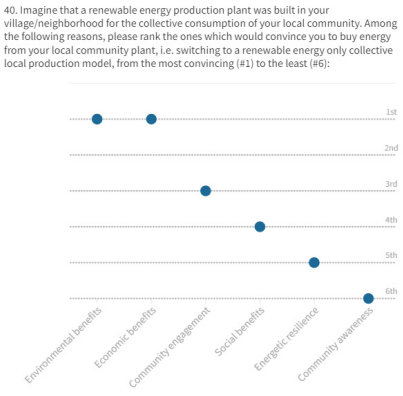
Figure 26. Ranking of benefits of installing individual RES systems in your own property (Mode)

Regarding the benefits that would come from being a prosumer by installing an individual renewable production system in their own property (fig. 26), the one identified as most relevant was the economic benefit (e.g. lower energy costs, potential income), followed by environmental benefits and energetic resilience. Again, community engagement and awareness are the least important benefits as perceived by the respondents.

STATISTICAL ANALYSIS

A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on System benefits (6-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($p < .05$). There were no significant differences for all the variables.

1st RUN



2nd RUN

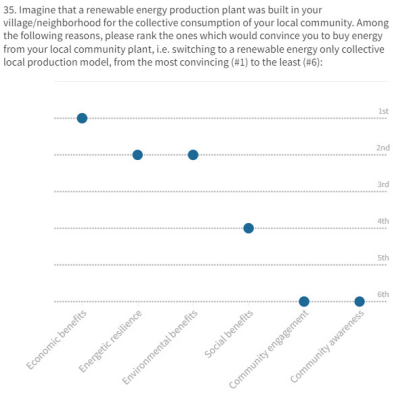
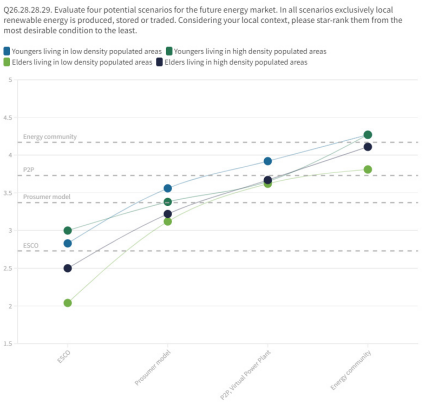


Figure 27. Perceived Benefits of consuming energy produced in local renewable energy production plants (Mode)

Similar to the previous run, for the majority of respondents, the main benefits of buying or consuming locally produced renewable energy are economic benefits, economic resilience and environmental benefits. Economic and Environmental benefits were the main benefits identified also in the first run. Again, community engagement and awareness remain the least important benefits perceived by the respondents (fig. 27).

5.11. PREFERRED BUSINESS MODELS

1st RUN



2nd RUN

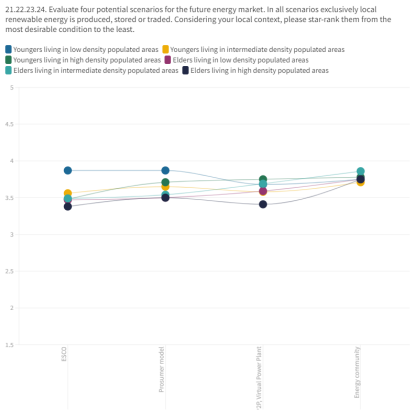


Figure 28. Preferred business models _ trends for Age and Density

				Cumulate Percentage		
	M	SD	Sum	25%	50%	75%
PROSUMER MODEL	3.69	.917	1958	3	4	4
P2P	3.64	.924	1933	3	4	4
ESCO	3.59	1.05	1905	3	4	4
ENERGY COMMUNITY	3.75	.915	1991	3	4	4

Table 11. Statistical analysis of environmental issues of most concern: M= Mean | SD = Standard deviation | Sum = sum of total votes received on a 5-point Likert scale | Cumulate percentage = Bayesian distribution

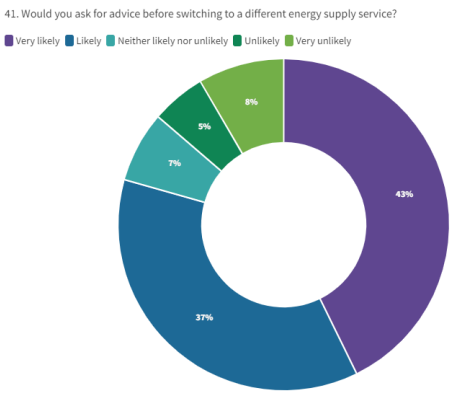
Table 11 sums up the score of the overall sample of respondents when asked about their favourite business model related with renewable energy production and consumption, from the end-user point of view. Differently from the first run, the most favourite business model does not emerge bluntly for the different age groups and the density areas. As it can be seen, the most favourite Business Model is the Energy Community model (M=3.75, SD=.915), while the least preferred one is the ESCO model (M=3.59, SD=1.05) but the distance between the opposite options is far less than expected (fig. 28).

STATISTICAL ANALYSIS

A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on Business model (4-levels variable). The average difference in the concern demonstrated significant differences among the different issues ($p < .05$). There were no significant differences for all the variables.

5.12. ASKING FOR ADVICE BEFORE SWITCHING TO A RENEWABLE-ONLY ENERGY PROVIDER

1st RUN



2nd RUN

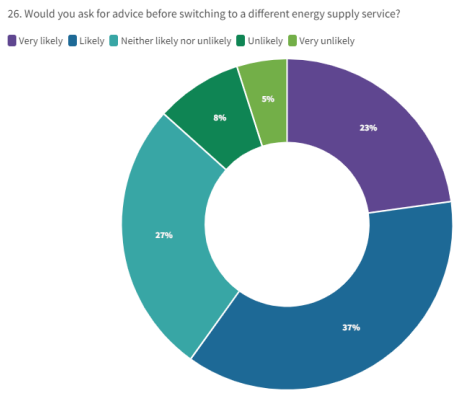


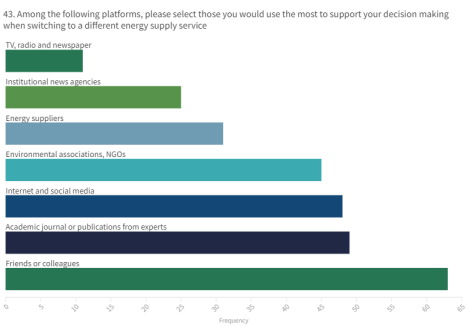
Figure 29. Likelihood to ask for advice before switching to a renewable only energy provider

The chart shows that around 60% of the respondents are likely or very likely to ask for advice before switching to a renewable energy provider. Table 12. shows that those more likely to ask for advice are those subjects living in a high population density with 73.4% of respondents likely or very likely to ask advice. Southern subjects (66.6%) and older subjects (64.2%) are also more likely to ask advice (fig. 29).

	Age		Population Density			Income		Geography	
	Youngers	Olders	Low	Intermediate	High	Low	High	North	South
VERY UNLIKELY	5.3%	3%	8.6%	5%	1.3%	5.5%	3.1%	4.9%	2.7%
UNLIKELY	9.3%	5.1%	13.9%	7.2%	5.1%	8.4%	15.6%	8.7%	6.8%
NEITHER LIKELY NOR UNLIKELY	26.6%	27.3%	32.5%	27.5%	20.3%	26.9%	21.9%	29.9%	24%
LIKELY	35.4%	44.4%	31.1%	36.9%	43%	35.9%	43.8%	37.8%	37.6%
VERY LIKELY	23.4%	20.2%	13.9%	23.4%	30.4%	23.3%	15.6%	18.8%	29%
TOTAL (LIKELIHOOD)	58.8%	64.2%	45%	60.3%	73.4%	59.2%	59.4%	56.6%	66.6%

Table 12. Statistical analysis of the likelihood before switching to a renewable only energy provider by age, population densisty, income and geography

1st RUN



2nd RUN

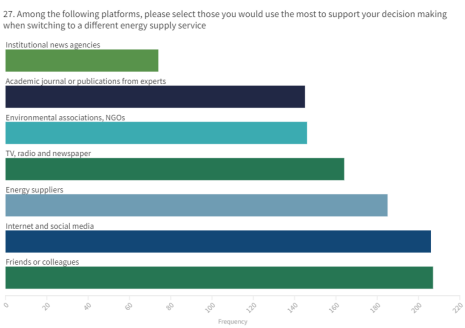


Figure 30. Preferred Source of Advice

When considering the 60% that are likely and very likely to ask for advice and information, the preferred source for this remains (as in the first run) mainly friends and colleagues, but this time with the addition of the internet and social media. However, academic journals or publications from experts, which scored second in the first run, scored second to last in this second run (fig. 30).

	Age		Population density			Income		Geography	
	Youngers	Olders	Low	Intermediate	High	Low	High	North	South
TV RADIO NEWSPAPER	31%	30.3%	32.5	34.7%	24.1%	31.9%	12.5%	30.9%	31.2%
INTERNET AND SOCIAL MEDIA	38.2%	41.4%	35.8	34.7%	47.5%	40.7%	21.9%	39.6%	39.8%
ACADEMIC JOURNALS	26.6%	27.3%	32.5%	27.5%	20.3%	26.9%	21.9%	29.9%	24%
PUBLICATIONS	27.5%	26.3%	16.6%	28.4%	36.1%	27.3%	28.1%	25%	30.3%
ENV ASSOCIATIONS, NGO	27.3%	28.3%	18.5%	31.5%	30.4%	27.1%	28.1%	24.7%	32.6%
ENERGY SUPPLIERS	33.1%	42.4%	39.7%	28.4%	**39.2%**	34.1%	46.9%	35.1%	34.8%
FRIENDS AND COLLEAGUES	38.9%	39.4%	35.1%	40.1%		38.8%	34.4%	37.2%	43%
INSTITUTIONAL NEWS AGENCIES	14.1%	13.1%	12.6%	13.5%	**15.8%**	14.5%	9.4%	13.5%	14.5%

Table 13. Factors influencing choices when asking for advice before switching to a renewable energy provider

More in detail, there are some interesting results as a function of country of origin, the built context and the level of education concerning the tendency to ask for advice before making choices related with energy provision (Table 13). Those showing the highest tendency to ask for advice primarily to friends and colleagues are:

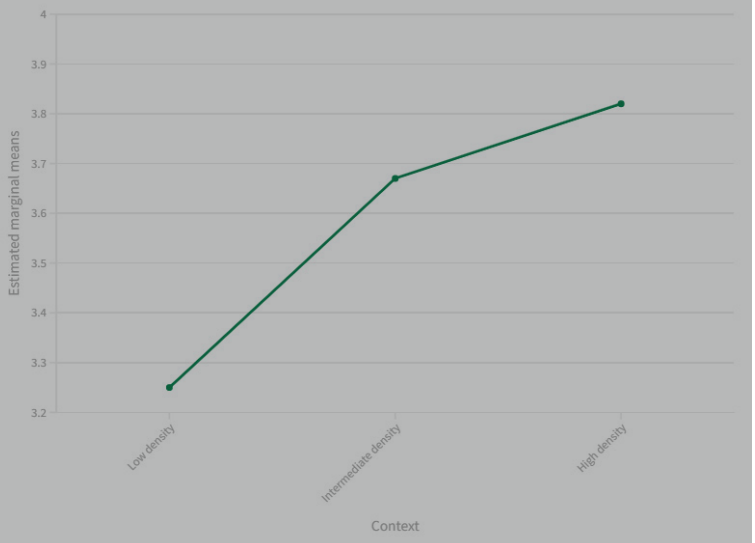
- people from southern countries
- people living in higher density areas
- people with lower levels of education

The country variable has a significant impact on asking for advice
F(5,258) = 2.27, ρ = .048

Between 1 and 2 (ρ = .000);
2 and 3 (ρ = .024);
2 and 4 (ρ = .019);
2 and 5 (ρ = .000);
2 and 6 (ρ = .000);
3 and 6 (ρ = .000);
4 and 6 (ρ = .000);
5 and 6 (ρ = .005)

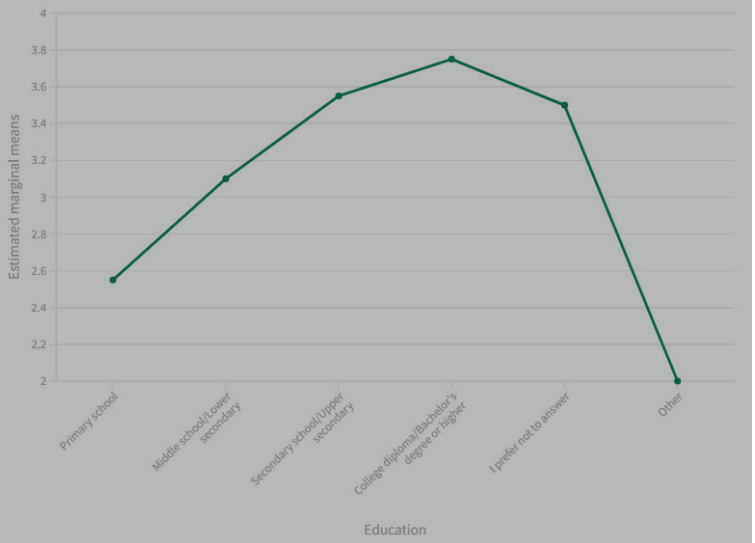
The context variable has a significant impact on asking for advice
F(2,258) = 6.36, ρ = .002

Between 1 and 2 (ρ = .000);
1 and 3 (ρ = .000);
2 and 3 (ρ = .009)



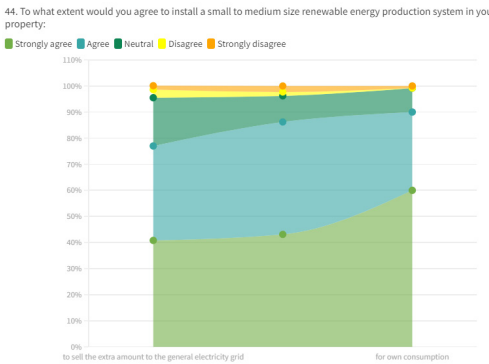
The variable Education has a significant impact on asking for advice
F(5,258) = 3.39, ρ = .003

Between 1 and 3 (ρ = .009);
1 and 4 (ρ = .000);
2 and 3 (ρ = .024);
2 and 4 (ρ = .000);
3 and 4 (ρ = .030).



5.13. CRITERIA OF ACCEPTANCE FOR INSTALLING A SMALL/ MEDIUM SIZED RENEWABLE ENERGY PRODUCTION SYSTEM IN OWN PROPERTY

1st RUN



2nd RUN

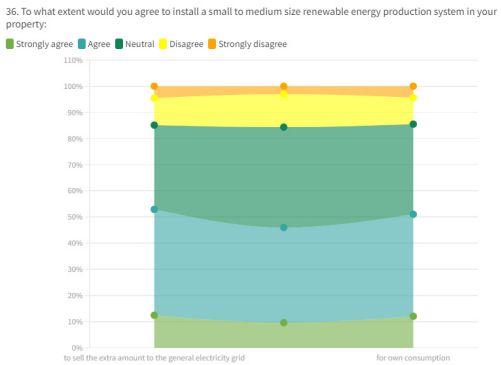


Figure 31. Acceptance Criteria for installing in own property

Agreeing to install a small/medium sized renewable energy production system in one's own property is not an easy decision to make. Considering "strongly agree" and "agree" together, in the first run we observed a slight preference for own consumption models (90% on the right of the graph). In this second run, it was not as easy to identify a preferential option: considering "strongly agree" and "agree" together, acceptance to sell extra energy to the grid (52.92%, left) results in being the one with the higher percentage, followed by acceptance for shared consumption (51.04%, centre) and acceptance for own consumption (45.96%, right) (fig. 31).

To sell extra energy to the grid:

	Gender		Age		Geography		Population density			Income	
	Male	Female	Younger	Older	North	South	Low	Inter	High	Low	High
Negative	16.3%	13.6%	17.1%	5%	14.9%	11.8%	18.6%	15.4%	10.8%	14.1%	34.4%
Neutral	24.7%	37.7%	30.3%	40.4%	37.8%	26.7%	34.4%	32%	30.4%	31.9%	21.9%
Positive	59%	48.7%	52.6%	54.5%	47.2%	61.5%	47.1%	52.7%	58.8%	54%	43.8%

Table 14. Statistical analyis of acceptance to sell the extra energy to the grid

Own consumption:

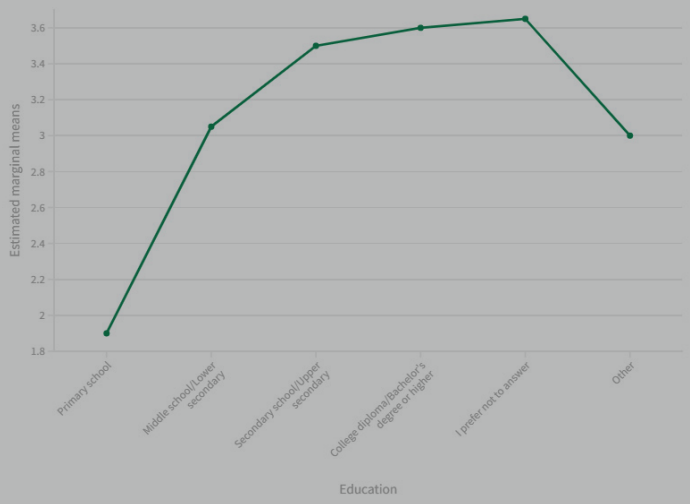
	Gender		Age		Geography		Population density			Income	
	Male	Female	Younger	Older	North	South	Low	Inter	High	Low	High
Negative	13.2%	15.6%	16.7%	5%	14.6%	9.8%	20.5%	15.3%	7.6%	15.2%	18.8%
Neutral	35.7%	33.4%	32.9%	41.4%	35.8%	34.8%	35.8%	34.2%	33.5%	33.5%	25%
Positive	51.1%	51%	50.4%	53.6%	49.6%	53.4%	43.7%	50.4%	58.9%	51.3%	56.3%

Table 15. Statistical analyis of acceptance to produce energy for own consumption

Unsurprisingly the level Education has a significant impact on the acceptance of installing small/medium size RET systems in one's own property both for own consumption or to get a discount in the energy bills: the acceptance increases up to secondary education and in both cases it drops again for top educated respondents (table 14 and 15).

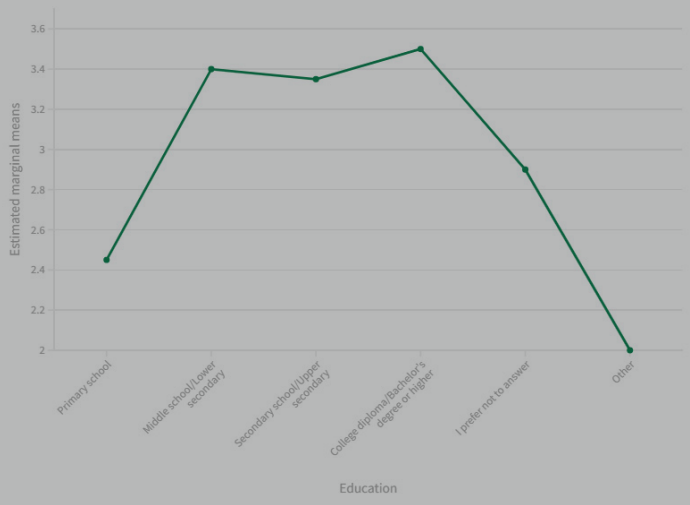
The level of education has a significant impact on installing small/ medium size RET property for own consumption F(5,258) = 2.69, ρ = .022

Between 1 and 2 (ρ = .026);
1 and 3 (ρ = .000);
1 and 4 (ρ = .000);
1 and 5 (ρ = .001);
2 and 3 (ρ = .004);
2 and 4 (ρ = .000).

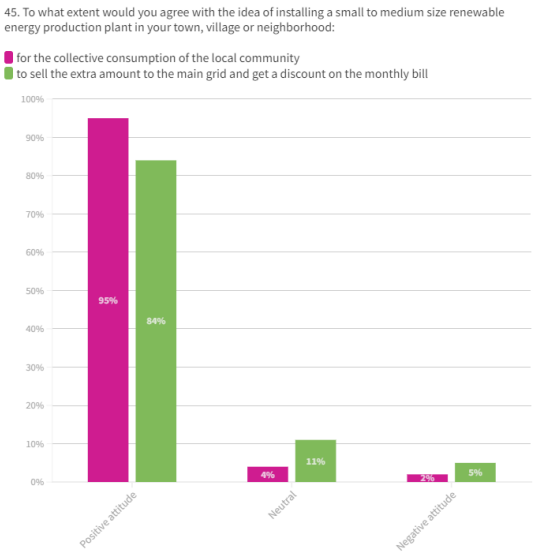


The level of Education has a significant impact on installing small/ medium RET neigh for selling to get discount F(5,258) = 2.36, ρ = .040

Between 1 and 4 (ρ = .012)



1st RUN



2nd RUN

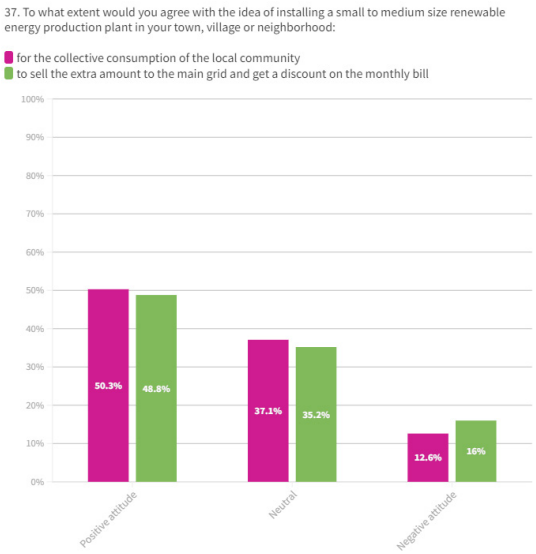
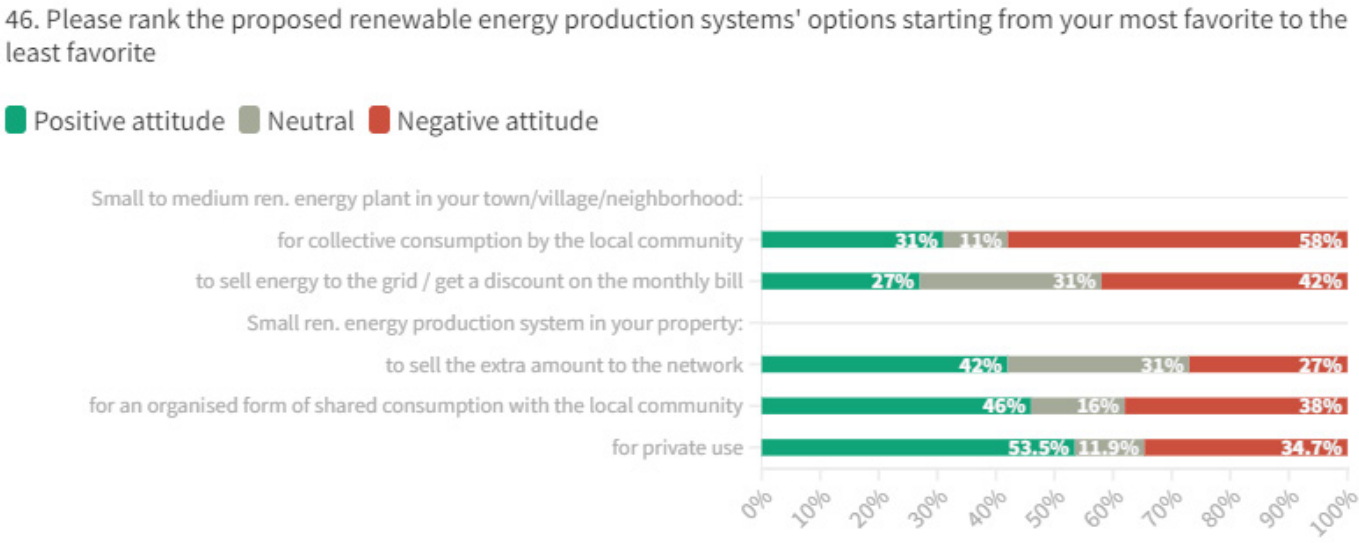


Figure 32. Level of agreement about sharing or selling the energy produced in a local energy production plant

Concerning the hypothesis of a local renewable energy production plant, 'being directly involved into the energy market to obtain economic revenues (i.e., "bill discounts") was considered as acceptable as "sharing for the collective consumption of the local community", meaning that the participation in the energy transition is driven more by energy saving and collective benefits than by the element of investment. This result is in line with that which was identified in the first run, even if neutral percentages are higher, the comparison is analogue (fig. 32).

5.14. FAVOURITE SYSTEM OPTIONS FOR A RENEWABLE ENERGY SUPPLY

1st RUN



2nd RUN

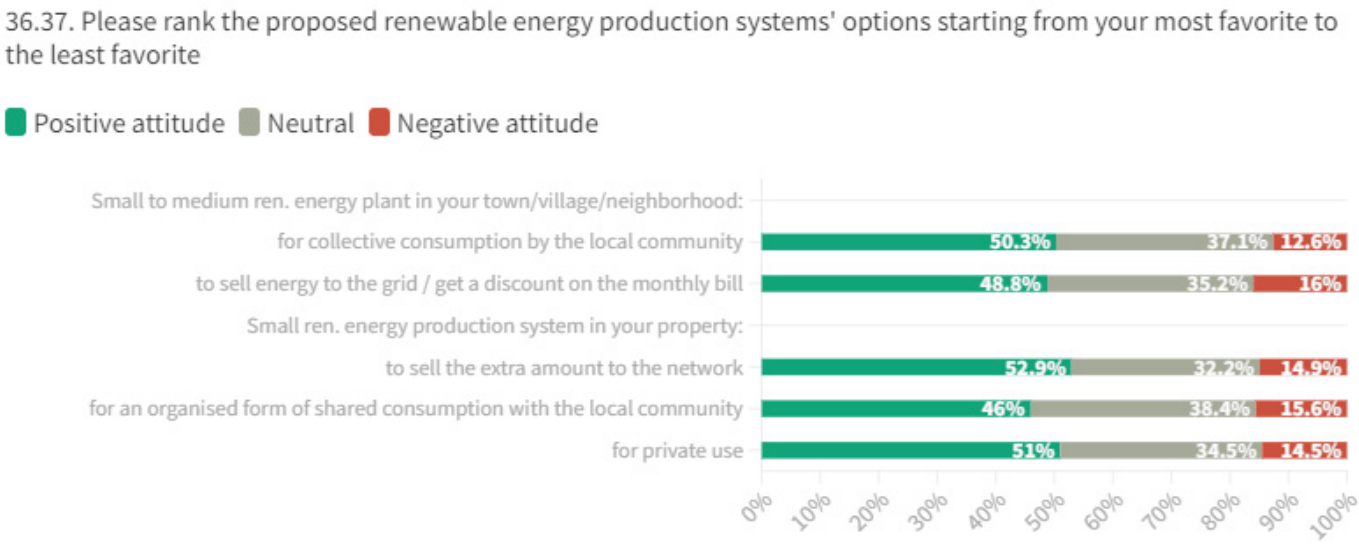


Figure 33. Respondent's favourite systems option for a renewable energy supply

In the previous consideration, both selling extra energy to the grid and sharing energy for the collective consumption were acceptable, the latter more than the first. The renewable energy system option, that was rated more acceptable, was the 'Small/Medium size renewable energy production plant built in your town to sell energy to the general electricity grid and get a discount on your monthly bill' (52.9%). The second most preferable option was the 'small renewable energy production system in your property to sell the extra amount to the network' (51%). The least most preferable option related to shared consumption, was the option'Small/Medium size renewable energy production plant built in your town for shared collective consumption', attracting the most negative attitude (46%) (fig. 33).

STATISTICAL ANALYSIS

A repeated multivariate analysis of variance (MANOVA) for Age, Population density, Geographical area and Income was performed on Prosumer benefits (5-levels variable). Overall, acceptance for own consumption has shown no significant differences between the mentioned variables.

Comparing opinions of involved stakeholders and communities over time: THE KIMMERIA PILOT CASE

The main objective of the survey was to analyse the evolution of stakeholders' opinion regarding energy communities. In particular, in this section we will analyse the case of the zvv pilot site (Greece).

6.1. BACKGROUND INFORMATION

In order to run a sound comparison between the cluster of participants surveyed in the first run and the cluster surveyed in the second run, background information must be assessed. The first difference between the first cluster of participants and the second one relates to gender composition: in the second run, the sample was skewed towards females (comprising 77% of the sample) whilst in the first run the sample had only 33% of females. Regarding age and the level of education, in the second run of the Kimmeria pilot case participants were older and had accomplished higher education. This shows that the survey has circulated outside the student community and reached different stakeholders. In particular, the survey shows that among the greek respondents, 53.5% of the subjects are part of the Kimmeria pilot sites, while 46.5% are not (fig. 34).

Internal feedback Greece

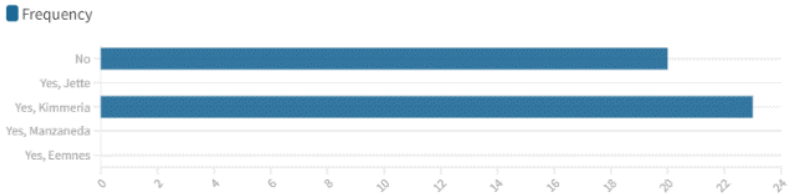


Figure 34. Link to pilot sites

Regarding the consumer type, the participants of the first run do not present significant differences from the participants of the second run. Thu allowing the comparison between the two groups. Furthermore, almost 14% of the sample knew the project for the last two years, 25.6% for the last 1 year. A large 60.5% met RENAISSANCE project only during the last 6 to 1 months (fig. 35).

Internal feedback Greece

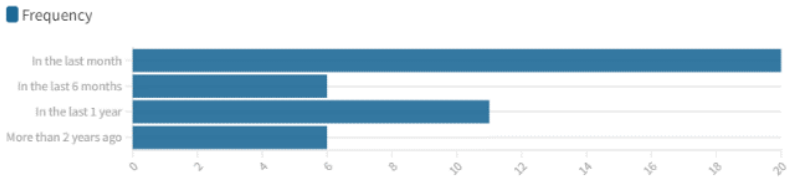
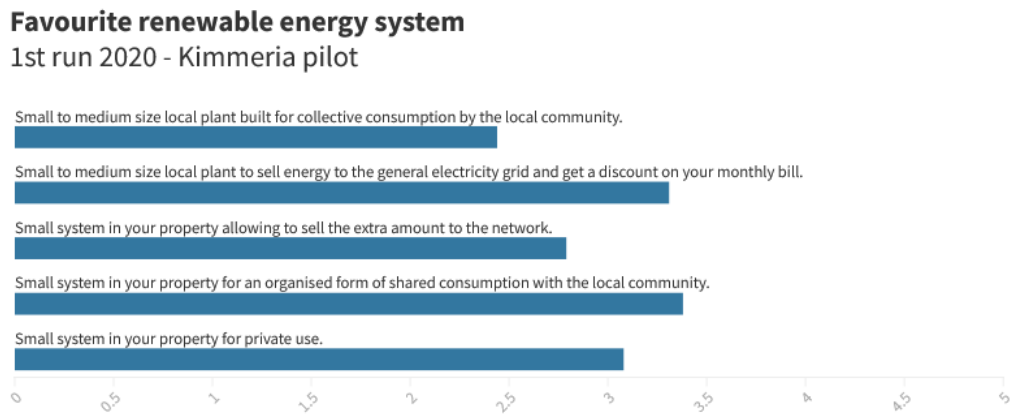


Figure 35. First hear about the project

6.2. GREEK SAMPLE FAVOURITE SYSTEMS OPTION FOR A RENEWABLE ENERGY SUPPLY

1st RUN Greece pilot - 2020



2nd RUN Greece pilot - 2022

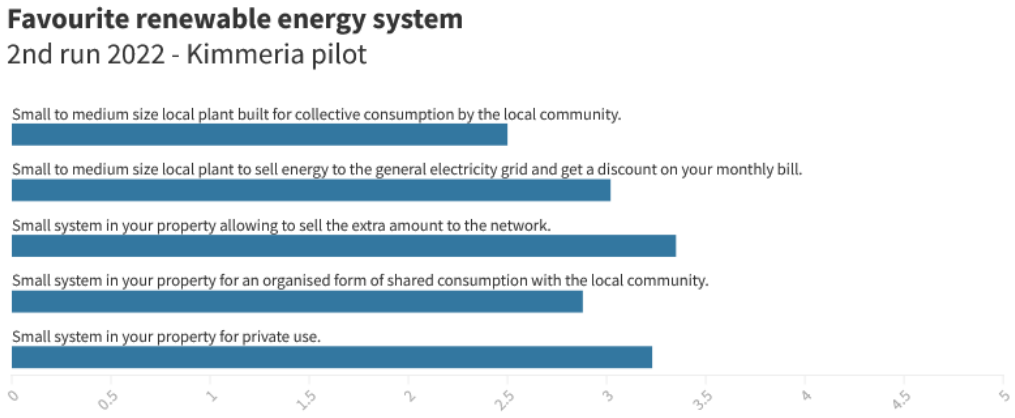


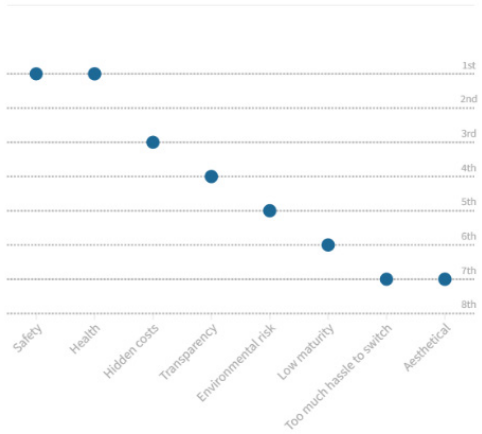
Figure 36. Favourite system

In the two Greek samples, from the 1st and the 2nd survey run, it was possible to observe significant differences in the most favourite production system (fig. 36):

- the 1st Greek sample preferred the "Small renewable energy production system in their property for an organised form of shared consumption with the local community" (M=3.38) and the "Small to medium size renewable energy production plant built in their town/village/ neighbourhood to sell energy to the general electricity grid and get a discount on their monthly bill" (M=3.31);
- the 2nd Greek sample preferred the "Small renewable energy production system in their property allowing them to sell the extra amount to the network" (M=3.35) and the "Small renewable energy production system in their property for private use" (M=3.23). The main reasons related to the different preferences between the participants in the first run and the second run can be linked to the older age of the participants. In fact, it has been shown that older people tend to be more egoistic than younger people and prefer private solutions (see section 5.14. - favourite system options).

6.3. GREEK SAMPLE BARRIERS TO SWITCH TO RENEWABLE-ONLY ENERGY SOURCES

1st RUN Greece pilot - 2020



2nd RUN Greece pilot - 2022

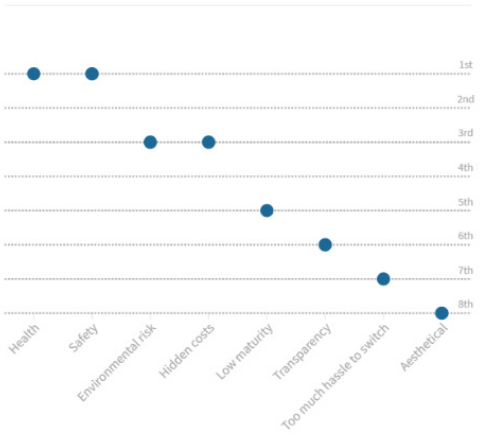
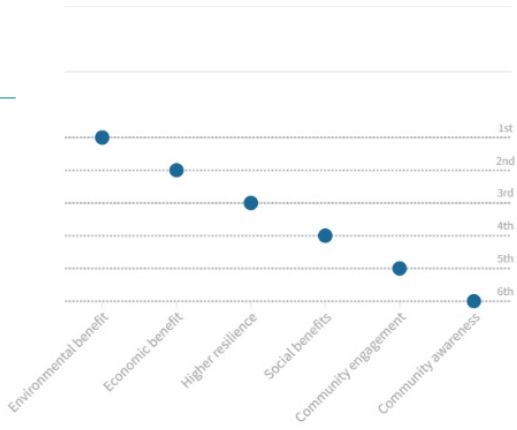


Figure 37. Risks

In order to assess the perceived risks associated with the adoption of switching to a renewable-only energy supplier the answers on a 8-points scale were weighted. The lower the average, the higher the risk associated with the system since the highest assignable score was 1. In terms of perceived risks in adopting such a production system, the 1st Greek sample and 2nd Greek sample identified Safety (1st Greek sample M = 3.27; 2nd Greek sample = 3.34) and Health (1st Greek sample M = 3.35; 2nd Greek sample = 3.30) as the most important. The two items were followed in the 1st Greek group case by hidden costs (M=3.96), while for the 2nd Greek group by Environmental risks (M=3.88). The main difference between the two samples relates to the environmental risks that took a much higher priority in the case of the participants of the second run (fig. 37).

6.4. GREEK SAMPLE DRIVERS TO TO SWITCH TO RENEWABLE-ONLY ENERGY SOURCES

1st RUN Greece pilot - 2020



2nd RUN Greece pilot - 2022

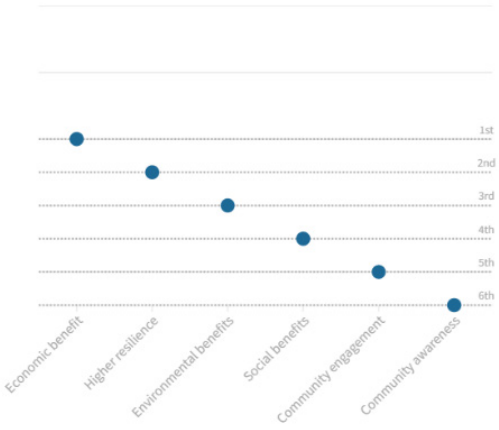


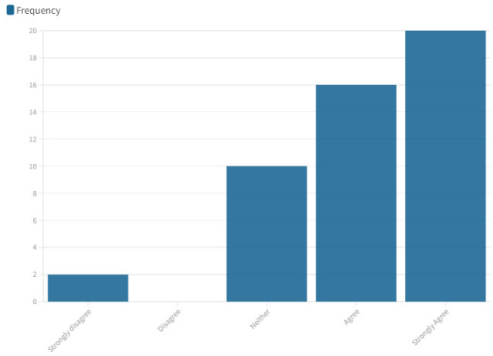
Figure 38. Benefits

In order to assess the perceived benefits associated with the adoption of a renewable-only energy supplier the answers on a 6-points scale were weighted. Average means were calculated for the 6-point answers item. The lower the average, the higher the benefit associated with the system since the highest assignable score was 1. For the 1st Greek group, the 3 most relevant benefits were Environmental benefits (M=2.71), Economic benefits (M=2.81) and Higher resilience (M=3.54).
For the 2nd Greek group, the 3 most relevant identified benefits were the same, but ordered differently: Economic benefits (M=2.26), Higher resilience (M=2.86) and Environmental benefits (M=3.23) (fig. 38).

6.5. GREEK SAMPLE DRIVERS TO INSTALL RES TO SELL THE EXTRA AMOUNT TO THE GRID

Q19.1 to sell the extra amount to the general electricity grid and get a discount on your monthly bill.

1st RUN Greece pilot - 2020



2nd RUN Greece pilot - 2022

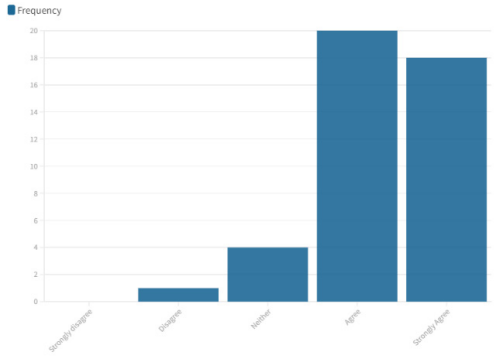
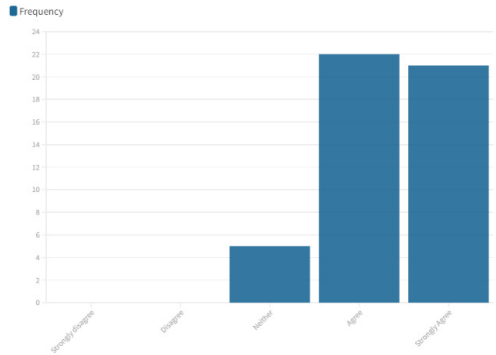


Figure 39. Sell extra amount to the grid and get a discount

Regarding the intention to sell the extra amount to the general electricity grid and get a discount on your monthly bill there is a clear accordance between the participants in the two runs. For both the 1st (75%) and 2nd (88.37%) Greek group there was an agreement or strong agreement in selling the extra amount to the general electricity grid and getting a discount on their monthly bills. This shows that monetary interests are a primary matter in the decision to adopt renewable energy sources (fig. 39).

6.6. GREEK SAMPLE PREFERRED BUSINESS MODELS

1st RUN Greece pilot - 2020



2nd RUN Greece pilot - 2022

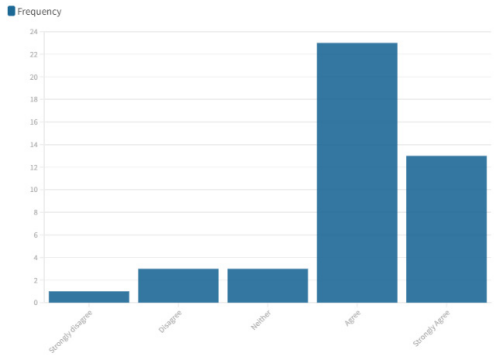


Figure 40. Collective consumption

For both the 1st (89.58%) and 2nd (83.71%) Greek group there was an agreement or strong agreement in adopting a renewable production system for the collective consumption of the local community (fig. 40).

OVERALL FEEDBACK from European pilot sites

7.1. PILOT SITES RESPONDENTS' OPINION ABOUT RENAISSANCE PROJECT IMPACT

Internal feedback Greece

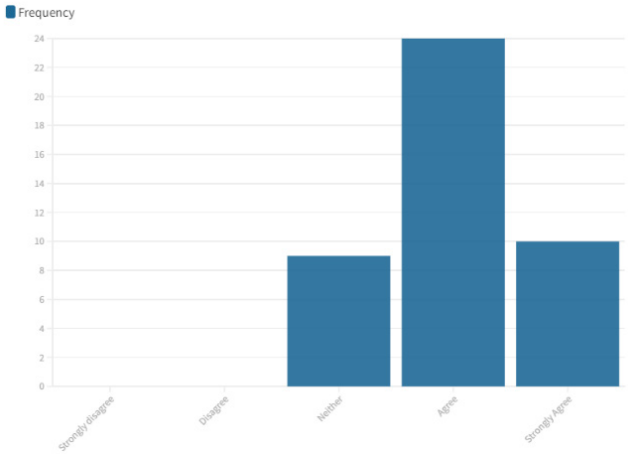
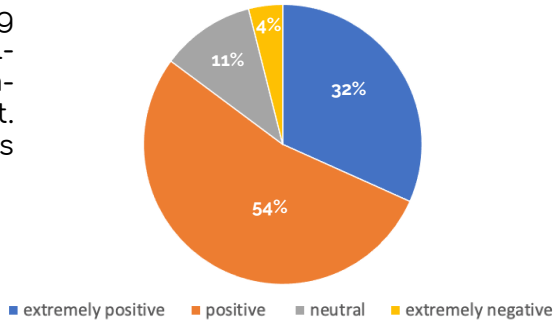
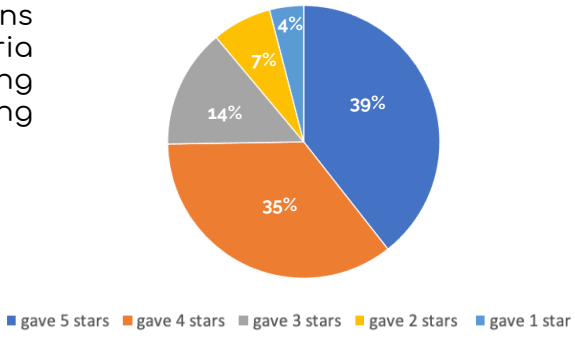


Figure 41. Opinion about Renaissance project impact

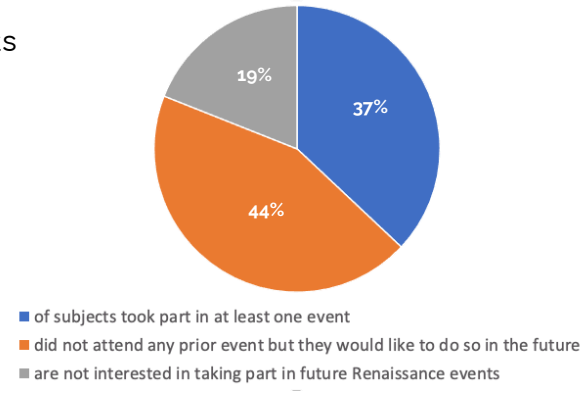
Finally, Internal feedback among pilot sites' respondents was collected to assess the perceived impact of the Renaissance project. The RENAISSANCE impact was perceived as:



The most positive evaluations came mainly from the Kimmeria pilot site. In particular, regarding project events feedback rating the average mean was 4 stars:



Concerning the project events participation:



Moreover, it is remarkable that:

- 25% of the sample knew the project for the last two years
- 39% for the last 1 year
- 36% in the last 6 or last 1 months.

This figure shows that above **60% of the survey participants have been following the project for over a year**. The high participation of greek respondents was likely due to the enthusiastic collaboration of the local research team composed by the Electrical Engineering professor Pantelis Botsaris, the PhD student Adamantios Papatsounis and the communication team composed by Paraskevi Giourka and Paraskevi Dimitriadou who worked effortlessly to involve engineering students into challenges, research activities and pilot sites events.

7.2. PILOT SITES RESPONDENTS' FEEDBACK ABOUT THE RENAISSANCE ENGAGEMENT STRATEGY

Answering the question **"How could we improve your experience with the RENAISSANCE project or other similar research projects in the future?"** respondents pointed out:

- the importance of better campaigns of advertisement to let more people know about the project;
- augmenting the number of public events and increasing the amount of open activities like pilot site tours;
- reducing the language barriers so to make research activities and results more accessible;
- creating more opportunities for practical tools demonstration and less theoretical approaches.

Thanks to the fact that respondents were constantly given the opportunity of providing open answers, the research team could collect qualitative insights about the ongoing activities and the overall stakeholder engagement approach. Such information definitely helped all partners identify, develop and exploit new strategies to involve the local communities. In particular, the latest official events focused more on direct interaction to showcase the tools or on organising hands-on sessions for participants to explore the tools, guided by members of the development team. In pilot sites more and more activities such as workshops, webinars and pilot site tours were run using the local language, sometimes with the support of a person translating for non-native speakers (e.g. Pilot sites tours in summer 2021, Steer-it-up event in October 2021, ESG and Policy meeting in May 2022, online webinars in 2022, final event in October 2022).

KEY FINDINGS and recommendations

8.1. KEY FINDINGS

Differently from the first survey run in which younger respondents declared a lower awareness of the RED II Directive compared to the older respondents, the results of the second run show younger respondents as significantly more aware than older respondents (see sec. 5.5 and 5.6) and also considerably more prone to pay higher bills if switching to renewable energy providers. It has to be noted, though, that people living with lower income are less likely to switch due to the fear of a too complex bureaucracy they might not fully understand (see sec. 5.8). Therefore younger adults, who are still struggling to reach full economic independence, are those most impacted by inadequate regulations.

Overall the economic benefit is largely considered as priority by all respondents, with respect to the collective benefit of sharing energy. Nevertheless the distance between diverging opinions is not as high as expected: respondents are interested in spending less with low hassle, yet they do not see renewable energy production as an investment, likely seen as an additional burden (see sec. 5.13), especially under the current complexity of the European regulatory context. The main conclusion here is that to have citizens onboard, "it must worth the trouble": not only incentives to buy assets and regulations facilitating access to financial services, but also technical support, capacity building and energy system management and maintenance should be somehow supported.

8.2. CONCLUSIONS AND RECOMMENDATIONS

European citizens are taking climate change and sustainable development issues more and more seriously. This attitude is exacerbated by the recent energy crisis and our social acceptance surveys confirm the importance of spreading awareness about energy communities and supporting their growth with appropriate regulations and incentive schemes.

Future research projects both at the European and global level should find ways to engage citizens and especially younger adults and people with lower income in the definition of incentive schemes and thus, in the identification and mitigation of regulatory barriers preventing them from actively participating in the transition.

The main recommendation from the RENAISSANCE research team for policy makers, energy market actors and decision makers is to:

- strengthen a holistic mindset at all levels, looking at the energy transition more as a social demand, which requires socially advanced strategies, than a merely technical or regulatory challenge;
- develop, strengthen and spread gender balanced and user-friendly approaches in order to effectively tackle energy poverty and literally empower all citizens;
- push towards simplification of bureaucratic procedures for citizens, without losing the capacity of accepting the broad diversity of energy ecosystems: there is no fit-for-all solution, since each community has a different set of needs and investment purposes that shall be accomodated;
- promote bottom-up and citizen led research, initiatives and ad-hoc financing schemes, to let hidden "energy transition" demand emerge.

9. Next steps

The research team observed interesting correlations between respondents investing in renewable energy systems who seek for lower energy bills with respondents who are more inclined to ask advice before switching to a renewable only energy provider. More in general, we can assume there is a "prosumer-investor" attitude emerging in such respondents segment that was not fully explored, due to our focus on the cognitive aspects, namely the behavioural intention to accept and adopt proposed solutions and models. Further analysis should be done to assess this emerging "prosumer-investor" attitude, by applying the prosumer acceptance index (Brambati et al. 2022) to a broader European representative sample, inquiring factors that were not considered by this study such as trust in decision makers and technology or including individual identity aspects, emotional factors and actual behaviours (Ostrom, 1969)[13].

13 Ostrom, T. M. (1969). The relationship between the affective, behavioral, and cognitive components of attitude. Journal of experimental social psychology, 5(1), 12-30

Business models description

This annex provides the extended descriptions of Business Models, as they were presented in the online available interactive survey. During MAMCA workshops more detailed and site-specific descriptions of the suitable business models were created, depending on the specific context.

Tabular I – KEY

Each model was expressed through 5 key characteristics:

1. Location of assets
2. Size
3. Kind of investment
4. Energy trading model
5. Decision-making proces

Prosumer Model (Local prosumers' energy company)

1. Prosumers are incentivized to install production systems in their own property.
2. Small sized system (e.g. solar panels on rooftops, small scale wind or geothermal systems).
3. Prosumers invest in their own energy production system for own consumption.
4. Energy is produced with the aim of collecting revenues; surplus energy is directly fed into the grid and remunerated by the central grid system operator for a set tariff.
5. The involvement in decision making is low. Beyond from the initial choices about investment and amount of energy traded, there is no power of decision on any other matter related to the energy production, consumption or trading. The amount of revenues collected by the prosumer/s depends on the amount of energy power installed.

Other kinds of organized prosumer model (e.g. P2P, virtual power plant, local energy association)

1. Energy end-consumers are incentivized to install production systems on their own property to become prosumers.
2. Small sized system (e.g. solar panels on rooftops, small scale wind or geothermal systems).
3. Prosumers invest in their own energy production system for own consumption. Energy is produced mainly to cover own consumption needs and to sell energy to end-consumers.
4. Surplus energy is traded directly to other consumers (e.g., the neighbors) or aggregated and sold to the wholesale energy market
5. The involvement in decision making is low. Beyond from the initial choices about investment and amount of energy traded, there is no power of decision on any other matter related to the energy production, consumption or trading. The amount of revenues collected by the prosumer/s depends on the amount of energy power installed.

Esco (Business as usual)

1. The energy supply company owns the energy plants that are dislocated locally.
2. Medium to large scale renewable energy plant.
3. Large investments from energy supply company owners are required. End-users are contributing to the return of investment simply buying energy from the company
4. Energy is produced with the aim of collecting revenues. Energy produced by the energy supply company is sold to the wholesale market. End-users pay their bill according to their current energy contract.
5. There is no involvement in decision making. Choices are taken by the management of involved actors and decisions follow the top-down flow.

Energy community (Community oriented)

1. Local renewable energy plants are installed in community members own property and/or dislocated in local available areas through a community decision process.
2. Small sized systems and/or medium scale systems.
3. Requires shared investments from all members of the community. The amount of energy production assets installed cover the overall community consumption.
4. Energy is produced to cover community consumption needs. Surplus energy is aggregated and sold to the wholesale market, directly to other consumers or stored for future demand. Revenues are distributed among community members in a form of retribution or new investments.
5. The involvement in decision making is high. All members of the community have the right to vote on issues concerning the use of collected revenues, new investments and market strategy.

> Annex II: full questionnaire

Open the following QR link to download the full questionnaire (2nd RUN version) in pdf

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Renaissance

RENEWABLE INTEGRATION & SUSTAINABILITY IN ENERGY COMMUNITIES

THANKS

We thank all the research team, including colleagues and contacts not directly involved in the RENAISSANCE project, all External Stakeholder Group members and all people who participated in our events or activities. Special thanks go to all pilot sites' leaders and involved stakeholders, who have often been asked extra effort to translate, to reach out for specific audiences and to develop or provide custom contents back and forth, in order to tackle the issues that constantly emerged while we inquired about engagement and acceptance. You really made the difference and this is how engagement should be done for the better!

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